

VAYU

V/2011

Aerospace & Defence Review



Transformation of the IAF
All eyes on the FGFA
Radars make the difference
50 years of INS Hansa
Army Aviation 25th anniversary
Defence Offset Policies



Cover : The prototype Sukoi T-50, also referred to as the PAK FA in Russia and FGFA in India, seen in flight at MAKS 2011 over Zhukovsky, near Moscow. (photo: AA Me, IN)

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ADVERTISING & MARKETING MANAGER

Husnal Kaur

BUSINESS DEVELOPMENT MANAGER

Premjit Singh

GENERAL MANAGER (UK)

Avi S. Sodhi

e-mail: avi@vayu-aerospace.com



Published by:

THE SOCIETY FOR AEROSPACE STUDIES

D-43, Sujan Singh Park,

New Delhi 110 003 India

Tel: +91 11 24617234

Fax: +91 11 24628615

e-mail: vayuaerospace@lycos.com

e-mail: vayu@vayuaerospace.in

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V/2011



Transformation into a Potent Strategic Force

34 In his interview with the *Vayu Aerospace Review*, on eve of Air Force Day, Air Chief Marshal NAK Browne, Chief of Air Staff articulates on the larger security challenges facing the IAF today. The CAS focuses on critical transformation of the IAF into a force that is modern, flexible and capable of tackling threats across the entire spectrum of conflict.



The IAF at 79: Quixotic Situations

42 Air Commodore Jasjit Singh, Director CAPS reflects on certain crucial elements, which actually require transformation of the mind in the Government, Air Force, Parliament and political leadership. His belief is that capabilities of Aerospace Power can be increased only if the human element is capable of exploiting it to maximum advantage.



Radars make (all) the difference

54 Exploiting digital electronics in the form of Active Electronically Scanned Array (AESA) systems are not only "must have" sensors for new combat aircraft but are offered as very cost effective means of

upgrading ageing fighters and as essential Intelligence, Surveillance and Reconnaissance (ISR) assets. Richard Gardner reports on these latest airborne radars.



Defence Offset Policies: The Road Ahead

62 India now ranks second in terms of arms imports (\$12 billion annually) and ninth in terms of global military expenditure (\$36.3 billion). SN Misra, formerly Joint Secretary HAL and presently Principal Secretary (CDA), examines the impact of India's Offset Policy on Defence Industry Capability, Self Reliance and the Aerospace Sector.



MAKS 2011 : all eyes on the FGFA

69 *Vayu Aerospace Review* was invited by the Russian Ministry of Trade and Commerce for the biennial Air Show at Zhukovsky, near Moscow. In her report on the Show, Esha Singh Alagh reviews the highlights where the Fifth Generation Fighter Aircraft (FGFA), otherwise known as the PAK-FA/T-50, basked in all glory, even as Indian hearts leapt with excitement to witness their future fighter. Also exclusive interviews with heads of RAC MiG and the Irkut Corporation.



Internationally Competitive

78 *Vayu's* interview with Andrei Dyachkov, General Director, Central Design Bureau for Marine Engineering 'Rubin', well known manufacturer of both ballistic-missile-carrying submarines and diesel-powered submarines. The impact of Indo-Russian cooperation on the Indian Navy has been remarkable.

Building on Relationships

90 *Vayu* interviewed with Alexander Mueller, Managing Director RUAG Aerospace Services, Germany on the Group's core competences in military and civil aviation. In a reverse situation, HAL are now supplying 'green' Dornier 228s to Germany for their 228NG programme and RUAG have a clear vision on creating new avenues of cooperation with the Indian industry.

50 years of INS Hansa

102 The Indian Navy marked the Golden Jubilee of INS Hansa with an international aviation symposium on 'Roadmap to Transformation' at Goa in early September. The various functions were climaxed by release of a special book 'On the Wings of Gold' a chapter of which is extracted for *Vayu* readers.

Arm of the Future

111 This was the theme marking Silver Jubilee of the Army Aviation Corps, the focused seminar addressed by Defence Minister AK Antony and COAS General VK Singh giving the inaugural address. Amongst those who presented papers were P Soundara Rajan of HAL whose organisation are exclusive suppliers of helicopters to Indian Army Aviation.

Armament Trials at ASTE

116 In his series on 'Testing Times' Air Marshal Philip Raj Kumar writes about the lesser known but equally important task of weapons testing at the Establishment at Bangalore. The K-13 first generation air-to-air missile was followed by the R-60 on MiG-21s and Magic I on over-wing pylons of the Jaguar.

Also :

Vayu Interview with General Jean-Paul Palomeros, Chief of the French Air Force; Hawks over Bidar; Review of the IAF book 'So that others may live'; Interviews with President of Honeywell Aerospace India; Rafael's Air Warfare Systems; The Global UAV Market; The Barak-8 SAM; Apaches, Night Hunters and Tiger Birds; Acts of War, The IAF's C-130J Super Hercules.

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Commentary, Viewpoint, Aviation & Defence in India, World Aviation & Defence News, Tale Spin.

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Flying backwards

Air India has dug itself into a financial hole, one so deep that even a well-run, profit-maximising organisation would find it difficult to escape. Its accumulated losses till 2010-11 total Rs 20,320 crore; its debt burden – including working capital loans – has risen steadily for the past years, and is now around Rs 40,000 crore. Why is Air India so buried in debt, and what lessons should its owners – India’s taxpayers – draw from its troubles?

A new report from the Comptroller and Auditor General, reveals the nature of the problem. A large component of Air India’s debt comes from the decision to buy 111 new aircraft in 2005, the interest burdens of which purchase have been crippling. The report will at least allow, once tabled, an open examination of how this error in management came to be made. Whether the decision was made in good faith or not, the larger problem is clear already: government unwillingness to allow the company’s management to properly estimate its needs and abilities, or to imagine a future without that outdated, socialist-era construct, of a “national carrier”.

The aircraft purchase is emblematic of the errors of judgement inescapable when a company like Air India is managed by the government. Financially unviable decisions are made, accountability is hard to pin down and empire-building substitutes for hard-headed management of the bottomline. A clear accounting of where and how decisions were made should convince India’s citizens and their representatives – to whom the CAG reports – of the lack of good sense in the state’s attitude to Air India. There are more than enough competing airlines now that consumers need not be supported through state intervention; instead, a cash-strapped Centre is faced with endless demands to bail out its dysfunctional airline. Expectations that Air India would turn around, such as informed the aircraft purchase, are largely responsible for getting us here. They should no longer rule decisions about the airline’s future.

From: The Indian Express

Defence and development

The recently announced government policy on defence equipment procurement, clearly intended to jump-start the indigenous defence industry, comes not a day too soon. Much of what appears in the new policy was first mooted six years ago by a committee chaired by Vijay Kelkar. The benefits of such indigenisation extend beyond reducing the country’s reliance on imports. Defence production can have economy-wide synergies, particularly with the manufacturing sector. India’s reliance on defence equipment imports at over 70 per cent of total procurement is unacceptably high. To be sure, there are a few indigenous success stories, notably in metallurgy and

special materials (the Kanchan armour on the Arjun tank and the composites used in light combat aircraft are world-class), radars and embedded software used to design the mission computer used in frontline aircraft, but wide-ranging success has been largely elusive.

The reasons for this weakness are many. First, spending on indigenous R&D is embarrassingly low. It is simply impossible for the Defence Research and Development Organisation and related agencies to do anything significant with these budgets, which could be charitably described as “shoe string”. These budgets need to increase significantly if the country is to see any meaningful contribution from the defence establishment. Second, even these meagre resources are spread too thin. Defence-sector PSUs are engaged in many unnecessary activities that could be left to others. A corollary of this is considerable redundancy, which needs to be reduced sharply. A rigorous technology audit that identifies existing strengths and weaknesses would identify feasible projects and technologies which could be pursued towards culmination with vigour, simultaneously rejecting (and eliminating) wasteful projects. This would require political will and strong leadership to take the tough decisions that are sure to be resisted by vested interests.

The experience of public-private partnerships in defence production has been disappointing. While there has been some progress recently in transferring technology from defence PSUs to the domestic private sector, it is far from adequate. As a result, private-sector capabilities in project management and execution remain vastly underutilised. Lack of clear procurement policies precludes investment in production facilities by the private sector, which would understandably seek long-term commitments to recover its investment. With defence R&D and production becoming prohibitively expensive, “co-development” and “joint production” are the way forward. It explains why even established superpowers with deep pockets and technological capabilities are opting to share expenses and spread the risk for technologies whose returns cannot be predicted. It is not possible for a country like India, with relatively meagre resources, to succeed by going it alone. As a first step, defence PSUs and indigenous industry must learn to work together. A few demonstrable successes will provide a definitive signal of technological capability, which will enable India to participate in collaborative arrangements as more than a fringe player. Moreover, India’s private sector must be encouraged to invest in defence production. The monopoly of state-owned enterprises must end. The defence industry in the US, European Union, China and other major industrial economies has shown how defence spending can promote industrial and technological development. There is no reason Indian industry should be denied this opportunity for growth.

From: Business Standard

Dassault

Sting in the tail

A cute embarrassment in Pakistan over the fact that Osama bin Laden was living in a hideout in the cantonment town of Abbottabad was quickly replaced by indignation and anger at the United States for staging the raid that killed the most wanted terrorist in the world. It was clear that Pakistani leadership was kept out of the loop by the Americans. All that American Seals left behind were some dead bodies and the tail section of a radar-evading helicopter used in the operation, which had to be abandoned due to it malfunctioning. The tail section of the helicopter survived the attempt by the US forces to destroy it.

By now most of the world has seen pictures of the damaged craft, as well as of other effects of the raid. While there was jubilation in many parts of the world, the Pakistani establishment was on the back foot and retaliated by defending the ISI and seeking out all those who had helped the Americans. The tail too became an issue, as the US demanded, and got it back, but not before, it is now alleged, Pakistan gave its long-time military ally China a look-see, or more.

Since the 9/11 attacks, the US has given Pakistan aid worth \$20 billion. However, it is no secret that Washington and Islamabad have, more often than not, competing agendas, even on Afghanistan, where the US needs Pakistan's help the most. Given that a relationship that had seen its share of ups and down has reached a new low, the hawks are active on both sides. The Inter-Services Intelligence agency and the military establishment are not likely to loosen their stranglehold on the civilian government in Pakistan. The diplomats will, therefore, have to work with them even as they strengthen the civilian government, encourage democracy in Pakistan, and address the damage, military as well as diplomatic, that this incident has caused.

From: The Tribune

Public sector flops

It is not often that a politician says something truly groundbreaking, but that is what Oliver Letwin, the Coalition's policy minister, has pulled off. He said that public sector employees needed to experience "some real discipline and some fear" to bring out the best in them. He spelt out precisely what that meant. If state employees were not producing the required results, "some will not survive; it is an inevitable and intended consequence of what we are talking about".

Mr Letwin's suggestion that people on the state payroll may actually lose their jobs if they are not up to scratch is genuinely radical. The public service has long been notorious for its inability to weed out under-performers. For example, just 18 teachers have been struck off the register for incompetence

over the past 40 years, even though there is general agreement that poor teachers can be numbered in their thousands. Such 'unsackability' is prevalent throughout the state sector. It is hardly any surprise that under the last government productivity in the public sector fell every year.

It is only when Mr Letwin's welcome message is subjected to the feather-bedded realities of Whitehall life that the pitfalls appear. We report today on the severance package enjoyed by Bernadette Kenny, the former director general for personal tax at HM Revenue and Customs (HMRC). The Treasury Select Committee produced an excoriating report on the inadequacies of HMRC during her tenure, saying that service delivery had fallen to "unacceptable levels in several areas", leading to "considerable dissatisfaction among the public and tax professionals". The chairman of HMRC, Mike Clasper has apologised, admitting that the department had been "overwhelmed" and that its performance "simply wasn't good enough". Yet when Ms Kenny left HMRC at the start of this year, she received a lump sum payment of £151,480 and will in addition receive £50,000 a year for five years – a total payout of more than £400,000. Such generosity is not confined to HMRC. For example, the Land Registry has made 1,065 staff redundant and they enjoyed an average pay-off of £74,579 each, racking up a total bill of just under £80 million.

Such largesse at taxpayers' expense is unacceptable. Once again, the gulf between people in the private and public sectors is exposed. If Mr Letwin's bold proposal to expose those on the state payroll to the blast of competition is to work, it is vital that the Government imposes employee contracts that ensure failure is not handsomely rewarded.

From: The Daily Telegraph, UK.

Corrigendum

Please refer to issue III/2011 of the *Vayu Aerospace & Defence Review*. We look forward to the insightful articles of your magazine which cover a wide array of topics. The CAS appreciated your article as well as photographs published on his taking over. A small error is however being brought to your notice. In the photograph of Jaguar conversion training pilots at page. 31, the photo caption reflects as "Charlie Brown (second from left)", whereas he is second from the right. It is requested that the necessary corrigendum regarding the same may please be done.

*Group Captain Vikas Sharma VM
Staff Officer to the Chief of the Air Staff*

Lockheed Martin Aeronautic

Viewpoint



The MMRCA : Transparency vs. National Security

As the prolonged Air Force proposal for purchase of the Medium Multi Role Combat Aircraft (MMRCA), enters its final lap after a torturous decade, there must be considerable anxiety within Air Headquarters who watch this slow process unfold even as they stare at dwindling combat aircraft force levels and safety problems with ageing fleets.

Since defence procurements attract great public attention, it was natural for the Ministry of Defence (MoD) to approach this entire programme with due caution. The principle articulated in the Foreword to the Defence Procurement Procedure (DPP) hence is for the process to be 'impartial' and 'transparent' and lays down various steps with competitors being kept abreast of respective performance at each of these. As this process unfolds in slow time however, a major concern seems to rear its head. In our anxiety to keep the process 'clean' and 'corruption free', have we compromised interests of national security? Put differently, the question is 'impartial towards what objective and transparency' but at what cost?

However, on the background first. Faced with rapidly dwindling force levels, the need to replace ageing MiG-21 fighters compounded by delays in the Light Combat Aircraft (LCA) programme, the IAF had issued its first global request for information (RFI) in 2001 with December 2005 as the planned date of issue of a formal request for proposals (RFP). In the interim the IAF's concept expanded from a lightweight multi role fighter to encompass medium fighter categories as well, a shift not without significant consequences as the two categories would then fall into differing weight, performance and cost domains. This is important, because all things being equal, the DPP stipulated the *lowest cost to be the winner* (emphasis added).

The RFI was re-issued in 2004 to four companies but, two years later, the formal RFP went out to six companies that appeared to meet the Air Staff Qualitative Requirements (ASQRs) and other conditionalities. Amongst the contenders were two US aircraft types, the Lockheed Martin F-16 and Boeing F/A-18 E/F Super Hornet, the Eurofighter Typhoon (consortium of UK,

Germany, Italy and Spain), the Russian MiG-29M, the French Dassault Rafale and Swedish Saab Gripen. Of these, the F-16 and the Gripen were single-engined while the others were twin-engined and of relatively heavier class. To keep the evaluation transparent, the IAF laid down 643 parameters against which each of the six competitors were to be extensively evaluated, technically and operationally. At that time the entire project was estimated to cost Rs. 42,000 crore.

The defence aerospace market is not only fiercely competitive, but owing to its technological and military-industrial impact, envelops a much wider strategic, economic and geo-political canvas. Not surprisingly, the US President on his visit to India had reportedly lobbied the Indian Prime Minister on behalf of US bidders as had the President of France and other senior leaders of countries involved. Focused on our desire to be 'impartial and transparent,' one could anticipate that the MOD was now riding a tiger of its own making.

When in late-April 2011 the MOD shortlisted two aircraft types, the Eurofighter Typhoon and the Dassault

Rafale, the inevitable aftershocks followed. It was more than a coincidence that a day after this announcement, the US Ambassador to India resigned “for personal reasons”. Being part of the Eurofighter consortium, the German Ambassador to India stated : “We regard India as a strategic security partner and that is why we do not insist on an end user monitoring agreement”, which was an indirect reference to certain US laws in this regard and India’s sensitivity to these.

Whilst this decision appeared divorced from any geo-political influence and seemed driven purely by the state of advanced technology of the chosen platforms and performance preferences, other significant programme elements including transfer of technology, offset obligations and costs had not contributed to this decision-making.

Not surprisingly there has been muted criticism, although from all accounts competitors who stand rejected still harbour hopes. There is now even talk of the IAF being offered a fifth generation fighter and companies that should have by now packed their bags, continue to advertise in the Indian media. It is difficult to judge whether these are signs of over optimism or is there more than meets the eye ?

One reason for this uncertainty is that the process is far from over. Evaluation of offset proposals along with technology sharing of the short-listed companies continues. Significantly, prior to opening of commercial bids the MOD is to carry out a bench-marking exercise to determine what ought to be the fair cost for this project. It is then that the biggest anti climax of this exercise may unfold in dramatic manner because such bench marking, which is a process of estimating the ‘fair price’, is by no means a simple task for this complex programme. It involves flyaway and production costs, life cycle costs, technology transfer issues and complex offset arrangements amongst many others. Since militaries and vendors rarely share commercial data on such programmes, comparisons with other similar programmes may at best be rough estimates and hardly conducive to realistic bench-marking.

This then raises more questions than answers. In keeping with our desire to be totally transparent, will the bench

marked figures become inviolable? What if both the short-listed candidates are substantially *above* those benchmarks? Is there an option to revert to some of the rejected, but certainly lower cost bidders? If so, what criteria will then be followed? Will, for example, the cost benefits of shortfalls against the 643 test points, for which they were rejected, be weighed against the costs? If not, are we so inhibited by our own process that we are willing to pay such very high prices? What if after ‘losing’, vendors dispute the benchmarked figure and are able to disprove them? Where does that leave the IAF and indeed the robustness of this entire process?

This brings us back to the initial poser. Being impartial to all the competitors is one thing, but to put our national security and strategic interests to inquiry by commercial enterprises is quite another. By quantifying in detail the 643 test parameters, we have to a great extent also bared open our operational and technical philosophy and thinking. Many an insightful analyst will already have scrutinised this data to access the IAF’s operational thinking. Potential adversaries must also have for long had access to this information.

As for transparency, if we choose to display transparency on our sleeves rather than practice it in spirit, the price that we pay may well be delayed decision-making to the detriment of our national security, as those who lose out could choose to question the very basis of our decision-making. What if forces inimical to our security interests exploit this situation so as to create mischief ?

The following lessons emerge from the unending saga of the MMRCA. Firstly, because we suffer from lack of confidence in the integrity of our own decision-making processes and people, we have externalised factors like impartiality and transparency, which though vital, should have remained internal to the system. In the process we have deprived the operational user of the freedom to make optimum operational and technical choices. The cure may well be worse than the disease.

Secondly, no operational requirement should be absolute. It must be tempered with the practical budgetary and industrial environment within which the entire

national security edifice operates including strategic benefits expected to flow into defence research, development and industry. Short listing based on just the operational evaluation without other factors runs counter to this philosophy. Hence *affordability* must begin to form a significant input into the defining of service operational requirements.

Ashley J. Tellis, a senior associate at the Carnegie Endowment for International Peace who specialises in international security, defence and Asian strategic issues and who had written a researched paper titled *Dogfight* on the MMRCA programme after the IAF had submitted its evaluation report to MOD and once the short listing was known, had this to state : “the deeper problem with the current two-step approach is... that it potentially permits a costly misallocation of defence resources that could over time subvert India’s larger national security. Simply put, a procurement process that does not include shadow prices in the first step of its evaluation is fundamentally flawed.... there is no such thing as ‘best’ technology in the abstract, especially where defence procurement is concerned. The pre-eminence of any war-fighting technology in the real world can be judged only against the constraints of price and, particularly in regard to India, against additional variables of consequence... what economists call, ‘constrained maximisation’.”

Recognising that aeronautics is one of the most significant technological influences of modern times which empowers nations with strength for international partnership and for economic development, the Aeronautical Society of India had, in 2004, submitted a proposal for an overarching *National Aeronautics Policy* along with a supporting organisation with a view to according national aeronautics the status of a national mission. The mission was expected to encompass civil and military needs as well as those of research, development and the aeronautical industry and would strive to bring Indian aeronautics on to the international stage as an equal partner, rather than perennial buyer.

If there is one lesson that emerges from the MMRCA process, it is that this long dormant proposal needs an urgent relook.

Air Marshal (Retd) Brijesh D. Jayal

Next steps on MMRCA 'imminent'

Speaking on the sidelines of the Sixth International Conference on 'Energising Indian Aerospace Industry' organised by CAPS and CII at the Manekshaw Centre in New Delhi on 21 September, Air Chief Marshal NAK Browne, Chief of Air Staff, stated that "We are in final stages of this process (of signing the contract for MMRCA) and (it will be done) hopefully by the end of the year."

Further, the Air Chief revealed that some of these issues are going to be discussed at the forthcoming meeting of the Defence Acquisition Council on 7 October. "Once those issues are cleared, hopefully by the middle of month, we should be in a position to open the bids."



Air Chief Marshal NAK Browne

Asked to comment on the acquisition schedule of the MMRCA, he said that "these would be inducted in the IAF by 2014". On the offset value of the programme, this amounted Rs 20,000 crore plus and would be implemented over a period of 13 years. "The MMRCA programme will generate enormous opportunities for the Indian industry from the system integrators down to tier 2, 3 and 4 levels."

Unique approach on Avro 748 replacement

The BAE (formerly Hawker Siddeley, former Avro) 748 medium transport aircraft has been in service with the Indian Air Force since the early 1960s, with HAL's Kanpur Division having licence built a total of 89 such aircraft, primarily for the Indian Air Force although 17 were delivered to the erstwhile Indian Airlines in the period 1965-70. The IAF has one squadron (No.11) equipped with the wide door version and there are several communication flights attached with various Commands for staff transportation. The Navigation and Signals School at Begumpet Airport, Hyderabad has operated half a dozen for specific training while there are a number of 748s at Air Force Station, Yelahanka which provide multi-engine aircrew training for IAF pilots, alongside An-32s and Do-228s.



The HAL-built Avro 748 has been in IAF service for nearly half a century.

The IAF has issued a Request for Information (RFI) for the 748's replacement with a total of 56 required. Although responses have reportedly been received from half a dozen OEMs, since the IAF has specified "rear loading capability," the only types that seem to meet the requirement are the Airbus Military C-295 and Alenia's C-27J Spartan. According to a Russian Industry spokesman, they too would be a contender for meeting the IAF requirement and the types that are immediately obvious are from the Antonov An-74 family. However, manufacturers of regional turboprop airliners have evinced interest in the programme and include Saab, ATR, Bombardier and Embraer.

Indian Naval Air Arm expansion plans

Indian Naval Ship *Hansa* marked the 50th anniversary of its commissioning at the Naval Air Station in Goa in the first week of September 2011. Apart from several functions, including INAS 551 celebrating its Golden Jubilee as well, the station held a two-day International Symposium on 'Indian Naval Aviation – Roadmap to Transformation'. The Governor of Goa, Dr SS Sidhu was Chief Guest at the special reception and dinner at INS Hansa on 5 September where he also released the Coffee Table Book 'On the Wings of Gold', published by the *Society for Aerospace Studies*. Vice Admiral DK Joshi, FOC-in-C Western Naval Command was in attendance.

An overview of the Indian Naval Air expansion and modernisation was the theme, presented by senior Naval Aviators including Vice Admiral Shekhar Sinha, CISC, Rear Admiral DM Sudan, ACNS (Air), Read Admiral Sudhir Pillai, FONA. Opening the Symposium was the address by Admiral Arun Prakash, former Chief of Naval Staff on 'Contours of India's Naval Aviation of the Future' followed by Air Commodore Jasjit Singh, Director CAPS on 'Air Dominance in the Maritime Environment'. As summed up by Commodore Ravneet Singh, CO INS Hansa, the new naval aviation assets at INS Hansa in the immediate years ahead will need upgradation of the infrastructure to support an entirely new generation of aircraft types, ranging from the MiG-29K and LCA Navy to possibly the BAE Hawk AJTs and Boeing P-8I LRMP/ASW aircraft. (see report in this issue)



Sea Harriers of INAS 300 at INS Hansa.

Agusta Westland

CAG criticises ordering of MiG-29Ks “without weapons”

In its recent performance audit tabled in Parliament, the Comptroller and Auditor General of India (CAG) has been critical of the manner in which 16 MiG-29Ks were ordered in January 2004 for the Indian Navy at Rs. 3,405 crore, “without finalizing the weapons packages for them, that led to the delivery of six jets without any weapons in December 2009”. Subsequently, five more MiG-29Ks were delivered in May 2011. Moreover, the Rs 98 crore contract for 40 BVR (beyond visual range) missiles for the MiG-29Ks was concluded without consulting the IAF, which has found them to be “unsatisfactory” with “unreliable serviceability”.



MiG-29 KUB of INAS 303

Another major criticism is that while the Navy has already begun to induct the 45 MiG-29Ks ordered from Russia for over \$2 billion, the 44,570-tonne aircraft carrier INS *Vikramaditya* (*Admiral Gorshkov* being refitted at a cost of \$2.33 billion) from which they are to operate will be delivered to India only by early 2013.

Indian Army Aviation marks 25th anniversary

In association with the Centre for Land Warfare Studies (CLAWS) and *Vayu Aerospace Review*, the Army Aviation Directorate held a National Seminar on their being ‘The Arm of the Future’, at the Manekshaw Centre on 13 September.



HAL Dhruv ALH of Army Aviation.

The keynote address by Minister of Defence AK Antony was preceded by the opening address of Lt Gen VK Ahluwalia, GOC-in-C Central Command (and Colonel Commandant Army Aviation Corps) and inaugural address by General VK Singh, Chief of Army Staff. The special address was by Admiral Arun Prakash, former CNS.

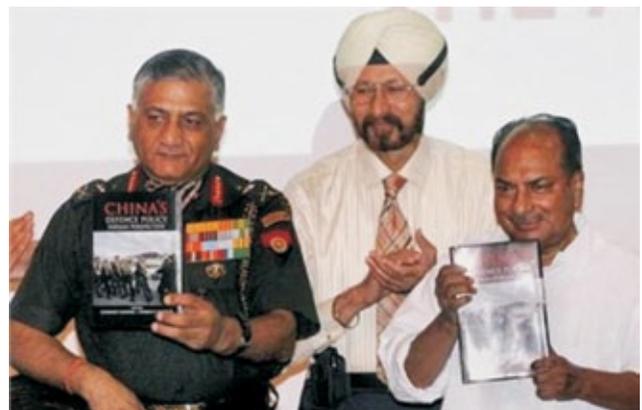
The ‘Philosophy of employment and envisaged role for Army Aviation in the future battlefield’ was articulated by Lt Gen Anil Chait, Commandant Army War College which was followed by papers presented by various senior Generals on “Force structuring and Modernisation” while P. Soundara Rajan, Managing Director Helicopter Complex, HAL reviewed his company’s support of Army Aviation which has exclusively operated helicopters built by HAL, from the light Cheetahs and Chetaks to the current Dhruv advanced light helicopters in several variants and the ALH Mk.IV WSI newly christened as the Rudra. (See report in this issue).

Defence Minister “advice on reconciliation” to the Services

The Defence Minister AK Antony has called upon the Services to ‘act in reconciliation amongst themselves’ while expanding their role on overlapping spheres so that the country can have better and strong Armed Forces. He offered to play ‘a limited role in finding reconciliation’ towards that effort. His remarks were made at the Seminar on Army Aviation in New Delhi when several speakers advocated a greater role for this youngest combat wing of the Indian Army.

“Although you (Army Aviation Corps) are going in for force accretion, while enhancing your capabilities and performing your role, you must ensure that there is perfect synergy between Army and Air Force. Services will have to act in reconciliation amongst themselves so that India can have better and strong and Armed Forces. In your attempt at arriving at reconciliation, I will try to play a limited role in finding such reconciliation”, he said.

The Defence Minister said that in the current scenario, asymmetric challenges can come through land, air or water and even by cyber space. In such a situation, a joint air, land and



General VK Singh, Brig. Gurmeet Kanwal, Mr AK Antony releasing CLAWS publications

IRKUT

maritime campaign will be an essential requirement. He called upon the Armed Forces to adopt a holistic approach to security as no single wing of the Defence Forces can work in isolation. "The need for synergy and pooling in of efforts and resources is being felt, like never before", he said. Referring to modernisation of the Armed Forces, he said, the government is fully aware that some nations are augmenting their infrastructure and modernising their military capabilities. He said, instead of unduly worrying about this, 'we must also continue to improve our infrastructure at a steady pace. At the moment, we are doing that', he said.

"Lack of integration" between Defence and Bureaucracy

According to authoritative sources in New Delhi, the Chiefs of Staff Committee, comprising the three Service chiefs, have informed the Prime Minister Dr. Manmohan Singh on the lack of integration between the Ministry of Defence and the three Services which contributed to prolonged delays in procurement, thus hampering higher defence management activities.



Apparently, Air Chief Marshal PV Naik, who was Chairman of the Chiefs of Staff Committee before his retirement on 31 July 2011, in a detailed communication to the PM had expressed the military's concerns. ACM Naik pointed out that the Kargil Review Committee, appointed after the 1999 conflict between India and Pakistan, had recommended integration between the defence ministry and the three Services and it was duly approved by a Group of Ministers. The Committee had recommended that the "structure and interface between the MoD and the Armed Forces Headquarters be comprehensively studied and reorganised". Many decisions of the GoM were implemented, resulting in the setting up of the Integrated Defence Staff (IDS), Defence Intelligence Agency (DIA) etc.

However the level of integration was not enough, with the civilians in the MoD having "overriding powers" over most crucial activities of the military, especially major equipment procurements. He suggested that it was high time that the government appointed senior military officers in the MoD, at the level of joint secretary etc.

In response, the MoD reportedly told the Chiefs of Staff Committee that the integration was "in fact complete and was visible in several aspects". The MoD cited the single file concept and the renaming of the defence headquarters as "Integrated" to back its claims.

India and UK sign LOA on collaborative Defence R&D

India and the United Kingdom entered into a letter of Arrangement on 16 September 2011, "to pursue collaborative Defence R&D Cooperation with UK's Defence Science and Technology Laboratory (Dstl) and facilitate making best use



of respective research and technology development capability through joint projects, collaborative research and industry and academia participation". The LOA was signed in London by Dr VK Saraswat, SA to Defence Minister and Secretary Defence R&D and Professor Sir Mark Welland, Chief Scientific Adviser (CSA), Ministry of Defence, United Kingdom.

Agni 2 Prime ballistic missile launch planned

The Agni-II intermediate range ballistic missile (2500- 3000 km) with a one-tonne nuclear warhead is planned for launch



in October, according to DRDO sources. An earlier launch was aborted in December 2010 owing to a problem in the control system in the first stage. The Strategic Forces Command of the Army, which handles nuclear weapons-delivery systems, was to conduct the launch.

The DRDO is now concentrating on launching the Agni-II Prime in October, 2011 and thereafter the Agni-V which has a range of more than 5,000 km, in December 2011.

Shourya missile launched

The DRDO-developed 700 km range Shourya missile was successfully flight tested from Launch Complex III of the ITR, Balasore on 24 September 2011. The missile was launched from a canister in a ground launch mode. The radar stations, telemetry stations, electro-optical stations all along the East Coast tracked and monitored all the mission parameters while ships located near the target also tracked and witnessed the final impact, which was within a few meters CEP.



Fifth C-130J Super Hercules delivered to the IAF

The fifth of six C-130J Super Hercules ordered by the Indian Air Force departed the Lockheed Martin facility in Marietta on 9 September enroute to Air Force Station Hindan near Delhi. "This aircraft, like its predecessors, was delivered well ahead of schedule," according to Lockheed Martin's spokesman. The IAF's sixth C-130J will be delivered in October.

The Indian Air Force purchased six C-130J-30s in early 2008 at a cost of up to \$1.059 billion. This package deal with the US government is under the Foreign Military sales programme, and India has retained option to buy six more of these aircraft for combined Army-Air Force operations.



Army and IAF on rescue and relief operations in Sikkim

The Armed Forces mobilised rescue and relief operation after a powerful earth quake hit Sikkim on 18 September evening. Within 90 minutes of the earthquake, two C-130J Hercules of No.77 Squadron at Hindan took off with 203 National Disaster Relief Force (NDRF) personnel, sniffer dogs, search and rescue teams, medical personnel carrying 9 tonnes of relief materials including tents, medicines and food stocks to Bagdogra. A team of 20 doctors from the Army Medical Corps (AMC) with essential medical supplies also flew to Bagdogra from Palam airport in an IAF Avro 748 while a Mi-17 helicopter with medical team and relief equipment lifted from Bagdogra for Gangtok. Another two Cheetah helicopters from Bagdogra carried out aerial recce missions to assess the damage caused by the 6.8 magnitude earthquake with its epicentre on the Indo-Nepal border in Sikkim.



Personnel of the NDRF board a C-130J Super Hercules of the IAF at Hindan in the late evening of 18 September enroute to Bagdogra.



An-32 offloading personnel and material at Bagdogra, with Avro 748 also in the picture.

The following day, two Mi-17 helicopters carried relief material and NDRF personnel to Lachen and Mangan, the interior regions of North Sikkim. Over 5,000 army personnel, including ten columns of army engineers each comprising 15-20 personnel, were pressed into rescue operations immediately after the first tremors were felt. Troops stationed in the area provided shelter to over 1,500 people including 1,000 civilians at Gangtok and 200 civilians at Darjeeling.

Thereafter, an IL-76 with 100 volunteers of No.2 NDRF battalion and 8 tonnes of material flew from Chandigarh to Bagdogra and were followed by two An-32s.

Four Dhruvs and five Cheetah helicopters of Army Aviation were on standby at Sukna Military Station, apart from two Cheetahs and a Mi-17 at Bagdogra plus two Mi-17 helicopters at Guwahati.

Indian Coast Guard expansion plans

The Indian Coast Guard have reportedly issued requests for information from selected vendors for the procurement of 16 light, twin-engined helicopters which would augment the current force of HAL Chetak in service. In addition, the Coast Guard have plans for extensive expansion of its air component which includes the induction of 14 medium helicopters for operation from both shore and ships, essentially their offshore patrol vessels (OPVs).



Do-228 of the Indian Coast Guard

As for fixed-wing aircraft, the Coast Guard currently operate 28 HAL-Dornier 228s from bases in Gujarat, Cochin, Chennai, Kolkata and Port Blair. It is learnt that the Coast Guard will expand their fleet of this aircraft type to some 40 aircraft even as a new RFP is being formulated for the multi-mission maritime aircraft (MMA), a total of 6 aircraft being considered in the first phase followed by another 3.

MiG-21s' phase out by 2017

The last MiG-21s of the Indian Air Force will be phased out of service by 2017 and replaced by modern fighter aircraft such as the Su-30MKI and indigenous LCA according to Minister of State for Defence M M Pallam Raju responding to a Parliamentary question.



Presenting statistics in his reply, over the years, the IAF had inducted a total of 946 MiG-21s in its inventory of which 476 of them were lost in various accidents over the past 45 years. The ministry acknowledged that most of these accidents had occurred due to old technology.

IAF Chief visits Germany

Air Chief Marshal N A K Browne visited Germany on an official invitation from his counterpart for a week from 6 September. Observers have noted that the visit is at a time when the Indian Government is at the final stages of the Medium-Multirole Combat Aircraft (MMRCA) acquisition programme for the IAF. Germany is the lead partner of the four nations manufacturing the Eurofighter Typhoon, which along with the French Dassault Rafale, has been shortlisted. The Air Chief was in Berlin to meet senior Ministers of the German Government and later visited the plant at Manching, near Munich, where the Eurofighter Typhoon is manufactured.

Two weeks later, in his key note address at the 'Energising Indian Aerospace Industry' Conference at New Delhi, Air Chief Marshal Browne stressed on the "total transparency" sought with the industry and made a special reference to his German visit where he observed Air Force personnel embedded with the industry in major programmes. This was the model he proposed for the Indian industry as well.



Impression of the Eurofighter Typhoon production line at Manching

French Air Chief in India

General Jean-Paul Palomeros, Chief of the Armee de l'Air (French Air Force) made an official visit to India in mid September and apart from meetings with the Indian MoD in New Delhi, visited the Air Force Stations at Gwalior and

Pawan Hans



General Jean-Paul Palomeros (right) with aircrew of French Mirage 2000

Jaisalmer. The General also flew in a Sukhoi Su-30 MKI at the base which also houses the Mirage 2000. (See special interview in this issue)

Indian Naval Chief visits Myanmar

Chief of the Naval Staff, Admiral Nirmal Verma visited Myanmar from 24-26 August 2011, the visit aimed at enhancing the existing Navy-to-Navy cooperation. He discussed issues relating to regional security and defence cooperation especially in the maritime domain.

Admiral Nirmal Verma met with the President of Myanmar, U Thein Sein and in addition had a series of meetings with high ranking officers of the Myanmar Armed Forces including the Commander in Chief of Myanmar Defence Forces Gen Ming Aung Hlaing and Commander in Chief of Myanmar Navy Vice Adm Nyan Tun.



Mahindra Group's 5-seater aircraft

The NM-5, five seater cabin monoplane developed by the Mahindra Group in collaboration with CSIR National Aerospace Laboratories, has made its first test flight in Australia and completed five tests by the first week of September.



Following the FAR 23 certification, series production could follow, the aircraft expected to cost around \$400,000 (about Rs 2 crore). Hemant Luthra, Chairman of Mahindra Aerospace stated that, "the market for small aircraft (20 seats and below) started to decline in 2007 but is expected to grow again in the coming years." The Mahindra Group acquired the Australia-based aircraft maker Gippsland Aviation about two years ago.

IAF to get Sukhoi 'Super 30s'

With some 272 Sukhoi Su-30MKIs on order for the Indian Air Force, this will arguably become the largest single aircraft type in service with the Indian Air Force through till the mid-21st century. The overall Su-30 programme has incrementally grown in size and scope since the contract was originally formalised in 1996 and it is assumed that by 2016, the IAF's order of battle will include 15 squadrons with the type.

The last batch of Su-30MKIs will become the first 'Super 30s' for which about \$ 2.4 billion has been allocated for their 'deep modernisation'. Defence Minister AK Antony has confirmed this to the Rajya Sabha, giving the current estimated cost for the upgrade programme as Rs. 10,920 crore and that the aircraft are likely to be upgraded in phased manner from 2012 onwards. (See article on MAKS 2011)



Boeing

IAF contracts and offset opportunities

Some 271 contracts/MOUs worth Rs. 112,000 crore have been signed in the current Plan by the Indian Air Force according to Air Chief Marshal NAK Browne, Chief of Air Staff IAF. He also mentioned that though modernisation is a continuous process, the maximum impact of modernisation in the air force will be visible during the 11th and 12th five year plans.

According to Ajai Chowdhry, Chairman CII National Defence Council, "the total opportunities in the Indian defence aerospace sector are going to be more than US\$ 100 billion in the next 10 to 15 years. These include fighter aircraft, transport aircraft, helicopters, Unmanned Aerial Vehicles and in the MRO sector. If we include civil aerospace sector also, the overall opportunities for the industry will be more than US\$ 250 billion over next 10-15 years."

IAF license for issuing digital certificates

Chief of the Air Staff, Air Chief Marshal NAK Browne has officially received license to issue Digital Signature Certificates by the Controller of Certifying Authorities (CCA), Dr N Vijay Aditya in a ceremony held at the Air Headquarters on 30 August 2011.

As a part of the AFNET (Air Force Network) Project, digital signatures issued by a license holder would provide legal recognition to an electronic document under the IT Act 2000. With this, the IAF would be able to put in place a Public Key Infrastructure (PKI), which is a practical strategy for achieving information security in today's highly networked environment. As an essential component for providing enhanced information assurance and identity management capabilities, PKI would provide data integrity, user identification and authentication, user non-repudiation, data confidentiality, encryption and digital signature services for programmes and applications on Air Force Network. It would also issue and manage software and hardware certificates on the IP/MPLS (Internet Protocol/ Multiprotocol Label Switching) network of the IAF. With this system in place, the IAF becomes the first defence organisation and the second Government body first being NIC (National Informatics Centre) to receive the coveted license.

First four Indra radar stations

Assigned to provide 9 radar systems which will be responsible for the 80% of the country's air space and as part of the project awarded by AAI in 2010, Indra is also equipping 38 airports with its air traffic management system.

Four out of the nine radar stations which Indra will start up in India to enhance air traffic management are at Chennai, Bellary, Bhopal and Porbandar, all equipped with secondary radars mode S, being of the most accurate aircraft identification technology.

Flight test of Prithvi (P-II)

The DRDO-developed Prithvi (P-II) tactical ballistic missile was once more flight tested on 26 September 2011 from Launch Complex-III, ITR at Chandipur. The launch was carried out by the Armed Forces as a part of regular training exercises. The missile impacted on the predefined target in the Bay of Bengal with very high accuracy of better than 10 meters. An Indian Naval ship close to the target monitored the final event.



Air Chief Marshal NAK Browne outlines vision for the IAF.

Air Chief Marshal NAK Browne who took over as the 23rd Chief of the Air Staff (CAS) from Air Chief Marshal PV Naik on 31 July 2011, has addressed the IAF thus:

"The IAF is well poised on the path of transforming itself into a potent strategic force". Outlining his vision statement for the IAF – 'People first Mission Always' – he said "While induction of the state of the art equipment and systems would lead to a major upgradation of our combat potential, our biggest strength 'Our People' must receive our highest attention." He added that "in whatever capacity you serve in the Indian Air Force, you remain our most valuable asset".



“I firmly believe that each one of us has a duty to care and look after the people placed under our charge. It is a sacred calling, for all leaders, men and women, irrespective of the rank and position. Our endeavour should be to empower our subordinates, by giving them required operating skills, through dedicated training and mentoring...while change is the hallmark of growth and progress, the biggest challenge facing us in the coming years is to manage this fast paced change effectively, without compromising on high operational standards. Operating across a broad spectrum of equipment vintage, would test our innovativeness and capabilities. The nation has reposed a high degree of trust and confidence in our capabilities. It is indeed an onerous asking, and I am confident that as capable men and women we will work shoulder to shoulder in discharging our responsibilities befittingly”.

Air Marshal KK Nohwar is Vice Chief of the Air Staff

Air Marshal Kishan Kumar ‘Timmy’ Nohwar took over as Vice Chief of the Air Staff (VCAS) at Air Headquarters on 1 August 2011. He had earlier served as Air Officer Commanding-in-Chief of Eastern Air Command at Shillong.

Air Marshal Nohwar was commissioned into the fighter stream of the Indian Air Force on 24 June 1972, has 3400 hrs of flying in his logbook. He flew the MiG-21 and later commanded a MiG-27 Squadron, is a qualified flying instructor, fighter combat leader, and an alumnus of the Defence Services Staff College and Air War College (USA).

He was Commandant of the Tactics and Air Combat Development Establishment (TACDE) and AOC of a fighter airbase. His important staff assignments include Chief Operations Officer, Deputy Commandant College of Air Warfare, Principal Director, Air Staff Inspection and Assistant Chief of Air Staff (Plans). He has also served as Chief of Staff at the Andaman & Nicobar Command, Deputy Commander-in-Chief of Strategic Forces Command and Senior Air Staff Officer at Training Command.



Air Marshal KK Nohwar reviewing a Guard of Honour at Air Headquarters on 1 August 2011

Air Marshal Satish Pal Singh is AOC-in-C SAC

Air Marshal Satish Pal Singh has been appointed as the AOC-in-C Southern Air Command. He was commissioned into the flying branch of Indian Air Force on 1 June, 1974, has flown over 6800 hours on various fighter and transport aircraft. The Air Marshal, a graduate of the Defence Services Staff College and Army War College Mhow, has attended the Political and Strategic Higher Study Course in Brazil.



Air Marshal Jagdish Chandra is AOC-in-C, Maintenance Command

Air Marshal Jagdish Chandra has taken over as AOC-in-C Maintenance Command on 1 September 2011. A graduate in Electronics and Communication Engineering and a post graduate in computer technology, he was commissioned in the Electronic stream of IAF's Engineering Branch on 8 July 1976. A versatile technical officer, he has experience on a wide range of Aircraft Radar, Communication, Weapons and Information Technology systems of the IAF. He was trained in France on Mirage 2000 Computerised Maintenance Management.

While speaking to Commanders, he stated that having adopted the year 2011 as year of consolidation and maintenance, “there is a need to identify areas of concern affecting operational assets, availability and evolve strategies to enhance logistical and maintenance support to operational units.”



SMSOs' Conference

A two-day bi-annual Senior Maintenance Staff Officers' Conference on 12-13 September 2011 inaugurated by the Chief of Air Staff at Air Headquarters, highlighted the operational imperatives and maintenance challenges of the IAF due to the wide spectrum of weapon systems and associated infrastructure. He urged SMSOs to be pro-active and address



the issues in right earnest. He deliberated on the issues of modernisation, challenges to security and ethos of IAF and reiterated the importance of human element and working as a team to gain the synergy in modern times

Air Officer-in-Charge Maintenance (AOM) Air Marshal J Neri carried out a brief overview of various fleets and covered actions initiated by Air HQs to enhance maintainability for safe operations. The two-day Conference reviewed complex maintenance issues in the IAF due to different environmental conditions, legacy systems with obsolescence and vintage related problems, state-of-the-art systems and requirement of infrastructure etc. Representatives from HAL and BEL interacted and presented their perspective on maintenance of equipment supplied by them.

Vice Admiral RK Dhowan takes over as Vice Chief of Naval Staff

Vice Admiral RK Dhowan has assumed charge as Vice Chief of Naval Staff (VCNS) at the Integrated Headquarters, Ministry of Defence (Navy). Vice Admiral Dhowan has held



various key command and staff appointments during his career, operational command appointments including the missile corvette INS *Khukri*, guided missile destroyers INS *Ranjit* and INS *Delhi* and the Eastern Fleet as Flag Officer Commanding Eastern Fleet (FOCEF). The Admiral's staff assignments have included prestigious appointments like the Deputy Chief of Naval Staff and Assistant Chief of the Naval Staff (Policy and Plans) at the Headquarters at New Delhi, Commandant of National Defence Academy Khadakvasla, Naval Adviser at the High Commission of India in London and Chief Staff Officer (Operations) at Headquarters Western Naval Command (Mumbai).

A navigation and direction Specialist, Vice Admiral 'Robin' Dhowan is an alumnus of the National Defence Academy, the Defence Services Staff College and Naval War College, Rhode Island, USA. The Admiral had also excelled during his initial training winning the coveted 'telescope' as Best Cadet and later the 'Sword of Honour' during his Midshipman training.

Vice Admiral Satish Soni is Deputy Chief of Naval Staff

Vice Admiral Satish Soni took over as Deputy Chief of Naval Staff from Vice Admiral RK Dhowan. Vice Admiral Satish Soni has previously held various important command and staff appointments in his career, sea commands including the ocean going minesweeper INS *Kakinada* and the guided missile corvette *Kirpan*, the stealth frigate *Talwar* and the guided missile destroyer *Delhi*. As a Rear Admiral he commanded the Eastern Fleet of the Indian Navy. The Vice Admiral was also Commandant of the National Defence Academy at Khadakvasla.



Vice Admiral Satish Soni (seen on the left) taking over as Deputy Chief of Naval Staff from Vice Admiral RK Dhowan at South Block, New Delhi on 30 Aug 2011

INS 'Satpura' commissioned

Chief of Naval Staff Admiral Nirmal Verma commissioned INS *Satpura* into the Indian Navy on 20 August 2011. *Satpura* is second of the indigenously designed and constructed stealth frigates of the *Shivalik* Class, built by Mazagon Dock Ltd at Mumbai.



INS *Satpura* is armed with an array of surface, sub-surface and air-defence weapons, which include long range anti-ship missiles, anti-aircraft missiles and anti-missile defence systems. The weapon sensor fit of the *Satpura* is controlled through a Combat Management System, designed and developed by the Indian Navy and manufactured by Bharat Electronics. The system allows seamless integration of the ship's systems as well as with the weapons and sensors of other Fleet ships, thus enabling the concept of 'Co-operative Engagement Capability' (CEC). The two multi-role helicopters are embarked on *Satpura* provide enhanced surveillance and attack capability.

INS *Satpura* has been conceived and designed by an Indian Naval design team. This class of ships will be the mainstay frigates of the Indian Navy in the first half of the 21 century. The incorporation of numerous new design features aboard INS *Satpura* effectively reduces the probability of her being detected at sea. The inbuilt structural, thermal and acoustic stealth features augment the potent capability of the ship to address threats in all dimensions of maritime warfare. The ship is propelled by two modern LM 2500 Gas Turbines, which enable speeds in excess of 30 knots (or over 55 kmph) and two SEMT Pielstic Diesel Engines for normal cruising speeds.

INS 'Karuva' commissioned at Vishakhapatnam

INS *Karuva*, the tenth indigenously built Fast Attack Craft (FAC) of the Indian Navy was commissioned by Air Marshal KJ Mathews, Commander-in-Chief Strategic Forces Command at Vishakhapatnam Naval Base on 25 August 2011. Vice Admiral Anup Singh, Flag Officer Commanding-in-Chief, Eastern Naval



Vice Admiral Anup Singh (right) with Air Marshal KJ Mathews.

Command and Rear Admiral (Retd) KC Sekhar, Chief Managing Director, GRSE were present on the occasion.

Named after an island situated on a tributary of river Kabani in Kerala, INS *Karuva*, measuring 52 metres in length and displacing 325 tons, can achieve speeds in excess of 30 knots with a complement of four officers and 39 sailors and built for extended coastal and offshore surveillance and patrol. With advanced MTU engines and latest communication sets, INS *Karuva*, like its counterpart INS *Koswari* commissioned earlier on 12 July 2011 will also be based at Karwar, under the Naval Officer-in-Charge (Karnataka) and will be deployed for Coastal Patrol and Anti-Piracy missions along the Konkan Coast and the Lakshadweep group of islands.

Amphibious vessels for Indian Navy

The government has cleared the Rs 2,176-crore acquisition of eight LCUs (landing craft utility), capable of 'hard beaching' on shores, to improve the Navy's amphibious warfare and island protection capabilities. The MoD is also finalising another project to acquire four large Landing Platform Docks (LPDs) for 'stand-off beaching' at a cost of around Rs 16,000 crore. The LCUs and LPDs will swiftly transport thousands of troops, heavy weapons and infantry combat vehicles over considerable distances away from the Indian peninsula.

The LCU project for the eight amphibious assault vessels will be implemented by the Kolkata-based Garden Reach Shipbuilders and Engineers Ltd and will be completed in three years. The LCUs are likely to be based at India's regional 'theatre command', the strategically-located Andaman and Nicobar Command (ANC). The four new LPDs will be built by Hindustan Shipyard (HSL) and private shipyards in collaboration with a foreign manufacturer.

With additional airstrips, OTR (operational turn around) bases and jetties, ANC is slowly being transformed into a major amphibious warfare hub. A strong military presence in the 572-island archipelago is considered imperative to counter China's strategic moves in the Indian Ocean as well as ensure security of the sea lanes converging towards Malacca Straits and this has gained momentum after commissioning the 16,900-tonne INS *Jalashwa*, known as USS *Trenton* earlier, and its six UH-3H Sea King troop-carrying helicopters for around \$88 million from the US in 2007.

Indian Naval UH-3H helicopters in Odisha flood relief

In quick response to the Govt of Odisha's call for aid towards flood relief on 11 September 2011, the Eastern Naval Command launched flood relief operations, deploying INS *Airavat* along with integral search and rescue (SAR) Chetaks off Paradip port. Two UH-3H helicopters from INAS 350 at Visakhapatnam were also positioned at Bhubaneswar airport and carried out air drop sorties in Fanki, Puri, Kendra Para, Cuttack, Nayagarh and Paika areas. A total 31,000 kgs relief material was air dropped.

Rolls-Royce contract with Cochin Shipyard

Rolls-Royce have contracted with Cochin Shipyard to supply 60 water jets for a new fleet of 20 Fast Patrol Vessels for the Indian Coast Guard. The contract will involve the supply of Rolls-Royce Kamewa water jets (three per vessel), and associated equipment including a control system which will enhance the manoeuvring capabilities of the vessels. The 50 metre long vessels, which are currently under construction, will reach speeds of 33 knots to operate in Indian coastal waters and around island territories. Their roles will include coastal patrolling, anti-smuggling missions, fisheries protection, as well as search and rescue duties.

Rolls-Royce has been in association with the Indian Coast Guard for 20 years, with 86 water jets already in service and other equipment such as controllable pitch propellers and stabilising fins operational on other vessels in the fleet. Rolls-Royce has also supplied a design and equipment package for three UT 517 design Pollution Control Vessels, the first of which *Samudra Prahari* entered service in 2010. Cochin Shipyard Limited has long standing experience in building Rolls-Royce-designed vessels with more than 20 UT design vessels delivered to date.

K Naresh Babu is Managing Director (Bangalore Complex) at HAL

K Naresh Babu has taken over as Managing Director, Bangalore Complex, Hindustan Aeronautics Ltd on 6 September 2011. Prior to this, he was General Manager (Planning) at HAL Corporate Office.

HAL's Bangalore Complex comprises nine full-fledged Divisions including one R&D Centre, engaged in manufacture, overhaul and supply of fighter/trainer aircraft, aero-engines, industrial marine gas turbines, aerospace launch vehicle structures and satellite structures in addition to facility management of Bangalore based Divisions, HAL Estate and Medical & Health for Bangalore based employees and their families.

Divisions of the Bangalore Complex are engaged in a variety of projects particularly the Hawk, LCA, IJT, etc. His key responsibility will be implementation of programmes like the MMRCA, Jaguar Darin III and the Mirage 2000 upgrade.



Sqn Ldr (Retd) Baldev Singh is HAL's Director Corporate Planning & Marketing

Sqn Ldr (Retd) Baldev Singh took over as Director Corporate Planning & Marketing of HAL on 16 August 2011; he was earlier Executive Director Flight Operations and the Chief Test Pilot (Fixed Wing) at HAL Bangalore Complex.

Highly experienced in various facets of aviation, he has a total flight test experience of over 6000 hours on 55 different types of aircraft, is a Qualified Flying Instructor and holds a diploma in Aviation Flight Safety from the Naval Post Graduate College, Monterey Bay, California, USA.

After operational flying on Hunters, MiG-21s and MiG-23s he qualified as a Flight Instructor in July 1983, did his experimental test pilots course in 1984 and was deputed to HAL in 1986. He retired from the Indian Air Force in 1989 and joined HAL.

He was involved with the LCA Programme from 1990 onwards and was deputed to the Aeronautical Development Agency for this purpose. On the LCA programme he worked extensively on the development and flight testing of the flight control laws and carried out the flight evaluation of these flight control laws at the Real Time simulator at BAE Warton in UK followed by the flight evaluation of these on the F-16, Lear Jet and NT-33 aircraft in USA.

VM Chamola is HAL's Director (HR)

VM Chamola was appointed as the new Director, Human Resources, Hindustan Aeronautics Ltd (HAL), prior to which he was Chief General Manager (CGM) HR in BEML and was also Additional General Manager (HR) at HAL.

Having much experience in various segments of HR coupled with unstinted efforts in streamlining the arena, HAL saw rapid changes during his previous term. He rationalised the transport services, brought in uniform system for canteen services and shift timings to name a few of his achievements. On assuming the elevated post he said, "it is challenging, we need to focus on bringing in more transparent and uniform systems".



Maiden flight of first Indian Navy P-8I

First of the Indian Navy's Boeing P-8I aircraft made its initial flight on 28 September 2011, taking off from Renton Field and landing two hours and thirty one minutes later at the Boeing Field in Seattle.

During the flight, Boeing test pilots performed airborne systems checks including engine accelerations and decelerations and autopilot flight modes, while taking the P-8I to a maximum altitude of 41,000 feet prior to landing. In the coming weeks Boeing will begin mission systems installation and checkout work on the aircraft at a company facility near Boeing Field.



"The P-8I programme is progressing well and we are looking forward to this potent platform joining the Indian Navy as part of its fleet," said Rear Adm. DM Sudan, ACNS (Air), Indian Navy.

The P-8I is the first of eight long-range maritime reconnaissance and anti-submarine warfare aircraft Boeing is building for India as part of a contract awarded in January 2009. An option for four additional P-8I aircraft was included in the original contract.



(From L-R) Commander Vishal Roy, Indian Navy, Rear Adm. DM Sudan, Assistant Chief of Naval Staff (Air), Indian Navy and Commodore Alok Bhatnagar, Naval Attache in Washington D.C.

Based on the Boeing Next-Generation 737 commercial airliner, the P-8I is the Indian Navy variant of the P-8A Poseidon that Boeing is developing for the U.S. Navy. In order to efficiently design and build P-8 aircraft, the Boeing-led team is using a first-in-industry, in-line production process that draws on the company's Next-Generation 737 production system. The aircraft features open system architecture, advanced sensor and display technologies, and a worldwide base of suppliers, parts and support equipment.

The P-8I is built by a Boeing-led industry team that includes CFM International, Northrop Grumman, Raytheon, Spirit AeroSystems, BAE Systems and GE Aviation. The Indian Navy has selected the P-8I to fulfill its long-range maritime reconnaissance and anti-submarine requirements and the C-17 Globemaster III for its strategic and long-range airlift requirements.



Government clears 10% disinvestment of HAL

The Defence Ministry has cleared offloading of 10% equity of Hindustan Aeronautics Ltd (HAL), the country's only military aircraft manufacturer, making it the third defence PSU after BEL and BEML to be headed for disinvestment. Defence minister A K Antony gave his "in principle approval" to the 10% stake sale of HAL over the next five years to bring in resources for the PSU's modernisation. After an evaluation of HAL, the proposal will go the department of disinvestment that will prepare a note for final nod by the cabinet committee on economic affairs.

The disinvestment will "reduce the government burden" for the proposed Rs 20,000 crore modernisation of plants of the Bangalore-headquartered HAL over the next decade, with the PSU slated to handle new programmes worth billions of dollars with foreign collaborators in the near future.

With a sales turnover of over Rs 13,000 crore, HAL is handling crucial ongoing projects like the Tejas light combat aircraft, Dhruv advanced light helicopter and indigenous production of the Russian-origin Sukhoi-30MKI fighters, all of which are running well behind schedule. The new projects on the anvil range from the medium multi-role combat aircraft (MMRCA) and fifth-generation fighter aircraft (FGFA) to light utility helicopters and multi-role transport aircraft (MTA).

Dr Prahlada is Vice Chancellor of DIAT at Pune

Dr. Prahlada, Chief Controller of Aero Programmes, DRDO has taken over as the Vice Chancellor of D.I.A.T (Defence Institute of Advanced Technology), a Deemed University which is an Autonomous Organisation fully funded by the department of



Defence Research and Development Organisation (DRDO).

Areas of academic studies and research cover a large canvas including Aerospace Computer Sciences, Mechanical Engineering, Electronics Engineering, Applied Physics, Chemistry, Mathematics and Material Science.

Dr A. Subhananda Rao is Chief Controller (Aero)

Dr. A. Subhananda Rao, has taken over as Chief Controller (Aero) at Bangalore. With the DRDO since 1975, he has contributed to Missile Technology at the Advanced Systems Laboratory, Hyderabad before taking over as Director H.E.M.R.L

[High Energy Materials Research Laboratory], Pune in 2004. Dr. Rao is also holding concurrent charge as Director GTRE since June 2011. As most of the Aero cluster labs are situated at Bangalore, he will be functioning at Bangalore to head various technology development programmes of the DRDO including the LCA.



PM Soundar Rajan is director DARE

PM Soundar Rajan, senior scientist is the new director of Defence Avionics Research Establishment (DARE), part of the DRDO engaged in design, development and integration of mission computer and avionics systems for combat aircraft. Soundar Rajan graduated from the College of Engineering, Guindy, Chennai in 1973 as an Electronics and Communication Engineer and received his Masters from IISc in 1989.



LCA (Navy) prototype engine ground run

The LCA (Navy) prototype NP-1 achieved a milestone with the first engine ground run (EGR) carried out on 26 September at 1830 hours. The primary objective of checking aircraft to engine integration and activation of the various systems like flight control, hydraulics, fuel, electrical, avionics, etc., "was successfully achieved". The aircraft will now go through a phase of refinements based on feedback identified during the course of the build up and also observed during the EGR, followed by a series of final integration checks and taxi trials before its maiden flight shortly.

The team steering the LCA(Navy) project comprises members of Indian Navy, Indian Air Force, HAL, DRDO, CEMILAC, DGAQA, CSIR Labs, Educational Institutions, other Public and Private Sector partners.



Sikorsky

Ministry to seek Rs.6500 Crore for Air India

The Government has launched all-out efforts to turn around the financially-crippled Air India. Days after appointing new management, the aviation ministry finalised a three-pronged strategy for reviving the airline, seeking Rs 6,500 crore as equity infusion to clear dues, reducing monthly cash loss of Rs 600 crore as much as possible and seeking support for the balance and restructuring of the Rs 44,000-crore loans. A group of ministers has decided that, every three months, Rs 450 crore will be paid as AI will get credit for current dues. This will leave Rs 900 crore (Rs 450 crore a month) for paying salaries and other expenses. The upfront equity infusion of Rs 6,500 crore is being sought to clear the dues of various agencies like oil and airport companies. AI owes Rs 2,300 crore to three OMCs (oil marketing companies IOC, HPCL, BPCL), along with over Rs 800 crore to the Airports Authority of India (AAI). The daily loss of Rs 20 crore or a monthly loss of Rs 600 crore will be addressed from several fronts to bring this figure to a minimum and then seek support for that. Civil Aviation secretary Dr. Nasim Zaidi with Rohit Nandan and financial advisor Bharat Bhushan “will find all possible means to cut losses and increase revenues.”



One of Air India's first B-777s being ceremoniously 'escorted in' to Mumbai airport by pair of IAF Su-30MKIs

Air India board defers delivery of Dreamliners

Air India's board has decided to defer the delivery of 27 Boeing 787 Dreamliners ordered several years back and delayed owing to several reasons. In fact, the government may even “curtail” the number of these aircraft which were part of the Rs 33,197 crore 50 aircraft deal ordered by the airline in 2005.

Civil Aviation minister Vayalar Ravi has stated that there “was no money to buy the aircraft ordered” but that “the board will have to make a final decision”. The order for these 27 aircraft, delayed by almost three years from its original delivery schedule beginning from September 2008 to October 2011, came under severe criticism from the Comptroller and Auditor General for being “risky.”

The final decision on the matter will be taken by the Cabinet Committee on Economic Affairs, which has approved

the purchase in 2005. Air India has demanded \$1 billion as compensation, while Boeing agreed to half a billion dollars. “Air India is not satisfied by Boeing’s offer and has constituted a committee to negotiate further,” said the source. Apart from the 27 Dreamliners, delivery of three B777s has been deferred on Air India’s insistence.

Rohit Nandan appointed Chairman of Air India

Rohit Nandan, till recently Joint Secretary in the Ministry of Civil Aviation was appointed Chairman of Air India Ltd, replacing Arvind Jadhav, whose 23-month tenure has been marred by industrial strife and a deteriorating financial situation.

Rohit Nandan is an Indian Administrative Service officer belonging to the 1982 batch and has become the fifth chairman of the airline in four years since the carrier was merged and V. Thulasidas retired in 2008.



First Q400 NextGen for Spice Jet

Bombardier Aerospace has delivered first two of the fifteen Q400 NextGen turboprop aircraft ordered in December 2010 to low-cost carrier SpiceJet.

SpiceJet will use its Q400 NextGen aircraft for high-frequency, point-to-point services to regional cities, complementing its larger jet aircraft that connect major Indian cities. SpiceJet currently serves 22 destinations in India, Nepal and Sri Lanka.



Dennis D. Swanson is Vice President, Boeing Defence Systems, India

Dennis D. Swanson has been named International Business Development vice president for Boeing Defence, Space and Security (BDS) in India, responsible for growing BDS business in India, including ensuring delivery on customer commitments, further strengthening relationships with industry partners and meeting India’s emerging security needs.

Swanson began his career with Boeing Commercial Airplanes (BCA) in 1989 and has held various positions within BCA and BDS, including managing industrial-participation programmes and supplier-management activities. For 16 years, Swanson contributed to Boeing's expansion into international markets by identifying new business opportunities, managing complex industrial projects and establishing key relationships in countries including India, Japan, Saudi Arabia, United Arab Emirates and Turkey.

Swanson's association with India began in 1999, when he led supplier management and procurement efforts for BCA in India. He was part of the team that began engaging with Indian industry to place offset contracts with Boeing's key suppliers in the country. Prior to his new role, Swanson was regional director for Industrial Participation Programmes in the Middle East and Africa region for BDS.

Raytheon Virtual Training System

Raytheon Company have signed a contract with BCL Secure Premises Pvt. Ltd. to provide a virtual immersive training system to the New Delhi-based company, which serves as an exclusive re-seller of VIRTSIM in the region. Raytheon is teamed with Motion Reality, Inc. (MRI) in providing VIRTSIM, a fully-immersive, 3-D small unit tactical training simulation system that applies MRI's industry-leading motion capture and Hollywood movie technology. A single system allows a full squad of up to 13 individuals to interactively train in customised mission scenarios with complete freedom of motion.

VIRTSIM trainees experience realistic sensory feedback, such as muscle stimulation, when they are 'shot' as they interact with other live or AI (artificial intelligence) characters in combat, law enforcement or security-based scenarios. The system has been refined by Raytheon and MRI through the past two years.

Saab and Wipro cooperation on Active Protection Systems

Saab and Wipro have signed a Teaming Agreement to jointly pursue opportunities for Active Protection System in the Indian market to manufacture, deliver and market Saab's entire suite of the Land Electronic Defence Systems (LEDS) in India. The Land Electronic Defence System (LEDS) provides active protection for light and medium combat vehicles as well as main battle tanks against engagement by weapons like the RPGs, anti-tank missiles, mortars and artillery shells. In this association Saab brings in the unique competence and technological knowhow and Wipro supports in aligning this to the Indian requirements, creating a unique offer to the Indian market.

Maini Group in agreement with EADS

The Maini Group of Bangalore has signed an agreement with Airbus and EADS "to jointly explore technology areas", which would be useful to Maini Precision Products for its long term growth in aerospace and for which EADS is offering a full

range of leading-edge technologies that are "proven, mature and available today." The agreement was signed by Axel Krein, Head of Research & Technology, Airbus and Bernd Wenzler, CEO Cassidian Electronics and from Maini Precision Products by Naresh Palta, CEO, Aerospace and Dr. C G Krishnadas Nair, Maini Group Adviser (A&D) & Chairman, MGA.

Mahindra Group and Eurocopter MOU

Mahindra Aerospace and Mahindra Satyam (representing the Aerospace manufacturing and engineering capabilities of leading Indian industrial house, the Mahindra Group) have signed a Memorandum of Understanding (MOU) for trade partnership with the Eurocopter Group and its Indian subsidiary, Eurocopter India. The partnership will be focused on manufacturing of sub assemblies, engineering and customisation of civil helicopters and the joint development of specific market segments. It is understood that the Mahindra Group will manufacture major assemblies of the Ecureuil helicopter at the new plant.

Tata Group to enter aviation business

According to sources, the Ratan Tata-led mega company is likely to expand into business jets, helicopters as well as for aircraft management and maintenance services. The group is in talks with Florida-based Avantair to establish a partnership in India. Avantair's business model is of fractional ownership, giving individuals and businesses the benefits of aircraft ownership at fraction of costs.

Tata Group's hospitality arm Indian Hotels holds some 62% stake in BJETS, which has a fleet of four aircraft comprising Cessna and Hawker jets. The Tata Group is also set to form a 50:50 joint venture with Hong Kong's Metrojet to offer aircraft maintenance services to the growing Indian corporate aviation market.

Pawan Hans Helicopters wins Award

Pawan Hans Helicopters Ltd has been awarded the *Best Aviation Company Promoting Pilgrimage Tourism 2011* in a function organised on 23 August 2011, the award presented by Subodh Kant Sahai Minister for Tourism to R K Tyagi CMD Pawan Hans in recognition of Pawan Hans in the Travel and Tourism sector.



Mine Protected Vehicles for Jharkhand Police

Brig Khutub Hai, MD & CEO, Defence Land Systems India (DLSI), handed over the Company's first Mine Protected Vehicle—India (MPV-I) to Jharkhand Police against the State's order for six MPVIs. DLSI is a joint venture enterprise between Mahindra & Mahindra Ltd. and global defence and security company BAE Systems PLC.

Built on Ural chassis, it incorporates a 'V'-shaped mono hull chassis which directs the force of the blast away from the occupants, has been tested to withstand the highest level of protection available in the country. Brig Hai also announced that DLSI has commenced serial production of its Mine Protected Vehicle (MPV-I) at its state of the art factory at Prithla, near Faridabad which has a present installed capacity of 100 MPV-Is per annum.



Simulators for Indian Defence Forces

Air Marshal K K Nohwar, Vice Chief of the Air Staff, has expressed that the present requirement of advanced simulators for providing effective training to Indian armed forces in a cost-effective manner is "significantly high". He has called for a strong and long-lasting partnership between Industry and the Armed Forces to meet the growing need of simulators and leverage simulation technologies to enhance combat potential and simultaneously provide better business opportunities for Indian industry in the defence simulation sector.

In his inaugural address at the National Seminar on *Leveraging Simulation Technologies* in New Delhi recently, Air Marshal Nohwar underlined the wider applicability of simulation technologies in the defence sector. He stressed that 'Simulation Technology' is the answer to enhance combat capability of the Indian armed forces, since joint warfare training under a common platform and a common doctrine can be effectively conducted through the optimal use of simulators. Besides, the use of simulators would significantly bring down the cost of flying and fuel and, most importantly, reduce loss of life and equipment.

VAYU Interview with
Sandeep Kishore,
EVP and Global Head of Sales
& Practice for Engineering and
R&D Services, HCL Technologies



VAYU: Please tell us about the product life cycle management systems for military aircraft programmes that you are currently working on.

We offer a wide variety of services for our defence customers and related programmes: engineering services including mechanical design, embedded software and hardware design for new products and also for re-engineering existing products. There has been huge demand in system re-engineering for technology obsolescence and BoM management in the last 12-18 months. Full system development is witnessing increased demand given the ongoing modernisation programmes in defence. The pace of decision making within these turnkey system engineering programmes is now picking up and will translate to multiple system and sub-system opportunities over the next 2-3 years. For select product life cycle elements like testing, qualification and engineering applications, HCL is offering complete platform development and operations. These elements are designed in such manner that it aligns to their technology objectives.

VAYU: How is the company placing itself in the defence offsets business? Have you tied up or signed any MoUs/ JVs with international companies?

Our relationship with the Aerospace OEM and Tier-1 global customers ensure that our engagements and projects are in sync with the defence offset programmes and requirements as required by the policies. Bringing design engineering services in the purview of offset programme is a key aspect of aerospace and defence business. We have also done some manufacturing related partnerships that can aid our customers in accordance with the offset policies.

VAYU: With the MMRC programme now in its final stages and only two European contenders left, are you in discussions with Eurofighter or Dassault for any potential offsets?

HCL does not comment on specific customer discussions. HCL is engaged in discussions with multiple aerospace and defence OEMs and Tier-1s and also with Indian defence organisations on addressing system and subsystem requirements.

VAYU: What projects are you working on with HAL, DRDO and BEL?

HCL does not comment on specific customer discussions. We are working on eight programmes in this segment with our customers across platform engineering, engineering services and subsystem designs. Further we are seeing increasing demand and are in discussions for various additional opportunities.

VAYU: Please tell us about your aero structures business and future expansion plans.

HCL enjoys the status of being one of the few Indian companies with significant experience in end-to-end aero structure design and engineering. OPTICOM is our solution to aid composite design cost optimisation for aero structure designs including optimisation on manufacturing and component usage. Our experience in aerostructures has been predominantly in the civilian aerospace sector and we are in discussions in both civilian and defence programmes through our aerostructure design proposition.

Rolls Royce

Saab India Technologies Pvt. Ltd. established

Saab has strengthened its commitment to become a long-term partner to the Indian defence industry, armed forces and national security with its new Indian entity *Saab India Technologies Private Limited*. The company is a fully owned subsidiary of Saab AB and will be starting on 1 October 2011.



Inderjit Sial, country Head.

Saab has been a supplier to the Indian armed forces since several decades, having signed its first license agreement in India very early in the relationship, which continues to be expanded. The establishment of Saab India Technologies Pvt. Ltd. results from the continuous presence in India, working closely with the defence industry, both private and public sector as well as with research and development organisations.

“In Saab’s ambition to enable India to develop a strong distinct position with its developing defence industry, the company continues to develop its competence in India with a growing organisation bringing in Swedish experienced personnel and hiring local Indian expertise. Saab India Technologies is the preferred employer for all competence and resources under the Saab umbrella”, says Inderjit Sial, Managing Director for Saab India Technologies Pvt. Ltd.

HAL in business agreement with Laversab India

Following long and rigorous field trials, HAL’s Helicopter Division has selected the Laversab 6300-M1A Air Data Test System as standard for the ALH Dhruv, with a long term business agreement. The agreement commits to a minimum off-take over a seven year timeframe based on current visibility, with options for add-on requirements. The agreement also covers supply of essential spares and periodic user training on proper usage and basic trouble shooting. Several Laversab ADT Systems have already been supplied against the LTBA and have been working satisfactorily at various locations across India. Laversab India sells, services and supports RVSM compliant automated pitot static testers, air data test sets and air data calibrators to customers in the commercial, military and corporate aviation markets.

GippsAERO agreement with Rolls Royce

GippsAERO, the aircraft manufacturing division of Mahindra Aerospace and Rolls Royce have signed an agreement to partner on engine technology for a new aircraft. This involves integration of the Rolls Royce M250 B-17F/2 engine with



the GA10 aircraft, which is currently being developed by GippsAERO at its Morwell, Australia plant, The GA10 project is currently at the prototype design phase with the certification process to begin in March 2012 and entry into service in 2013. Type Certification for the GA10 aircraft will follow and GippsAERO forecast sales of some 20 aircraft per year, in India, North America, Europe and Asia.

Stop Press Agni II launched

Another DRDO-developed Agni II ballistic missile was launched successfully on 30 September 2011 at 09:30 hrs from the Wheeler Island off the coast of Orissa, the launch making it a hat trick after successful launches of the Shourya and Prithivi-II, missiles on 24 and 26 September 2011 respectively.

The 2000 km range, two-stage Agni intermediate range ballistic missile, developed by the Advanced System Laboratory (ASL), is already inducted by the Forces and forms part of India’s Strategic Forces Command. The two-stage missile is equipped with advanced high accuracy navigation system, guided by an advanced command and control system and propelled by solid rocket propellants. The missile reached an apogee (peak altitude) of 220 km before the trajectory brought it to impact on target. Two vessels located near the target have tracked the missile at its final stages.



Brahmos

'A Significant Growth Pillar'

VAYU Interview with Mr. Pritam Bhavnani, President of Honeywell Aerospace India



VAYU : People are wondering about the next steps on the Jaguar re-engining programme now that your competitor has pulled out of the competition. Any directives from the Indian Air Forces or Ministry of Defence in this regard ?

PB : Honeywell remains fully committed to supporting the Indian Air Force and the Indian Ministry of Defence

in their procurement process for an engine upgrade for their fleet of Jaguar aircraft. Honeywell's engine offers best-in-class thrust-to-weight ratio, minimal thrust deterioration, a modular engine design and integrated engine health monitoring system. Our engines have proven high reliability and durability crucial for operation in the widest possible range of operating environment



The T-Hawk UAS

which we feel would best meet the needs of the IAF when that time comes. In terms of moving forward, we are waiting for directives from the IAF and Indian MOD on how they plan to proceed.

VAYU : Have the Indian Armed Forces evaluated the T-Hawk UAV? What are the different applications and where can they be applied?

PB : Yes, the Indian Armed Forces have evaluated the T-Hawk UAV. The T-Hawk features a small, 8 kg ducted-fan engine, which allows it to hover and watch, ideal for surveillance and detection to provide real-time situational awareness in critical conditions. It can offer protection for military convoys and civilian transport and has a broad range of applications including homeland security, detection of improvised explosive devices and damage assessment.

In addition, the T-Hawk is very effective at detecting indicators of hostile activity and supporting troops that are in active contact with the enemy. It has been used effectively in conditions of heavy rain and its versatile payload packages allow it to operate day or night and in conditions of rain, heat haze, and dust clouds.

Overall, Honeywell's T-Hawk has strong potential to significantly enhance the Indian Armed Forces' defence capabilities.

VAYU : Could you brief us on ongoing projects (including the TPE331 engine) and your decades old relationship with HAL?

PB : Over 25 years ago, Honeywell Aerospace and Hindustan Aeronautics Limited (HAL) launched its successful collaboration with the TPE331-5 engine. The TPE331-12 engine programme builds on this success, producing engine components - and ultimately engines - for export around the world.

Honeywell licensed its TPE331-5 engine technology to HAL for manufacturing. As a result, HAL is now responsible for engine production as well as full aftermarket service and support for customers including the Indian Air Force, Coast Guard and Navy. Over 200 TPE331-5 engines from HAL have been fielded to date.

The TPE331-12 transition programme is proceeding well through the second

phase where more complex parts and assemblies are made by HAL. In the first half of 2012 we expect HAL will complete upgrade of the TPE331-5 test stand for the TPE331-12 and this will be calibrated and ready for engine test by middle of 2012. Following completion of this upgrade HAL will deliver fully assembled engines to Honeywell.

VAYU : Has your proposed new technology centre opened in India? What does this establishment expect to do? How 'big' is Honeywell India?

PB : Honeywell operates a captive Research Development and Engineering (RD&E) centre in India: Honeywell Technology Solutions. It provides technology, product and business solutions to Honeywell which meet global quality, innovation and lifetime performance standards. HTS is headquartered at Bangalore with locations in Shanghai and Beijing, China; Brno, Czech Republic and Hyderabad and Madurai, in India.

Employing over 8000 people globally with diverse engineering skills, coupled with programme management, quality assurance, systems engineering, technology and market analytics, HTS provides total solutions to other Honeywell businesses in Aerospace, Automation & Control Solutions, Research and new product development and IT services and

solutions. Earlier this year HTS expanded its facility in Hyderabad, adding capacity and capabilities in all these areas.

Overall, Honeywell International is a Fortune 100 global diversified technology and manufacturing leader. Each of the company's four businesses - Aerospace, Automation and Control Solutions, Transportation Systems, and Specialty Materials - has operations in India. Honeywell has set up state-of-the-art manufacturing and engineering operations for its automation, turbocharger and refining businesses and operates its global centres of excellence for research, product development and innovation in India. Honeywell directly employs more than 11,000 people based in Delhi, Pune, Bangalore, Hyderabad, Chennai, Gurgaon, Madurai and several other cities.

Honeywell's Aerospace business in India has been growing rapidly, driven by new technologies that enable Indian operators to save money and improve safety simultaneously. From air traffic management technologies that have modernised Delhi, Hyderabad and Bangalore airports to partnerships with India's largest aviation players including Hindustan Aeronautics Limited (HAL) and Airworks, Honeywell is working to improve efficiency, reduce cost and minimise risk in India's aviation industry. Despite the current economic downturn, Honeywell Aerospace is showing strong

performance in all three of its business areas (Air Transport and Regional, Business and General Aviation and Defence and Space).

VAYU : Is there any Honeywell equipment on the C-130Js that is already operational with the IAF? Any on the C-17s that are yet to arrive?

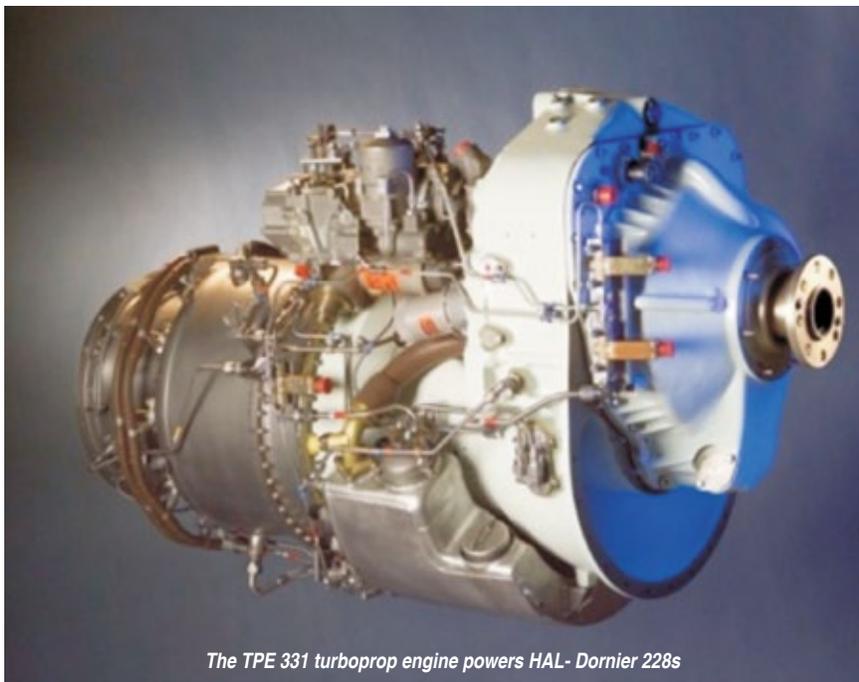
PB : Honeywell offers a complete suite of aircraft systems that help to ensure mission readiness and aircraft safety for both the C-130J and the C-17. On the C-130J we provide the Enhanced Ground Proximity Warning System, Flight Management System, Digital Autopilot, Control Display, Embedded Global Positioning and Inertial Navigation System and Radar Altimeter. We also supply a range of mechanical systems including the Environmental Control System, Auxiliary Power Unit, Cabin Pressure System, valves, fuel controls and oil pumps.

On the C-17, Honeywell equipment includes Flight Instruments and Display, Navigation Systems, Radar, Airframe Valves, Auxiliary Power Unit, TCAS and the Environmental Control System.

VAYU : On the civil airlines and private aviation sector, how is the company placed? Which Honeywell avionics and equipment are installed in these?

PB : The Indian market is a significant growth pillar for Honeywell Aerospace as we are a major contributor to India's aerospace industry and its overall success. From 'nose to tail,' our broad portfolio of technology solutions including avionics, which enable Indian operators to save money and improve safety simultaneously, are used on most commercial aircraft and business jets across India. From technology development to product manufacturing to customer service and support, the Indian organisation contributes to every part of our business for customers around the world.

Furthermore, our air traffic management technologies that have modernised Delhi, Hyderabad and Bangalore airports as well as our partnerships with India's largest aviation players including Hindustan Aeronautics Limited (HAL) and Airworks, demonstrate Honeywell's strong commitment to improving efficiency, reducing cost and minimising risk in India's fast growing aviation industry.



The TPE 331 turboprop engine powers HAL- Dornier 228s

TRANSFORMATION OF THE IAF



VAYU interview with Air Chief Marshal NAK Browne, Chief of Air Staff, IAF

would be on continuing to transform the IAF into a force that is modern, flexible and capable of tackling threats across the entire spectrum of conflict. A comprehensive modernisation plan is already under implementation. It involves enhancement and modernisation of our Air Defence and Offensive Strike capabilities, enhancement of our force multipliers and operationalisation of our Space and NCW capabilities.

Jointmanship and Integration is the key to success in any future war. There is a greater need to synergise our technological and operational capabilities with the sister services towards enhancing our joint operational capability. Here I feel that the IAF, due to its inherent characteristics of flexibility and responsiveness will have to remain prepared with a wide array of responses catering for all possible contingencies. Jointness would be essential not only in employment of combat forces, but also in integrated development of operational concepts and strategies for war fighting.

Well trained and motivated air warriors are the backbone of the IAF. It is important to prepare them to absorb high end technology of the IAF's modernisation process in the shortest time. IAF's vision - "People First - Mission Always" aptly puts the focus on our people. I am clear in my mind that they are our most important resource. Their needs always come first, and besides improving the quality of life of our air warriors, we also have to address their training and skill enhancement needs as well.

VAYU : Congratulations on assuming command of the Indian Air Force at a time which will witness a paradigm change in the technological capabilities of our air arm. Please review the areas in this context which should receive priority over the next few years.

CAS : Thank you for your felicitations. As the Chief of the Air Staff, I am fully seized of the larger security challenges facing the IAF today. First and foremost, we need to continue moving forward as per our plan of acquiring full spectrum strategic capability. Keeping the security environment in mind, especially in our troubled neighbourhood, my critical focus



Mainstay of the IAF's combat force will be the Sukhoi Su-30MKI.

IAI

The fifth Lockheed Martin C-130J-30
'Super Hercules' of the IAF.



VAYU: What is the ideal force structure of the IAF, correlated with the envisaged threats and likely operational tasks of the IAF in the next decade? Could there well be a reassessment in view of the increasing perceptions of a two-front threat to the nation?

CAS: The IAF envisages a modern force capable of challenging and thwarting multi dimensional and multi front threats, in keeping with our perceived security challenges of the future. The Long Term Perspective Plan of the IAF has been formulated up to the 14th Plan period and lays down the road map for capability building in consonance with our emerging aspirations in the region. The IAF aims to equip itself with a good airlift capability, extended reach and special operations capability by induction of Very Heavy Transport Aircraft, Flight Refuelling Aircraft and Special Ops Aircraft respectively. We are also upgrading our existing fleet of aircraft to enhance their operational relevance in the future. Our new inductions include the MMRCA, C-17, modern helicopters and a variety of Surface to Air Guided Weapons & Radars. Dedication of the Air Force Net last year, on-going operationalisation of an Integrated Air Command & Control System which will network all our sensors, and a plan to link all IAF platforms in a phased manner is a step towards our long term plan of operating in a network centric environment. These capability enhancements in terms of inductions/upgradations, Force Enhancers, modern aircraft, Surface to Air Guided Weapons,

Radars and Networking will provide us an ideal force structure, which would cater for all envisaged threats and operational requirements of the future.

VAYU: The public focus of recent acquisitions for the IAF has been on combat aircraft. Despite this, considerable time is still taken to acquire such assets that the IAF urgently requires. How can the process for selection and service induction be expedited? Does the continuously amended Defence Procurement Procedure reflect on such a need?

CAS: A typical procurement cycle takes anywhere between 20-34 months for the contract to be signed. In case of aircraft procurement it takes another two years or more for deliveries to begun, taking the total gestation period to nearly five years. The IAF's Long Term Perspective Plan is spread over 15 years and caters for the phasing out of old aircraft/equipment over the plan period and induction of new aircraft/equipment from overseas OEMs/ Indigenous Defence production depending upon the technology sought. While we understand the IAF's urgent need to procure aircraft and modern systems, the lead time for these procurements is a known fact and has been catered for in our planning process. Procurements are presently progressing on schedule after certain course corrections which took place a few years ago. However, to cater for any urgent requirements, the DPP also has a provision for fast track procurement, which can be used when necessary.

VAYU: The IAF has long supported development of the Tejas LCA as potential replacement of the large numbers of MiG-21/MiG-27s now steadily being phased out of frontline service. What are the immediate consequences of the prolonged delays in LCA induction and its impact on the IAF's long term re-equipment programme?

CAS: The Light Combat Aircraft was given IOC-1 in January this year and we expect the first operational squadron to be formed by end of next year. Without going much into the background about the reasons for delays in the past, I would say that we have worked out a fleet wise phase out plan for the MiG-21 / MiG-27 ac, which is also dovetailed with the expected LCA induction plan.

VAYU: Assuming that the LCA Mk II would meet most of the IAF's requirement for this class of fighter, how could the IAF commit itself to ordering this aircraft type in quantity which would also gain for the indigenous aircraft industry a foothold in the potential export market?

CAS: The IAF is upfront funding 30% of the D&D cost of the LCA Mark II aircraft, which highlights the extent of IAF's commitment to the indigenous LCA programme. In order to remain a reckonable strategic force well into the future, the support of a well developed indigenous production base is essential. The IAF wants to be actively involved at every stage, from concept to successful completion of the programme. The number of LCA Mark IIs to be ordered by IAF will certainly provide a big fillip to the indigenous aircraft industry.

Eurojet



The Tejas Light Combat aircraft will enter service with the IAF in 2012.

VAYU : Considering that India and Russia are committed to jointly develop and produce a fifth generation fighter aircraft (FGFA), what are your views on the ADA-Proposed advanced medium combat aircraft (AMCA), in view of the technological levels of competence and the timelines which fit into the IAF's long term planning?

CAS : I think it would be premature to talk about the AMCA programme which is at an initial stage of feasibility study at ADA.

VAYU : Most air accidents have been attributed to 'human error'. What must be done to improve the initial quality as well as flying training system in the IAF? Can you elaborate on the rejection rate for pilots during their various stages of training, including in operational squadrons and if there has been perceptible difference since induction of the AJT?

CAS : Training remains a big area of concern at the moment, primarily as the HPT-32 basic trainers have been grounded for almost two years and the new BTA is still two years away. We foresee that our training patterns will stabilise fully by 2013. Having said that, I will add that we have instituted many proactive measures to ensure that we provide a good foundation to our young trainees. The rejection rate of pilots in IAF is around 8-10% at the ab-initio stage, which is akin to most of the other air forces of the world. No compromises are made in the laid down standards as far as training is concerned. With the induction

of Hawks with the IAF in 2008, the situation has somewhat improved and the young pilots trained on these trainers have demonstrated a better safety record as well as enhanced situational awareness. We have now decided that the current batch undergoing training on MiG-21 variants would be the last batch (completing training in December 2012). Thereafter, all stage-III training will be conducted on Hawk trainers only.

VAYU : Most of the legacy surface-to-air missiles in IAF inventory are to be supplemented by new generation

SAMs, including those developed and produced in India. How does this fit into the overall concept of air defence in the new millennium?

CAS : IAF has planned multi-layered integrated Air Defence of strategic and High Value Assets (HVAs) of the nation, as well as of critical Armed Forces' facilities. The concept envisages use of aircraft in the offensive and defensive Air Defence roles followed by Surface to Air Guided Weapons (SAGW). To attain the desired value of deterrence, SAGW Systems have been planned for induction, with varied ranges so as to

Launch of a Pechora (SA-3) surface-to-air missile.



Ruag



The Boeing C-17 Globemaster III will enter IAF service to provide very heavy transport airlift capability.

provide a befitting riposte - from the Low Level Quick Reaction Missiles that would engage low level targets at closer ranges to the higher reach long range SAGW systems (LR SAMs). The Induction Plan has been conceptualised keeping in view the modern threat that our potential adversaries pose, whilst simultaneously being in sync with state of art technology available globally. The aim is to provide 'Integrated Air and Missile Defence' umbrella over our area of interest.

VAYU : Aid to civil power by the IAF is assuming increasing importance. Is the government planning to induct additional logistic support aircraft and helicopters for the IAF which would be

located in various affected parts of the country since diversion of aircraft from other commitments to meet frequent demands of civil authorities could affect air maintenance of the army?

CAS : The IAF has always been at the forefront of all HADR requirements. IAF anticipated the increased requirement for this capability a few years ago, and has gone in for procurement of 80 Medium Lift Helicopters (MLH) and six new units would be raised with these. The new units are spread across the country in such a way that they not only cater to our overall operational deployment, but also meet the requirement of aid to civil power across the country. Further, IAF is in the process of purchasing 15 Heavy

Lift Helicopters (HLH) which would also be utilised towards Aid to Civil power, especially for mobilising heavy equipment and material to disaster affected areas. In the recent earthquake, which rocked the north east region, IAF responded promptly by activating two C-130 special operations aircraft within 2 hours of receipt of information. In fact, these aircraft were the first ones to reach Bagdogra along with the NDRF team.

VAYU : Finally, on the eve of the IAF's 79th anniversary, what would be your message to the Air Force and the nation?

CAS : The Indian Air Force has come a long way from its beginning as a tactical force. We are transforming into a potent strategic force in tune with national aspirations. The road ahead is long and arduous but we need to be patient and resolute to maintain the course. The IAF vision addresses not only the physical security of India but the protection of our core values and enhanced national interests based on the country's growing stature in the world. In the coming decade the IAF envisions itself to be a modern force with cutting edge technologies. At the same time we have to be flexible, adaptable, highly responsive and with extended reach. The nation has reposed a great degree of faith in the capabilities of its Air Force and I am very sure that all the men and women in blue are capable, confident and committed to live up to this trust-always and every time.

Jai Hind !



Cassidian EADS

The IAF at 79:



Hakimpet flight line with Chetaks, Kirans and Iskras, before the latter were phased out.



It has almost become a cliché that the Indian Air Force is undergoing a seminal transformation. There are many ways of looking at this transformation and taking it forward in the direction it should go. All Air Forces are technology intensive and it is but natural that the bulk of the issues concerning transformation would deal with technological issues and debates. But the most difficult and crucial element in transformation actually requires transformation of the mind – in the government, in the Air Force and in the parliament and with political leaders. The handicap is increased because military forces by their nature of the profession, are proverbially conservative in their approach to operations, training and preparedness. And that obviously points to the human factor and its critical importance.

Technology has been advancing exponentially which might lead to a conclusion that the value of the human being in a high-technology environment would become less. But this conventional wisdom would be disastrously inaccurate

and could lead to serious deficit in future capabilities. The fundamental lesson of military history is that force employment, planned, managed and executed properly in relation to the adversary, is the crucial key to victory and hence far more important than technology and/or force ratios. After all, it is the human element that remains crucial in warfare and if the technology moves to higher levels, the human element must be able to not only cope with it but also re-adjust its role and utility to make the maximum use of high-technology systems.

Hence my belief that advances in technology certainly increase the capabilities of aerospace power, but only if the human element is capable of exploiting it to the maximum advantage over that of the adversary. For example the Pakistan Air Force, a professional force, was equipped in 1965 with most modern combat aircraft, radars and weapons. But this did not translate into victory and Pakistan was on the verge of collapse when faced by the technologically inferior



BAE Hawk Mk.132 Advanced Jet Trainer.

Quixotic Situations



MIG-21bis at an IAF operational fighter station.



and numerically only marginally superior Indian Air Force. Even the long planned “massive” pre-emptive attack on three IAF airfields on 6th September did not produce the results it had hoped for since the planned 55-aircraft offensive resulted in just one strike by 8 Sabres which reached the target at Pathankot (and imposed heavy losses on the IAF) while the two strike formations tasked to target Adampur and Halwara never reached their targets and suffered significant losses when engaged by IAF Hunters.

This in turn naturally leads us to the issues of training and military professional education of air warriors young and old. It is for this reason that air forces - and for that matter all military forces - place great emphasis on sound and efficient training. The Indian Air Force is no exception. It has produced outstanding air warriors and continues to do so. But the achievement is that much greater because this is achieved in spite of severe odds proving the old adage that fighting men have often to pay for the failures of the planning men.

Flying exercises with other air forces in recent years have proved that Indian Air Force flying and maintenance acumen is amongst the best in the world. But this should not lead to complacency that “everything is fine” with our training system. It is to the credit of the system and individual air warriors that they have been performing outstandingly in peace and war. But the truth is that pilot training in the Air Force has been in a continuing deep turmoil where even the basic patterns and syllabus of flying training are altered in order to meet the exigencies of the circumstances mostly brought about by shortage of training aircraft and infrastructure such as academy space. Of all the issues that have a bearing on the grim situation that exists, the availability of suitable aircraft and infrastructure stands out.

One has only to look back at the saga of the AJT (Advanced Jet Trainer) required to prepare young pilots for frontline fighter squadrons. The fact is that till the BAe Hawk trainer was acquired just few years ago, the IAF had no aircraft for this role since 1972 when the



HAL built Jaguar two-seat operational trainer.

Vampire trainer was retired. The original plan was to replace it with the HF-24 Marut trainer (and 18 aircraft had already been manufactured for this purpose). But for some reason the Marut was not considered, in all probability because it had remained underpowered and Hakimpet, the nominated base for such training was at an altitude of over 2,000ft with a comparatively short runway. But we had any number of other airfields close to sea level, including Tezpur (where the advanced flying training was eventually carried out on MiG-21s from the 1970s). So, the IAF had to “manage” with high-performance MiG-21s by withdrawing them from as many as five frontline squadrons till they finished their airframe/engine life and acquisition of an advanced jet trainer (AJT) at much higher prices became an imperative.

Past Experiences

If there is any single lesson from the 79-year history of the Indian Air Force, it is that the Service has always adjusted

to shortages of aircraft, infrastructure and even pilots, rather than trying hard to reshape the force size and related issues to achieve desired results. The more this phenomenon happened but was managed with a degree of success, the greater has been the tendency to take ad-hoc measures to “manage” with what we have. The most recent, and drastic, example has become the unplanned drop of nearly 23 % in combat force levels after 2005 which will take around 15 years to make up since even more aircraft will fall due for retirement on their life expiry and newly acquired aircraft would provide only partial recompense. Worryingly, in spite of what the Lafontaine Committee of Flight Safety stressed in 1982-83, training aircraft and infrastructure have received even lower attention than has the combat force !

In order to carry out an objective analysis with sufficiently broad data base, we need to go back to the early 1960s when the IAF force level was authorised by the Cabinet in a series of changes, to grow from a 25 squadron force to 64 squadrons.



HAL HPT-32 Deepak basic trainer taxiing past flight line at AFA, Dundigal.

In order to meet this planned expansion in the context of the Chinese threat and frontier war in 1962, a “thousand pilots a year” scheme for pilot training (and correspondingly similar numbers in other branches) was put into effect. The existing five Auxiliary Air Force Squadrons and their assets, including Vampire aircraft, were incorporated into the regular air force. Overall, the flying and ground training syllabus was heavily curtailed and even private Flying Club facilities were utilised during this national emergency over the years from 1962 till 1967.

But the Government, after sanctioning a 64 squadron force, found that it could not spare the resources and hence followed a simplistic solution : limit the force size to 45 squadrons (35 combat and 10 transport)! As an interim step, some IAF pilots were then sent to the United States for fighter conversion where most outshone the best of their local contemporaries. As it happened, we “only” averaged an output of around 450 pilots per year during the five years of this emergency training scheme. This was still a figure far above what could be absorbed in a 45 squadron force which was then forming and reached this level only by about 1970s by which time the pilot intake had been reduced. Young pilots were reduced to fly as little as 3-5 hours per month in many cases, very often on obsolete aircraft. Knowledge about the Service was hardly imparted. It took quite a long time for the Air Force to see the ‘Bulge’ subside - and then we landed up with pilot shortages !

However, it is the issues of principle and policy that I focus on. The first issue was that of the prestigious Air Force Academy (AFA) plan : while the Dundigal Academy was still under construction it was found, in the late 1960s, that this was based on a gross and incongruent underestimate of the number of pilots that would be required to be trained at the Academy from the ab-initio to the Intermediate stage when the cadets would get their commissions and ‘wings’ as the symbol of becoming a service pilot. The Elementary Flying School at Bidar was to be closed down but since it took some time for a second runway to be built at the AFA to accommodate the increased operations, the Air Force Station Bidar continued with HT-2s. By end of the 1960s, Air HQ worked out an air staff requirement for a new primary trainer. This was modified by

Rafael

the CAS to include turbo-prop powered aircraft although the HPT-32, selected replacement of the HT-2, remained fitted with a piston engine. Unfortunately too, somebody also decided that the HPT-32 could be used as a small air taxi with the result that, like many other HAL designed aircraft, the HPT-32's weight was higher than the design stipulation.

1982 Lafontaine Committee on Flight Safety. Unfortunately this aircraft was underpowered and hence in any training sortie would spend a great deal of time climbing back on full throttle (thereby straining the engine) and leaving limited time for training of the pupil especially in an aerobatics sortie. After the mid-1990, the HPT-32 engines started to give

HPT-32 comes into land.



From this time on, flying training of the IAF started to get into difficulties mostly as a result of the non-availability of suitable training aircraft and strained infrastructure. At the basic stage, the HT-2 was now really obsolete and increasingly unreliable. Young cadets were sent solo with an instructor as a safety pilot and a new term for solo ('dolo' which was solo and dual combined) came into being. This continued for nearly a decade till the HPT-32 was cleared for flying by the

increasing problems, culminating in an engine failure which resulted in a fatal accident involving two instructors in July 1999 and the aircraft fleet was finally grounded. Interestingly, when Air Marshal LM Katre was Chairman HAL in 1983, he asked for a turboprop-engined HPT-32. HAL produced the prototype in less than six months, the HTT-34, but that is where the programme remained, as a one off.

The large number of pilots inducted during the post-1962 emergency continued

to pose serious administrative challenges. And yet it was clear that if we went by the AFA plan, the number of pilots being commissioned would remain miniscule. Air Chief Marshal PC Lal set up a Permanent Manpower Committee in 1972 and its first charter was to work on a steady state requirement of pilots since the emergency period inductees granted permanent commissions would begin start retiring from the mid-1980s onwards and, given the reduced induction after 1967, there would be serious shortages of pilots in the Air Force by the 1990s. This Committee calculated the need for a steady induction of around 144 Air Force pilots per year, besides meeting requirements of the Army and the Navy with some vacancies for foreign students from "friendly countries". Unfortunately by now there were no aircraft left in the training inventory except for the HAL Kiran Mk I, used till then for the second stage of flying training. The larger problem was that there was no infrastructure to train such numbers every year and an additional flying academy (or even two) would be required. Unfortunately, this has still not been created although there are a large number of airfields spread across India, mostly in the eastern states, built during



Antonov An-32 leads pair of Dornier Do-228s in flypast; both types are used for multi-engine conversion training at Air Force Station, Yelahanka.



HAL HJT-16 Kiran intermediate jet trainer which is presently also employed at the basic training stage.

the Second World War, which could be adopted for the purpose.

So, within a decade of the Lafontaine Committee Report, which placed flying training on a sound capability and skill-based criteria at the end of every stage of training, where the Basic (Stage I) stage would produce pilots flying with safety and in confidence, following which the Intermediate (Stage II) stage would produce a 'service pilot' to fly an aircraft to its limits with skill and safety, these principles were given the 'go by'. For decades, it was only after Stages I and II, that pilots were trifurcated into the fighter, transport and helicopter streams. The reason essentially was shortage of training aircraft and the limitations of having a single Academy. A novel approach to the basic problem of shortage of aircraft was then adopted, separating the pilots into three streams (fighter, transport and helicopter) after the basic stage itself, well before the individual had learnt the ropes of becoming a 'service pilot'. He was to therefore become a role-oriented pilot before becoming a service pilot. The Army then began to train their pilots directly on helicopters, which not only poses difficult challenges to the pupil, but is also far more expensive.

It is against this background that we need to view the current crisis. The basic stage has virtually disappeared after the HPT-32s were grounded in July 2009. The HJT-16 Kiran Mk.I was harnessed for use at this stage. To look back to the early 1960s, the British RAF had realised that an 'all-through-jet training' scheme actually led to increase in accidents because the jet aircraft posed far less challenges to the ab-initio trainee and deficiencies showed up much later in operational squadrons. The IAF in turn found that landing accidents with MiG-21s had shown marked increase in the 1970s after the change in training patterns.

Even though we now have increasing numbers of Hawk AJTs for Stage III, the HJT-16s available for Stage II are increasingly being stretched, used for both the Basic and Intermediate Stages which implies that they will finish their life much earlier than originally anticipated. Unfortunately, its replacement, the HJT-36 intermediate jet trainer (IJT) which has been designed and remains under development at HAL, is showing a number of problems. There is a serious risk that if not attended to by the Government on the highest priority, we will start falling short of even Stage

II (Intermediate stage) aircraft and therefore flying training. With Stage I now being undertaken on HJT-16s, the IAF may once again be forced to curtail flying training syllabus with far reaching consequences when such student pilots get to combat squadrons and then fly advanced (and very expensive) combat aircraft being planned for induction.

Some months ago, the Raksha Mantri informed Parliament that the IAF was short of 600 pilots which focuses on the other dimension of our flying training problems. It is obvious that this shortage of 600 pilots is actually at the lower ranks. In the Air Force, those 'few' who actually engage in combat are at (or below) the level of squadron commanders. The implication of this shortage, therefore, goes far beyond mere numbers. The real-world consequence is the large number of posts where experience of the pilot is seen as essential, would actually be vacant. Compounding this, the work load of pilots in combat squadrons will inevitably become even higher, distracting the few from their primary task of flying advanced combat aircraft safely and to their limits, in defence of the nation.

Air Commodore (Retd) Jasjit Singh

Hawks over



The author visited the Indian Air Force base at Bidar, where the next generation of fighter pilots are being put through their paces in a programme that is becoming a benchmark for modern air combat training. Situated around 160km from Hyderabad, the small town of Bidar is host to one of the Indian Air Force's five Flying Training Establishments. Here, trainee pilots fresh from the Air Force Academy are taught the skills and techniques required of a modern fighter pilot before being assigned to combat units of the world's fourth-largest air force.

Bidar has been an IAF training base since the early 1960s but has been remodelled and refurbished for the arrival of the BAE Systems Hawk Advanced Jet Trainer. The runway has been extended to 9,000 feet for training requirements, new facilities for aircraft and engine maintenance and testing have been built and a new computer-based learning syllabus introduced.

The responsibility for this new era of training for the IAF has recently been

assumed by a new Commanding Officer at the base, Air Commodore Dharkar, who shares the reasons behind the Hawk's selection.

"The Hawk is an exceptional training platform with good hands-on flying

training capability. It provides good introduction to new pilots of the electronic cockpit so that when trainees go on to fly new generation platforms they have prior knowledge of how to use these effectively. The Hawk is a good bridge from a low



The Adour Mk871 on test stand.

Bidar

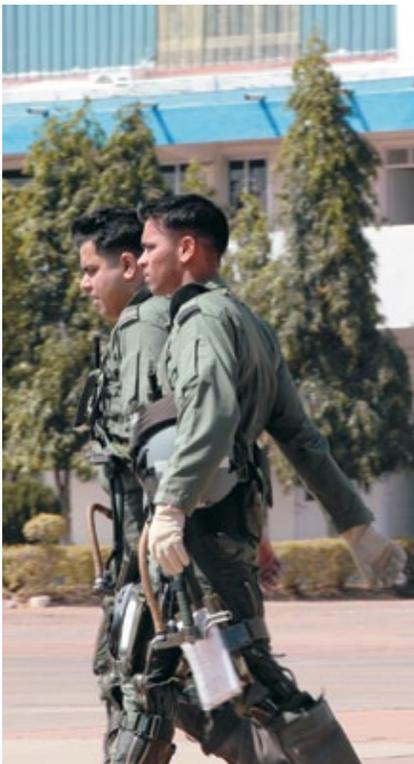


sorties to bad weather which is important as our trainees aren't instrument rated so they cannot fly in poor conditions."

"We fly between 60-90 sorties per day from the base and around two-thirds of these would be Hawk sorties – in fact, we generate the highest amount of single-engine flying hours in the country from this base."

Introduction of the Hawk has been relatively rapid, with over 15,000 flying hours being logged since the first aircraft arrived in 2007. Under the terms of the acquisition contract the first 24 aircraft and engines were assembled and tested in the UK by BAE Systems and Rolls-Royce respectively, with the subsequent 42 being built under license by Hindustan Aeronautics Limited (HAL) in Bangalore. For Rolls-Royce, this marked the latest chapter in a longstanding partnership with HAL which began licensed production of the Orpheus engine in 1956. The Hawks are now operating alongside Orpheus-powered Kiran aircraft at Bidar.

While some initial training of Indian pilots onto the Hawk was conducted at



Flying instructor and student prepare for a training sortie.

capability to a very high capability platform." The IAF operates the Mk132 variant of the Hawk advanced jet trainer powered by the Rolls-Royce Turbomeca Adour Mk871 engine. An earlier variant of the Adour, the Mk811 has been powering the IAF's fleet of Jaguar aircraft since the early 1980s.

Optimum

The choice of Bidar as the central hub for fast jet training is no surprise. Like all other air forces globally, the IAF needs to maximise the availability of its assets and an intensive flight training programme requires optimum flying conditions to function well.

"Bidar is located in central India, away from the bigger hubs and is excellent for airspace and weather," Air Commodore Dharkar explains. "Our location on the Deccan Plateau protects us from the tropical conditions that are experienced on the coast. Flying conditions are invariably good all year around and the climate is relatively mild – except from mid-March to mid-May – so we don't lose many



Commanding Officer at Bidar, Air Commodore Dharkar



Air Force Station Bidar has a fully computer-aided training system

Performance

“The Hawk brings a huge step-up in capability as a training aircraft, bridging the gap between the basic piston-engined trainer and the high performance flying of an advanced fighter aircraft. It is aerodynamically much more forgiving and is a great introduction for trainee pilots to familiarise on before they go into fighters.” Another of the instructors, Squadron Leader Kohli, outlined the requirements that the IAF is looking for in its new fighter pilots:

“Two things are important – flying skill and the ability to fly a particular aircraft. It’s about learning how to use the systems and handle the technology and develop advanced techniques. To this, each instructor can add their own personal experiences from operational flying into the training mix.”

That training mix also includes a large amount of classroom-based tuition – of a typical 4.5 hour flying sortie only 50 minutes are actually spent flying the Hawk – and Bidar now boasts a fully computer-aided learning system for the instruction of pilots, engineers and technicians. The classroom is backed by a staff of 35 instructors which has a suite of screen-based training modules available to teach students in the areas of mechanics, avionics and weapons. In keeping with the need to accelerate the

RAF Valley in the UK, operations at Bidar are now in full swing with nearly 40 aircraft operating from the base.

One key element of the new training programme is that the Hawk is new to everyone, and as Air Commodore Dharkar explains:

“At the moment we are training the trainers as they will not have flown the Hawk before – this is therefore part of a very steep learning curve. They must learn to fly it and fly it well, then learn to instruct on it. It takes between six and eight weeks to learn to train on the basic

syllabus and another six weeks to learn to teach the advanced stage.”

Squadron Leader Naithani of Bidar’s Hawk Operational Training Squadron B, the *Bravehearts*, is one of the new instructors:

“Previously all IAF pilots had flown the Kiran and so could instruct on this platform. But at the moment none of the instructors has learned on Hawks so we have had to learn how to fly the aircraft first. The new pilots that are going through now will be able to do this and will be the instructors of tomorrow.”



training syllabus, the new system marks a step-change in capability for the IAF – a tremendous benefit given the required high throughput of pilots from the base.

To the outsider, the glamorous side of training India’s fighter pilots of the future is about flying fast jets, but to enable the intensive flying rate to be sustained requires an engineering support team that is equally dedicated and innovative.

Bidar’s Chief Engineering Officer, Group Captain Mohan probably knows the Hawk better than anyone else in the IAF. He was based at the BAE Systems plant in Brough, UK for 3.5 years, overseeing the technical acceptance of the airframe and engine. Despite the IAF’s long experience with the Adour engine through the Jaguar programme, Group Captain Mohan has been surprised with the smooth induction of the Mk 871 variant.

“The engine is very tolerant to some of the foreign object debris incidents that we see. We were quite surprised to see how much damage it can sustain and still operate normally. That was a big learning point for us and the Rolls-Royce engineers helped to us to gain a greater understanding of the engine’s capabilities and tolerances.”

To deliver the high availability requirement for the Hawk’s fleet, Group Captain Mohan relies on a team of 29

engineering officers. The engine side of the operations is supported by a Rolls-Royce deployed service representative, and operates from a dedicated propulsion engineering centre which includes an uninstalled engine test bed. Bidar’s two Hawk Operational Training Squadrons currently have the capability to train 60

students per year but, with an eventual fleet of at least 106 aircraft, courtesy of a second batch of 40 Hawks ordered in mid-2010 (with an additional 17 aircraft destined for the Indian Navy), the ability to ramp this up to twice that level seems to be a well-laid plan.

Servicing the IAF’s voracious appetite for new fighter pilots requires a combination of state-of-the-art training assets, a dedicated support team and an ideal training environment. It is not a responsibility that Air Commodore Dharkar takes lightly but he is confident that he has the assets in place to deliver India’s next generation of frontline fliers.

“We will require a tremendous amount of well-trained pilots and the Hawk is crucial to achieving this. I’m honoured to be responsible for the training of India’s future pilots. ‘I am still learning in my new role but thankfully I have not had to think about whether the Hawks are performing as required as the feedback is invariably that they are exceptional, so the change to the aircraft has been a real boon for the IAF and its future expanding capabilities.”

Nick Britton

Communications Manager, Rolls-Royce Defence Aerospace Business (Special thanks to The Rolls-Royce Magazine)



IAF Hawk AJT on the flight line

New Boy on the Block

The IAF's C-130J Super Hercules



Its formal induction covered in *Vayu's* Issue II/2010, here is more on the Lockheed Martin C-130J Super Hercules being delivered to the Indian Air Force. Not only is the C-130J the most advanced airlifter ever built, but the version being built for India sets a new standard for both capability and programme performance.

The C-130Js for India are being delivered under the US Government Foreign Military Sales programme. Since it began, the programme has received praise as it has delivered aircraft well ahead of schedule and significantly below budget. The teamwork between the US Government, the Indian Government and Lockheed Martin is “an outstanding example of both political and military cooperation” and ushers in a new enduring partnership between Lockheed Martin and India. Discussions are underway for

the potential acquisition by the IAF of additional C-130Js.

This is the IAF's first experience with the C-130 and the package being provided by the US government is comprehensive. The contract includes six aircraft, training of aircrew and maintenance technicians, spares, ground support and test equipment, servicing carts, forklifts, loading vehicles, cargo pallets and a team of technical specialists who will be based in India during a three year initial support period. Also included in the package is India-unique operational equipment designed to increase Special Operations capabilities. India's new airlift fleet will be based at Air Force Station Hindan.

The Indian Air Force's C-130J Super Hercules has a highly integrated and sophisticated configuration primarily designed to support India's special operations requirement. Equipped

with an Infrared Detection Set, the aircraft can perform precision low-level flying, airdrops and landing in blackout conditions. Self-protection systems and other features are included to ensure aircraft survivability in hostile air defence environment. The aircraft also is equipped with air-to-air receiver refueling capability for extended range operations.

The C-130J is specific for India's mission environment, which often involves operating out of austere, high-elevation airstrips in hot conditions and is powered by four Rolls Royce AE2100 engines and Dowty six-bladed propellers. The C-130J has been operated for the past several years in the mountainous areas of Afghanistan (in conditions similar to India) and performed exceptionally well.

The C-130J combines the latest in aerospace technology with a rugged airframe design, resulting in an aircraft

that gives the operator more capability with greater operational efficiency. The C-130J's flexibility on range, payload and missions is unmatched by any other aircraft in production or planned. With a payload range capability of over 4,000 nautical miles coupled with the ability to land on a 2,000 foot unprepared strip high in the mountains in hot temperatures the C-130J is a proven asset that has provided critical support when employed.

The C-130J is not just a cargo transport but its range of missions includes special operations, aerial refueling, search and rescue, paratroop, electronic surveillance and even weather reconnaissance. The high level of systems capability means that even a C-130J in standard configuration is a sophisticated platform capable of missions far in excess of any earlier model C-130, regardless of how much the 'legacy' aircraft has been modified. A good example of this is in the special operations role, where the C-130J has greater mission capability than any special operations aircraft currently flying. When upgraded with other systems and capabilities, the C-130J allows the Indian Air Force to operate the aircraft autonomously day or night and in all weather conditions.

The net effect of these improvements is enhanced performance of the aircraft, and greater reliability of the systems and components. For instance, as compared with earlier C-130 models, the C-130J provides 40 percent greater range, 40 percent higher cruising ceiling, 50 percent decrease in time-to-climb, 21 percent increase in maximum speed and 41 percent decrease in maximum effort takeoff run.

A key to the C-130J's increased performance is the new propulsion system. Four Rolls-Royce AE 2100D3 engines (each flatrated to 4,591 shaft horsepower) generate 29 percent more thrust, although they are 15 percent more fuel efficient. The all-composite six-blade Dowty Aerospace R391 propeller system is lighter and has fewer moving parts than previous Hercules propellers. Engines are precisely controlled by a full authority digital electronic control (FADEC).

Heart of the new Super Hercules advanced technology is its modern flight station with multi-function, LCD screen for aircraft flight control, operating and navigation systems. In addition to the four displays on the instrument panel, pilots use holographic head-up displays as primary flight instruments, a precedent among military air transports.

Check List

- The Indian Air Force has exercised its options for six additional C-130J's (not formally announced yet)
- The sixth aircraft will come into India late October 2011
- All aircraft have been delivered ahead of schedule
- The aircraft have been delivered below budget costs
- Two C-130Js deployed by the IAF in September 2011 for rescue operations in Sikkim utilising special night landing capabilities

The displays are compatible with night vision imaging systems, enabling crew to operate the aircraft in areas where special missions dictate blackout conditions. The dual mission computers manage and automate many of the functions formerly performed by the flight engineer and navigator. Aircraft systems are constantly monitored and the crew advised on aircraft status.

Some new systems of the aircraft are managed by the mission computers and include the full authority digital engine controls, the advisory caution and warning system, automatic thrust control, computerised maintenance recording, the electronic circuit breaker system, enhanced stall warning system, advanced digital map, and a state-of-the-art communication/navigation suite.

The C-130J takes advantage of Global Positioning System and other highly reliable, automated navigation and route planning aides, which allows the cockpit crew to focus on the mission and on flying rather than on managing aircraft systems.

The C-130J is a proven asset that has seen combat service in several theatres, performs maritime patrol and weather reconnaissance missions and is routinely engaged in humanitarian and disaster relief efforts around the world. The immediate deployment of C-130Js within 90 minutes of the recent earthquake in Sikkim is testimony to its capability.

Courtesy: LM



The spacious cargo hold



RADARS

Make (All) The Difference



Richard Gardner reports on the latest airborne radars

The Selex Galileo Euroradar Captor-E is an advanced AESA radar and is to become available on the Eurofighter Typhoon from 2015.

The recent Paris air show saw an increasing concentration of sales effort on new generation radar systems. These new products, exploiting digital electronics in the form of Active Electronically Scanned Array (AESA) systems are not only “must have” sensors for new combat aircraft, they are being offered as very cost-effective

means of upgrading ageing fighters, and increasingly, as essential Intelligence, Surveillance and Reconnaissance (ISR) assets, making command and control, early warning and intelligence gathering air platforms far more capable.

Early phased array radars were passive and scanned a volume of space, steering beams electronically rather than

mechanically. Multiple beams could continue to scan while others could track targets in an active mode. This introduced a high resistance to jamming and an ability to greatly expand the information available on a radar screen. An obvious application was for large land and sea based air defence radars that could provide long range warning and more precise



tracking of multiple targets. Gallium arsenide microelectronic developments in the 1980s further shrunk the physical size of the transmitter-receiver modules (TRMs) allowing radar arrays to be built within more compact dimensions opening up the way for adoption on smaller combat aircraft, such as multi-role fighters, where its performance could transform the multi-

role potential of the airframe. AESA radars use a wide band of frequencies which can be changed after every pulse has been emitted. Multiple beam transmissions (using different frequencies) can be combined to receive, through system processing, radar images as if using a more powerful single beam. Progress over the last decade has seen a whole

range of different airborne AESA radars appear on the military market for use in ISR, AEW and Sea Search platforms, and these include use aboard UAVs and helicopters, and lighter than air vehicles. But nowhere is the competition more heated today, as lobbying for competing aircraft demonstrated at Paris, than in the combat jet market where the new radar is recognised as making a real difference.

Typhoon vs Rafale

Europe's aerospace and defence companies have been developing AESA radars for combat use for at least two decades and after extensive development work, including ground and air-testing, production AESA radar systems are now emerging from Thales in France and Selex Galileo in the UK and Italy. France is currently the only European country that has fully committed to a production AESA for its front line combat fleet by placing orders, though during the Paris air show, the Eurofighter Typhoon launch customers (UK, Germany, Italy and Spain) repeated their commitment to proceed with the AESA radar for introduction on Typhoon from 2015. In February this year, Thales announced that the production model of the RBE2 AESA radar had been validated on the Rafale multi-role combat aircraft, following extensive flight tests. The French government subsequently ordered this system for the latest Tranche 4 batch of 60 aircraft and delivery to the French Air Force and Navy will start in 2013.

The RBE2's introduction will enable Dassault to fully exploit the performance of the MBDA Meteor BVR air-to-air ramjet missile on the Rafale and the extended detection range will also benefit the use of other stand-off weapons, including Scalp. The added reliability of AESA technology means that the active front end of the radar will only require maintenance every 10 years, greatly increasing aircraft availability. The ability of the RBE2 radar to detect and track slow moving targets, such as ships, small vessels and surface vehicles, as well as low signature air targets, such as helicopters and UAVs, will combine with enhanced Synthetic Aperture Radar (SAR) ground imagery, providing an accurate and extensive ground picture with automatic terrain avoidance and safe low level, high speed, terrain following navigation in day



The Dassault Rafale will be the first European fighter to introduce an operational AESA radar in 2013.

or night conditions and in any weather. The Rafale, with its large multi-function head down cockpit displays, head up display and integrated helmet display capability, has outstanding situational awareness, as was demonstrated to *Vayu* by the Dassault sales team at Paris in an impressive combat simulator suite. The new radar will combine with the Rafale's advanced optronics systems to present a powerful fully integrated battlespace picture, allowing covert long-range detection, identification and tracking.

Until the US Joint Strike Fighter enters service, Rafale and Typhoon will have

the most advanced and comprehensive data fused operational systems in service. Rafale has been designed from the start to maximise its mission flexibility and the key to this is the integration of its AESA radar and a very complete set of aircraft sensors that will allow targets to be identified positively at stand-off ranges, tracked continuously, prioritised according to mission requirements, and then engaged with the most appropriate weapons. The nature of the sensor systems greatly eases the task for the pilot. The RBE2 is fused with the Front Sector Optronics (giving a stealthy passive

approach), the Spectra electronic warfare suite and a secure, interoperable datalink. Other Rafale aircraft can share the data available from the formation, and other ISR and command and control assets, in the air and on the ground.

In the Eurofighter consortium, and among the operating nations, it was always planned to replace the existing ECR-90 Captor-M, mechanically scanned multi-mode radar with an upgraded AESA development, to enhance performance and reduce life-cycle costs. Captor-M is recognised as being an extremely capable radar, but the intention is to replace the forward array to upgrade it to the E model. This has been designed to be easy to fit and integrate into the Typhoon bringing all the usual AESA gains, such as increased range, faster target tracking of multiple targets and simultaneous air-to-air and air-to-ground modes. It will also offer better detection of targets with reduced radar cross sections and will be better equipped to operate in unfavourable electronic warfare conditions. The extent of the development work that has already gone into developing this AESA radar for Typhoon can be judged from the fact that Europe has already built and test flown several successful demonstrators, and more work has recently been sanctioned. Under the AMSAR project, longer term AESA prospects for growth beyond Typhoon were studied and evaluated. This was



The Thales RBE2 AESA radar seen here was test flown and validated on a Rafale earlier this year. (Thales photo)

aimed at a BAE proposal with MOD for a UK Future Offensive Air System (FOAS), as a successor to the Tornado GR4. This was being considered as either a manned or unmanned advanced stealthy combat air platform, in appearance not unlike the Sukhoi T.50 PAK/FA and Chinese J-20, but this study lapsed with the UK firming up its industrial commitment to the F-35 Joint Strike Fighter, although further independent studies continued into an advanced stealthy UAV combat platform, which became the Taranis demonstrator.

With the continuing need to enhance the Typhoon radar, Euroradar undertook in 2002-2007, a company-funded development of Captor-M with a new AESA front-end. The prototype radar demonstrator was successfully test flown in Typhoon development aircraft DA5 in 2007, and was known as CAESAR-Captor. In February 2010 the UK MOD announced a £19 million contract with Selex-Galileo to further develop an even more advanced AESA radar demonstrator, to be flight tested in a Tornado GR4. This MOD Technology Demonstrator Programme (TDP) could also have applications such as on a production UCAV based on Taranis, or whatever emerges from the Anglo-French studies. The TDP is to look at integrating AESA technology with enhanced, wider field-of-vision performance in all weathers and in day and night conditions, with high resolution Synthetic Aperture Radar (SAR) for ground mapping, and communications features. The intention is to further de-risk these technologies and raise the level of maturity on the enabling hardware. Ground and range testing will be undertaken with flight testing starting in 2013.

Selex Galileo is also offering its ES-05 Raven AESA radar for the SAAB Gripen NG. SAAB has been actively promoting the Gripen NG in export markets and the Swedish government has announced its intention to support the Gripen with a series of upgrades to keep the aircraft in service for the next 30 years. It is intended to introduce the Raven AESA radar later this decade, with production models available from 2015. The technical and engineering solution on the ES-05 features a swashplate antenna mounting, similar to that on the Captor-E solution on Typhoon, which will allow for + or- 100 degrees of scanning angle



The Raven ES-05 from Selex Galileo is being developed for the SAAB Gripen NG multi-role fighter, and is also suitable for similar medium-size fighter upgrades to AESA (Finmeccannica photo)

movement to maximise the situational awareness and the quality of SAR images. This wider angle of scanning allows for more agile manoeuvring (up to 90 degrees) while keeping the target tracked. This minimises closure rate with the target, places the aircraft within the enemy's clutter return and still allows for full guidance of Beyond Visual

Range missiles. Selex Galileo claims that this development, which exploits the AESA technology but adds valuable extra performance at the edges of the radar's coverage, will make it a world beating system on the Typhoon from 2015. The company has also developed the lightweight Vixen 500E AESA fire control radar for use in small fighters



The Northrop Grumman APG-81 AESA radar seen here in its flight test configuration is destined to provide the F-35 Joint Strike Fighter with outstanding performance in the air-to-air and air-to-ground roles. (Northrop Grumman photo)

The NG SABR AESA radar is designed to be scalable for different combat aircraft applications and is seen here mounted aboard a test and evaluation executive jet. (Northrop Grumman photo)

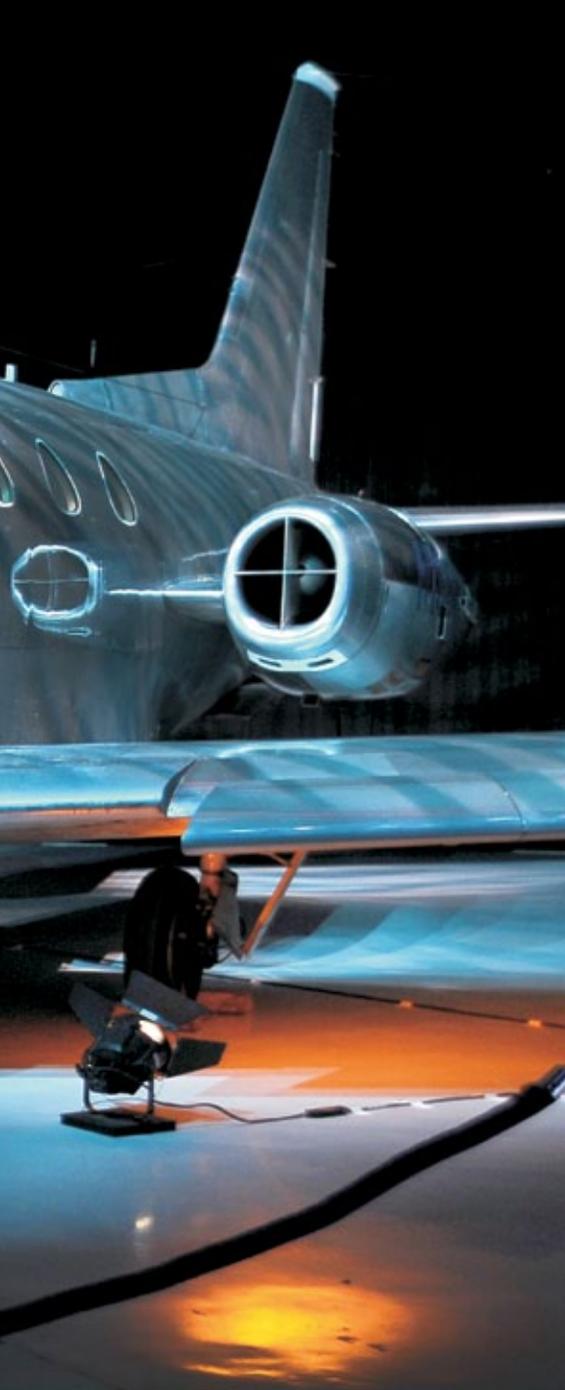


and lead-in fighter trainers. It offers higher reliability and performance than existing mechanically scanned radars in this category. Speaking in London, just before the Paris air show, senior executives in Selex Galileo confirmed that the company, with the full support of Eurofighter and the sponsoring governments, is willing to offer a long-term partnership with Indian industry on Captor-E and future developments and support throughout the aircraft's life-cycle, if Typhoon is chosen by the IAF. This is seen as an opportunity to generate considerable extra business opportunities for both parties which might well include existing and new export customers for Typhoon.

Flying sensors

The arrival of AESA radars in operational service is just the start of the next airborne revolution in situational awareness. In future they will be incorporated into platform structures so that in effect the whole aircraft becomes one flying information gatherer, able to find, share and respond accordingly. Fewer numbers will be required to achieve mission success, but the biggest challenge will be keeping the solution affordable. Though these radars have been under development for some time, they are now offered as an off-the-shelf customer option. They are also being offered as the basis for upgraded

versions of third generation fighter aircraft, especially where they can utilise as much existing avionics architecture as possible, to reduce the task of modifying the platform. In this context the combination of an advanced AESA radar in a modernised third generation airframe, incorporating a glass-cockpit, precision weapons and targeting pods, comprehensive defensive aids suite, secure tactical radio communications and possibly a helmet sight, presents an attractive and affordable procurement package that will give the customer an enhanced and formidable fighting capability but at a fraction of the cost of a fourth generation fighter.



put into mass production, and so new US air programmes will be built incorporating the most adaptable and effective sensor systems imaginable – starting with the F-35, which from the end of this decade is due to become the most systems integrated combat aircraft ever. Its Northrop Grumman AN/APG-81 radar will be fused with an advanced electro-optical Distributed Aperture System, to give unprecedented all-round situational awareness. It will act not only as an attack aircraft against sea and land targets, and as an air superiority fighter, but will also become a node in the battlespace network.

There has been much discussion regarding the affordability of the F-35 JSF, and its delayed introduction into service, and so Boeing and Lockheed Martin have been actively examining ways of extending their F/A-18 and F-16 production lines through the rest of the decade. To do this they have realised that AESA radar plus upgraded defensive suites and passive electro-optical systems could be the key to securing future orders for these 35-year old designs. Boeing has not been slow to seize the opportunity to upgrade its F/A-18E/F family with conformal tanks, radar cross-section reduction features and AESA radar. This has become an attractive and powerful new product, with obvious appeal to existing early-model F/A-18 C/D customers, such as Canada, Australia and Finland, as well as to the US

Navy. So far only the USN and Australia have elected to adopt it as a JSF gap-filler, but Boeing has been pushing the Super Hornet aggressively around the world in competitions for new fighters, though it was unsuccessful in the first round of the Indian Air force MMRCAs contest. From 2005 new F/A-18s started to introduce the Raytheon AN/APG-79 AESA radar in place of the previous AN/APG-73 radar, which is also being replaced in the earlier 135 Super Hornets in USN/USMC service. This comprises a completely new radar from the front-end array to the back-end processor and operational software, and makes the aircraft more lethal and at the same time less vulnerable. The active electronic beam scanning, which takes place at nearly the speed of light, optimises situational awareness and provides enhanced air-to-air and air-to-ground capability. The agile beam enables the radar's different modes to interleave in near real-time, so pilot and rear crew member can use both modes simultaneously, a great tactical advantage. In the air-to-ground mode the radar features higher resolution ground mapping capability. The radar is also now in service aboard the EA-18 Growler Electronic Warfare version of the Super Hornet. The system has an open architecture and uses compact off-the-shelf parts to deliver great performance and reliability. The solid-state TRMs virtually eliminate mechanical failure and have helped to create significant

In the West, the Raptor is regarded as an air dominance platform, rather than an air defence dog-fighter. Its integrated sensor systems can exploit its powerful Northrop Grumman AN/APG-77 radar to track up to 100 targets simultaneously, whether in the air or on the surface or at low level, and the weapons can be launched against selected priority targets at distances of up to 240kms, but it is not regarded as an attack platform with a multi-role capability. It is recognised by the US government that the pattern of world power is changing, and that it can't afford to maintain today's massive air fleets, let alone match in numbers, the new generation of Chinese and Russian combat aircraft that are being



The SAAB combination of Embraer 145 and Erieye AESA AW&C radar system makes for a very compact but highly effective airborne ISR platform; the Erieye is particularly good at pin-pointing small moving surface targets such as vehicles and fast boats. (Embraer photo)

reductions in maintenance down-time for the radars. Across the aircraft fleet, this translates into increased operational availability and reduced man-hours and spares consumption in the support chain.

Raytheon has exploited its AESA experience from the Super Hornet's radar into the AN/APG-82(V)1 for the USAF's modernisation of its extensive F-15E Strike Eagle fleet. This takes the processor from the AN/APG-79 and the antenna from the AN/APG-63(V3). The new radar offers a more than twenty-fold improvement in system reliability over the legacy AN/APG-70 radar, which is sure to add to its appeal with squadron maintainers as well as pilots. The older F-15C air defence fighters have also been upgraded, starting back in 2000, with Raytheon-supplied AN/APG-63(V) 2 AESA radars, which brought a ten-fold increase in reliability and the ability to track up to 14 targets and attack up to six simultaneously. One of the factors that resulted in the selection of the F-15 SG by the Republic of Singapore Air Force, and the Royal Saudi Arabian Air Force, beating fourth-generation rivals, was the AN/APG-63(V)3 AESA radar. Building on all this manufacturing expertise and sales success, Raytheon has developed a new advanced lightweight AESA radar, the RACR, aimed at the upgrade market aboard a range of combat aircraft, such as the F-16. It is offered as a drop-in replacement and an affordable option for cost-conscious customers seeking to re-life multi-role fighters with plenty of operational life remaining. It has also been cleared to be offered as an option on new-build F-16 Block 60 aircraft for export customers. The USAF is seeking an AESA upgrade for between 300 and 600 older F-16s and

is awaiting an industry response, with both Northrop Grumman (offering a scalable AESA radar) and Raytheon (offering the RACR) in a good position, should a firm programme be agreed. With budget cuts on the horizon and over-expenditure on the F-35 a concern, it is by no means certain that the F-16 upgrade will proceed on the scale originally intended, if at all.

Israel active

The market for upgraded radars has not been left to the USA or Europe alone in the West, with strong competition from Israel in particular. IAI's Elta Systems has been in the AESA market for over 20 years and introduced its first platform solution (on a Boeing 707) in 1989. It has subsequently developed two more generations of AESA radar systems since then for Airborne Early Warning and Command and Control as well as for combat aircraft, such as the F-16 and Sea Harrier. Radar platform aircraft include the Il-76, Boeing 707 and Gulfstream, and now the new Airbus Military C-295 AEW&C demonstrator.

This new Airbus/IAI co-operative project has been developed quickly to meet emerging international requirements for a multi-purpose radar platform, and the first aircraft only took to the air two weeks before the Paris air show. Designed to give a 3D situational awareness picture over a very wide volume of space, this new project fully exploits the Israeli company's experience in AESA radar technology to give Electronic, Signals and Communications Intelligence (ELINT, SIGINT and COMINT) data. It is aimed at meeting the needs for Airborne Early Warning, Command and Control, Battlefield Management, Homeland Security, Counter-Smuggling, Maritime



The Sukhoi T50/PAK FA next generation fighter will enter large scale Indian Air Force service and an AESA radar will be an important component in its integrated weapon system. (Sukhoi photo)

Patrol and Border Protection. Elta claims this flexibility in capabilities contained in one airframe is unique. The radar systems are fully integrated comprising a fast rotating, low power consumption rotodome system, which combines electronic scanning with 360 degree coverage. It has separate radar arrays and IFF arrays offering low weight compared to existing rotodome radars and a no-compromise high performance, but carried in a medium size twin turboprop airframe to help keep the resulting system affordable. The continuous 360 degree radar coverage avoids any blind spots on the radar picture and the stabilised system

A surprise addition to the line up of new aircraft at Paris this year was the C-295 AEW&C, a joint venture between Airbus Military and Elta of Israel, which is developing the integrated AESA radar system.



compensates automatically for banking and aircraft motion. Combining rotating and electronic scanning means the radar picture does not suffer any delays and it is claimed that the scan is twice the speed of any other similar airborne system. In the SIGINT role, the system provides automatic detection, classification and direction finding, with angular tracking of airborne targets. An integrated underbelly mounted radar provides moving target indication with dual land or sea capability, and the ability to identify surface shipping in the MR role. The un-refuelled on-station endurance is eight hours.

Elta has developed the EL/M2052 with a view to widening export sales beyond the Israeli Defence Force's own requirements. This AESA radar has been designed for application in the F-16, Mirage 2000 and F-15. It can track up to 64 targets simultaneously and is lightweight (around 300lbs weight). It has long range tracking and is well suited to the anti-shipping role. AESA radar is ideal for multi-role maritime air platforms, including carrier-based aircraft. India has refitted its Sea Harriers with Israeli-supplied EL/M2032 radars and the EL/M2052 has been offered for use on the Tejas.

This brief survey has not included Russian and Chinese developments of AESA radars, but as in the West, these countries are developing upgrades for existing combat and specialist radar platforms as well as next generation aircraft. Similarly, the next generation of Maritime Patrol aircraft also feature AESA technology to provide greatly improved surveillance and tracking performance – and with the benefit of easier maintenance and greater reliability, permitting far greater utilisation of assets, so fewer platforms can do more. In an age of rapid defence inflation, that must be a good thing.

DEFENCE OFFSET POLICIES



The IAF's newly inducted C-130J-30 Super Hercules

THE ROAD AHEAD

S.N. Misra, formerly Joint Secretary HAL and presently Principal Secretary (CDA), examines the impact of India's Offset Policy on Defence Industry Capability, Self Reliance and the Aerospace Sector.

India now ranks second in terms of arms imports (\$12 billion annually) and ninth in terms of global military expenditure (\$36.3 billion). Despite its fairly strong indigenous military production capability base, India's dependence on imports is staggeringly high, at 70% over the past many years and showing no signs of abatement.

Following recommendations of the Kelkar Committee (2005) the Defence Ministry introduced offset provisions in its *Defence Procurement Procedure 2005 (DPP-2005)* for capital acquisition schemes exceeding an estimated cost of Rs. 300 Crores, or around \$66 million, to bolster its defence industry capability with subcontracting, foreign direct investment (FDI), Joint Venture arrangement, Manufacture Repair and Overhaul (MRO) capability as also exports. The scope, however, did not include technology transfers and indirect offsets.

The guidelines were further liberalised in DPP's 2009 and 2011 by including provision for credit banking and civil aerospace and homeland security products. A *Defence Production Policy (DPP-2011)*

was promulgated in January 2011, outlining a road map for indigenisation with specific thrust to upscale India's indigenous R&D and manufacturing capability for critical items by involving the private sector and academia.

Prior to issue of a formal offset policy, offset arrangements through license production, technology transfer and counter trade have been in vogue since the early 1960s, with Russia and a few western countries contributing a high level of manufacturing capability for combat aircraft and engines.

This article examines impact of the offset policy during the period 2005-2011 for bolstering India's military industry capability through various options delineated in the offset policy and the road ahead in terms of policy options and their implementation.

The experience so far in offset realisation of around \$2 billion, shows that it has mainly been for sub-contracting of low-end products and services, establishing MRO facilities, training and simulators with fairly balanced participation by the private and public sector. However, the expected inflow

of FDI, JV and long term business partnership in design, development and manufacturing technology of high end products with foreign OEMs (Original Equipment Manufacturers) has still not come about.

It is argued that further procrastination in major policy issues like increasing foreign equity component, allowing technology transfer in priority areas and using multipliers, be best avoided if India intends to build its defence manufacturing capability in critical technologies given the massive opportunities in the aerospace sector which are presently in the pipeline. India can certainly become a global hub in the reputed OEM's supply chain as has been the experience with countries like China. The need for a fully empowered, technically equipped independent Offset Facilitation Agency to ensure effective implementation of the massive offset opportunity in the pipeline must be pursued.

Offset Contracts: period 2005-2010

Broad details of the 12 acquisition programmes and offset contracts concluded with foreign companies during 2005-2010 is shown in Table 1.

Table 1 :**Offset cases : contracts finalised 2005–2010 (in Rs Crore)**

Programme	Foreign Companies	Contract Value	Offset value
Medium Power Radars	IAI Elta, Israel	810	243
Upgrade of MiG-29s	ROE, Russia	3856	1233
Fourth Fleet Tanker	Fincantieri, Italy	800	240
Long Range Maritime Recce / ASW aircraft	Boeing, USA	10684	3205
Harop UAVs	IAI, Israel	720	220
Mi-17 helicopters	Rosoboron Export Russia	4950	1485
C-130J aircraft	Lockheed Martin, USA	3666	1100
EO/IR pods - Jaguar upgrade	Rafael, Israel	350	159
Fourth Fleet Tanker - under option clause	Fincantieri, Italy	800	240
Low Level Transportable Radar (LLTR)	Thales, France	570	171
AW 101 helicopter	Agusta Westland UK	4227	1268
UAVs	IAI	1265	379
Total		32698	9943

(Source : Defence Offset Facilitation Agency, MOD)

Analysing the Offset Contracts, it is clear that

- There was steady increase from \$ 48.6 million in 2007 to \$519.5 million in 2008, then \$ 974 million in 2009 down to around \$ 700 million during 2010.
- The aerospace sector accounts for 65%, balance by the other services.
- Level playing field concerns have been addressed as the Indian private industry accounts now for 70% in value of these contracts.
- The DPSUs (HAL and BEL), and Tatas plus Land T from the private sector, are major players.
- SMEs and IT companies also have a fairly substantial share.
- In terms of FDI inflow for infrastructure, production and Rand D, the impact has been minimal.
- Only a single case of credit banking has been approved so far.
- But there is no positive impact on exports !

Major Areas of Offset Realisation

These are sub-contractorisation (58%) involving supply of fuselage, cabins, radome, tail cone, data link, and other products; Engineering projects and Project management; Overhaul and Repair facilities (16%) ; various types of training facilities, Simulators and Ground Handling/Support Equipment (8%).

The aerospace sector has historically been the prime beneficiary of Offsets, as most advanced countries market their combat aircraft with varying degrees of offset obligations. The United States accounts for nearly 60% of the global arms production which was \$471 billion in 2008. Of the 100 major global armament producing companies, some 80% were engaged in aerospace products.

In India, the aerospace sector is a virtual monopoly of Hindustan Aeronautics Ltd. which has been beneficiary of technology transfers (TOT) for some time, through licence-manufacturing arrangements. The impact (of such offsets) in major TOTs transferred by Russia for the MiG-21 (1960-70s), MiG-27 (1980s) and Su-30 (1990s onwards) has energised HAL to achieve higher levels of technology capability in manufacturing of combat aircraft and their engines.

These TOT arrangements, however, have not created defence industrial capability for supplying advanced weapons systems that would be competitive against western equipment, nor has the technology gap closed.

The types of work realised through offset arrangement by HAL are seen in the table below:

Build to Print	32%
Design to Build	21%
MRO Facilities	27%
Software Packages	12%
Design Packages	8%

(Source : HAL)

The 'Build to Print' option provides very little opportunity for value addition unlike under 'Design to Build' where the industry must have design capability/ 'Know Why' capability.

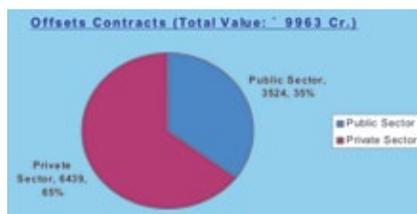
Opportunity in the Aerospace sector

The rise of China's ambitious military plans and the tragic events in Bombay in November 2008 have resulted in India's commitment to spend over \$ 80 billion on defence and security-related procurements over the next five years. Because of perceived regional threats, India is expected to continue to modernise its naval, ground and aerospace forces with major emphasis on intelligence and precision strike capabilities.

As for civil aviation, it is estimated that over the next 20 years India will require approximately 1100 commercial airlines at a cumulative cost of \$ 130 billion which represents about 4% of the worldwide forecast for commercial aircraft.

Air India had ordered 43 aircraft from Airbus: 19xA319s, 4xA320s, and 20xA321s plus 68 aircraft from Boeing 27xB-787s, 8xB-777s, 15xB-777-ERs, 18xB-737-800s.

The value of offsets concerning Airbus has been assessed as \$720 million, of which 50% would be with the aeronautical sector. The State Trading Corporation is the nodal agency for this offset administration. The areas for offsets would be aircraft component design, engineering and data management services, technical publication services, raw materials and semi finished products.



Major Areas of Offset Realisation

Interestingly the following types of transaction also qualify for multipliers :

Type of Transaction	Multipliers
Training in India	5
Training Abroad	2.5
Technical Assistance	2.5
Investment in Joint Venture	1.5

With Boeing, the estimated value of offsets is \$ 1.9 billion including Boeing's commitment for investing \$ 185 million towards MRO and aircrew training. The offsets are both direct (aerospace projects) and indirect in nature, with the endeavour to increase capability, transfer technology, promote exports and create jobs.

Indirect offsets include, most importantly, critical nano technologies and other areas like investment in infrastructure, Oil and Gas, rail, water and air transportation, plus financial services, health care customers and consumer financial services.

It would be noted that the scope covers a broader national capability development. The multipliers are based on the importance of type of offsets such as direct purchase and exports leading to technology development. 'Investment'

gets a multiplier of 5 depending on valuation of investment. University initiation also gets a multiplier of 5.

In other words, the offset policy of the Civil Aviation Ministry is more imaginative and inclusive in nature, and these are expected to be discharged by 2023.

'Military big ticket' acquisitions

Military aviation acquisitions in the pipeline like the MMRCA, QR-SAM (Quick Reaction Surface to Air Missile), Mirage-2000 (upgrade), as also 155 mm howitzers (self propelled) are of the order of \$ 23 billion with around \$ 9 billion expected to be generated as offsets. The IAF itself will account for 70% of these offsets while the Army has an equivalent of around 20%. (See Table 3).

Challenges for Realisation

HAL is engaged in liquidating offset programmes with Boeing, IAI and Turbomeca. Contracts with Boeing and Pratt&Whitney include work packages like passenger doors, up-lock box assemblies, digitization of drawings. The contracts with Turbomeca are quite substantial and humungous for which offsets, HAL has to create dedicated facilities for aerostructures, engine shops, expand

existing facilities for composites, forging and castings and also MRO facilities.

There is need for strategic alliance with the IT industry for design and engineering support and with private sector industry including the TVS Group, Tata Advanced Materials, L&T, Godrej, Crompton Greaves, Dynamatic Technologies and so on. HAL needs to get international certification such as AS9100 and NADCAR.

To realise these offset opportunities the Tata Group are also establishing facilities for manufacturing aerostructures by forming JVs with Boeing, Lockheed Martin, Sikrosky and Augusta Westland.

Challenges in aircraft manufacturing are mainly in the areas of titanium welding, steel metal work and production of major assemblies. The proposed JV between Tata Power with Boeing and Sikrosky are likely to address some of these. However, in terms of design capability and integration, HAL remains the prime centre and must work in tandem with large private organisations as also a large number of SMEs to cover the considerable gaps in production of fighter aircraft structures, stealth systems and propulsion.

The Road Ahead

The experience with offsets in India has shown that this has mostly been confined to sub-contractorisation of low-end products and services, setting up of simulation and training facilities, project management skills, depot maintenance facilities and manufacture of Ground Handling/Support Equipment. There is some perception that offset requirements are getting diluted by including items like simple tenting and domestic air conditioners under the heading "troop comfort equipment".

Issues on Technology Transfer

It is not surprising that as far as the aircraft industry is concerned, the kind of technology being transferred will not usually be current (owing to export control regulations, commercial and IP interests in the technology developed) and will instead be proven technology with manufacture of components, assemblies, sub-systems and such systems already outsourced to recognised tier suppliers of the global supply chain. Domain knowledge in manufacture invariably lies with these tier suppliers and it has been HAL's

Table 3

Proposal	Service	Approximate Value (in Rs crores)	Appx. Offset Value (in Rs crores)
QR SAM	Army	4500	1350
Aerostat Radar Comint/Slint System	IAF	1995	598
LUH	Army & IAF	3432	1030
AFVP	Army	1965	590
MMRCA	IAF	42,000	21,000
Mirage 2000 Upgrade	IAF	12,000	3600
FRA	IAF	2124	637
Attack Helicopter	IAF	3094	928
155mm (SP)	Army	5499	1650
155mm (towed)	Army	12640	3792
MCMV	Navy	5971	1791
155mm ultra light howitzers	Army	2900	870
Air-to-Air missiles (MICA)	IAF	4572	1372
LCA engines	IAF	2700	900
		102292	40108
		(\$ 23 billion)	(\$ 9 billion)

experience that the project management systems of such global players can only provide broad information on queries and clarifications that are sought on the technologies while adapting them to our environment. This results in project delays and time overruns which would need to be absorbed within the financial models of the projects.

Documentation and configuration control is another area where there will be several gaps during such transfers of technology. Documentation supplied is generally from archives of the licensor and needs much upgradation during the production phase. Process sheets are usually not transferred in their entirety as the OEM depends on its vendors for a large proportion of the work and who hold these documents. Design documents with details of stress analysis, dynamic and thermal loads, ballistic profiles etc. are not usually transferred which would mean that dependence on OEMs would continue for concessions, modifications, tropicalisation and upgradation unless the basic design knowledge is available with the licensee. No Indian company, other than HAL, has the domain knowledge as integrators of aircraft, even after such transfers of technology.

While manufacture of components and sub-systems could be undertaken through a process of transfer of technology with relatively less number of issues and problems, systems integration in an aircraft is of an entirely different dimension. A typical example is of aircraft flight control system integration which involves a myriad of complex subsystems (such as hydraulic, pneumatics, electrical, electronics and fuel systems etc.) besides having sound domain knowledge in complicated fields of aerodynamics, flight mechanics and aero elasticity. Complex interface issues arise during integration processes for which solutions are not always defined in TOT documents.

The efficacy of system integration is always proven during flight evaluation. Flight testing with telemetry monitoring and instrumentation analysis of test flight results are an involved and complex process and the flight test documentation has to be adapted to specific environment and needs.

Adapting the product to our environment could result in several



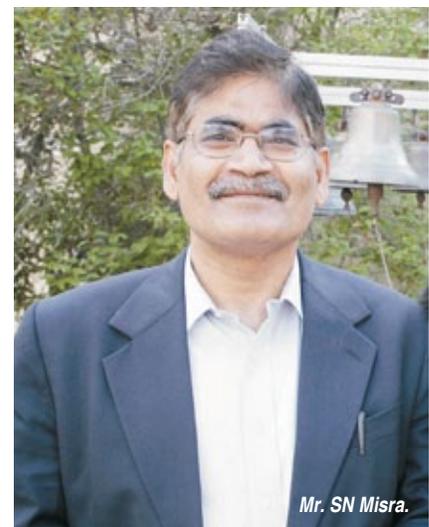
modifications and changes, yet another area where domain expertise plays a crucial part. Almost all aircraft that are acquired through TOT have undergone several modifications and changes before induction in the operational inventory.

Tooling and tool design transferred are specific to the equipment used by the licensor and cannot be adopted without trials and modifications.

In conclusion, it must be noted that as against an expectation of \$ 10 billion value of offsets during the 11th Plan period (2007-11), the realisation has been actually around \$ 2 billion (till March 2011). More than the quantity, it is the 'quality of offsets' realised that is worrisome and inclusion of items such as simulators have diluted the very objective of offsets. The response to FDI inflow and JV formation has been rather tepid. Building upon design, development and production capability in key technologies should be our major policy thrust. Licence agreements in the past for aircraft, ships, and armoured fighting vehicles have built substantial capability in our DPSUs/ OFs, both in terms of manufacturing and to a lesser extent in design and development but technology transfers must be kept as an option in our offset policy. Bilateral defence cooperation and diplomatic fora should be utilised to bring in key technologies by leveraging major programmes, with diplomatic initiatives.

An FDI increase up to 50%, with suitable safeguards, is likely to make a perceptible difference to FDI inflow and in all probability bolster manufacturing capability in major platforms and subsystems.

India's aim should be to become a global hub in reputed OEMs supply chains. Value addition in the manufacturing sector should be the thrust area. A national offset policy should be put in place to have a proper perspective of national priorities in terms of infrastructure and social sector requirement. The Defence Offset Policy should be a subset to overall economic development goals and inclusive growth while subserving specific defence needs.



“You have a very professional Air Force”

VAYU interview with General Jean-Paul Palomeros, Chief of Staff of the French Air Force



VAYU : Welcome to India and we trust you have had a meaningful visit to our country and the Indian Air Force. At the close of your official visit, would you like to articulate for our readers your overall impressions on the IAF in terms of professional capabilities and similarities in approach with the ‘Armée de l’Air’?

General Palomeros: It is wonderful to visit India. It is an Air Force to Air Force visit. The Indian Air Force Chief of Staff NAK Browne had invited me when we met in Turkey and I am pleased to have found time. We are involved in many operations together with wide-ranging cooperation in operational concepts and equipment and understanding each other is paramount. You have a very professional Air Force and it was interesting to meet the personnel in Gwalior and Jaisalmer. The Indian Air Force is looking towards modernisation, towards the future. We shared experiences especially those from the recent Libya operations. This has been a very fruitful trip.

VAYU : The Indian and French Air Forces have for over half a century operated similar combat aircraft, beginning with the Ouragan, continuing with the Mystere IVA and presently the Mirage 2000. You have been a Mirage 2000 pilot yourself: how long will the French Air Force continue with the type and are there any plans for upgradation similar to those of the IAF?

General Palomeros: I met Indian pilots who flew the Mirage 2000 and they were very happy with the aircraft and enjoyed flying it just like I am. It has a very operational air weapon system. The Mirage is a very robust aircraft with gross potential and no major overhauls since it was developed. The French Air Force upgrades its Mirage fleet quite frequently. We recently added the Link 16 to the new Mirage 2000D. This aircraft has been upgraded to have a strong multi-role capacity similar to what the Indian Air Force is looking for. It is important to put in new radars, improve the systems and sensors. The French Air Force believes that it should share the development with other customers to reduce over all costs and we are eager to cooperate with the IAF especially where important data links are concerned. We also worked with the Air Force of the United Arab Emirates in Libya who operate the Mirage 2000s as well.

It is very difficult to guess the life span of the Mirage 2000 but I believe that the Mirage would be of vital use to the French Air Force for at least the next 15 years.

VAYU: Obviously the Dassault Rafale has scored well with the IAF so far and is included in the shortlist for the MMRCA requirement. What are the key lessons from the Rafale employment in operations over Libya?

General Palomeros: The French Air Force had to respond to the call of

deployment in very short time. The first aircraft to be sent was Rafale which was used for various operations – offensive, recce, intelligence etc. The Rafale displayed its ‘omni-role’ capability which I experienced myself. Operating from Saint Dizier in north-eastern France, the Rafale flew for 8-9 hours operations and then moved on to Corsica. The Rafale’s serviceability was very impressive. French combat aircraft accomplished more than 4,500 sorties in roughly 20,000 flight hours, something which amounts to about 25% of all the sorties performed by the NATO-led coalition. On top of that the French fighter aircraft carried out 35% of all NATO strikes, damaging or destroying over 1,000 targets using mostly GBU-12s and Sagem’s AASM ‘Hammer’ 250kg guided bombs. The MBDA’s Scalp missile was fired for the first time in action. MBDA’s is a great success story for Europe and its weapons have been adapted on the Rafale.

We have really achieved the dream of our predecessors who wanted ‘a single aircraft capable of carrying out all missions’. We thank them for their far thinking plans. The Rafale has a full spectrum of capabilities but also gross potential for development. Next year, the Thales AESA radar will be installed, and is currently at the experimental operational flight test phase. Although the Rafale has all systems integrated and the information flow for the crew is comprehensive, it is very simple machine.



The Rafale leads the Mirage 2000

We have three Rafales stationed in Afghanistan on a permanent basis and five in the UAE which are fully operational.

We are ready to share complete information, with full confidence and look forward to a full partnership with the Indian Air Force. Both the Forces are moving towards the same direction and we should cooperate with each other to fulfil our operational objectives.

VAYU: The last Indo-French joint air exercise (Garuda) was considered a great success. Can you please comment on the future collaborations and interactions between the Indian and the French Air Forces?

General Palomeros: We are planning our next Indo-French joint exercise for the end of 2012. It needs a lot of planning and budgeting. The planning is as important as the exercise as many resources are involved. It is great working with the IAF. Not many Air Forces can operate in offensive, defensive and use UAVs. Well trained people are required for this. This would become the most important objective for our future exercises. Training people is for them to be prepared and react quickly specially for such operations as in Libya, as an example.

VAYU: The French Air Force is very much involved in overseas commitments (15 different operations in 13 countries). This must pose considerable challenges as this is coincident with the deep resources reduction plan which will reduce the French combat aircraft strength by 1/3rd. Your comments please! Also, the French Air Force is reorganising its commands, units and assets under 'Air 2010'. Can you explain the steps being taken in this regard and the progress achieved?

General Palomeros: The French Air Force has three major challenges to face as a part of the major reforms directed by the President for the entire organisation. The first challenge is to reduce the number of aircraft. We now need to concentrate on quality more than quantity to perform as well and better than we have been doing so. The second challenge is to reduce 10 bases out of the 35 existing ones and make the best of the existing assets. This would help us save money which can be invested in modernising other areas such



Lineup of Dassault Rafales



General Jean-Paul Palomeros (right) with Squadron Leader Udayan Kumar after flight in Sukhoi Su-30MKI

as the Rafale, UAVs, and Tactical Anti-Ballistic Missile defences etc. The greatest challenge would be to manage the human resource well to operate this in the best possible manner. 23% of the human resource in the French Air Force are women who love what they are doing. Officers of the FAF are very talented, motivated and working in solidarity to achieve competency.

Modernisation is a big tool for motivation. When the pilots know they are operating the very best machines in the world, like the Rafale, they feel motivated to perform better. I saw the same motivation for excellence here in India.

I think we have been successful in our reforms. We reduced 10 commands to 5 which are the 'Air Operations', 'Combat', 'Support', 'Strategic (nuclear deterrence)' and 'Human Resource'. I am happy that we made the changes before 2010 as everything is more or less in place now. In terms of reductions, we are making best use of the multi-role capabilities of aircraft like the Rafale which is also nuclear capable and the upgraded Mirages. The 'White Paper' which forms the guideline, allows us to keep operational our aircraft which are around 300 in the Air Force and the Navy together. We have the same Rafale with the Navy, with minor changes like the undercarriage. This has allowed common training and sharing the logistics support and spare parts, which is very good planning I believe.

VAYU : During the Paris Air Show you described the Unmanned Aerial Vehicles as “remote-controlled, since humans must remain in control of these vehicles”. What is the way forward for this? How will the Anglo-French joint study group on a new medium-altitude, long-endurance UAV effect the ‘interim acquisition’?

General Palomeros: UAVs need humans in the loop. I saw the Indian UAV unit in Jaisalmer and I believe we are on the same track. We have used the existing UAVs in Afghanistan and since mid-August in Libya as well. We need more UAVs on an urgent basis and are looking at Israel to work on the Heron TPs among others. Looking towards 2020 we have to develop new UAVs and there is a wide scope of innovation in terms of platforms and operations. This is the prime age for UAVs. The French-UK study on UAVs will be an important perspective to shape its future, where the UAVs of the future will also be combat capable.

The Unmanned Combat Aerial Vehicle (UCAV) is important. The Dassault-led UCAV Neuron demonstrator’s maiden flight is scheduled for 2012 which is a cooperation between six countries. UCAVs are very useful for deep penetration into enemy space and we are pushing to build an operational demonstrator in conjunction with the new generation fighters. I see this as a part of the overall new generation combat fleet by 2025-2030. We need to keep on investing and modernising these vehicles.

VAYU : You had a chance to fly the Indian Su-30 MKI at Jaisalmer. What was your experience on this aircraft?

General Palomeros: This is a very different aircraft type and cannot be compared to our equipment. The Su-30MKI has thrust vectoring which gives sudden change of flight direction which is an excellent advantage. This is a huge aircraft, we cannot afford it but it is an impressive machine!



MAKS 2011



All eyes on the FGFA



What had historically begun as the 'Mosaeroshow' at Zhukovsky a decade ago in 1992, has evolved into becoming the MAKS International Aviation and Space Salon, Russian aviation industry's biennial showcase event. *Vayu Aerospace Review* was invited by the Russian Ministry of Trade and Commerce for the Show and Esha Singh Alagh reports:

Unlike *Vayu's* last visit to Zhukovsky when the temperatures were far below sub zero, in August 2011 the sun shone bright over Zhukovsky as MAKS 2011 got off to a bigger and busier start. This was arguably the *Fifth Generation Fighter Aircraft's* Show and the Pak-FA/T-50 basked in all glory with the two prototypes flying over cheering crowds. While one peeled off and disappeared, the other continued to display its characteristically stealthy form in a 15 minute demonstration.

Many Indian hearts leapt with some excitement that their future fighter was cynosure of all eyes, albeit at this foreign air show. Still while the military sector gave an insight into the future, the civil side was the star performer, with many commercial deals signed. MAKS has become another hub for the medium-haul market: Ilyushin Finance concluded a \$2.2 billion deal with Irkut Corporation for 50

of the new MS-21 medium range airliners while Sukhoi Civil Aircraft Company and Indonesian regional carrier PT Sky Aviation signed a contract for the purchase of 12 Sukhoi Superjet 100/95B aircraft in a deal valued at \$ 379.2 million. The Airbus 320neo which had notched record deals at the Paris Air Show 2011 also had successes with an MoU for eight aircraft with Transaero Airlines.

As President of the United Aircraft Corporation Mikhail Pogosyan said "We need to become successful not only in the segment of military equipment, but also in segments of the transport and civil aviation," with UAC now determined to become a serious global player in civil aviation.

This biennial show was held over the week 16-21 August 2011 at Zhukovsky, not far from Moscow with a visitor count of 440,000. 627 aerospace industry companies, including 473 Russian and 154 foreign, took part even as General Director Aviasalon JSC, Vladimir Borisov announced that, "according to preliminary

estimates deals worth more than \$ 10 billion were signed."

Russian Prime Minister Vladimir Putin made his appearance on 17 August 2011, clearly upbeat on debut of the FGFA. He visited various pavilions and oversaw the signing of numerous contracts. The Russian PM announced the setting up of an air industry cluster at the suburb of Zhukovsky, which would eventually become the core of national aerospace industry innovation, uniting scientific research institutes, design bureaus and production lines in a single "powerful intellectual technological centre". Putin also promised that by MAKS 2013, headquarters of Russia's United Aircraft Corporation would be transferred to this location together with other aviation institutions.

MAKS 2011 boasted an aircraft static display which extended over 3 kilometres, with Russia's military might on display: fighters included the MiG-35, Su-35, Su-30MK, MiG-29K and helicopters



Line up of aircraft at the static display at Moscow.

Boeing's 787 Dreamliner made its Russian debut at MAKS 2011.



included the Ka-52 Alligator as well as the Mi-28NE Night Hunter. Also on display was the Yak-130 combat trainer aircraft which has lately gone into service with the Russian Air Force. After a four-year break, the US Air Force appeared at MAKS and put on public display their C-5 Galaxy heavy-lift transporter, A-10 Thunderbolt attack aircraft and P-3C Orion ASW aircraft. Indian companies participating,

Rolls-Royce RR300 engine certified in Russia

Rolls-Royce announced that its RR300 engine has received IAC-AR certification enabling flight operations for the Robinson R66 helicopter. The RR300 engine, which powers Robinson's first gas-turbine aircraft, received flight certification from the US Federal Aviation Administration in October 2010 and is in service with the R66.

Greg Fedele, Vice-President Rolls-Royce, Civil Helicopters stated that "We have been working very closely with the Robinson team to achieve this key milestone and it is recognition of the safety and validity of the Rolls-Royce RR300 design. This important new certification will increase opportunities for R66 sales and growth across Russia."



The Airbus A380 was major attraction at MAKS 2011.



Increasing numbers of the Yak-130 are being inducted into the Russian Air Force.



Sukhoi and MiGs in dramatic flypast over Zhukovsky.

other than HAL and BrahMos, was Bharat Electronics which displayed their range of avionics. The GTRE Kaveri engine, installed on an IL-76 Flying Laboratory from the Gromov Flight Research Institute, was on static display.

As at Le Bourget, the Airbus 380 and the Boeing 787 Dreamliner were parked

alongside adding some competitiveness to the static display. Aeroflot is keen to acquire the A380 and are at the negotiation table. Christopher Buckley, Vice President Airbus said that “we have new operators, we are very proud of SkyExpress, with Tatarstan and we’ve sold eight A320s to Transaero”. Randy Tinseth, marketing

vice president for Boeing Commercial Airplanes also expressed Boeing’s interest in the Russian market and added that “over the next 30 years we (Boeing) expect to invest \$27 billion in Russia, about \$18 billion in titanium, \$5 billion in engineering support and expertise and about \$4 billion in other ventures.” (India’s offset managers to note!)

Flying displays, other than those by the T-50, included performances from the Su-30 and Su-35 multirole fighters, the Su-34 strike aircraft and the Superjet 100 passenger airliner. RAC-MiG showcased several variants of its MiG-29 fighter and two-seat version of the MiG-35 multirole fighter, as well as the MiG-29K carrier-based fighter in service with the Indian Navy and also ordered by the Russian Navy. Then there were a range of Russian helicopters - cargo, passenger, medevac, reconnaissance as well as attack—climaxed by formation aerobatics by the *Russian Knights, Strizhi, Russian Falcons, Rus and Baltic Bees*.



Beriev 200 water bombs with the Russian national colours.



IL-76 testbed with the GTRE developed Kaveri engine (seen underwing in grey colour).

Bombardier gets tentative C-Series order from Russia

On 17 August 2011, Bombardier announced signing of the letter of intent with Russia to procure 10 C-Series aircraft with an option for 10 more. “We have signed a letter of intent for 10 firm C-Series orders or three CS100s and seven CS300s. There are also options for three more CS100s and seven more CS300s,” announced Bombardier’s spokeswoman Haley Dunne. She further said that the “list price of CS100 is \$57.8 million and of the CS300 is \$66.6 million, putting the value of the firm orders at about \$640 million. With the options, the total would rise to \$1.28 billion of these fuel-efficient medium-haul airliners. “The first flight is scheduled for the second half of 2012, with the CS100 expected to go into service by the end of 2013 while the CS300 would go into service by late 2014.

Sukhoi T-50: The Game Changer

The Sukhoi T-50, aka Pak-FA or FGFA, being jointly developed by Russia and India, made its public debut at MAKS 2011. President of UAC Mikhail Pogoyan announced that “the T-50 will provide the backbone not only of the Russian Air Force but also that of India’s”. The Indian Government has confirmed its intention of procuring upto 250 of these

supersonic cruise, extreme maneuverability, an advanced warning system and conformal carriage of weapons. Various missile systems are going through final tests and the Tactical Missile Munitions Company has revealed an “unequalled 200-km range interceptor missile”.

Russian Prime Minister Vladimir Putin and HAL Chairman Ashok Nayak



T-50's Chief Test Pilot Sergey L Bogdan with Vayu's Esha Singh



had 400 hours of familiarisation on the aircraft and its systems before he made the maiden flight of the T-50 in January 2011. Of the 80 test flights of the T-50 so far, Bogdan has made 70 of them. The Slavic test pilot's name means 'God's Gift' and truly the T-50 is gifted to have him in control!

Russian reports have put a price tag of \$ 100 on the T-50 and United Aircraft Corporation have forecast that they will build “1000 T-50s over the coming decades” and hope to “control as much as a third of the world's stealth fighter market”.

In contrast, the US F-22 Raptor began life nearly two decades ago but is confined to the USAF and will also have company in

aircraft while Russia is planning around 200, with first deliveries to the latter service planned for 2016-17.

During the visit of Russian President Dmitry Medvedev to India in December 2010, Rosoboronexport, Hindustan Aeronautics Limited and Irkut signed the contract to begin preliminary design studies of the new aircraft named the *Perspective Multi-role Fighter (PMF)* by the Indian Defence Ministry. An official stated that “the total cost, including options and the value of production of the aircraft, will make this the biggest defence programme ever in the history of India, with production of upto 250 aircraft”.

The PMF project involves the design and development of a next-generation fighter with advanced features including stealth,



alongside other senior officials from India and Russia watched the T-50 perform over Zhukovsky. The Indian version is to be a twin-seater unlike the Russian single seater. Although rain marred the display on the last day and the pilot had to make an emergency landing, this surely was the ‘shape of the future’.

Having flown most Russian fighter types and with 4500 flying hours under his belt, Chief Test Pilot Sergey L Bogdan

the form of the multi-national F-35. Then, Chinese have their stealth fighter J-20 whose public debut was in January 2011.

HAL Chairman Ashok Nayak stated that the “project (FGFA) was well on track” and that details on selection of the Indian systems would be finalised during the full-scale design review. India has committed \$ 295 million for the initial design phase which will extend over a period of 18 months.

In conversation with Sergei Krotkov, Director General RAC MiG



Speaking with *Vayu Aerospace Review* at MAKS, Director General of RAC MiG Sergei Krotkov and RAC MiG's Director for Marketing and Sales Col. Mikhail T Globenko answered questions relating to MiG-29K naval fighters for India as well as the MMRCA programme. They reiterated that "India is their most important foreign customer and would remain so for years to come."

The Indian Navy ordered 12 MiG-29Ks and four two-seat MiG-29KUBs in 2004 as a part of a \$ 1.5 billion deal including the refurbishment and purchase of aircraft carrier *Admiral Gorshkov*. As a follow on, in a deal estimated \$1.5 billion, India took the option of ordering 29 additional MiG-29s bringing the Indian Navy's total number to 45. According to Krotkov, "RAC MiG have now delivered 11 MiG-29K/KUBs and is planning to send the remaining 5 from the initial contract by the end of 2011". INS *Vikramaditya* is also expected to be commissioned by the end of next year.

Responding to the 'disqualification' of the MiG-35 from the Indian MMRCA shortlist, Krotkov stressed that "the MiG-35 would be the most cost-effective option" and also that "(MiG) had demonstrated Active Electronically Scanned Phased Array Radar (AESA) and scored a direct hit with the missile launched during evaluation trials". He further said that he respected India's decision regarding the MMRCA but development of the MiG-35 would continue. Significantly, the Russian Air Force has included the MiG-35 in its future procurement programme.

However the MiG-29 will long continue to fly in Indian Air Force colours. In 2008, the Indian Government signed a contract with RAC MiG for upgradation of 63 aircraft, worth \$ 960 billion. Six of these are being upgraded in Russia with the rest in India. The first test flight of the extensively upgraded MiG-29UPG took place on 4 February 2011 and is expected to finish flight trials and join service by the "end of 2011". The MiG-29UPG will include new slot-array Phazotron NIIR Zhuk-M2E radar and OLS-UEM optical sensor as well as a helmet-mounted sight and new avionics in the modern glass cockpit.



RAC MiG's Director for Marketing and Sales Col. Mikhail T. Globenko (left) and Director General of RAC MiG Sergei Krotkov (right)



Alexey Fedorov, President/Chairman of the Board, Irkut Corporation

The Sukhoi 'Super 30'



What has for some time been obliquely referred to as the Sukhoi 'Super 30' aircraft, was formally confirmed so by the Irkut Corporation at MAKS 2011 in August this year. According to the spokesman, the last batch of 40 Sukhoi Su-30MKIs on order for the IAF will be the first 'Super 30s', under which programme, the Indian Government has allocated close to US \$2.4 billion for 'deep modernisation' of the type. On 18 August 2010 Indian Defence Minister AK Antony stated at the Rajya Sabha that the current estimated cost for the upgrade programme is Rs 10,920 crores and that the aircraft are likely to be upgraded in a phased manner from 2012 onwards.

The overall Sukhoi Su-30 programme for India has incrementally grown in size and scope since the contract was originally formalised in 1996, when an order was placed for 40 Sukhoi Su-30MKIs. An interim batch of 18 Su-30Ks was received but these were eventually to be upgraded to the final standard even as new-build aircraft were received (in the event, these were left as is with the IAF and 18 new Su-30MKIs were delivered from Russia). With another

10 aircraft ordered (diverted from a cancelled Indonesian order), these first 50 aircraft were of varying standards, finally incorporating canards and AL-31FP engines, with thrust vectoring. The aircraft were systematically upgraded from the Su-30MKI Mk.I standard to Mk.II and finally the Mk.III which is the version currently produced under licence at HAL Nasik.

The first 50 Su-30MKIs from Russia were to be followed by 140-license built by Hindustan Aeronautics Limited and these have been supplemented by another 40 ordered in 2007 plus another 42 ordered in June 2010, making a total of 272 aircraft, arguably the largest number of any aircraft type ordered for the Indian Air Force in the past two decades.

By March 2011 HAL had reported by delivered 99 Su-30MKIs to the IAF which now has seven frontline squadrons operating the type. The HAL production will continue till completion of confirmed orders even as the last 42 would be of the 'Super 30' standard. As earlier reported, these will incorporate the new Phazotron Zhuk-AE Active Electronically Scanned Array (AESA) radar (also referred to as Irbis or 'snow leopard'), having a head on range-while-search in lookup mode

of 180-190km, new onboard mission computers, electronic warfare systems and an enhanced glass cockpit with smart multi function displays.

Amongst its suite of new generation weapons could be the Novator K-100 long range missile for air-air engagements and significantly, the air-launched BrahMos supersonic cruise missile, which at 2.5 tonnes, will require considerable modification to the airframe. It is learnt that two squadrons of Su-30s will have this capability.

According to Alexy Fedorov, President and Chairman of the Board, Irkut Corporation, the 'deep modernisation' will apply not only to the new aircraft under production or delivery but to those Su-30MKIs already in service with the IAF. The IAF's order of battle by 2016 will include 15 squadrons of the Su-30MKI/Super 30.

As an aside and for statistical record, a total of 205 MiG-21FLs were ordered or built for the Indian Air Force followed by 223 MiG-21M/MFs and then 295 MiG-21bis (125 of which were 'deep modernised' to become the MiG-21 Bison). With another 115 MiG-21U/UM tandem seating trainers received, this makes a total of 838 MiG-21s of all types received by the Indian Air Force.

POWER PERFORMERS

Irkut's MS-21 and Sukhoi's Superjet 100

On the civilian side, the Russian Technologies State Corporation, through its subsidiary Aviation Capital Services LLC leasing company, signed a contract with JSC IRKUT Corporation for the 50 MS-21 short/medium range airliners (to be delivered between 2017-2022) with options for 35 more. The contract was signed by the general director of Aviation Capital Services LLC Roman Pakhomov and by President of the JSC IRKUT Corporation Alexey Federov in the presence of Russian Prime Minister Vladimir Putin.

Irkut displayed a mock-up of their MS-21 that included the cockpit, a business-class cabin, representative length of an economy cabin and galley, along with the power circuit and the wing box. According to officials, "the MS-21's cabin design will raise passenger comfort in the economy class (where the seating is six abreast), close to business-class levels". The wings will have carbon fibre components, a first for Russia. The MS-21-300 and MS-21-200 airliners can seat



The Superjet 100



181 and 150 passengers in single class configuration respectively and airlines have a choice of either the PD-14 engine

by the JSC United engines Engineering Corporation, or the PW1400G from Pratt & Whitney, USA.

Eurocopter at MAKS

Eurocopter highlighted capabilities of its helicopter product line for the Russian and CIS market at MAKS 2011. Exhibiting with its parent company EADS, Eurocopter displayed scale models of the single-engine AS350 B3, along with the twin-engine EC135 and EC145, all of which have been ordered by customers in the region. Eurocopter holds 70% share of the overall share of the Russian and CIS marketplace for Western-supplied turbine-engine helicopters.

Russia's UTair Aviation currently operates the AS350 B3, AS355N and BO105 helicopters and will expand its fleet with the enhanced AS350 B3e version and the EC175 as launch customer. A training academy and certified maintenance centre are being located at UTair's engineering facility in Tyumen and is one of three such Russian operations qualified by Eurocopter.

Another Eurocopter customer in Russia is Gazpromavia, which is receiving eight EC135 helicopters equipped with Russian-built mission avionics from Transas Aviation. Also, three EC145s are operated by the Moscow Aviation Centre, which uses the helicopters for medical evacuation and emergency missions.



The AS350B3



The Sukhoi Super Jet 100 gained eventful exposure at MAKS 2011. This 100-seat regional jet was designed, developed and built by Sukhoi Civil Aircraft Company (SCAC), in partnership with Alenia Aeronautica opened its score with a contract valued at \$379.2 million when PT Sky Aviation (Indonesian regional aircraft) purchased 12 Sukhoi Superjet 100/95B aircraft with deliveries scheduled in 2012. SCAC has also signed a deal with JSC VEB-Leasing to purchase 24 SSJ100s for lease to UTair.



BrahMos Aerospace establishes 'Centre of Excellence'

On 16 August, the first day of MAKS, BrahMos Aerospace signed a MoU with the Moscow Aviation Institute (MAI) and NPO Mashinostroyeniya (NPOM) Corporation to establish a 'Centre of Excellence' for High Speed Aerodynamics. Marking 10th anniversary of first launch of its missile BrahMos has signed a similar MoU with the Indian Institute of Science (IISc). "Brahmos will initially fund \$1 million

each to IISc and MAI. It will step up the funding contingent to the progress achieved by both institutes who would be closely cooperating on the project. There will be an exchange of scientists and engineers between IISc and MAI and the intellectual property of the research will be the property of BrahMos". The agreement was signed by Brahmos CEO Dr. Shivathanu Pillai, MAI Director Prof. Gerashenko Anatoly and Furshenko

Andrei, Russia's Minister for Science and Technology.

Russian Prime Minister Vladimir Putin visited the BrahMos pavilion on 17 August and wished the Joint Venture much success in all its endeavours. He added "BrahMos is a brilliant example of international defence cooperation". On display outdoors was a full-size mock-up of the air-launched BrahMos cruise missile to be carried by Sukhoi Su-30s.

10 Sukhoi Superjet 100/95LR aircraft will upgrade the Gazpromavia fleet.

The SSJ 100 made its first flight on 19 May 2008 and received type certification from IAC AR (Russian Certification Authority) in February 2011. On 19 April 2011, the first production aircraft was delivered to Armavia. The first SSJ100 aircraft in Aeroflot colours began commercial operation on 16 June 2011 with a second on 26 August 2011. Flying low level during its display at MAKS 2011 this new airliner is predicted to leave its mark in the civilian market!

The VIP version of the Sukhoi Superjet by the SCAC found some buyers as India's Aviotech signed a MoU for the purchase of ten Sukhoi Business Jets (SBJ) with an option of ten more.

CFM International maintains strong presence in Russia

CFM International continues to maintain a strong leadership position within the Commonwealth of Independent States with CFM56 engines powering more than 300 single-aisle aircraft for 24 airlines throughout the region. "We have great relationships with all the airlines in the region and look forward to strengthening them even further in the future," said Lionel Gobert, Vice President of International Sales for CFM International. "By 2013, we will have approximately 900 CFM56 engines in the region and we expect that number to grow to more than 1,200 by 2016, more than any other Western engine manufacturer." All CFM56 engines being delivered in the CIS region today are either the CFM56-5B or CFM56-7BE configuration, both of which, offer airlines "significant benefits".

The RS Alliance

Rosoboronexport - company of Rostekhnologii group - ZAO ITT Inertial Technologies of Technokomplex, and Sagem (Safran group) announced creation of the joint venture 'RS Alliance' at MAKS 2011. The joint venture has been formed primarily to manufacture the new fifth-generation LINS-100RS inertial navigation system which is designed to provide military aircraft with high precision navigation capabilities. This joint venture would be based in Russia and operate under the Russian law.

The Russian Helicopter Day



New variant of the Mi-26, the 'T2' on display at Zhukovsky.

‘Russian Helicopter Day’ was celebrated on the very first day of MAKS 2011. Russian Helicopters, the industry holding and a subsidiary of UIC Oboronprom, showcased their diverse range including the Mi-34C1, Ka-226T, Mi-38 and Mi-26T2 on static as well in spirited flying displays.

The new light Mi-34C1 helicopter is intended for civil and military pilot training and expected to enter the market as a cost-effective option. Certification of the Mi-34C1 is expected in late 2011 and serial production of the light helicopter is slated to start with Arsenyev Aviation Company Progress in 2012.

Also seen at MAKS 2011 was the light coaxial Ka-226T helicopter with a medical module of U.S. origin. The new Ka-226T variant was developed by Russian Helicopters to enhance the emergency medical air evacuation capabilities of services that are displaying interest in this model alongside Russian insurance companies that are interested in helicopter ambulances within life insurance services. This medevac helicopter is equipped with two Turbomeca Arrius 2G turboshafts, the first time these French engines are installed on a coaxial-rotor machine.

Two prototypes of the new passenger and cargo Mi-38 were showcased at static as well as flying displays: OP-1 with TV7-117V engines and OP-2 with Pratt & Whitney engines. Certification of this helicopter is scheduled in 2014.

The world’s heaviest helicopter, Mi-26T2, which is currently conducting developmental test flights, was at MAKS 2011 too. The helicopter is fitted with a modern BREO-26 avionics suite designed

by the Ramenskoye Design Company, the glass cockpit having five multi-functional LCDs that can display a coloured image of external loads, a new digital autopilot and a new navigation system. The helicopter is also fitted with an additional Tranzas TSL-1600 light to visually control external loads at night and capable both of standard and IR lighting to be used in combination with night vision goggles. The Mi-26T2 is powered by D-136-2 engines.



The Mil Mi-28NE Night Hunter, on offer to India.

Internationally Competitive



Borey-class nuclear submarine

VAYU Interview with **Andrei Dyachkov,** **General Director, Central** **Design Bureau for Marine** **Engineering “Rubin”**



Andrei Dyachkov, General Director,
Central Design Bureau for Marine
Engineering (JSC CDB ME Rubin)

Rubin is well known in India as developer of the Project 877EKM vessels forming the backbone of the Indian Navy’s submarine fleet. Headquartered in St. Petersburg, the company not only develops nuclear and conventional submarines, it also carries out exploration of oil and natural gas fields in ocean shelf areas. Over 950 submarines have been built to Rubin designs including nuclear-powered underwater cruisers armed with intercontinental ballistic missiles such as Projects 667 and 941 which form the core of the Russian nuclear deterrent force. **Vayu** interviewed Andrei Dyachkov, General Director, Central Design Bureau for Marine Engineering “Rubin” who shared his views on the company’s prospects in the Indian and global markets.

VAYU : Rubin is widely known as a manufacturer of ballistic-missile-carrying submarines and diesel-powered submarines which are of two very different kind. How does this

facilitate transfer of technology and other interactions between both?

Dyachkov: Rubin develops both nuclear-powered and non-nuclear submarines and this gives it a huge advantage over companies that work in only one of the two areas. The weapon and propulsion systems aside, the basic ship-building principles for submarines remain the same whether powered by nuclear or non-nuclear fuel. Working simultaneously in the two fields, gives Rubin immense possibility to apply newly developed technologies for either types.

To elucidate on this: nuclear-powered submarines are widely known for their ability to stay submerged for longer periods. Engineers from Rubin have developed practical engineering solutions to enable this aspect and time tested it on the nuclear submarines. In this scenario, the issue of life-support of submarine crews demanded a lot of time and effort. In particular, Rubin developed and perfected systems for electro-chemical generation of oxygen for breathing. Today, non-nuclear submarines

are also required to stay underwater for long periods which mandate proper life-support systems for the crew.

This is just an example of technical aspects. In another sphere, design houses do not always have a stable workload whether in Russia or in other parts of the world there are always peaks and troughs in orders for development of new submarines. As a rule, the design cycle commences with the preparation of a draft design and concept of a ship to meet new requirements set by the defence ministry of the buyer’s home country. This is followed by the documentation phase, lead vessel construction, manufacturer and customer acceptance trials and only after this a newly-built ship goes into service. This whole cycle takes around 30-35 years. Hence, the gap between the construction of new ships is a long one and there is a pause in development as there is no requirement for submarines ‘better’ than the existing ones.

By combining the development of both nuclear and non-nuclear submarines, Rubin enjoys the option of optimising workload by ‘distributing’ development cycles over a period of time as there is always a requirement for new design and technical solutions. This is a big plus in the current global situation as funding for new designs gets tighter owing to the worldwide economic downturn. This chain continues each time and although certain technical solutions and hardware differ for nuclear and non-nuclear submarines, they have many things in common.



Project 949A submarine.

VAYU : Which are the most important programmes for Rubin presently and the challenges faced by the enterprise today?

Dyachkov: Our most advanced products are the *Borey*-class nuclear underwater cruiser and the *Lada*-class conventional submarine (the export version is the *Amur 1650*). Both types are included in the government programme for development of the Russian Navy up to 2020. We are proud to be a long-standing supplier of the Russian Navy.

The last two decades have been important ones as the destiny of the Russian Navy and Russian shipbuilding industry was being decided among other reforms. Thanks to key decisions made by the Russian government, such as those in favour of the *Borey*-class submarines, this huge industry and its suppliers were allocated state funding and given new challenging tasks. This support has enabled us to stay in business, to complete development and construction of new naval equipment and systems, keep our skilled employees in place and create jobs for the younger generation of Russian shipbuilders. The importance of this can hardly be overstressed considering the complexity of submarine development and construction.

VAYU : Your enterprise carries out various projects on exploration of oil and natural gas fields in ocean shelf areas. Why did the famous submarine developer commit to such sort of work?

Dyachkov: Commencing work on the sea platforms and, more generally, Rubin's decision to enter the market for exploration of oil and gas fields in the shelf areas was caused by our company's new strategy for further development. The management determined three major directions that would allow Rubin to stay afloat and ensure stability as an industrial enterprise: first the development of nuclear and non-nuclear submarines for the Russian Navy, then military technical cooperation with foreign countries and active sales promotion of ships for the global market and finally, development of complex equipment for oil and natural gas fields in the shelf areas.

When we started working in the third direction, we understood pretty well that this area was heavily competitive. Rubin designers and engineers had to master brand-new technologies such as computer-aided design, manufacturing and engineering (CAD/CAM/CAE), 3D-modelling, etc and a special structure had to be established within the enterprise for training, re-training and improving skills in the most advanced computer-aided technologies. Besides, we had to get acquainted with and master the respective standards, which were different to those we were used to in our work on submarines.

The 3-D modeling skills acquired are now most helpful on submarine development. The boost that we gave ourselves by entering into a highly-competitive market is now paying off. Initially, Rubin acted as a subcontractor

to well-known western companies. The most important project so far has been the *Prirazlomnoye* platform which was installed in early September 2011. Rubin took part in the design work on this platform. Besides, we were also involved with *Shtokman*, *Sakhalin* and other projects on exploration for natural resources.

In February 2011, Rubin came first in the competition launched by Gazprom on development of a helicopter platform able to operate in heavy ice conditions. Rubin is the head enterprise on this project.

VAYU : The most popular design is the Kilo-class (Project 877, 636 and their variants). Although it has been around for a while, the 'Kilo' continues in production and generates new sales including recent Vietnamese and Algerian orders. Even the Russian MoD is procuring a few Project 636(mod) submarines. Why so when Rubin makes the more advanced Project 677?

Dyachkov: It is true that even today the Kilo-class remains a very good option and generates export sales. As you probably know, the Project 877EKM gave way to the more advanced Project 636, which was a next step in development of the Rubin diesel submarines. Permission to export an improved version of the baseline ship armed with the Club-S weapons system was a big leap in our competitiveness in the international market.

The very fact that the Russian-made submarines come equipped with the

Club-S missile system is completely in line with maritime doctrines of the purchasing nations, specifically non-nuclear submarines with universal weapon systems which can defend the coastline from enemy surface and submarine forces and if necessary, can also mount strikes on enemy coastal targets. Presently, none of the European nations offer submarines with a powerful missile system able to commit land strikes. Although development of such systems is on-going, the issue of exporting them is a complex matter as it involves technical and political interaction.

For well-known reasons the Russian Navy did not order diesel submarines in large quantities following breakup of the Soviet Union but this seems to be changing. The MoD set before us a task to design and build a series of non-nuclear submarines in the shortest time possible. We found we could fulfill this task only by means of launching construction of well-proved Project 636 submarines with serious upgradation. Since these new submarines are intended not for export, the communications and information-control systems have been changed accordingly, the torpedo and missile systems altered as international treaties on non-proliferation of missile technologies are no longer applicable. Admiralty Shipyards are initiating construction operations of the Project 636 submarines.

Rubin is also working on the more advanced Lada and its export version, the Amur 1650. This product is available for export from the Rosoboronexport state arms trade agency. The decision for development of Rubin's fourth generation non-nuclear submarine was made in the 1990s when there was transition from the command to market driven economy. Anyway, during the Lada development phase, more than 200 scientific research and experimental hardware contracts were fulfilled, leading to creation of principally new pieces of equipment. The head vessel 'Saint-Petersburg' came into being and underwent acceptance trials. The submarine was commissioned and went into service with the Russian Navy in 2010. We continue to improve the Lada in a belief this is a very promising product and that it will take a prominent place in the arsenals of the navy of our own and our overseas customers.

VAYU : Indo-Russian military and technical cooperation has been in existence more than half-a-century. What has been the impact of this cooperation on the Indian Navy?

Dyachkov: Let me start with an observation that India was the first overseas customer for whom the Russian shipyards manufactured customised warships of special exportable designs. By that time the Soviet Union had exported only "factory standards", and had been the very same ships as those our shipyards made for the Soviet navy or the ships previously operated by the navy of our own and at some point of their service cleared for export. During the fifty years since our military technical cooperation began, the Soviet Union (and then Russia) became the main supplier of warships and naval hardware technologies to the Indian Navy.

Touching on the matter of cooperation between the Rubin and India, I can say the following: in the 1986-2000 timeframe India took delivery of ten Project 877EKM diesel-powered submarines. They were built in Russia to the documentation prepared by the Rubin design bureau. Purchase of those vessels carried special significance: India decisively became the largest export customer for Russian submarines. The last of submarines in this batch, the *Sindhushastra*, was built to an improved design, the Project 08773, and became the first ship armed with the Club-S missile system. Starting in 2000, all other Indian navy submarines of the Project 877EKM have been undergoing midlife upgrades in Russia (at the Admiralty Shipyards and, later, the *Zvezdochka*) and getting armed with the Club-S in the process.

Another milestone in the Indo-Russian relationship in the new century is the contract for rework of the ex-Russian navy heavy aircraft carrying cruiser, the *Admiral Gorshkov* into a STOBAR through-deck aircraft carrier. After this rebuilt, the ship will join the Indian Navy under the name of *Vikramaditya*. The respective contact is being materialised by the Sevmash company. All this gives ground to assert that the Indo-Russian military technical cooperation has strong foundations and a huge potential in many naval applications.

VAYU : The Amur-1650 armed with the BrahMos missile is understood to be offered to India in case a new tender for non-nuclear submarines is initiated. The previous project went to France with the Scorpene proposed. What should Russia and Rubin in particular do so as to regain its position in the Indian market?

Dyachkov: We are well aware of the Indian Government's policy on diversification of its weapons procurement and treat this with respect. Russia cannot pretend to have any kind of monopoly in the Indian market. Obviously, India looks for the best options available and would purchase only that equipment which is internationally competitive and can be manufactured in India under license. The Russian side intends to participate in the international tenders initiated by the Indian government and offer the most competitive products on favourable terms. Rosoboronexport state export agency is bidding in a number of such tenders already.

On a number of occasions, Indian defence ministry officials have spoken of a requirement of non-nuclear submarines. Such statements were initially heard in the late 1990s, when, in parallel to negotiations with France, India discussed with Russia, possible licence production of the *Amur-1650* submarines. One of the conditions put forth by the Indian side was that the submarine must have air-independent propulsion (AIP). Rubin is developing a system with an electrochemical generator for both the newly built and in-service submarines for upgradation. Hydrogen is generated on-board the submarine through reformation of the diesel fuel. This solution is bench-tested using an experimental power unit. From a ship designer's point of view, the AIP will be confined to some blocks in the modules compartment. This will not entail considerable re-development nor any sort of serious revision of a classic submarine layout. The difference will be confined to insertion of an additional compartment.

When it comes to selection of a suitable submarine design, the customer normally wants to assess not just components but the whole submarine from an overall efficiency and lethality point of view. Recently, we discussed this with the Indian Naval Chief Admiral Nirmal Verma during his visit to Russia and stressed that the Amur-1650

RUBIN

offers a considerable advantage. Our submarine comes equipped with very powerful weapons system that can fire advanced anti-ship missiles, even in salvo. Besides, it can handle numerous functions for a non-nuclear submarine such as targeting ground targets with long-range cruise missiles launched from underwater mode. Such missiles and technologies are available only from Russia. Our nations have joined forces on development of the BrahMos supersonic cruise missile. Reportedly, this weapon shall also be capable of underwater launches. Speaking to the media at the MAKS air show on 16 August, 2011 Chief Executive Officer of BrahMos Aerospace Dr. Sivathanu Pillai announced that first launch of the BrahMos missile from a submarine was being planned for later this year. It makes sense to equip the Indian Navy's submarines with this weapon in the future.

VAYU: Six Scorpene-class submarines are under construction in India. Are Russian companies, Rubin in particular, ready to make similar number of submarines in India should Russia win the new tender?

Dyachkov: Needless to say that the Russian side, namely Rosoboronekspert state arms export agency which bids in the international tenders, tries to completely meet customer requirements and wishes. We were shown some possible schemes under which four submarines were to be constructed in India and two at the manufacturer's own shipyards in their home country. There is another possible option of constructing four

submarines at Indian government shipyards and two at privately held facilities. We are ready to assist the Indian shipbuilders in case they will undertake license production of the Amur 1650.

VAYU: When Russia first began making submarines a century ago, the international community referred to them as 'submarines of the Russian type'. The Soviet Union developed and built submarines of very special and unusual designs armed with heavyweight anti-ship cruise missiles nicknamed 'carrier-killers'. Can we speak of 'the submarine of the Russian type' today?

Dyachkov: The current state of science and technology development does not allow global differences. By outward appearances, submarines developed in different countries do not differ much. The laws of hydrodynamics and the achieved level of scientific and technological base pre-determine many technical solutions in modern submarine designs, regardless of country of origin.

As for the term 'submarines of the Russian type', I can say that during World War II the US Navy launched and built powerful aircraft carrier groups. Consequently, our task for various solutions was to create the means to counter those groups. As a result, a number of remarkable submarine designs came into being including the Project 949A which is operational till today. One peculiarity now is that a nuclear-powered strike submarine is not as

narrowly specialised as it used to be. Development of missiles has reached a point which enables the submarine to strike at various targets, including enemy ships and coastal installations and do so at stand-off ranges. Recent military campaigns, including those in Iraq and Libya, have demonstrated high efficiency of nuclear-powered strike submarines employed on land-strike missions.

VAYU: We understand that Admiralty Shipyards will have to move out of St. Petersburg as the city expansion forces large shipbuilding enterprises to do so. Where will the Rubin-designed diesel submarines be constructed?

Dyachkov: The Admiralty Shipyards will be moving to a new site on the island of Kotlin, situated fairly close to St. Petersburg. The United Shipbuilding Corporation (OSK, a large government-held holding structure controlling most of the Russian shipbuilding industry) is preparing timetables of the move so that all contractual obligations of the Russian submarine builders are met. Moving the Admiralty Shipyards to the new site will be timed so as to provide smooth transition and fit in the current and future plans of construction of new non-nuclear submarines. Besides, another company, Sevmash in Severodvinsk, has amassed considerable experience in building various submarines and so, in case the Admiralty Shipyards get loaded to capacity with orders, there is always a possibility to place additional orders with Sevmash.

(All photos courtesy Rubin's PR Department)



Project 949A submarine

The cutting edge



Rafael's Air Warfare Systems

Pair of Israeli F-16s equipped with Python 5s

Rafael's air warfare systems are considered as amongst the best in the world. The airborne missile systems include active-radar as well as full-sphere IIR air-to-air missiles for short-to-beyond

visual range threats (Python-5 and Derby). Its array of air-to-surface missiles (SPICE 1000 and 2000) includes stand-off weapons and precision-guided ammunition kits for use against high-value

ground targets. Rafael's electro-optic targeting and navigation pod (Litening) is the most widely used pod in the world and its unique airborne reconnaissance pod (Reccelite) is known for its ability to shorten the sensor-to-shooter cycle. Rafael's airborne communication systems include ROIP voice communication solutions, data links and wireless networks for full connectivity on all levels. Rafael also offers advanced airborne electronic warfare products including support jammers, RWR, ESM, ELINT and ECM systems.

The Python-5 is a fifth generation air-to-air missile that provides the pilot engaging an enemy aircraft with full sphere launch capability. The missile can be launched from very short to beyond-visual ranges with greater kill probability, excellent resistance to countermeasures, irrespective of evasive target manoeuvres or deployment of countermeasures. Python-5 combines advanced new technologies with operationally proven Python-4 components. The missile incorporates a new dual



The Spice weapon system



Israeli F-16 with the Spice

waveband imaging seeker, advanced computer architecture, Inertial Navigation System (INS), sophisticated Infra-Red Counter-Counter-Measures (IRCCM) and sophisticated flight control algorithms. The Python-5 maintains Python-4's unique aerodynamic airframe, INS, powerful rocket motor, warhead and proximity fuze.

The Derby is an active radar air-to-air missile that provides fighter aircraft with performance in both short ranges and Beyond Visual Range (BVR) intercepts. The missile enables operational flexibility and multi-shot capability and can be launched at an enemy aircraft by day or night and in all-weather conditions. Additional Derby capabilities include look-down/shoot-down, sophisticated fire and forget mode and an advanced ECCM tailored to the customer's operational requirements. Derby's light weight allows it to be adapted to various modern fighter aircraft, including the F-5, Mirage 2000 and F-16.

The Spice stand-off, autonomous, air-to-ground weapon system impacts on and destroys targets with pinpoint accuracy and at high attack volumes. Spice is in service with the Israeli Air Force and under contract with several international customers.

The Spice guidance kit can be mounted on general purpose and penetration warheads: Spice-1000 for 1000 lb warheads such as Mk-83/RAP1000/BLU-110 and Spice-2000 for 2000 lb warheads such as Mk-84/RAP2000/BLU-109. Spice-2000 achieves a stand-off range of

over 60 kilometers. Spice-1000 achieves an even greater range, owing to its unique deployable wings. The weapon uses state-of-the-art navigation, guidance and homing techniques to achieve effective

destruction of targets with a CEP of better than 3 meters.

The Spice-2000, and especially the Spice-1000 with its deployable wings, are easily integrated onto a wide range of single and dual-seat fighter aircraft, and requires no aircraft modifications. The Spice achieves high serviceability with a low life cycle cost and its simple operation and dedicated Mission Planning System requires only basic aircrew training.

The RecceLite is a self-contained self-cooled multi-sensor tactical reconnaissance system, consisting of an airborne pod based on the Litening Targeting and Navigation Pod and a ground exploitation station. The RecceLite simultaneously collects Infra-Red (IR) and Visual (VIS and near IR) digital images within a very wide field of regard, in accordance with an automatic mission plan and/or manual operation.



Elements of the RecceLite System : Pod, Ground Exploitation Station and Data Link

Rafael had featured its families of air-to-air systems, such as the Python-5 and Derby missiles at Aero India 2011 as well as the Spice stand-off, autonomous, long range, guided air-to-ground missile. In addition, Rafael displayed its Litening and RecceLite Pods for target acquisition and reconnaissance. Some of these systems are reportedly in service with the Indian Air Force and Indian Navy.



RecceLite Line of Sight Capabilities : Full spherical coverage, any ROI shape, stabilised motion-compensated image

The images and the data annotation are recorded on a solid state recorder and transmitted to the exploitation station via the RecceLite data link. The images are then interpreted at the ground exploitation station.

The RecceLite has been chosen by the Israeli, Netherlands, Italian, German, Spanish, Indian, Brazilian and the Colombian Air Forces and is currently being used for variety of operational needs. The RecceLite concept is completely innovative, and is changing the way in which reconnaissance would

be carried out. The concept comprises a single pod system, with a single sensors payload having sensors in both IR (infrared) and VIS (visual and near infrared) wavebands, with the capability to direct the line of sight of all sensors towards any direction in space (excluding aircraft obscurations).

Building upon these features and capabilities, RecceLite can perform low, medium and high altitude missions, at tactical or standoff ranges, simultaneously in IR, VIS and NIR (Near IR) wavebands, during the same

mission, with a single pod, and without replacing the sensors suite.

The mission planner or operator does not need to sacrifice resolution for coverage or vice versa, as is the case in conventional reconnaissance systems. By using the spot or area mode, the mission planner or operator can dwell on a high-value target area for as long as required and gather images at the best resolution in both IR and VIS. The IR and VIS sensors have comparable high resolution.

The Litening is a combat-proven multi-spectral airborne targeting and navigation pod, designed for navigation and target illumination to improve day and night attack capabilities. Litening presents pilots with real-time, Forward Looking Infra-Red (FLIR) and Charge Coupled Device (CCD) imagery. The high sensor resolution enables pilots to reliably identify the combat objects and consequently to avoid collateral damage fully operational 24 hours a day and in adverse weather conditions. The sensors are incorporated in a single pod and provide fighter aircrew with the flexibility to perform multiple missions/tasks including laser spot detection enabling co-operative missions with target hand-over, laser marking for co-operative missions with Night Vision Goggles (NVG), performance of low level night flights (navigation), EO Point and Area Tracker and Inertial Tracker, and identification of aerial targets from Beyond Visual (BV) ranges.



Litening pod on F-16

The Global UAV Market in 2011-2021



The EADS Talarion

Demand for advanced technology UAVs

The global unmanned aerial vehicle (UAV) market remains dominated by North America, with the United States of America being the largest defence spender in the world. Europe is enhancing its UAV industry through regular funding and development programmes, while Asia-Pacific, the third-largest market, also offers a potentially attractive investment opportunity for the future.

UAVs are the next generation of aerial platforms to be deployed by armed forces around the world. Demand for UAVs has been enhanced with the successful deployment of these systems in combat operations in Iraq and Afghanistan, these unmanned platforms being used as force multipliers, performing intelligence, surveillance and reconnaissance (ISR) missions, target recognition, damage assessment and electronic warfare. Increasing number of countries are investing in this capability. Mini and VTOL UAVs are also affordable and capable of performing ISR missions and demand for these cost-effective UAVs is rising in countries with limited spending power.

Elbit to supply Hermes 900 UAS

Elbit Systems Ltd has been awarded a contract to supply a Latin American country with Hermes 900 Unmanned Aircraft Systems (UAS), which will also include complementing ground control stations, as well as Elbit Systems Electro-optics DCoMPASS payload and radar systems. Hermes 900 builds upon the vast operational experience of the Hermes 450, backbone of the Israel Defence Forces' UAS fleet. Hermes 900 offers enhanced capabilities, from higher flight altitude (over 30,000 ft) to longer endurance and larger payload capacity. The system's unique multipurpose payload bay enables it to carry a wide variety of payloads of different shapes and sizes to enable quick "conversion" between various payload configurations.



The deployment of US forces across the globe has resulted in strong demand for medium-altitude, long-endurance (MALE) UAVs. Expenditure on high-altitude, long-endurance (HALE) UAVs is expected to be the second-highest, constituting around 31% of the market. The recent successes of unmanned drones in combat operations over Afghanistan and Iraq, and the multi-role capabilities and advantages that an unmanned combat aircraft could bring to a battlefield are also encouraging the US to spend increasingly on unmanned combat air vehicles (UCAVs).

Demand for UAVs in Europe has also increased during the last decade as several European nations have participated in the wars in Iraq and Afghanistan as part of the International Security Assistance Force (ISAF) and in various peacekeeping operations carried out by the EU, UN and NATO. The successful use of UAVs by the US and Israel in these operations has underlined the importance of UAVs to European nations, who have partnered with the US and Israel in programmes such as the Euro Hawk and Harfang to develop local UAV development and manufacturing capabilities.

Security threats posed by cross-border insurgents, illegal immigrants, pirates, hostile nations and terrorist organisations such as al-Qaeda and Jemaah Islamiah (JI) have enhanced the need for defence systems capable of carrying out surveillance and intelligence gathering missions. UAVs provide enhanced coverage along remote sections of a country's border, while UAVs equipped with electro-optical (EO) sensors can identify images from an altitude of 60,000 feet and provide real-time imagery to a ground control operator, who can then make fast, informed decisions regarding deployment of border patrol forces. UAVs also have a higher probability of tracking illegal immigrants seeking to enter a country through dense forests or mountainous terrain.

An increasing number of countries are developing UAVs to meet their own defence needs or for export to the global defence market. Capabilities include relatively low-cost enhanced intelligence, surveillance and reconnaissance (ISR), electronic attack (EA), strike missions,

First Euro Hawk in Germany

Euro Hawk, the first high-altitude, long-endurance (HALE), signals intelligence (SIGINT) unmanned aircraft system (UAS) based on the RQ-4 Global Hawk produced by Northrop Grumman for the German Bundeswehr, has touched down in Manching, Germany. The system had taken off on 20 July from Edwards Air Force Base, California and landed at the Manching Air Base the next day. The UAS will carry a new SIGINT mission system developed by EADS Deutschland GmbH (Cassidian) and integrated in Manching, Germany. Delivery of the first demonstrator to the Bundeswehr is scheduled for mid-2012, with another four systems scheduled tentatively between 2015 and 2017. EuroHawk GmbH, a 50-50 joint venture of Northrop Grumman and EADS Deutschland GmbH (Cassidian), serves as the national prime contractor for the German Ministry of Defence through the system's entire lifecycle.



IAI Heron contract extended



Australian Minister for Defence Materiel Jason Clare has announced extension of the contract to provide Heron to Australian forces in Afghanistan till the end of 2012. The Heron provides aerial support and surveillance in support of Australian and coalition operations in Afghanistan.

suppression/destruction of enemy air defence (SEAD/DEAD), network nodes, communications relays and combat search and rescue (CSAR). UAVs have high endurance levels and modern UAVs such as the ScanEagle are equipped with synthetic aperture radar (SAR) which can pick out objects not readily visible to infrared (IR) or EO cameras.

Laser-powered UAVs are innovatively powered by a laser transmitter which converts power from a primary source, such as a battery, generator or AC powerline, into a single-wavelength beam of light. These UAVs are capable of staying airborne for their entire lifecycle as this method of recharging avoids the need to land and refuel, which may also improve the lifecycle and maintenance costs.

The UAV market will undoubtedly be buoyed in coming years by the growing interest for civilian usage. Possible civilian UAV applications include law enforcement, traffic control tasks, aerial photography, fire fighting, for scientific research, environmental monitoring, energy and electrical facility monitoring and coast guard support.

There literally are hundreds of different UAVs now in production or undergoing development, ranging from small bird-like nano and micro air vehicles up to fully stealth strike aircraft. The latest edition of the *International Military and Civilian Unmanned Aerial Vehicle Survey*, published in April 2011, provides an invaluable and unique independent assessment of the current UAV market, focusing on the operators, manufacturers and requirements in 57 countries and is packed with details of more than 610 UAVs available for military and civilian use. It also provides a fascinating insight into programmes and UAVs in less known countries developing these systems including China and Iran.

USS 'Halyburton' and embarked Fire Scout UAVs complete deployment

The USS *Halyburton* (FFG 40), its two Fire Scout unmanned aerial vehicles and Helicopter Anti-Submarine Squadron Light 42, Det.2, returned to Naval Station Mayport on 3 August, completing a seven-month deployment. During its deployment, the *Halyburton* operated under Combined Task Force 508 along with with USS *Bainbridge* (DDG 96) and other partner nations in both the 5th and 6th Fleet areas of responsibility. The *Halyburton* team crew performed tasks under NATO Maritime Group 2, conducted numerous counter-piracy operations in the Gulf of Aden and conducted intelligence, surveillance, and reconnaissance (ISR) missions in support of Operation *Unified Protector*, employing the MQ-8B Fire Scouts. MQ-8B operators pushed the unmanned helicopter to its operational limits, setting records for maximum altitude, range, and endurance. More than one thousand deployment flight hours were recorded, with 438 hours flown by the Fire Scout.



Global Hawk completes full system flight with MP-RTIP sensor



Northrop Grumman's RQ-4B Block 40 Global Hawk unmanned aircraft system (UAS) has completed its first full system flight with the high performance AN/ZPY-2, also referred to as the *Multi-Platform Radar Technology Insertion Programme* (MP-RTIP) sensor. This is a first for the fleet of Block 40 Global Hawks that will be delivered to the UAS' main operating base at Grand Forks Air Force Base, N.D. The MP-RTIP-equipped Block 40 Global Hawk provides capabilities for both military and domestic applications. Flying at altitudes up to 60,000 feet for more than 32 hours per sortie at speeds approaching 340 knots, the Block 40 Global Hawk provides persistent coverage through all types of weather, day or night, thereby providing vital near real-time imagery to the operations director.

IAI Malat unveils its GHOST

Israel Aerospace Industries (IAI) has unveiled the GHOST, an innovative, small hovering unmanned platform. GHOST weighs approximately 4 kg (9 lbs), and provides real-time intelligence to ground forces operating in urban areas. It is equipped with an automatic vertical takeoff and landing system and can loiter for up to 30 minutes. The system was designed with twin rotary electrical engines for silent support on day and night special operation missions. The unique man-machine interface and operational concept is based on the principles behind computer



games and makes the system extremely intuitive to operate and requires little training. The entire system can be carried in backpacks by two soldiers and includes two platforms, batteries, and a command and control unit with communications. GHOST is suitable for paramilitary and homeland security applications due to its simplicity and ease of operation.



Lockheed Martin's Samarai Flyer

Inspired by a maple seed, Lockheed Martin's Samarai handheld vehicle has been made public. Weighing less than half a pound, Samarai demonstrated vertical takeoff and landing, stable hover, and on-board video streaming. While the aircraft flew a series of flights in the roughly 40 foot test area, it streamed live video from a camera that rotated around its centre providing a 360 degree view without a gimbal.

Samarai is mechanically simple with only two moving parts. Because it is 16 inches long and weighs less than half a pound, an operator can easily carry the vehicle in a backpack and launch it from the ground or like a boomerang. The design is scalable to meet different missions, including surveillance and reconnaissance and payload delivery.



The Blue Devil Block II programme

Rockwell Collins is playing a key role in the U.S. Air Force *Blue Devil* Block II unmanned aerial system (UAS) by providing a full suite of systems that will enable the 335-foot-long airship to provide persistent surveillance. The U.S. Air Force awarded the \$86.2 million *Blue Devil* Block II development contract to MAV6, a defence technology company, who chose Rockwell Collins to equip the airship with a flight control system, vehicle control system and radios. In addition, Rockwell Collins'



networking solutions will provide real-time, 'ad hoc' communications capability for the programme. Rockwell Collins will also provide the ground control

station leveraging capabilities from the company's Simulation & Training Solutions business for the *Blue Devil* Block II.

Building on Relationships

VAYU interview with **Mr Alexander Mueller,** **Managing Director,** **RUAG Aerospace Services,** **Germany.**



VAYU : Congratulations on your assuming the position of Managing Director RUAG Aerospace Services. Would you care to inform our readers of your multi faceted experience in the industry ?

AM : Well, thanks a lot. I have started my professional career in the German Army where I did my studies in aeronautics at the Federal Armed Forces' University in Munich. During my time as an Army Officer, I have spent 5 years in Paris working for the multinational armament procurement agency OCCAR on Franco-German and Franco-German-British armament programmes. Having served 12 years in the German Army, I eventually left the German Official Services and joined Eurocopter beginning 2001. Working as Commercial Manager, I had the pleasure to support the EC145's launching customer, the French 'Sécurité Civile' and 'Gendarmerie Nationale', during the introduction into service of this helicopter. In 2003 I took the position of Engineering Director for one of two Eurocopter maintenance sites in Germany, before joining Australian Aerospace in 2005 to lead the Australian NH90 Programme as well as the Aussie Tiger Programme including the respective final assembly lines. I returned to Germany in 2008 to take responsibility of all German based maintenance facilities of Eurocopter. In

2010, I joined RUAG Aerospace Services to become its Managing Director.

VAYU : A brief please on the RUAG Group, its increased focus on the international market and particularly in the aviation sector.

AM : RUAG is an international Technology Group for Aerospace and Defence with more than 7,700 employees all around the world. The group's holding company is located in Switzerland and it has production sites in Switzerland, Germany, Austria, Hungary, Sweden and the USA. The annual turnover in 2010 was in excess of 1,5 billion Euros. The RUAG Group is organised in five divisions: RUAG Space, RUAG Defence, RUAG Technology, RUAG Ammotec and RUAG Aviation, whereas RUAG

Aerospace Services in Oberpfaffenhofen, Germany, belongs to the latter division.

RUAG Aerospace Services Ltd is one successor company of Dornier which went into receivership in 2002. Being a 100% subsidiary of the Swiss RUAG Aviation, our esteem is to combine 'Swiss precision' with 'Made-in-Germany' to support world wide customers to highest standards possible.

VAYU : Which are the areas that RUAG Aviation have concentrated on and does the core business of MROs still remain priority? Kindly give examples of recent programmes including those in Switzerland and abroad.

AM : RUAG Aviation's core competences are in military aviation and civil aviation. The majority of our



The RUAG Do-228NG.



German Air Force Alpha jet

current military programmes are support arrangements with the Swiss or German government customers as well as with other international customers. RUAG' activities are based on integral service programmes for the Swiss Forces' Super Puma, F/A-18, F-5 and EC635 as well as of the repair and overhaul of selected respective components. In Germany, RUAG has built and is supporting the UH-1D helicopters of the German forces – a contract that we hold for more than 40 years now. This demonstrates our commitment and how highly regarded our services are to the German government customer.

Further, RUAG is together with Dassault Systems Type Certificate Holder of the Alpha Jet, a light trainer and fighter aircraft that was developed and built by Dornier and Dassault in the 1970s. We delivered up to 5 Alpha Jets per month to the German Air Force. This aircraft is not in production anymore, but will continue to fly until 2025 and we have the pleasure to support the respective customers.

Traditionally, RUAG Aviation has a strong MRO background, but has also assumed the role of an aircraft OEM with relaunch of the Do228 NG production. In the domain of aircraft manufacturing, we can rely as well on Dornier's long lasting expertise gained during the production of the Fiat G.91 in the 1950s and '60s, of the Alpha Jet in the 1970s and last, but not least, of the first Do 228 versions.

VAYU : We understand that in the financial year 2010, RUAG boosted their turnover and achieved good profits: what is the projection for the next few years ?

AM : RUAG will continue to grow with all five divisions in the respective international markets whilst building on the strong presence in Switzerland and Germany. Like every global player in our industry, we are following the development of the BRIC countries with interest and engaging actively. We are indeed very interested in undertaking business in India which is on the edge of becoming a global power.

VAYU: Although RUAG Aerospace are a relatively little known entity in India, the fact that they have 'inherited' the mantle of the erstwhile Dornier GmbH, immediately makes them highly regarded partners in the ongoing Dornier 228 light transport aircraft programme which was assigned to HAL in late 1983.

AM : Indeed, we have very good experiences in our co-operation with HAL. The first flight of the Do 228 was in 1981 and only shortly afterwards we had been able to sign a licence agreement with HAL to build this aircraft for the Indian market. The aircraft is still built today and in two years time we are looking forward to celebrate this co-operation that then lasts for 30 years, which is outstanding and certainly unique in the aviation world.

VAYU : We now have a reverse situation where HAL are supplying major fuselage and wing assemblies to RUAG for their 228NG programme. What are the immediate plans in continuing and even strengthening such industrial links with HAL ?

AM : We have manifold plans to broaden our co-operation with HAL. Ideas and concepts that we like to discuss with our Indian partner. HAL is indeed supplying the airframe and the wings sections to our Do 228NG programme, but is currently not able to take benefit from product improvements for the Indian assembly line: product improvements that have become standard for the Do 228 'New Generation' (NG). We believe there are various business and marketing areas in which we could put the co-operation with HAL on a new level and to the benefit of all stakeholders, RUAG, HAL and finally the Indian Government.

VAYU : RUAG are achieving success in marketing and sales of the Dornier 228NG, with recent orders for the type from a number of countries including Japan, Norway and Germany itself : what are the projections for increased sales over the next years ?

AM : The Do 228 NG fills a gap in the new aircraft market. An aircraft of this size and performance is not built anymore. We have experienced a large market demand and a lot of our customers have been



The RUAG Do-228NG en route for delivery to an European customer.

surprised that the initial assembly line was stopped. The Do 228NG basically serves two markets: the demanding commuter market requiring best-in-class performance as well as rugged, proven and reliable design that provides state-of-art mission and navigation management systems at lowest in-service support costs possible.

The second market is the special mission market. Customers in this market segment focus on extended on-station times and cutting edge reconnaissance and data link technology. The Do 228NG is purpose made for the special mission market because of its rectangular shaped airframe which can accommodate a broad range of sensors at the same time and owing to its second-to-none payload/range performance. The special mission market is a growing market around the world ranging from maritime and border patrol aircraft to specialised transport or paratrooping aircraft. All of those missions fit well with the Do 228NG and we expect our fair share in this market segment.

VAYU : Now the Bangladesh Navy have ordered two Dornier 228NGs for maritime patrol, as also search and rescue. You are aware that the Indian Navy and Coast Guard have been operating a large fleet of HAL-Dornier

228s in a similar role : could their experience have been used to further such marketing opportunities ?

AM : Absolutely, this is one of the topics we would like to discuss with HAL and with the Indian Navy and Coast Guard respectively. The Indian operators have a splendid experience with the HAL-Do 228 and could provide valuable input in further developing the 'New Generation'. We believe that operators around the world could benefit from such experience of the Indian Forces.

VAYU : Continuing on the 'enviable' legacy of Dornier, now assumed by RUAG Aerospace Ltd which is functioning exactly on the site and facilities at Oberpfaffenhofen (again very familiar to HAL and the Indian Defence Industry since the mid-1980s), what is your 'vision' for creating new avenues of cooperation with the Indian industry ?

AM : Indeed, HAL and RUAG (or for that purpose former Dornier) have a lot in common. This might be the reason why the business partnership between both companies has developed so well. India requires being present on the world's important military aircraft markets to assume its growingly important role in the world. We believe that shrinking defence budgets all

around the world create a fertile ground for Indian defence technology exports. RUAG Aerospace Services Ltd and HAL could set up an industrial co-operation that combines cost and time efficient production with high quality access to international defence markets. 'Designed by India, built for India, exported to the world.'

VAYU : Finally, being aware of your background with Eurocopter, including an assignment in Australia, can this be leveraged in strengthening of the maintenance, repair and overhaul (MRO) infrastructure for not only the existing helicopter fleet in India but also the very large numbers of rotorcraft being inducted over the next decade ?

AM : Well, eventually, governments around the world become more and more aware that in-service support is an integral part of the aircraft's life cycle starting with its design and ending with its phasing out or re-marketing. To answer your question: yes, I think we should leverage not only my but RUAG's experience in maintenance, repair and overhaul of aircraft and components thereof. However, this has to be discussed with our business partner HAL as part of the above mentioned industrial co-operation.

Apaches, Night Hunters and Tiger Birds



The Boeing AH-64D Apache

Meeting India's attack helicopter requirement

In anticipation of the impending deal, the United States Defence Security Cooperation Agency (DSCA) notified Congress on 22 December, 2010 of a possible Foreign Military Sale (FMS) to the Government of India of various engines, equipment, weapons, training, parts and logistical support for a possible Direct Commercial Sale of 22 AH-64D Block III Apache helicopters. The complete package is worth approximately \$1.4 billion. The notification was made in advance so that, in the event that the AH-64D proposal is selected, the United States might move as quickly as possible to implement the sale. The proposed sale is projected "to contribute to the foreign policy and national security of the United States by helping to strengthen the U.S.-India strategic relationship and to improve the security of an important partner (India) which continues to be an important force for political stability, peace, and economic progress in South Asia."

As per the notification, if the Government of India selects the Boeing-U.S. Army proposal, the Government of India will request a possible sale of 50 T700-GE-701D engines, 12 AN/APG-78 Fire Control Radars (FCR), 12 AN/APR-48A Radar Frequency Interferometers, 812 AGM-114L-3 Hellfire Longbow missiles, 542 AGM-114R-3 Hellfire II missiles, 245 Stinger Block I-92H missiles, and 23 Modernised Target Acquisition Designation Sight/Pilot Night Vision Sensors, rockets,

training and dummy missiles, 30 mm ammunition, transponders, simulators, global positioning system/inertial navigation systems (GPS/INS), communication equipment, spare and repair parts; tools and test equipment, support equipment, repair and return support, personnel training and training equipment; publications and technical documentation, U.S. Government and contractor engineering and logistics support services—and other related elements of logistics support to be provided in conjunction with a proposed direct commercial sale of 22 AH-64D Block III Apache Helicopters.

Sensor technology remains a key advantage of the twin-engined AH-64D (maximum take-off weight is 10,433-kg) which is deployed by the United States Army in Afghanistan as part of Operation *Anaconda* and in support of Operation *Iraqi Freedom*. The AH-64D 'Apache Longbow' is equipped with the Northrop Grumman AN/APG-78 millimetre-wave FCR capable of performing under poor-visibility conditions, less sensitive to ground clutter, while the short wavelength allows a very narrow beam width, which is resistant to Electronic Counter Measures (ECM). The AN/APG-78 additionally incorporates an integrated AN/APR-48A Radar Frequency Interferometer for passive location and identification of radar-emitting threats. Block III includes increasing digitisation, the joint tactical radio system, enhanced T700-GE-701D turbo shaft engines (each

providing 1,265kW) and drive systems, capability to control Unmanned Aerial Vehicles and new composite rotor blades to increase the Apache's cruise speed (284 km/h), climb rate (889m/min) and payload capability. The ferry range is 1,900-km and service ceiling is 6,400-m, with endurance of 3 hours 9 minutes. Lockheed Martin incidentally has developed a new targeting and night vision system for the Apache, using second-generation long-wave Infra Red (IR) sensors with improved range and resolution. The new system is called *Arrowhead* and has a targeting Forward Looking Infra Red (FLIR) with three fields of view, a dual field-of-view FLIR, a Charged Coupled Device (CCD) TV camera, electronic zoom, target tracker and auto-boresight.

The 30 mm automatic Boeing M230 chain gun is located under the fuselage (1,200 rounds of ammunition) and provides a rate of fire of 625 rounds a minute. AGM-114L-3 Hellfire Longbow air-to-surface missiles with millimetre wave seeker performs in full fire and forget mode up to a range of 12-km against armoured vehicles and fortified installations. Stinger Block I-92H Air-to-Air Missiles (AAM) are carried for armed escort and self protection. In the close support role, the helicopter carries 16 Hellfire missiles on four four-rail launchers plus 4 Stinger AAMs. The Longbow Apache can execute an attack in 30 seconds while remaining behind natural terrain if necessary.

The radar dome atop the rotor blades is unmasked for a single radar scan and then remasked, enabling the processors to determine the location, speed and direction of travel of up to 256 targets.

Its competitor, the Mil Mi-28NE (NATO reporting name 'Havoc') is the Russian all-weather day-night military tandem seating anti-armour dedicated attack helicopter (maximum take-off weight 11,500-kg) with no intended secondary transport capability, better optimised than the Mil Mi-24 for the anti-tank role. The helicopter design has strong emphasis on crew survivability and has two heavily armoured cockpits including the windshield, which can withstand impact by 7.62-mm and 12.7-mm bullets and 20-mm shell fragments. The helicopter has non-retractable tricycle tail-wheel type landing gear. The energy-absorbing landing gear and seats protect the crew in a crash landing or in a low-altitude vertical fall of up to 12 metres/second.

Powered by two 2,200-hp Isotov TV3-117VMA turbo shaft engines, fitted on either side of the fuselage, the Mil Mi-28NE can fly at a maximum speed of 300 km/h, fly rearwards and sideways at speeds up to 100 km/h and able to hover turn at 45 degrees a second. It is equipped with an auxiliary power unit for self-contained operation. The main rotor has new high-efficiency blades with swept-shaped tips, and the narrow X-type tail rotor (55 degrees) has reduced noise characteristics. A new design of all plastic rotor blades, which can sustain hits from 30 mm shells, has been installed on the Mi-28NE helicopter.

An integrated electronic combat system has been integrated with the main sensors, being the Albalet millimetre-wave FCR antenna, mounted above the rotor head, and a FLIR system. The system displays the helicopter location on a moving map indicator, with flight, systems and target information on Liquid Crystal Displays (LCD). The pilot uses a helmet-mounted target designator, which allocates the target to the navigator's surveillance and fire control system. The navigator/weapons officer is then able to deploy guided weapons or guns against the target. The targeting system follows the direction of the pilot's eyes. The integrated surveillance and fire control system has two optical channels providing wide and narrow fields



Russia's Mil Mi-28NE

of view, a narrow-field-of-view optical television channel, and laser rangefinder. The system can move within 110 degrees in azimuth and from +13 degrees to -40 degrees in elevation. The crew are equipped with night-vision goggles.

The Mil Mi-28NE carries a single turreted 2A42 30 mm cannon, stabilised in two axes, with a muzzle velocity of 1,000 m/s in an under nose barbette, plus external loads carried on small swept-back, mid-mounted stub-wings with four suspension units. Countermeasures pods are mounted on the wingtips. The Mil Mi-28N Night Havoc is armed with up to 16 Shturm and Ataka Anti-Tank Missiles (ATM) supplied by the Kolumna Design Bureau (KBM). The Shturm is a short-range, radio command-guided missile. The Ataka missile's guidance is by narrow radar beam and maximum range of the missile is 8 km. The missile has a tandem shaped-charge warhead for penetration of 950 mm to 1,000 mm armour. The helicopter can also carry four containers, each with 2080 mm unguided rockets or with five 122 mm rockets. The helicopter can alternatively carry containers with grenade launchers, 23 mm guns, 12.7 mm, and 7.62 mm machine guns, aerial bombs, and incendiary tanks.

While the Mi-28 is not intended for use as a transport, it does have a small passenger compartment capable of carrying three personnel, the planned purpose being to enable rescue of downed helicopter crews.

Complementing the selected type will be the HAL Light Combat Helicopter (LCH) whose maiden flight took place on 29 March, 2010 marking successful culmination of three years of design and development efforts by Rotary Wing Research & Design Centre (RWRDC) of the Helicopter Complex and informally named 'Tiger Bird', perhaps inspired from the design painted on the prototype. Projected to meet requirements of the

Indian Air Force and the Indian Army, who have ordered 64 and 114 units respectively, the LCH is being developed as a dedicated attack helicopter derived from the Advanced Light Helicopter (ALH) Dhruv and to be fitted with weapons and special mission systems and having a crashworthy wheel landing gear.

The LCH inherits many technical features of the Dhruv including its rotor system transmission, power plant, hydraulics, IADS, and avionics. The features that are unique to LCH are its sleek and narrow fuselage, tri-cycle crashworthy landing gear, tandem cockpit, self sealing fuel tanks, aerofoil shaped stub wings for weapons, armour protection, NBC protection and low visibility features which make the LCH "lethal, agile and survivable." Notably, the flight controls and hydraulics of Dhruv have been redesigned for the LCH. With Initial Operational Clearance (IOC) scheduled for December 2011, deliveries are expected to take place between 2013 and 2014. The helicopter is powered by two HAL/Turbomeca Shakti turboshaft engines, each generating up to 871 kW and can run for up to 3,000 hours without maintenance. It features a Full Authority Digital Electronic Control (FADEC) system, which decreases work load of the pilot by automatically counting engine cycles. The LCH has a cruise speed of 260 km/h, a maximum speed of 275 km/h, climb rate of 12 m/s. and ferry range of 700 km.

Fitted with a chin-mounted, twin-barrel M621 20 mm cannon on a Nexter THL-20 turret, LCH armament will include 70 mm rockets and air-to-air/air-to-ground missiles plus Laser Guided Bombs on the weapon stations. The MBDA PARS3 and indigenous Helina with a range up to 7 km are favoured anti-armour weapons. The helicopter would have day/night targeting systems for the crew including the helmet pointed

sight and electro-optical pod consisting of CCD camera/FLIR/Laser Range Finder (LRF)/Laser Designator (LD). The LRF and LD facilitate measurement of range and guidance to the laser guided missiles respectively. The Digital Video Recorder would enable recording of the vital mission for debriefing purposes. The turret gun skewing is controlled by the Helmet Mounted Sight (HMS) of the gunner, who along with the pilot receives adequate inputs from Multi Function Displays (MFD). The LCH is also fitted with a Self Protection Suite consisting of Radar/Laser warning receivers and Missile Approach Warning Systems (MAWS) plus Countermeasures dispensing system. It is planned to integrate IR/Laser missile jammers on the helicopter. Another addition is a Data Link for Network-Centric Warfare (NCW) operations facilitating transfer of the mission data to the other airborne platforms and ground stations operating in the network, thus facilitating force multiplication. The LCH is designed for low detection (visual, aural,



HAL Light Combat Helicopter, the 'Tiger Bird' ?

radar and infrared) and includes armour protection of critical areas.

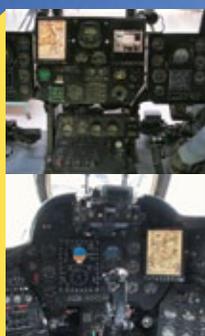
A 30 minute dry running capability of the gear box is a built in-feature to survive after any ballistic hit to the transmission system. Crashworthiness features are built into the wheel landing gear and main structure while dual redundant systems also enhance effectiveness of helicopters in the battlefield environment. The performance features of the LCH including rate of climb, cruise speed,

service ceiling are comparable with those of contemporary helicopter types such as the Agusta A129 Mangusta and Tiger. Development costs of the LCH have been "relatively low" compared to that of other helicopter types in its class, ensuring lower unit costs. "LCH design is optimised to ensure ease of maintenance with improved reliability of all the onboard systems to keep the life cycle operating costs low as well," stated a HAL designer.

Sayan Majumdar

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The SAM for all reasons



Barak-8 to enter both Indian Navy and IAF service

A robust area air defence Surface-to-Air Missile (SAM) system remains an invaluable asset of any 'blue water' navy. To obtain such a system, in February 2006 Israel and India signed a joint development agreement to create the new Barak-NG (now referred to as Barak-8) medium shipborne Surface-to-Air Missile (SAM), as an evolution of the eight-cell vertically launched 10-km range Barak-1 system in service with both navies. While the Indo-Israeli joint-venture must strive hard to replicate success of the Indo-Russian joint-venture exemplified by the PJ-10 BrahMos supersonic Anti-Ship Cruise Missile (ASCM), approved by the Cabinet Committee on Security (CCS) in July 2007, Barak-8 (including its land based application) surpasses the BrahMos project in scope and size, and may well be the largest joint defence development project ever undertaken between India and any country. Conflicting reports however indicate that it was only in April 2009 that India ultimately formalised the \$1.1 billion deal with Israel for joint development of the Barak-8, with pre-production deliveries expected to start in early 2012.

Prime partners for the programme are the Indian Defence Research & Development Organisation (DRDO), with Israel Aerospace Industries (IAI) missile and space group acting as leading subcontractor with IAI Elta Systems providing the radar and Rafael to produce critical components of the interceptor missiles. According to the bilateral agreement, India will locally produce and support the systems. Indian firms will contribute the solid fuel smokeless dual-pulse rocket motors and the pneumatic actuation system. IAI will provide most of the applicable technology, just as Russia did for the BrahMos by offering its Onyx/Yakhont (SS-N-26) missile as the base platform with Rafael developing the multi-function phased array radar and the missile seeker. For the Indian Navy layered defence capability will be provided by the long range Barak-8 along with other SAM and Close-In Weapons System (CIWS), a key requirement especially in relation to rampant proliferation of ballistic and cruise missiles in Asia. The layered SAM/CIWS network along with shipborne fighters from projected aircraft carriers will enable the

IN to operate in high-threat areas outside land-based air cover by establishing local air superiority. Bearing in mind that hostile submarines are likely to make attack with sea-skimming anti-ship missiles, Anti-Submarine Warfare (ASW) screening becomes analogous to air defence.

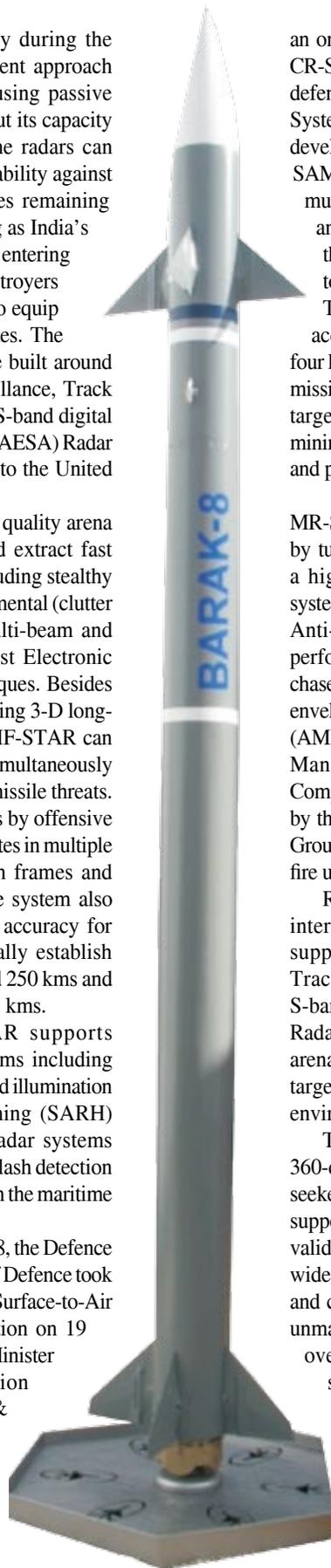
The Barak-8 missile provides effective protection from all form of aerial threats, including manned, unmanned as well as Precision Guided Weapons (PGM) up to 60 to 70-km (probably a "very conservative" figure) and a ceiling of 16 kms, thanks to a dual-pulse solid rocket motor. Vertical Launch System: the missile initially acquires positional energy in form of height, which can be traded for kinetic energy in terms of speed to retain its manoeuvre capability even at the end of its flight. In addition while the first motor pulse propels the weapon through most of its trajectory, the second fires as the missile approaches target. This ensures that the missile is not just coasting in the final stages, but has the energy necessary to secure multiple chances against fast, manoeuvring targets taking evasive action or random weaving. More importantly the Active Radar Homing (ARH) seeker

endows Barak-8 with extensive autonomy during the final stages of intercept. This is an excellent approach for dealing with saturation attacks even using passive ship radars, which can track many targets but its capacity to illuminate targets remain restricted. The radars can operate intermittently to ensure their survivability against enemy Anti-Radar Missiles (ARM) besides remaining free to track other targets. Besides emerging as India's primary naval area air defence SAM, initially entering service on *Kolkata* class guided missile destroyers (DDGH), in Israel, the Barak-8 is slated to equip its next-generation *Saar 5+* frigates/corvettes. The combat suites of both vessel classes will be built around the Elta EL/M-2248 Multi-Function Surveillance, Track & Guidance Radar (MF-STAR) conformal S-band digital solid-state Active Electronic Scanned Array (AESA) Radar System which Elta claims to be "superior" to the United States SPY-1 AEGIS radar.

MF-STAR can deliver an accurate high quality arena situation picture and weapons support and extract fast low Radar Cross Section (RCS) targets including stealthy cruise missiles, even in the toughest environmental (clutter & jamming) conditions by employing multi-beam and pulse Doppler techniques as-well-as robust Electronic Counter Counter Measures (ECCM) techniques. Besides acting as the ship's primary sensor in providing 3-D long-range air surveillance at medium ranges, MF-STAR can automatically track and classify threat and simultaneously besides searching the horizon for potential missile threats. In parallel, it supports multiple engagements by offensive and defensive weapons. The agile radar operates in multiple simultaneous modes, offering short search frames and Track-While-Scan (TWS) revisit time. The system also offers rapid tracking update rate and high accuracy for priority targets. The radar will automatically establish tracks of high flying targets at ranges beyond 250 kms and also low flying targets at ranges above of 25 kms.

For weapons guidance, MF-STAR supports different operating modes of missile systems including mid-course guidance of ARH/SARH SAM and illumination enslavement for Semi-Active Radar Homing (SARH) SAM, thus making dedicated guidance radar systems redundant. Also incorporated is automatic splash detection and measurement, to support naval gunnery in the maritime security and CIWS role.

For land based applications of the Barak 8, the Defence Acquisition Council (DAC) of the Ministry of Defence took the decision to develop a Medium Range-Surface-to-Air Missile (MR-SAM) with Israeli collaboration on 19 June 2006. On 4 January 2007 the Defence Minister cleared formation of the Price Negotiation Committee headed by Defence Research & Development's head VK Saraswat and Israeli Aircraft Industries (IAI) Itzhak Nissan. On 16 December 2008, the Cabinet Committee on Security (CCS) cleared the programme and DRDO informed CCS that MR-SAM was the land derivative of



an ongoing Barak-8 SAM project for the Navy (a.k.a. the CR-SAM). On 27 February 2009 India signed a \$1.4 billion defence contract with IAI to co-develop an Air Defence System for the IAF. This DRDO-IAI joint venture will develop and equip the Indian Air Force (IAF) with nine SAM squadrons, each including two batteries comprising a multi-mission radar system performing target acquisition and guidance, Command & Control (C&C) element and three container-launchers each mounting eight missiles to replace the obsolete the Pechora (SA-3 'Goa') SAM. The total would come to nine C&C centres, eighteen acquisition radars, eighteen guidance radars, and fifty four launchers armed with four hundred and thirty two (432) missiles. The missile is reputed able to decimate multiple targets both at high and low altitudes indicating a low minimum range and thus be able to function as both an area and point defence missile.

Capable of engaging targets 70 kms away, MR-SAM is four times more manoeuvrable (being aided by tungsten jet vane system for thrust vector control and a highly evolved electro-pneumatic control actuation system) than the indigenous Advanced Air Defence (AAD) Anti-Tactical Ballistic Missile (ATBM) system which performs sub-optimally while engaging aircraft in tail-chase mode thereby reducing the air defence engagement envelope. The land-based Barak-8 Air & Missile Defence (AMD) system concept includes highly sophisticated Battle Management, Communication Command & Control, Computers & Intelligence centre (BMC4I) to be produced by the MBT Division of IAI's Missiles, Systems & Space Group. It will offer both stand alone operations for a single fire unit, as also Joint Task force Coordination (JTC).

Rafael will supply the vertically launched Barak-8 interceptor missile, while IAI Elta Systems Ltd. will supply the Land-Based-Multi-Function-Surveillance, Track & Guidance Radar (LB-MF-STAR) a rotating S-band digital Active Electronic Steering Array (AESA) Radar System that can deliver an accurate, high quality arena situation picture, and extract low radar cross section targets like stealthy cruise missiles, even in the toughest environmental conditions.

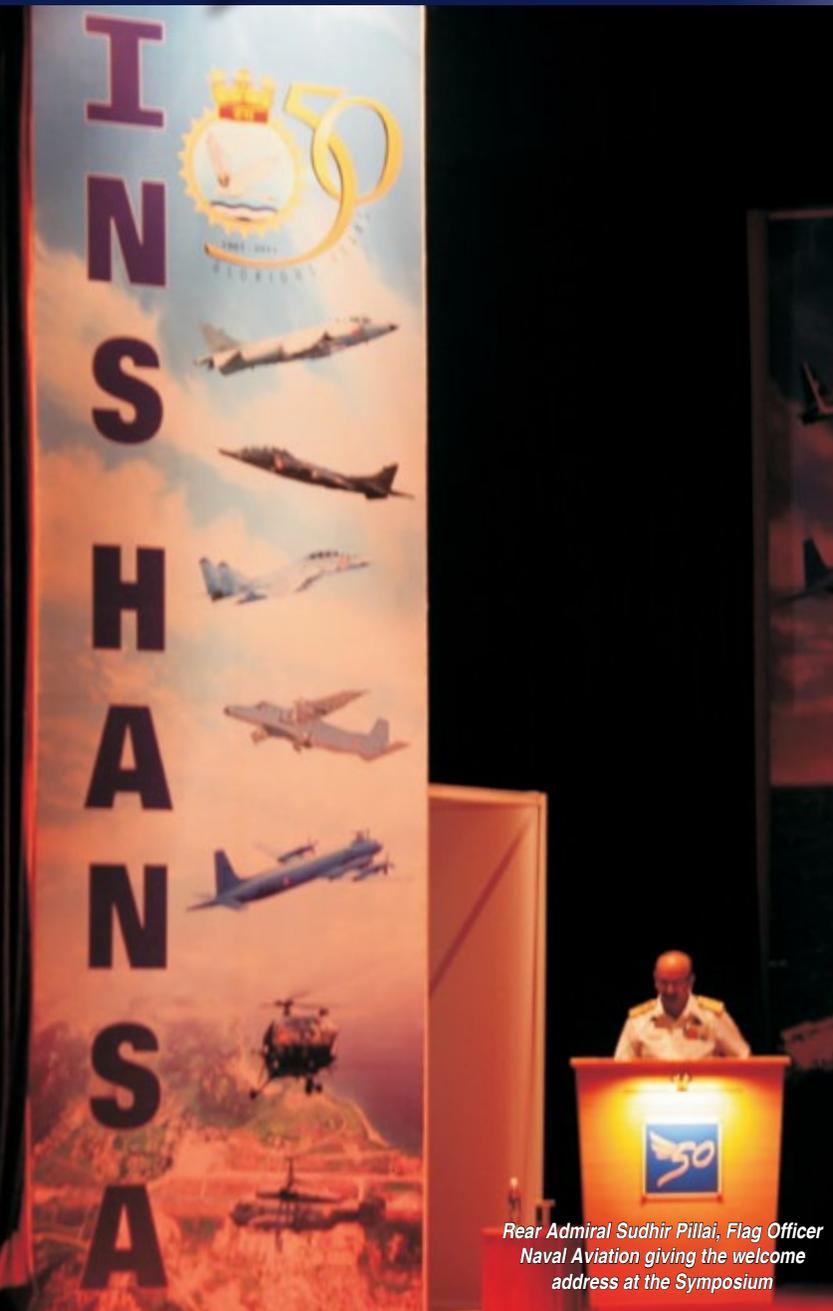
The vertical-launched missile is designed to offer 360-degrees protection, utilising the advanced active-radar seeker. The missile is equipped with a two-way datalink, supporting mid-course updating and terminal updating and validation. To extend its datalink and C3 coverage over a wide area, the system will integrate surface-based radars and communications elements with airborne manned and unmanned elements, maximising its operability and range over all types of terrain. Progress of the projects are shrouded with 'mystery' yet rumoured to be in final stages of development having undertaken successful initial firings.

And IAI still retain an ace up its sleeves, as the company has hinted that their Barak-8 air-defence missile may well be adapted for launch from airborne platforms.

Sayan Majumdar

The International Aviation Symposium

Indian Naval Aviation – Roadmap to Transformation



Rear Admiral Sudhir Pillai, Flag Officer Naval Aviation giving the welcome address at the Symposium

Integrated Defence Staff to the Chiefs of Staff Committee (CISC), which formally launched this two day International Aviation Symposium at Goa, attended by senior Naval officers, including Vice Admiral BK Joshi, FOC-in-C, Western Naval Command and an array of distinguished retired senior Naval Officers and special guests plus executives from International companies who were invited to present papers at the sessions that followed.

Venue was the *Rajhans* Auditorium, close to the Dabolim Airport Terminal where were gathered Naval Aviators in their whites, addressed in turn by the Flag Officer Naval Aviation, Rear Admiral Sudhir Pillai and then Vice Admiral Shekhar Sinha before formal commencement of the inaugural session. Admiral Sinha's talk on the transformation of the Indian Navy, which appropriately focused on its air arm, will be reproduced in the forthcoming issue of *Vayu Aerospace Review*.

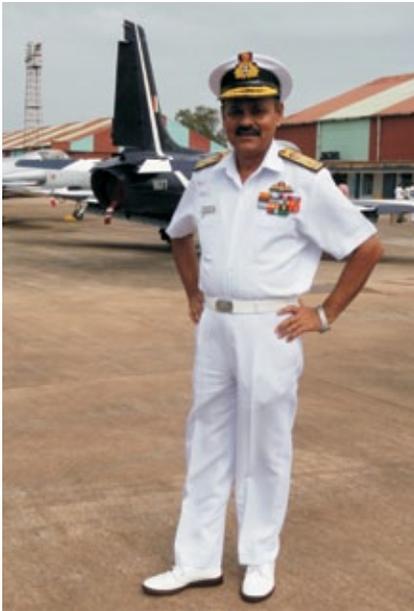
The inaugural session had former Chief of Naval Staff, Admiral Arun Prakash talking on 'Contours of India's Naval Aviation of the Future' which was followed by Air Commodore Jasjit Singh, Director Centre for Air Power Studies (CAPS) on 'Air Dominance in the Maritime Environment'.

In the session on 'Future Maritime Battlespace Management' were parallel presentations by executives of



Outside the Rajhans auditorium are (L to R): Cdr Shiraz Azad of INAS 300, Cdr Biplab Hota CO INAS 303, Rear Admiral Davinder Sudan ACNS (Air), Cdr Shivnath Dahiya (test pilot with the NFTC), and Cdr Dalip Singh Commanding Officer INAS 552 (the Sea Harrier training squadron)

The occasion was to mark the Golden Jubilee Anniversary of Indian Naval Ship *Hansa* and Indian Naval Air Squadron 551. 0850 hours on 5 September 2011 saw arrival of the 'Grey Eagle', Vice Admiral Shekhar Sinha, who is presently the Chief of



The 'Grey Eagle' Vice Admiral Shekhar Sinha, presently CISC at MoD

Northrop Grumman on 'Transformation in Battle Management Command and Control for future IN operations', with specifics on the evolution and present status of the E-2D Hawkeye AEW aircraft going into service with the US Navy. Tommy Hultin, Business Development Director from SAAB in Sweden spoke on 'Maritime Surveillance and Future of a Maritime Patrol Aircraft in a Network Context'. The attributes and versatilities of the Saab 2000 aircraft were elaborated upon.



Dr SS Sidhu, the Governor of Goa releasing the Coffee Table Book 'On the Wings of Gold', publication on INS Hansa at its Golden Jubilee

Training Philosophies'. The first paper was on 'Enhancing Airfield Infrastructure in Support of Growing IN Footprint' by Tata Strategic Electronics Division after which the BAE Systems representative talked on 'Approaches to modern support and training delivery systems'.

The first day's proceedings ended with participants heading back to change for the formal evening programme which was the Command Reception at INS Hansa Wardroom Mess. This glittering function was highlighted by the release of special

published by INS Hansa in association with *The Society for Aerospace Studies*, and a coffee table book on INAS 551. The ceremonies were followed by a reception and dinner at the Officers' Mess where too were present the Chief Minister of Goa, Digamber Kamat and Chief Secretary Sanjay K Srivastava with scores of dignitaries including those from overseas who were invited for the symposium.

Valedictory Session of the Symposium began on 6 September morning at the *Rajhans Auditorium* with speakers from Boeing on



The Phantoms of INAS 551 in their hangar with one of the Kirans they operate.

The working lunch, hosted by the Navy at the nearby Bogmalo Beach Resort, refreshed participants for the next session on 'Evolving Infrastructure and

commemorate postage stamps by Dr Shivinder Singh Sidhu, Governor of Goa who then released the coffee table book on INS Hansa, 'On the Wings of Gold'

'Life Cycle Costing in Procurement and Elimination of Redundancies in Disparate Platforms', this being followed by Paul Hermann's presentation on 'Advanced



The Heads of Department outside the VIP lounge, 'Swagat' at INS Hansa.



Rear Admiral Sudhir Pillai with Commodore Pran Prashar, the pioneer Indian Naval aviator in front of the latest acquisition, the MiG-29K at INS Hansa.



Past and present : (L to R) Cmde PE Macaden, Cmde Richard Clarke, VAdm Subhash Chopra, Cmde Pran Prashar, Adm Arun Prakash, RAdm K Mohanan, VAdm Shekhar Sinha (Grey Eagle), Cmde Ravneet Singh

hangar which formed the backdrop for a series of group photographs amongst much nostalgia and bonhomie.

Reflecting the enthusiastic response to the Indian Navy's programme on its roadmap to transformation, a special session was arranged at the *Rajhans* Auditorium later in the afternoon where Northrop Grumman gave a structured talk "only for serving naval officers" following which were three key presentations : 'Effective Asset Management through Maintenance and Logistics, in Partnership with the Private Sector' by John Gay of Rolls Royce ; the Navy Rafale by Jerome Puech of Dassault Aviation and last, but certainly not the least, a presentation on the Sea Gripen by Tony Ogilvy of Saab.

Commander Nitin, the ever ebullient and strikingly knowledgeable master of ceremonies, provoked the audience into raising pertinent questions which continued until the curtains were



Commodore Ravneet Singh, Commanding Officer INS Hansa

Propulsion Technologies for Naval Aviation Applications', based on the revolutionary EJ 200 with thrust vectoring nozzles developed by Eurojet. Mike Kelly of Lockheed Martin presented 'Advances in STOVL Technology and Operations', with reference to the F-35 joint strike fighter which is on threshold of its induction into service.

While visitors went back to the Bogmalo Beach Resort for lunch, special invitees went to INS Hansa where INAS 551 (Phantoms) were celebrating their 50th anniversary with a boisterous programme of song and dance followed by the traditional 'bara khana'. All seven aircraft types based at INS Hansa were on static display outside the Phantom's

rung down on what had been a most meaningful two day event at the Indian Navy's premier air station, INS Hansa. The coming decades will undoubtedly witness dramatic transformation of Indian Naval Aviation as it becomes one of the world's most powerful air arms. The symposium was indeed an apt curtain raiser!

Avi oil

MARKING THE GOLDEN JUBILEE OF Indian Naval Ship Hansa



Aviator's view of INS Hansa.

INS Hansa is the largest air base of the Indian Navy, housing seven flying squadrons, operating seven different types of aircraft and manned by over 2500 personnel. The full-fledged airfield at this naval air station also hosts both domestic as well as international flights around the clock, testimonial to its importance as one of the world's most diverse airports.

INS Hansa is home to several of the Indian Navy's premier air squadrons, including INAS 300 *White Tigers* with Sea Harrier V/STOL fighters, INAS 310 *Cobras* with the Dornier 228 Information Warfare aircraft, INAS 315 *Winged Stallions* with the IL-38SD 'Sea Dragon' MR/ASW aircraft, INAS 551 *Phantoms* with the HJT-16 Kiran Mk.1/2 basic jet trainers, INAS 552 *Braves*

which is the Sea Harrier Training Squadron, INAS 339 *Falcons* with their revolutionary AEW Kamov Ka-31 AEW helicopters and 321 *Flight Angels* with the Chetak helicopter for SAR and utility tasks. The latest combat aircraft to be inducted by the Indian Navy is the new generation MiG-29K, which has initially been formed as an Intensive Flying Trials Unit (IFTU), which will be commissioned as INAS 303 *Black Panthers*. A major maintenance facility for the Tupolev Tu-142M and Ilyushin IL-38 long-range maritime reconnaissance aircraft and for the Ka-31 helicopters is also located at this massive naval air station.

Equipped with so many aircraft types plus variants, INS Hansa is responsible for numerous and diverse roles and tasks.

The Operational role and task of INS Hansa is to undertake maritime air surveillance, prepare, maintain and provide aircraft for carrier operations, provide Search and Rescue cover for military flying, provide facilities to conduct major exercises and operations including those with foreign navies and provide aid to civil power (including aircraft) whenever tasked.

At INS Hansa are located maintenance facilities for Western and Indian-origin aircraft, comprising Kirans, Sea Harriers, Dornier 228s and Chetak helicopters. Russian-origin aircraft comprise the Ilyushin IL-38SD and Kamov Ka-31 AEW helicopters. Also maintained are operational flights of the fleet at sea, visiting IN/ IAF/ Army aircraft as well as military aircraft from foreign navies.



The Half Century

The genesis of INS Hansa goes back in time to when a Naval Detachment was established at Coimbatore in 1952 as a tender to the Gunnery School of INS Venduruthy, its main purpose being to provide facilities by way of accommodation and messing for the range parties which came for musketry at the Small Arms Range at Madukkarai. The Establishment continued to perform this function until 2 September 1958 when a Naval Jet Flight (a tender of INS Garuda) was formed at the Air Force Storage Depot, Suler under the command of Lt Cdr BD Law.

The two establishments, although entirely separate units, were accommodated in the same area and the sailors were messed together. The officers were however accommodated in the Officer's Mess of the Air Force Administrative College, Coimbatore. The Naval Jet Flight consisted of four officers and 56 men and initially had one Vampire T Mk. 55 trainer and three Vampire FB Mk.52 fighters, along with one jeep station wagon and one three tonner vehicle to convey officers and men to Suler and back. As all flying and maintenance effort was confined to Suler, the Jet Flight had to undergo an extremely crowded routine. Lt RH Tahiliani took over command of the Naval Jet Flight from Lt Cdr BD Law when the latter was posted as the Commanding Officer of



Sea Hawks in formation over Grande Island, close to Dabolim airfield which was to become home base for the 'White Tigers'.



Before the 'liberation of Goa': Vickers Viking airliner of Transportes Aereos da India Portuguesa (TAIP) at Dabolim.

INAS 300, which was then being formed in the United Kingdom. On 28 November 1959, a Naval Officers' Mess was formed at Coimbatore, which consisted of two wartime barracks formerly occupied by Nursing Officers of the Royal Navy during the World War II. As there was no government sanction for a Officers Mess at this time, it was raised as an annexe to the Command Mess at Cochin. On 28 November 1959, Lt RAJ Anderson took over from Lt RH Tahiliani who proceeded to France for the Test Pilot Course.

It was under Lt Anderson that the Naval Jet Flight was renamed as INAS

550 (A), which was subsequently changed to INAS 551 in September 1961 and commissioned as such. Throughout 1960, INAS 550 (A) fulfilled the function of training pilots proceeding to join the two newly formed frontline Squadrons, INAS 300 in the UK and INAS 310 in France. Lt Anderson left on 1 September 1960 to join INAS 310 as the Senior Pilot and Lt RS Grewal took over command of the Squadron on this date.

In March 1961 the Naval Detachment and INAS 550 (A) were amalgamated and became the Naval Contingent, Coimbatore under the command of Lt Cdr

T Chakraverti. This reformed organisation was commissioned as INS Hansa on 5 September 1961. The Navy had been in the quest for a permanent home for the frontline squadrons of the aircraft carrier INS *Vikrant* and for operational flying training of the pilots who joined these Squadrons. The airfield at Dabolim was taken over by the Indian Navy soon after the Liberation of Goa and thereafter certain civil works were sanctioned with the objective of shifting the air element of INS Hansa to that airfield. Meanwhile INAS 300, the frontline fighter squadron from the INS *Vikrant* had been located to



'Old man of the sea': Short Sealand comes into land at Dabolim soon after it becomes INS Hansa.

INS Hansa in November 1961. Thereafter and as soon as the minimum facilities for aircraft operations were made available at Dabolim, it was directed that INS Hansa be moved from Coimbatore in phases.

On 18 June 1964, INAS 551 and the administrative facilities of INS Hansa were moved to Dabolim and with this, the commissioning pennant of Hansa was transferred to Goa. INAS 300 stayed back and figured in the second phase move in September 1964, when the Squadron disembarked directly at Dabolim from the INS *Vikrant*.

The vast potential of the Dabolim site was to be exploited fully and plans for the expansion to a full fledged fighter base – India’s premier Naval Air Station – were drawn soon after the shift of INS Hansa. Although the civil works did not keep pace with the operational expansion of the Naval Air Station, adequate facilities to support the two Sea Hawk Squadrons INAS 300 and INAS 551 and rotary wing element of the aircraft carrier were available at Dabolim. In March 1969, a new SAR and Logistic Squadron consisting of 6 Alouette III (Chetak) helicopters was commissioned at INS Hansa. The new Squadron, INAS 321 supported all the ship borne flights of Alouette III helicopters and the Hansa SAR flight. The Garuda SAR Flight, though part of INAS 321, was permanently based at Cochin.

1969 also saw the foundation laid of permanent living accommodation for the Naval Air Station. Work on single sailors barracks and quarters for married officers and sailors was then in full swing and it was hoped that by early 1970 the Hansa Ship’s Company would move into their permanent barracks for the first time in history of the establishment. Thereafter the hardships and overcrowding of the last nine years would have become a thing of the past. GCA equipment was flight tested and declared operational on 13 July 1970. INAS 310 completed its shift to Dabolim during April-May 1971 and satisfactory arrangements for their accommodation, both domestic and technical were made. However, workshop support for the squadron aircraft was still to take place.

On 15 October 1971, the Naval Air Station was geared to meet operational commitments at short notice in view of the heightened tensions between India



In 1971, the Sea Hawks went to war, performing their first mission 'in anger'. Seen here is Babu Jagjivan Ram, Defence Minister at INS Hansa meeting personnel of INAS 300 before they embarked on the INS Vikrant and sailed to the East.



On 18 November 1976, INAS 312 ('Albatross') was commissioned at INS Hansa, Dabolim with five Super Constellations, these being re-serialised IN 315 to IN 319 as their third identity.

were armed, all available aircrew were present at Naval Air Station between 0600 to 1830. Two to four armed Sea Hawks were placed at ORP in condition three, the other aircraft were camouflaged and dispersed. The Operations Room, ATC, armament and maintenance facilities were made available around the clock. One helicopter armed with two depth charges was available from 13 December 1971 onwards. During daylight hours whenever air raid warning 'Red' was

On 7 December 1971 two jet aircraft were launched to search for SS *Toronto*, a merchant ship which was believed to be carrying contraband. The search aircraft located and identified the ship in position 105 miles from Dabolim. On 13 December 1971 four armed Sea Hawks were detached to Cochin to meet an anti-shipping strike commitment off Trivandrum. However, the aircraft returned on 14 December 1971, without any luck but on 17 December 1971, three

armed Sea Hawks were detached to be positioned at Cochin to meet any strike commitment from there.

The Station ADR Complex was put into operation effectively and regularly for flying since mid-September 1974. The newly constructed Sailors' Institute was inaugurated by the Officiating Naval Officer-in-Charge, Goa Captain JC Puri on 24 April 1974. The new air to ground range at Cavellossim was commissioned on 25 November 1974. Front Gun, Rocket and Depth Charge work up was conducted satisfactorily.

Rear Admiral VEC Barboza and Commodore BK Acharya visited INS Hansa on 18 November 1976 for Commissioning Ceremony of INAS 312, the Navy's first land-based maritime reconnaissance squadron equipped with ex-Air India and ex-IAF Super Constellations, these four-engined aircraft becoming the largest aircraft in naval inventory. The first dedicated MR/ASW aircraft was the Ilyushin IL-38 (three of these IN 301, 302 and 303) arriving at Dabolim from the USSR on 2 September 1977. INAS 315 was commissioned on 1 October 1977 with RAdm MK Roy, the Flag Officer Commanding Eastern Fleet as the Chief Guest. In December 1977, RSBN equipment was installed on the approach to Dabolim's runway. Commissioning of INAS 333, the new anti submarine warfare helicopter squadron with Ka-25s took place on 11 October 1980 when VAdm OS Dawson, FOC-in-C Southern Naval Command, Cochin



Each of the 'Kashin'-class guided missile destroyers received from Russia from 1980 embarked a Kamov Ka-25 ASW helicopter which were formed into INAS 333 ('Eagles'), commissioned on 11 December 1980 at Dabolim. The first of these are seen in formation over southern Goa.

was present. The Coast Guard's first helicopter squadron was commissioned by the Deputy Defence Minister KP Singh Deo on 22 May 1982, where VAdm MR Schunker, DGCG, RAdm S Paul, FOGA and other service and civilian dignitaries were present. An ILS System was installed at INS Hansa in November 1983 to facilitate operation of VVIP aircraft for the Commonwealth Heads of Government Meeting (CHOGM). The first three INAS 300 Sea Harriers arrived at Dabolim on 16 December 1983. The Sea Harrier Simulator was commissioned on 14 May 1984 by Flag Officer Commanding-in-Chief, Southern

Naval Command, VAdm KK Nayyar and the eighth Sea Harrier (TMk.60 Trainer) IN 652 arrived on 18 April 1985 from the U.K.

On 5 September 1986, INS Hansa celebrated its Silver Jubilee. In a unique gesture, the then three Commanders-in-Chief, Vice Admirals GM Hiranandani, S Jain and SC Chopra were present at the occasion which was celebrated with ceremonial divisions, *Bara Khana* and a dinner-dance in the Wardroom. A flying display was put up by all types of aircraft at the station followed by a group photograph with all seven types of aircraft that have flown from NAS Dabolim as the backdrop.



Cdr. (later Admiral) Arun Prakash with Sea Harrier at INS Hansa. To celebrate the reformation of INAS 300 at INS Hansa, the Maharaja of Rewa presented the Squadron with an actual 'White Tiger' (albeit stuffed) which was then ceremoniously installed in the Squadron briefing room.

The full length of runway became available for use from 15 June 1986, the total length becoming 11,250 feet with enhanced LCN 80 for heavy aircraft operations, which was just in time as three Tupolev Tu-142M aircraft (IN 311, 312, 313) flew into Dabolim on 30 March 1988 on a direct flight from Simpherphol (USSR), thus heralding a new era in naval aviation history. IN 314 and 315 also arrived on 13 April 1988. INAS 312 was recommissioned on 16 April 1988 by Raksha Mantri K C Pant. Three more aircraft (IN 316, 317) arrived on 16 August 1988 and IN 318 on 20 October 1988, to make this one of the largest unit establishments of Indian Naval Aviation. However INAS 312 later relocated to INS *Rajali* at Arakkonam and thus India's largest military aircraft was to operate from India's largest runway, at 4500 metres, including the overrun.

Meanwhile, the Sea Harrier Operational Flying Training Unit (SHOFTU) was commissioned as INAS 551 'B' Flight on 16 April 1990, becoming an independent squadron in its own right as INAS 552 on 7 July 2005.

Earlier, INS Hansa was actively involved with its Naval air elements during the Kargil crisis in May 1999 'Operation Vijay'. The entire air station



Kiran Mk.1 flying low at INS Hansa with an IL-38SD on the ground.

was at the highest degree of alertness and readiness both operationally as well as from security of the base point of view. Two Dornier 228s of INAS 310 were detached to a forward base of the IAF and a third Dornier 228 was positioned at CGAS Daman, these aircraft extensively flying along the IB/LOC all along the western frontiers.

The Sea Harriers of INAS 300 were on high alert and at short notice for operating from a forward base apart from being alerted for operational missions from dawn to dusk along with the Kirans of INAS 551 'A'. All product/maintenance support units including the BSF/ALD/AED were geared up to produce the maximum number of aircraft and add to



Impeccable formation of the Sea Harriers.



On static display at INS Hansa : Dornier 228 with Sea Harriers and Kiran Mk.1

the maintenance support of operational units both from the base and ex fleet ships.

Chetaks of INAS 321 carried out two patrol sorties each day over the coastal and harbour areas along the coast for surveillance against intruding or suspicious vessels. INS Hansa was activated to provide uninterrupted, round the clock security/vigilance to the vast areas housing operational facilities and VAs/VPs of INS Hansa. Normal operations were resumed by 10 July 1999 with de-escalation of

tension between the two countries. All flying operations had been focused in accordance with higher directives.

Just a few years later, following the audacious attack by terrorists on Parliament House in December 2001, security of the air station was enhanced, with SPRINGEX 2002 reinforcing the operational readiness of all squadrons. The joint Exercise Varuna was held on 14 May 2002, the Sea Harriers operating alongside aircraft launched from the French carrier *Charles De Gaulle*. Post-Kaluchak incident by enemy intruders, the

air station geared up fully on 19 May 2002, and the entire air station assumed highest degree of readiness with one Dornier 228 detached to operate from a forward base on 23 May 2002. During Operation *Parakram*, the Sea Harriers had embarked on the carrier *INS Viraat* from 22 December to 12 April 2002 with the Squadron achieving high operational status.

A paradigm shift in air combat capability from INS Hansa was ushered in when the first batch of MiG-29K new generation fighters were delivered



Ka-31AEW with its radar antenna fully deployed.



The formidable MiG-29K coming in to land at INS Hansa.

Saab Gripen



Dramatic display of the Sagar Pawan formation aerobatic team colouring the sky with their Kiran Mk.IIs.

at Dabolim on 4 December 2009. The first two aircraft (single seater IN 671 and twin-seater IN 801) were re-assembled and test flown by Russian test pilots before being handed over to the Defence Minister AK Antony at a ceremony at INS Hansa on 19 February 2010. The first 16 MiG-29Ks ordered will be augmented by another 29 such aircraft which will eventually embark on the aircraft carrier INS *Vikramaditya* (the considerably modified and re-equipped former Russian naval carrier *Admiral Gorshkov*.)

The Indian Navy has also supported the Tejas light combat aircraft (LCA) programme whose naval variant is to supplement the MiG-29Ks in service. For operation of these ‘tail hook’ fighters, creation of Navy-specific flight-test facilities in Bengaluru and Goa, construction of a shore-based flight-test facility or SBFT at INS Hansa (for enabling arrested landing recovery) plus takeoff from a half-metal half-concrete 14-degree ski ramp and a flight deck ranging from 195 metres to 203 metres in length, and validating the simulation model for flight performance within ship-motion limits will be carried out. The SBTF will also have its integral flight-test centre equipped with line-of-sight telemetry/high-speed three axis photogrammetric systems, systems for validating thrust measurement algorithms, systems for measuring wind-flow patterns, INS/DGPS-based trajectory measurement systems, RGS integration facility, plus a workshop.

At the Golden Jubilee, Commanding Officer of INS Hansa, Commodore Ravneet Singh NM shared a vision of the future including new assets at INS Hansa. Looking into the immediate years ahead, the extensive and elaborate infrastructure at INS Hansa will support an entirely new generation of aircraft types, ranging from the MiG-29K and the LCA Navy, to the BAE Hawk advanced jet trainers and Boeing P-8I long range maritime patrol and ASW aircraft.

[Extract from ‘On Wings of Gold’ published by The Society for Aerospace Studies]

Army Aviation



HAL Dhruv Mk.III, with the Shakti engine, flown by Brig. AS Sidhu on the Siachen Glacier at a height of over 19,500 ft. asl.

ARM OF THE FUTURE

This was the theme marking silver jubilee of the Army Aviation Corps. A focussed seminar on 'Army Aviation: Arm of the Future' was held at the Manekshaw Centre on 13 September 2011 organised by the Centre for Land and Warfare Studies (CLAWS) in collaboration with the Army Aviation Directorate while *Vayu Aerospace Review* was the exclusive media partner. After decades of effort to establish the need for integral Army Aviation, this arm came into formal existence on 1 November

1986 and the quarter century of integral support of the Indian Army thereafter has validated that policy decision. Even though the Army's Aviation Corps has proven its mettle time and again, it still requires expansion and modernisation for it to meet its clear mandate and in fact match its counterparts in many parts of the world, including Pakistan, to become a truly effective 'force multiplier of the third dimension'.

The key note address was delivered by the Defence Minister AK Antony



Defence Minister AK Antony at the Manekshaw Centre, flanked by Major General PK Bharali (extreme left), Gen VK Singh (COAS), Lt Gen VK Ahluwalia and Brig. Gurmeet Kanwal (extreme right)



himself, with Chief of the Army Staff General VK Singh giving the inaugural address. Colonel Commandant Army Aviation Lt Gen VK Ahluwalia, presently GOC-in-C Central Command, former Chief of the Naval Staff, Admiral Arun Prakash and Brig Gurmeet S.Kanwal Director CLAWS, emphasised the theme of the Seminar with their insightful inputs.

AK Antony stressed upon the role and spirit to be maintained in the expansion and modernisation of the Army Aviation Corps. "Although you (Army Aviation Corps) are going in for force accretion, while enhancing your capabilities and performing your role, you must ensure that there is perfect synergy between the Army and Air Force. The Services will have to act in reconciliation amongst themselves



Lt Gen SPS Sehgal, former ADG Army Aviation with Brig. Sandeepan Handa



Maj. Gen. PK Bharali (left) with Lt. Gen. VK Ahluwalia before the Seminar.



Mr. P Soundara Rajan of HAL with Brig. AS Sidhu of Army Aviation



Defence Minister AK Antony 'mobbed' by the media after his key note address



Senior Army officers at the foyer of the Manekshaw Centre



Army Command flags with a portrait of Field Marshal Sam Manekshaw at the Centre which is named after him

so that India can have better and stronger Armed Forces. In your attempt at arriving at reconciliation, I will try to play a limited role in finding such reconciliation!"

General VK Singh reiterated Mr. Antony's views and asserted that 'closer integration' was required in future battle areas. The former Chief of Naval Staff Admiral Arun Prakash, who had won the Vir Chakra while flying Hunters with the Indian Air Force in December 1971, looked back on the evolution of naval and army aviation services in other countries and stressed on 'indivisibility of air power' to fulfil the operational tasks of the Defence Forces.



"Father of Indian Army Aviation", Maj General (retd) Atma Singh

The inaugural session, moderated by Lt General KS Jamwal, had on its panel Lt Gen Vijay Oberoi (Retd) speaking on 'Learning from the past and looking ahead'; Lt Gen Anil Chait, Commandant Army War College who spoke on 'Philosophy of employment and envisaged role of Army Aviation in the Future Battle Field' and Lt Gen VG Patankar (Retd) who had been 15 Corps Commander in

the valley, who referred to 'Management of Army Aviation in Tactical Battle Area.' The underlying theme remained 'being a soldier first and flyer next,' this approach being fundamental to fulfilment of the Army's role in varying geographical environment, employing both assault and attack helicopters plus UAVs in the tactical battle zone. "The key is to be better prepared for future wars which could

be short, limited in scope and along the tenuous land borders".

After this animated first session, with much food for thought, was a break for lunch before the second session on *Force Structuring and Modernisation*. This began on a focussed theme to review practical needs and solutions for Army Aviation in its growth as an 'arm of the future'. Chaired by Lt Gen (Retd) VK Kapoor, the first speaker was Lt Gen Sumer Singh who is currently Director General Perspective Planning, on *Capability development and desirable profile of Army Aviation*, this being followed by *Indigenous Helicopters for the Army Aviation* appropriately addressed by P Soundara Rajan, Managing Director Helicopter Complex HAL Bangalore and finally *Integration of attack and assault helicopters in combat operations* addressed by Lt Gen BS Pawar (Retd).

The panel articulated on capability aspects according to operational requirements being an imperative, with the vastly different and mostly difficult terrain needing specific weapon systems. India's long western front, from the foothills of J&K, through the plains of the Punjab and desert terrain of Rajasthan to the swamp lands of the Rann of Kutch, necessitated dedicated attack helicopters. On the other hand, the northern frontiers which comprise high mountains need agile and high-altitude capable helicopters for mobility and manoeuvre apart from rapidly bringing to bear concentrated fire power. With the Army operating the HAL-built Chetaks and Cheetahs over the past twenty five years, now augmented by the HAL Advanced Light Helicopter, the Dhruv and its weaponised version Rudra will be mainstay over the years to come. Select training and procurement of specific equipment is needed to increase the AAC's capability which ranges from reconnaissance and observation tasks to battlefield assault and focussed fire power in attack.

It was an eventful day for Army Aviation which was rightfully marking its anniversary with clear plans for the future. This fledgling combat wing of the Indian Army is determined to become the vital support mechanism, upholding its motto of *Suveg Va Sudrid* ('high speed and potent strength') as the primary battle-winning factor in the future.



Advanced Light Helicopter Mark IV is the 'Rudra'

In mid July 2011, the Indian Army 'christened' the Advanced Light Helicopter WSI (Weapon Systems Integrated) as the *Rudra*. According to the Vedas, Rudra is a Rigvedic God, associated with wind or storm and the hunt. The name Rudra is taken as a synonym for the god Shiva and the two names are used interchangeably. Rudra is described as being armed with a bow and fast-flying arrows, discharging "brilliant shafts which run about the heaven and the earth," a reference to the destructive power of lightning from the skies.

The Indian Army has ordered a substantial number of Rudras, the first squadron of which is likely to be formed in the current financial year 2011-12. The HAL Rudra will be fitted with stub wings which can carry up to eight anti-armour missiles, four air-to-air missiles or four rocket pods of 68mm rockets. In December 2006, Nexter Systems (formerly Giat) was awarded contract for the THL-20 20mm gun turret which has the M621 low-recoil cannon combined with a helmet-mounted sight. One of the options is the Nag anti-tank missile being developed by the DRDO, having imaging infrared guidance and a range of about 4km. The Rudra will also have FLIR (forward-looking infrared), CCD (charge coupled device) camera and target acquisition system with thermal sight and laser rangefinder. A naval variant, whose development status is not clearly known, will carry two torpedoes or four anti-ship missiles.



HAL: exclusive suppliers to Indian Army Aviation

On 1 November 1986, when Indian Army Aviation came into existence, all the 170 helicopters transferred to it from the Indian Air Force were Chetaks and Cheetahs built by Hindustan Aeronautics Limited. Over the next 25 years, these were supplemented by batches of more light helicopters from HAL Bangalore, including the Lancer which is armed version of the Cheetah.

The first HAL Dhruv Advanced Light Helicopter for the Indian Army was formally inducted into service on 15 September 2001 and has been followed by a steady stream of deliveries to equip five Army Aviation utility squadrons currently operating the type. The Dhruv Mk.III, with the Shakti engine has recently created a world record landing on the Siachen Glacier at a height of over 19,500 feet asl. This was flown by Brig. AS Sidhu, then Commander Aviation Brigade at Leh.

The number of ALHs on confirmed order (all marks and variants) by the Army and Air Force total 159, of which the Air Force will take 54 and the Army double that number, including 54 Rudras.

Meanwhile two prototypes of HAL's Light Combat Helicopter have been test flying since the first made its maiden flight in 2010, with the second displayed at the Aero India show in Yelahanka during February 2011. The Indian Army has shown keen interest in the LCH and has deputed pilots and senior officers from the Aviation Corps on the project. HAL has firm orders for 114 LCHs from the Indian Army but plans are to acquire future variants which will propel the Indian Army into arguably having the largest fleet of combat helicopters, not only among the three Indian armed services, but perhaps in the entire Asian region.

The LCH is particularly important for the Army's evolving strategy in the high mountain frontiers with Tibet-China. In his presentation during the Army Aviation seminar in New Delhi, a senior General articulated "the philosophy of employment and envisaged role of Army Aviation in the future battle field". The difficult terrain along the high mountain ranges makes it imperative for 'third dimension vectoring' to provide the manoeuvre and mobility needed with

application of concentrated fire power at decisive places. The Indian Army plans to deploy its Light Combat Helicopters, with their superior high altitude performance characteristics, in the mountain sectors while the Advanced Light Helicopter WSI (*Rudra*) will be deployed with defensive formations in the plains and desert terrain.

The overall philosophy of Army Aviation assets is to employ the R&O helicopters at tactical levels, dedicated attack helicopters with offensive Divisions the *Rudra* with defensive formations along the Western borders, the LCH along the mountain fronts, even while enhancing rapid reaction forces with tactical and medium lift helicopters. There would be dedicated helicopter assets with the Special Forces while considerable numbers of UAVs and UCAVs would be integral with the field formations. As for fixed wing aircraft for intra theatre communication and light logistic support, it is logical that the HAL-built Dornier 228 would be the Army's choice but such induction would be considered at a later time frame.



Indian Army aviators in Alaska

A batch of four officers from the Indian Army Aviation Corps visited 16 Combat Aviation Base (CAB), located at Fort Wainwright in Fairbanks, Alaska under the United States Army Pacific Command (USAPAC). Lt. Cols. Sanjay Vadhera, Kapil Agarwal, Dheeraj Sethi and Major DK Chaudhary visited Alaska under a mutual exchange programme enabling the Indian Army and United States Army Aviation officers “to share knowledge and expertise in organisation, employment and operations of helicopters.”

During the 5-day programme at Fort Wainwright, Colonel Robert W Werthman, Commander 16 CAB, briefed the Indian Army aviators focusing on General Support Aviation Battalion (GSAB), Attack Reconnaissance Squadron (ARS), and Aid to Civil Authorities comprising fire fighting, support to remote communities, repatriation of human remains, search and rescue and aerial support in case of a natural disaster.

Lt. Colonel Casey, Executive Officer (XO) 16 CAB briefed the Indian Army aviators on Officer Cadre Management, Simulator Training, Training in conjunction with other arms, Aerial Gunnery training and Evaluation Programme.

The briefing gave the visiting officers an overview of the operations carried out by 16 CAB UH-60 and CH-47 helicopters in Iraq and Afghanistan. Other subjects covered were Hot Refuelling Procedures, Daily Servicing Schedules, Automation of Maintenance Activities and Inventory Management.

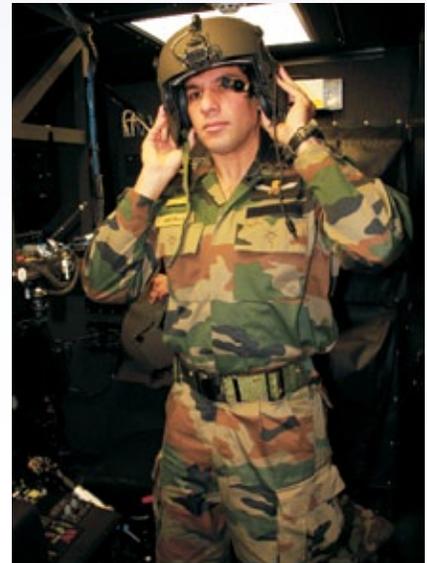
The Indian Army aviators also got hands on experience of flying the UH-60 (Black Hawk) and OH-58 (Kiowa Warrior) helicopters.



Maj. DK Chaudhary, flying instructor, at the Combat Army Aviators Training School in Nasik, India, climbs into an OH-58D Kiowa Warrior prior to a demonstration flight.



Indian Army Aviation officers being briefed on aircraft maintenance procedures with a CH-47 Chinook.



Lt. Col. Dheeraj Sethi, adjusts his pilot's helmet during training session in the Aviation Combined Arms Tactical Trainer at Fort Wainwright, Alaska as part of the Subject Matter Expert Exchange hosted by the 16th Combat Aviation Brigade, US Army.

TESTING TIMES

Air Marshal Philip Rajkumar writes about this less known, but equally important task of....



Seeker head of the infrared homing K-13 air-to-air missile.

....armament trials at ASTE

The Aircraft and Armament Testing Unit (A&ATU) which was earlier based at Kanpur, became the Aircraft and Systems Testing Establishment (ASTE) in August 1972. Though the new name of this premier testing unit in the IAF did not contain the word 'armament', weapons testing remained one of the major tasks of the Establishment.

A lot of the work that goes on is classified and one has to respect the thirty year rule before being able to write about it. Thus I will confine myself to armament testing that was done at the ASTE between 1973 and 1981. This was the period, immediately after the December 1971 war with Pakistan and there was great drive to achieve a degree of self reliance in meeting the requirements of weapons normally used by the IAF. These were all unguided munitions and consisted of 250 and 500 kg HE bombs with both normal

and retarded tail units, unguided 68mm rockets and gun ammunition of various calibres. There also some attempts to improve the K-13 air to air missile of Soviet origin and the RM3-B target missile which was used for training squadron pilots in missile launch procedures and techniques.

The K-13 was a first generation air-to-air missile with infra red (IR) guidance. It had an uncooled lead sulphide (PbS) detector which was sensitive to IR radiation in the 1-2.5 micro meter wavelength. When the missile was pointed towards a heat source emitting at the correct wavelength the missile 'locked on to the source and an audio tone would be generated in the pilot's earphones. The pilot had to then gently manoeuvre the aircraft to get the loudest possible audio tone and then fire the missile. Pilots disliked this somewhat cumbersome procedure which was difficult to do in

combat situations and wanted a simple light in the cockpit to indicate 'lock on'. The Defence Electronics Research Laboratory (DLRL) was tasked to improve the missile under the code name *Project Blunt*. They developed a passive radar homing head which would 'lock on' to the reflected radar energy from the target. The IR homing head of the missile was replaced by a nicely engineered radar homing head within the available space and weight budget of the IR head. The pilot had to keep illuminating the target with his radar till the missile impacted. This was not such a great idea because the 'fire and forget' characteristic of the IR missile was lost. On top of that the DLRL engineers retained the audio tone and did not provide a lock-on light ! But it did have some advantages over the IR homing system because it was possible to fire against targets hidden by fog and clouds.

A DLRL trial team brought a modified missile to Kanpur in April 1973 and I was project pilot for the trials which involved carrying the modified missile throughout the cleared K-13 envelope of altitude, speed and normal acceleration. The new homing head and modified electronics withstood the rigours of carriage very well. For the next sortie I flew behind a target Marut aircraft but after achieving radar lock on the target, the missile head refused to lock on. The DLRL scientists were very disappointed and said they would return after some more work. They returned in December 1973 and this time the trial venue was Poona. I ferried a Type-77 (MiG-21FL) to Poona from Bangalore as ASTE had moved there in June 1973. At Poona the missile head locked on nicely to the target Type-77 aircraft as soon as the aircraft's air-to-air radar lock on was achieved. I tried this out at various altitudes from 3 km to 11 km and the head performed well. The DLRL scientists were thrilled but unfortunately the IAF showed no interest in pursuing the programme and the project was closed. I felt we should have continued the project till the phase of firing the missile against a radar reflecting target. This would have enabled the design team to gather data to refine their guidance algorithms.

In May 1973 a team from the Armament Research and Development Establishment (ARDE) said they were ready for live firing trials of the indigenised version of the RM3-B target missile. This was a target missile which was used to train pilots in the art of K-13 missile firing. It looked like a K-13 except that the homing head, warhead and proximity fuse had been removed. A pyrotechnic flare designed to burn for a much longer period than the missile rocket motor, was fixed to the aft end of the missile body. On launch the flare ignited automatically and provided the heat source for the K-13 to lock on to. The standard procedure was to carry a RM3-B missile on one under wing pylon and a live K-13 missile on the other. The firing procedure was to first fire the RM3-B in a 30 degree nose up attitude and wait for the missile to arc downwards after motor burn out. As the target missile crossed the horizon on its downward trajectory the K-13 would be launched after taking care to put the relight switch 'on' in the cockpit and making sure the

audio tone indicating 'lock on' was loud and clear in the earphones. The Type 77's R-11F2S-300 engine was prone to flame out due to missile plume ingestion and this was a necessary precaution. The relight switch had to be put off within two minutes or else that would burn out! Live missile firings were carried out over the sea off the Saurashtra coast with the aircraft operating from Jamnagar or off the Orissa coast with the aircraft operating from Kalaikunda.

For this particular trial I went to Jamnagar from Kanpur, did a carriage trial through the cleared envelope of the Type77 and then had the missile inspected by the trial scientists for any signs of stress or damage. Everything was satisfactory and I then fired three RM3-B target missiles at different flight conditions and ensured that the missile motor was functioning reliably. On the next sortie I launched the RM3-B first and followed it with a K-13. Unfortunately the IR head did not lock on to the flare and the missile did not go anywhere near the target. A second attempt met with similar failure. I then remembered some college physics and a law called the Stefan-Boltzman law on black body radiation. This law states that the 'frequency of radiation is directly proportional to the fourth power of the absolute temperature of the radiating body'. Frequency and wave length are inversely related: higher the frequency shorter the wavelength and vice versa. Since the PbS detector was sensitive to IR radiation only in the 1-2.5 micrometer wavelength it was possible to work out the temperature at which the flare should burn to enable the detector to lock on. When I discussed this with the ARDE scientists they found that the pyrotechnic composition was not generating the required temperature. They used a hotter flare for the next sortie and I was able to achieve a lock on and the K-13 went very close to the target missile and exploded. The trial was a success. We had a small party in the Jamnagar Mess that night!

Sometime later I was asked to fire the newly acquired R-60 air-to-air IR missile against an RM-3B target missile. This time I did the firing from a Type 96 (MiG-21M) over the Bay of Bengal, off the coast. I read the operating instructions for the R-60 and noted that there was a possibility of the proximity fuse of the

missile being activated by very small red hot burnt propellant particles in the wake of the target missile. I therefore deliberately delayed my R-60 launch by a couple of seconds to prevent any mishap. That precaution saved an ugly accident because the R-60 went towards the target missile initially and then blew up well short of it. By then I had turned away from the direction of firing. Discretion is always the better part of valour! Thereafter R-60 missiles were launched only against flare targets.

The last missile trial of some interest was adapting the R-60 missile for firing from the over wing pylons of the Jaguar because the originally adapted Magic I missiles were reaching the end of their service life. The Magic II was far too expensive and the cheaper and readily available R-60 was chosen. Air Head Quarters ordered ASTE to do a proof of concept firing of the R-60 from the Jaguar as soon as possible. This task was given to ASTE when I was the Chief Test Pilot. I went to Adampur and got two R-60 launchers loan allotted to ASTE from a MiG-23MF squadron and bolted it on to the over wing launchers of a Jaguar fighter using the same bolts used in the MiG-23MF. The test engineer, Gp Capt Aravinda Agrawal modified the firing circuit bypassing the armament safety box and SqN Ldr JP Singh went and fired the R-60 successfully from the modified Jaguar over the Chandipur range in Orissa. From go ahead to launch took only 90 days at a cost of Rs 25,000. The Vice Chief of the Air Staff, Air Marshal Raghavendran was very happy with this quick response by ASTE to an operational need. Air Head Quarters then tasked HAL to develop a proper engineering modification scheme. Unfortunately the engineering modification raised the height of the over wing pylon/launcher combination excessively. The pylons acted like two huge wing fences and it was felt that handling qualities may have deteriorated. By then I was the Commandant, ASTE and the handling qualities evaluation was done by the project pilot and the Chief Test Pilot. They could not make up their minds and asked me to be the final arbiter. I flew two sorties of wind up turns, raising the 'g' in a turn slowly, carefully noting 'g' at onset of strong buffet. I then flew with the original Magic I missiles and found that



R-60B air-to-air missiles attached to MiG-21 bis.

the buffet boundary had been lowered to an unacceptable limit. ASTE was forced to reject the mod.

In the mid 1970s the Aeronautical Development Establishment (ADE) developed a subsonic target missile called 'Fluffy' to be used for practice firing by surface to air missiles (SAM) crews at the Suryalanka range. This was a medium sized missile weighing about 500 kg, somewhat similar to the present day Lakshya pilotless target aircraft. It had a cordite motor which enabled it to fly for about 40 km after being launched from a mother aircraft. It was designed to be carried and launched from the under wing pylon of a Canberra B.Mk.66 aircraft. The development of the missile was done in several phases. Initial carriage trials were done at Bangalore and then safe separation trials were done over the Indian Space Research Organisation range at Sriharikota, north of Chennai. The missile was always released on a south easterly heading just as the aircraft crossed the coast so that the missile fell harmlessly into the sea. The missile was tracked by the cine theodolites at the range and accurate

trajectory data was available for post flight analysis. After satisfactory separation and unpowered flight with an auto-pilot were successfully demonstrated the cordite motor was installed and powered flight tests were conducted. I flew over a dozen sorties in a Canberra B.66 in 1977 for these trials. The missile was certified by the Chief Resident Engineer's office and HAL started to manufacture them. The Fluffy target system was used for some years at Suryalanka and was eventually superseded by the Lakshya pilotless target (PTA) aircraft. The Fluffy development programme could have been pursued further to convert it into a precision guided stand off missile by introducing a warhead and guidance into the system. No one was willing to listen to a Squadron Leader's suggestion!

After the December 1971 war, an acute need was felt to have some retarded bombs in the IAF inventory. Retarder tail units allowed the bombs to be released at 100 meters AGL and enabled the aircraft to get clear of the debris envelope before the bomb exploded. Air Marshal YV Malse, as the Vice Chief of Air Staff,

ordered an in-house programme to be started at No.1 Base Repair Depot at Kanpur. It was called *Project Reinbo*. A team of technical officers headed by late Wg Cdr AJ Srinivasan developed a retarder tail unit (RTU) which could be fitted to the body of a standard 1000 lb HE bomb in place of the normal tail unit. The retarder unit consisted of four cruciform metal petals which were folded flat along the bomb body and opened after release to slow down the bomb. The petals were held in place by rugged canvas straps and the bomb was nose fused. The straps were designed to withstand air loads up to 420 knots indicated air speed (KIAS). Initial trials done in 1973-74 using the Hunter and Canberra were successful. About 150 RTUs were produced by a small production facility set up at No.1 BRD itself. Unfortunately quality control of the production process was poor and one could never be sure that the canvas straps would withstand the air loads. In 1977, I dropped a number of these *Reinbo* RTUs from a Type 96 at Jamnagar. Air HQ wanted the bombs to be cleared up to 1000 kmph IAS. Strengthened straps were



Jaguar with Matra Magic I on the wing top.

used but the straps could not withstand the air loads at that speed. We were able to clear it only to 850 kmph IAS and Air Head Quarters did not place fresh orders for the RTUs. It was a very commendable effort by the team at No.1 BRD. In case of dire necessity we could have used the *Reinbo* RTUs in operations.

Following failure of the *Reinbo* retarder tail units to be inducted for service use, Air Head Quarters tasked ARDE at Poona to develop a RTU for the standard 1000 lb HE bomb. The team at ARDE developed a RTU using a parachute which was stowed in the tail unit of the bomb. It was difficult to tell the difference between a normal tail unit and the RTU. The first flight of this developmental trial was done by me in February 1980. One bomb with the RTU and another dummy bomb on the other side acting as a counter weight were dropped over the Kollegal range about 60 km south of Bangalore. To get photographic evidence of the blooming of the parachute, two rear facing N-9 gun cameras running at 20 frames/sec were mounted facing backwards in a locally

fabricated pylon which was carried on the centre line station of the Type 96. The look angles of the cameras were adjusted to capture both the separation from the pylon and the blooming of the parachute. Only dummy bombs were dropped at Kollegal. The parachute retarding system worked very well. The parachute was developed by the Aerial Delivery Research and Development Establishment at (ADRDE) at Agra. A number of phases of trials were conducted both at Bangalore and Jamnagar to clear this RTU for service use. Development of the nose fuse was a particularly knotty problem as to get the bomb to explode consistently with the required time delay took a lot of work. Finally the RTU was cleared for service use in 1985. This was a success story for ARDE and all at ASTE who had participated in this long drawn out development were very pleased.

During the trials we got stuck for some time because both the N-9 cameras available at ASTE became unserviceable. Off I went to an equipment depot at Kanpur to look for spare cameras. Just when we were about to give up the search

because there were no cameras shown in the stock registers an equipment assistant took us to a hangar where a lot of unused spares for the B-24 Liberator aircraft were lying around. The aircraft had been retired from service 10 years earlier but spares were still available ! To our good fortune we found half a dozen brand new N-9 cameras still wrapped in the original factory grease wrappings. We took possession of the cameras without even voucher action as the depot records did not show them as being held in stock! I believe those cameras are still in use at the ASTE.

Armament testing at ASTE formed an important segment of our work. Air HQ was constantly inducting new weapons and it was ASTE which tried them out first. At the same time some effort was always devoted to indigenisation programmes. Fuse development was a particularly difficult process especially when working with live weapons. It is to the credit of the Establishment that in over 50 years of this kind of work, an impeccable safety record has been maintained.

USAF receives first production F-35 Lightning II

On 14 July 2011, the first production Lockheed Martin F-35 Lightning II Joint Strike Fighter (JSF) was delivered to the USAF, assigned to the 33rd Fighter Wing/58th Fighter Squadron at Eglin Air Force Base in Florida. The F-35A, which had made its maiden flight on 13 May 2011, was flown in by Lt Col Eric Smith of the 58th FS, who is the first US Air Force pilot qualified on the F-35. On 20 July, a second aircraft was delivered to Eglin, when US Marine Corps Major Joseph Bachmann landed at the base.



The F-35s which are now officially on the USAF inventory as part of the 33rd Wing, the JSF training unit, will be used for initial activities associated with training pilots and ground crew. These personnel will then begin coursework at Eglin's new F-35 Integrated Training Centre this autumn.

Russian Air Force to acquire 40 Su-30SMs

President of the Irkut Corporation Alexey Fedorov, has confirmed that his company is in negotiation with the Russian Defence Ministry for an order for up to 40 Sukhoi Su-30SM multi-role fighters. He said that a contract should be signed by 2012 which will comprise a firm order for 28 of the type, with an option for a further 12 aircraft. The Su-30SM is based on the thrust vectoring Su-30MKI that was developed to meet Indian Air Force requirements and the new variant has been evolved to suit Russian Air Force technical specifications. Fedorov stated that two development Su-30SMs are already being built at Irkutsk and upon completion should commence flight testing by the end of 2011.



The largest order for the Russian Air Force had been announced two years back at MAKS 2009, which comprised a contract for 64 new Sukhoi fighters for the Russian Air Force, including 48 Su-35s, 12 Su-27SM3s and four Su-30M2s.

A batch of 32 Su-34 strike fighters are also on order, with five pre-production units undergoing tests. For the future, it is also learnt that the Russian Air Force will order an initial batch of ten Sukhoi T-50/PAK-FA fighters for a trials and testing unit, with plans to acquire upto 60 more (although other media reports mention a total of 200).



RAF Typhoons over Libya

RAF Typhoon FGR Mk.4s, based at Gioia del Colle in Italy have continuously flown 'dawn patrol' missions over Libya as part of NATO's commitment for protecting the civilian population. These differ from those deployed in the UK and the Falklands which are equipped primarily for 'air-to-air' combat. There are six Typhoons currently stationed at Gioia del Colle air base, with eleven pilots.



Sagem's AASM Hammer in Operation Unified Protector

Four months of operations have provided an opportunity to report feedback from the French segment of *Unified Protector*, the international operation over Libya initiated within the UN resolution 1973. The French Air Force and Navy have made intensive use of a new precision stand-off weapon, the AASM-Hammer. Right from the start of the operations on 18 March 2011, the Hammer's use has been at the very forefront of operations. Alongside with Mirage 2000 D bombers armed with Paveway (from the base at Nancy), the Rafale's from their base in France (Saint-Dizier) destroyed Libyan tanks with the weapon (after a six hour mission, across Europe and the Mediterranean Sea). On 21 March, France extended its deployment to the



Seen at Solenzara air base in Corsica (France), AASM-Hammer guided bombs attached to a Rafale. Over Libya, AASM-Hammer performed missions within planned scenarios or in time-sensitive targeting modes, such as SEAD (Suppression of Enemy Air Defences), destruction of aircraft on airfields, and ground targets.

Solenzara base in Corsica, closer to the theatre of operations with the same weapons aboard.

AASM-Hammer features an INS-GPS guidance and propulsion kits fitted to standard bombs of different sizes: 125 kg, 250 kg, 500 kg and 1,000 kg, the latter dubbed the “bunker buster” because of its ability to penetrate several meters of reinforced concrete.

USAF testing of laser-guided Maverick

The US Air Force has completed developmental testing of Raytheon’s AGM-65 E2/L, the newest variant of the laser-guided Maverick missile, clearing the weapon for operational testing. The laser-guided Maverick missile is a direct-attack, air-to-ground precision munition extensively used by the US Air Force, Navy and Marine Corps in ongoing combat operations. During the US Air Force-Navy test effort, the Air Force conducted aircraft integration as well as laboratory and flight tests of the new laser-guided Maverick on the A-10, F-16, AV-8B and F/A-18 aircraft types. Air Force testing culminated in a series of three live-fire shots against moving and static targets from an A-10 and F-16.



The first four of 24 new Lockheed Martin advanced Block 52 F-16s produced for the Royal Moroccan Air Force have been delivered to Morocco.

New French MALE UAV Deal

On 20 July 2011, at a meeting of the *Comité Ministériel d’Investissement* (Ministerial Committee for Investment), French Minister of Defence and Veteran Affairs, Gerard Longuet announced that negotiations had begun with Dassault Aviation for the provision of a new Medium-Altitude, Long Endurance (MALE) unmanned air vehicle (UAV) system. The new UAV is intended to replace the EADS Harfang system currently in *Armée de l’Air* (French Air Force) service in Afghanistan.

The Harfang was developed by EADS from the IAI Heron UAV to meet France’s *Système Intérimaire de Drone* interim MALE requirement. The new UAV offered by Dassault is based on IAI’s more advanced Heron TP variant, customised in association with the Israeli company as the F-Heron TP, which only entered service with the Israeli Defence Forces 18 months ago as the Eitan. It will act as a stop-gap from 2014 pending the entry into service in 2020 of the future Franco-British MALE UAV that is being developed under a government-to-government co-operation agreement signed in November 2010. The new UAV, named Telemos, will be largely based on the BAE Systems Mantis UAV that is already undergoing flight testing.



Hypoxia grounds F-22A Raptor

After a series of pilot hypoxia incidents in US Air Force F-22A Raptors, Lockheed Martin have halted deliveries from the production line at Marietta, Georgia, pending further investigation of the fault. Even though Lockheed Martin has continued to manufacture the type, they have been unable to undertake the necessary flight testing after final assembly.

Similarly, government test pilots from the Defence Contract Management Agency (DCMA) have not been able to perform acceptance flights on the aircraft.

The most recent F-22A to be handed over to the USAF was on 22 June, but this will be the last until the flight restrictions are lifted, so that pre-delivery testing can be completed. Four other aircraft have technically been handed over to the USAF, but placed in storage at Marietta until the flight ban is lifted and then flown to the 1st Fighter Wing at Joint Base Langley-Eustis in Virginia.



Bolivian K-8VBs delivered

The last of six Hongdu K-8VB Karakoram jet trainer and light attack aircraft ordered by the *Fuerza Aérea Boliviana* (FAB-Bolivian Air Force) were formally accepted on 23 June 2011 at Cochabamba Air Base. FAB commander General Tito Gandarilla has earlier stated that the aircraft would arrive in April, but their arrival was delayed primarily because they were dispatched from China by sea, rather than as air freight, as had been originally planned. In 2010, 29 FAB pilots and technicians had been sent to China to train in flying and maintaining of the K-8s. Reassembly of the aircraft at Cochabamba was undertaken by these technicians, assisted by Chinese technical personnel from CATIC.

The K-8VBs will be operated from Cochabamba by *Grupo Aéreo de Caza 34* (GAC 34), which currently flies the Pilatus PC-7 Turbo Trainer. GAC 34 has been selected to operate the type because of its previous experience in the anti-narcotics trafficking role for which the K-8VBs have been acquired.



File Picture of Pakistan Air Force K-8 Karakoram Intermediate Jet Trainer

Ugandan Su-30MK2 deliveries begin

On 10 July 2011, deliveries of Sukhoi Su-30MK2 fighters to the Uganda People's Defence Force (UPDF) Air Wing began with the first flight from Entebbe Airport, followed by a second the next day. Neither Rosoboronexport nor Sukhoi commented on the \$740 million contract, but reports indicate that the deal involves eight Su-30MK2s.

Acquisition of the new generation fighters provides a major boost in capability for the UPDF, which currently relies on six ageing MiG-21s as its frontline fighters.



Nigerian Alpha Jets back in service

According to the Nigerian Chief of Air Staff, Air Marshal Mohammad Umar, four Nigerian Air Force Dassault Breguet/Dornier Alpha Jets have been recently returned to operational service. He stated that the aircraft had been refurbished and made airworthy again by an unspecified overhaul company in Germany. These have now been returned to Kainji Air Base, where originally No. 99 Air Weapons School had a total of 24 Alpha Jets. It is learnt that some ten aircraft were lost in accidents and the balance grounded owing to lack of finance to procure spares and carry out routine maintenance.



Black Hawks for Taiwan

On 30 June, Sikorsky Aircraft Corporation was awarded an \$48.6 million contract through the US Army for procurement of four Black Hawk helicopters in 'green' configuration for delivery to Taiwan. The helicopters are being acquired under the US Foreign Military Sales programme in a deal that also includes unspecified government furnished equipment. The estimated completion date is 30 May 2013.

It is recorded that Taiwan had earlier requested a total of 60 UH-60M Black Hawks but this was not progressed.

INDIA AVIATION

Taiwan unveils upgraded IDF

The first six Republic of China Air Force (ROCAF) AIDC F-CK-1A/B *Ching-Kuo* Indigenous Defence Fighters (IDF) to have been upgraded by AIDC in its Taichung facility on 30 June, will be followed by a further 65, which are scheduled for completion by the end of 2012. After upgrade, the single seat F-CK-IAs will be designated F-CK-ICs, while the two-seat F-CK-IBs become F-CK-IDs. They are also being renamed as the *Hsiung Ying* (Brave Hawk). The upgrade comprises new avionics with new multi-function colour displays in the cockpit while the mechanically scanned radar is also improved to better deal with electronic counter-measures and a wider range of weapons will be carried. The ROCAF had received over 130 of these indigenous defence fighters (IDFs), both single and twin seaters but after some attrition, only 71 are to be upgraded.



T.50 FGFA offered to South Korea

According to Colonel Wi Jong-Seong of the Republic of Korea's Defence Acquisition Programme Administration (DAPA) Russia's PAK-FA (Sukhoi T.50) will be included in the competition to meet Korea's FX-III fighter requirement. He revealed that Sukhoi had expressed its intention to compete earlier in 2011 and will now be evaluated against the Boeing F-15SE Silent Eagle, Eurofighter Typhoon and Lockheed Martin F-35 Lightning II.

The South Korean FX-III project involves the acquisition of 60 fifth-generation stealth fighters, at a value of around \$8 billion. The selection process would be completed by October 2012 and it is hoped that the first aircraft will enter service with the Republic of Korea Air Force (ROKAF) in 2016.

Bangladesh Navy order Do228NGs and AW109E Powers

On 20 July, Ruag Aviation announced that the Bangladesh Navy has placed an order for two Dornier 228NGs (new generation) twin-turboprop aircraft. These will be used for maritime patrol and search and rescue missions along the extensive Bangladesh coastline, and are the first fixed-wing aircraft operated by the Bangladesh Navy in this role. Delivery of both aircraft is scheduled for early 2013. The contract also includes comprehensive aircrew and maintenance personnel training.

Currently, the Bangladesh Navy does not have any fixed-wing aviation assets, but have recently taken delivery of two AW109E



Power helicopters. Following advanced pilot operational training on these helicopters at Shah Amanat Airfield, Chittagong, these helicopters were formally accepted into service on 19 July 2011. Helidecks' contract for training five pilots extends for a period of ten months and will culminate with day and night deck landing qualification for the aircrew.

S-70i Black Hawk delivered to 'undisclosed' customer

Sikorsky has delivered three S-70i Black Hawk helicopters to an "undisclosed" customer. The helicopters assembled and completed to customer specifications and flight tested at Sikorsky's production facility in Mielec, Poland, are the first-ever deliveries of the international variant of Sikorsky's helicopter. The three medium-lift aircraft are among six S-70i assembled and flight tested at PZL Mielec since the Polish company became part of US-based Sikorsky Aircraft Corporation in 2007. They departed Poland's Rzeszow-Jasionka Airport within an Antonov An-124 Ruslan cargo aircraft following a week of flight acceptance activities in Poland. The company plans to expand production to 10 aircraft in 2012 and to 22 helicopters in 2013.

Eurofighter Typhoon interception training with Lufthansa A380

On 22 August 2011, after Vienna's Mayor Dr Häupl christened the new Lufthansa A380 as *Wien* at the hub of Austrian Airlines, two Austrian Typhoons conducted a QRA training interception of the new Airbus during its flight through Austrian airspace. The Typhoons scrambled from their base in Zeltweg/Styria, intercepted and flew in formation with the A380.

As Austrian Eurofighter pilot Major Günter Taschler said, "The challenge was how to approach the big wing span of the civil aircraft, in order to make eye contact with the pilot. It



is also not that easy to approach the aircraft from below, since the airflow generated by the large surfaces of the aircraft can become difficult for the Typhoon!”

NGC E-2D Advanced Hawkeyes ordered

Northrop Grumman has been awarded contracts by the US Navy for the E-2D Advanced Hawkeye worth \$795 million. Northrop Grumman will manufacture and deliver five low-rate initial production (LRIP), Lot 3, E-2D Advanced Hawkeye aircraft to the US Navy. Also under this contract, are long lead materials for five LRIP, Lot 4 and E-2D Advanced Hawkeyes.



Ron McIntire, Coast Guard Acquisition HC-144A Project Manager (second from left), leads the Coast Guard final acceptance team to accept delivery of the Coast Guard's 12th HC-144A. EADS North America and Airbus Military counterparts joined in delivery ceremony at the Airbus Military final assembly line 29 June 2011.

Ghana orders C295s

Ghana has signed a contract with Airbus Military for acquisition of two C295 aircraft, to be delivered from the beginning of 2012. Including this new order, 85 C295s have been ordered by 14 customers. Over 75 C295s currently in operation in 11 countries have accumulated more than 100,000 flight hours.

Vietnam receives C212-400

The Vietnam Marine Police has taken delivery of the first of three C212-400 ordered from Airbus Military. The second aircraft will be delivered later in 2011 and the third in early 2012. This modernised C212-400 series incorporates the latest systems and technologies, such as a Flight Management System (FMS). The C212-400 will primarily be used in the Maritime Patrol role and carry out missions such as coastal surveillance, monitoring of illegal fishing, drug trafficking and smuggling, among others.



Cobham systems for USAF KC-46 tankers

Cobham has been awarded two subcontracts by Boeing related for the hose and drogue aerial refueling system that will be used by the US Air Force's new KC-46 tanker aircraft. The contracts, valued in excess of \$73 million, relate to the Engineering and Manufacturing Development (EMD) phase of the programme, including development hardware. In early 2011, the United States Air Force (USAF) selected Boeing to provide its next generation strategic tanker, the KC-46. Shortly thereafter, it was announced that Boeing had selected Cobham to provide the hose and drogue refueling systems, which will be manufactured by Cobham Mission Equipment at its air to air refueling centre in Davenport at Iowa. Deliveries on the engineering phase begin in 2014, with low-rate initial production starting in 2015.

300th Sikorsky UH-60M for US Army

Sikorsky has delivered the 300th UH-60M Black Hawk helicopter to the US Army, which first began in 2006. With a new airframe, avionics and propulsion system, the aircraft is the most modern in a series of Black Hawk variants that Sikorsky has been delivering to the US Army since 1978. Sikorsky Aircraft also has delivered UH-60Ms to other US federal government agencies and to international customers. The company is expected to deliver more than 950 UH-60M aircraft to the US Army by 2025.



ATOS system on board ATR 42MP

The *Guardia di Finanza* Air-Naval Operational Command based in Pratica di Mare and SELEX Galileo are celebrating ten years of operations of the ATOS aerial surveillance system on board ATR42 MP aircraft produced by Alenia Aeronautica, currently operated by the Maritime Exploration Squadron (GEA). SELEX Galileo has sold over 45 systems in the last ten years on different types of platforms, both fixed and rotary-wing aircraft, including the ATR42, ATR72, Dash-8, CN235 and Beechcraft King Air 350. Applications of the ATOS system in Italy include the ATR 42 MP and a light-weight version installed on P166-DP1 used by *Guardia di Finanza*.



ATOS on board ATR42

Brazilian Navy to acquire additional S-70Bs

The Brazilian Navy has signed an agreement with the US Government to acquire two additional Sikorsky S-70B maritime helicopters via the Foreign Military Sales (FMS) process. In 2010, the Brazilian Navy contracted for four S-70Bs also through the FMS system, with deliveries starting in December 2011 and continuing through the end of the first quarter of 2012. Sikorsky expects contract finalisation for the additional two aircraft in 2012. The multi-role S-70B Seahawk helicopter will perform anti-submarine and anti-surface warfare missions, among others.

CAE awarded multiple military contracts

CAE has been awarded a series of military contracts valued at more than \$115 million, including a contract from the United States Navy to develop two MH-60R helicopter simulators, a contract from Boeing to design and manufacture training devices as part of the C-130 Avionics Modernisation Programme (AMP) for the United States Air Force, a contract from 'Professional Way' in Malaysia to build a CAE 3000 Series AW139 full-flight simulator and a contract from the United States Army to develop a suite of Abrams tank maintenance trainers.

MH-60S helicopters for Royal Thai Navy

Two MH-60S Seahawk helicopters have been delivered to the Royal Thai Navy, marking first delivery of the MH-60 to an international customer. The aircraft were acquired via the US Government's Foreign Military Sales programme, and will be part of the Royal Thai Navy's fleet modernisation programme to augment the capabilities of six Sikorsky S-70Bs and six marinised S-76B helicopters acquired through US Foreign Military Sales in the late 1990s.



Cassidian MILDS for Korean *Surions*

Cassidian, the defence and security division of EADS, will equip the *Surion* utility helicopter of the Korean Army against missile attacks. Following a multi-million euro contract from Korean Aircraft Industries, Cassidian will deliver a first batch of 24 of its AN/AAR-60 MILDS (Missile Launch Detection System), until 2013. The order comprises about 100 sensors. Cassidian already supported the Korean company Lig Nex1 in the development of the helicopter's electronic warfare system and delivered 36 sensors during the development phase. MILDS is a passive imaging sensor, detecting the UV radiation signature of approaching missiles.



Japan Coast Guard to get new EC225s

Following intensive relief operations after the great east Japan earthquake in March 2011, the Japan Coast Guard, Eurocopter Group and Eurocopter Japan have signed a tripartite contract for the supply of three additional EC225 helicopters to the Japan Coast Guard. These aircraft will be the first civilian helicopters to be equipped with the most advanced mission system to be deployed for search and rescue as well as law enforcement missions. The acquisition will reinforce the fleet with new aircraft that have the technology and capability to carry out complex search and rescue (SAR) as well as anti-piracy missions.



(photo: Nobuo Oyama)

UK contract for 14 new Chinooks

Boeing has received a \$1.64 billion contract from the UK Ministry of Defence to provide 14 new CH-47 Chinook helicopters and associated support for the first five years to the Royal Air Force. The new-build CH-47 Mk-6 Chinooks are part of the MoD's *Strategic Helicopter Vision* to modernise its helicopter force structure, and will expand the RAF fleet to 60 Chinooks. The CH-47 Mk-6 Chinook has a new, machined monolithic airframe with UK-specific avionics, forward-looking infrared radar, a rescue hoist, aircraft defensive systems, and interoperable communication and navigation equipment. The new helicopters will be compatible with the existing UK Chinook fleet.



EADS delivers 180th UH-72A Lakota to US Army

EADS North America has achieved another milestone on the UH-72A Lakota Light Utility Helicopter (LUH) programme as the company has delivered more than half the planned 345



Lakotas to the US Army. The UH-72A Lakota, built by the company's American Eurocopter business unit, is one of the US Army's most successful acquisition programmes and is repeatedly noted by DoD officials for its "on-time and on-budget" deliveries. The UH-72A is based on the EC145 multi-role helicopter and was developed by EADS' Eurocopter division.

Cobham to convert A330 into RAF Voyagers

Cobham has received the first of 12 Airbus Military A330-200 aircraft at its Bournemouth facility for conversion into the *Voyager*, the Future Strategic Tanker Aircraft (FSTA), a variant of the A330 Multi Role Tanker Transport (MRTT) for the Royal Air Force. This aircraft is the first to be converted by Cobham in the United Kingdom. As part of the *Voyager* conversion, Cobham will install a pair of its fifth generation wing-mounted 905E aerial refuelling pods to all 12 aircraft and seven *Voyagers* will also be fitted for Cobham's 805E centre-line mounted fuselage refuelling units.



Is this China's 'Soar Dragon'?

A new unmanned aerial vehicle UAV has been seen for the first time at the Chengdu Aircraft Company's Huangtianba airfield which is assumed to be China's *Soar Dragon*, first revealed at the 2006 Zhuhai Air Show. The *Soar Dragon* is of stealth design, features a joined double wing and is similar in dimensions to the Northrop Grumman RQ-4 Global Hawk.

It is a large UAV with a length of 14.33metres, a wingspan of 24.86 metres and a height of 5.41 metres. Because of the joined wing, the *Soar Dragon* is longer and higher than the Global Hawk, but with a much shorter wingspan at about 70% of the RQ-4As.

This 'Chinese Global Hawk' might even be superior in cruising speed to the RQ-4A at a predicted 750km/hour at a height of over 18,000 metres, but China is still years behind the US in the design of aeronautical engines. The predicted flight range for *Soar Dragon* is 7,000km with a combat radius of around 2,000km and maximum cruise duration of about ten hours.

According to Chinese officials, the *Soar Dragon* is a "high-altitude, high-speed unmanned aircraft system, comprising the UAV flight platform, mission payload and ground control system, which provides peacetime and wartime intelligence to satisfy the needs of future warfare." This is presumed to be stepping-stone for a larger strategic UAV, possibly the long-haul *Solar Eagle*, which will be a key link in the Chinese Control Communications Computers Kill Intelligence Surveillance Reconnaissance (C4KISR) system.



Delta orders CFM56-7BEs for 100 Boeing 737-900ERs

Delta Air Lines have ordered 200 CFM56-7BE engines to power 100 Boeing Next-Generation 737-900ER aircraft scheduled to begin delivery in 2013. The engine order is valued at approximately \$2.2 billion at list price. This new Delta order contributes to what has already been a very successful year for CFM.

Boeing launches 737 MAX with CFM LEAP-1B engines

Boeing has unveiled the 737 MAX, the new engine variant of the 737, which new family of aircraft, (737 MAX 7, 737 MAX 8 and 737 MAX 9) builds on the Next-Generation 737. The 737 MAX will deliver big fuel savings, a targeted 7 percent advantage in operating costs over future competing airplanes as a result of optimised CFM International LEAP-1B engines, more efficient structural design and lower maintenance requirements. When compared to a fleet of 100 of the most fuel-efficient airliners presently, this new model will emit 277,000 fewer tons of CO₂ and



save nearly 175 million pounds of fuel per year, which translates into \$85 million in cost savings. The company has already received commitments and orders for 496 aircraft from five airlines.

UTair order 20 AW139 helicopters

Russian Helicopters (subsidiary of JSC UIC Oboronprom, part of Russian Technologies State Corporation) and AgustaWestland have signed a memorandum of understanding for 20 AW139 helicopters to be assembled in Russia. AgustaWestland and Russian Helicopters have also recently announced the establishment of HeliVert, a joint venture company which will assemble and deliver to UTair a batch of AW139 helicopters from its Tomilino plant in the Moscow region. HeliVert's Tomilino plant will have the capacity to assemble up to 20 helicopters per year, with production to start later in 2011 and progressively increase to a steady state regime by 2015.



Cebu Pacific orders 30 A321neo aircraft

Cebu Pacific of the Philippines has finalised a firm order with Airbus for the purchase of 30 A321neo aircraft. With this, the carrier has increased its total firm orders for the A320 Family to 71, of which 16 have already been delivered. The airline currently operates 25 A320 Family aircraft, including the 16 purchased from Airbus plus nine leased aircraft.



Fourth EC225 for China Ministry of Transport

Delivery of the latest EC225 to the China Ministry of Transport's Rescue and Salvage Bureau completes fulfillment of the contract signed in 2009 for supply of two EC225s for offshore search and rescue missions, with the earlier unit being delivered end of June in 2011. The two new helicopters are to be operated by the Rescue and Salvage Bureau (CRS) for offshore SAR missions, the first of which was delivered in end June with the second aircraft being handed over at a delivery ceremony held in Zhuhai.



Sukhoi Superjet 100 Flight Simulator deployed in Russia

The new Full Flight Simulator for the SSJ100 aircraft has been put in place in Zhukovsky, near Moscow, by the Training Centre managed by SuperJet International, the joint venture between Alenia Aeronautica and Sukhoi Holding. The FFS is produced by French manufacturer Thales, replicating the SSJ100 cockpit and enabling pilots to achieve the SSJ100 Type Rating training without flying. The new FFS "Reality 7" is equipped with LCOS Projectors for the visual system, electro-hydraulic motion system and new IOS station with improved ergonomics.



Lufthansa orders 30 A320neos

Lufthansa has placed a firm order for 30 Airbus A320neo Family aircraft, comprising 25 A320neo and five A321neo aircraft, which will be powered by new-generation Pratt & Whitney PW1100G turbofan engines. With this latest order the Lufthansa Group, Airbus' biggest airline customer, will have purchased a combined total of 443 Airbus aircraft. The A320neo Family also incorporates large *sharklet* wing tip devices, which together with the new more efficient engines, will deliver up to 15 percent in fuel savings.



Boeing delivers 400th aircraft to GECAS

Boeing reached a major milestone with GE Capital Aviation Services (GECAS) by delivering the leasing company's 400th aircraft, a Next-Generation 737-800. GECAS leasing customer Xiamen Airlines will operate this milestone airliner. Till date, GECAS has ordered 485 aircraft from Boeing, including several models of the 737, 747, 757, 767 and 777 families.



Bombardier CSeries for Braathens Aviation

Braathens Leasing Limited has placed a firm order for five Bombardier CS100 and five CS300 mainline jetliners. Braathens also took options on an additional ten CSeries aircraft. Based on list prices for the CS100 and CS300 aircraft, the firm order contract is valued at approximately \$665 million which could increase to approximately \$1.37 billion if the ten options are converted to firm orders. The CS100 is scheduled to enter revenue service in 2013, followed by the CS300 aircraft in 2014.



P&W PurePower PW1500G engine in maiden flight

The Pratt & Whitney PW1500G engine made its first flight in June 2011, launching the engine family's first flight test programme. The PW1524G engine for the Bombardier CSeries aircraft had its maiden flight on Pratt & Whitney's 747SP flying test bed at Pratt & Whitney Canada's Mirabel Aerospace Centre in Mirabel at Quebec in Canada. In addition to full engine testing, Pratt & Whitney has performed critical part level and engine sub-system testing to validate designs for the PurePower engine programme, including design validation of the Fan Drive Gear System, fan blade for bird ingestion and blade containment and compressor performance for the advanced PW1000G core. The PW1500G engine test programme will involve a total of eight test engines over the next 18 months with engine certification scheduled for 2012. Entry into service is scheduled for 2013.



Eurocopter delivers 100th EC225 to Bristow Group

Eurocopter has marked the 100th delivery of an EC225, this received by Bristow Group Inc., a provider of helicopter services to the offshore energy industry worldwide. The landmark EC225 was supplied in the oil and gas configuration but can be used by Bristow in other missions owing to the multi-role helicopter's designed-in operational flexibility. Bristow was launch customer in the oil and gas market for the EC225 when the type was introduced into service in 2005 as well as becoming launch customer for the AS332L in the early 1980s.



Indra contracted by AW for simulators

Indra of Spain and an IT multinational in Europe have announced their partnership with AgustaWestland for the design and development of the Aircrew Training Equipment (ATE) for the British Ministry of Defence to train pilots of the new AW159 Lynx Wildcat helicopter. The devices will be operational and in service to provide training for the Army from early 2013, and for the Royal Navy from early 2014. This contract positions Indra into the UK simulation market as a reference supplier for one of their most representatives' platforms. Indra will provide state-of-the-art synthetic training technology including two Full Mission Simulators (FMS), a Flight Training Device (FTD) and Cockpit Procedures Trainer (CPT).

Garuda Indonesia orders 25 A320s

Garuda Indonesia has finalised an order with Airbus for the purchase of 25 A320 Family aircraft as per an MoU announced during the Paris Air Show in June 2011. The order makes Garuda Indonesia a new A320 Family customer and covers 15 standard A320s and 10 A320neo aircraft for operation by the carrier's low cost unit Citilink. The airline will announce its engine selection for the aircraft in the near future.

Self Ad



Cathay Pacific buys 12 Boeing 777s

Cathay Pacific will buy 12 B-777s from Boeing at a list price of more than \$3 billion as part of the airline's expansion plans. The Hong Kong-based carrier said it would buy four 777-300ER passenger aircraft and another eight 777-200F freighter aircraft for a total list price of \$3.28 billion, but added it had won "significant price concessions" from the US aircraft maker. Cathay would start taking delivery of the aircraft from 2013.

Skywest Airlines/Virgin takes delivery of ATR 72-500

Australian carrier Skywest Airlines has taken delivery of its first ATR 72-500, which is also the very first ATR 72 aircraft in Australia. Skywest Airlines will operate its new ATR fleet on behalf of Virgin Australia, as part of a 10-year agreement signed recently between both airlines to create a regional network for Virgin Australia. This delivery follows the contract for four ATR 72-500s and four ATR 72-600s, plus five options, signed in 2011 between ATR and the leasing company Avation PLC. The remaining three ATR 72-500s will be delivered this year, while the four ATR 72-600s will enter into service in 2012. All these ATR 72s will carry the new white and red livery of Virgin Australia.



European Airline orders four Bombardier Q400s

An 'unidentified' European airline has signed firm orders for four Bombardier Q400 NextGen high-speed turboprop airliners. The transaction includes options on an additional four Q400 NextGen aircraft. Based on the Q400 NextGen aircraft list price, the firm order is valued at approximately \$126 million.



ATR delivers its first ATR 72-600

ATR has delivered the first of two ATR 72-600s to Royal Air Maroc, which is the first operator of the new ATR "600" series. These ATR 72-600s of which the first aircraft was on display at the Paris Air Show 2011, are the first ones to be equipped with the new *Armonia* cabin, specially designed for ATR by the Italian company Giugiaro Design. These are also the first ATR aircraft to be equipped with the new avionics suite developed by Thales, which features a new glass cockpit with five screens and new communication, navigation and monitoring systems. It is also equipped with a new flight management system (FMS), automatic pilot, alert management and a new computer including new aircraft maintenance functions, among other developments.



Hiroshima Prefecture orders AW139

AgustaWestland and Mitsui Bussan Aerospace have announced that Hiroshima Prefecture of Japan has contracted for an AW139 medium twin helicopter. This aircraft will be used by the Hiroshima Prefecture Disaster Relief Department to perform fire fighting and disaster relief missions. The helicopter is due to enter operational service in 2012. This AW139 sale follows an order for the same helicopter type by the Saitama Prefecture in November and by the Fire and Disaster Management Agency in April 2011 and continues operations of the AW139 in the Japanese context for fire fighting and disaster relief applications.



American Airlines order 460 narrowbody airliners

American Airlines, through the parent company AMR Corporation, has reached agreements with Airbus and Boeing for what is arguably “the largest aircraft order in aviation history”, covering a total of 460 narrowbody, single aisle aircraft from both the A320 and B737 families. Both types have proven to be significantly cheaper to operate than AA’s current fleet.

Airbus has secured majority of the deal with firm orders for 260 aircraft which, according to AA, has the “flexibility to convert delivery positions into variants within the A320 Family including the A319 and A321.” Of these, 130 will be the new engine option (neo) version, with AA becoming the first US airline to order the variant. AA has also signed option and purchase agreements for another 365 aircraft. Deliveries of the current A320 Family will start in 2013, with the A320neos coming online in 2017.

Boeing has also secured orders for 200 B737s, plus options on a further 100. There is flexibility to convert “the new deliveries into variants within the B737 family, including the B737-700, B737-800 and B737-900ER.” Deliveries are scheduled to commence in 2013 through until 2022.

Most interestingly, American Airlines has stated that it “intends to order 100 of Boeing’s expected new evolution of the B737NG,” which will be powered by CFM International’s LEAP-X engine. Also, AA is scheduled to take delivery of a total of 54 B737-800s from 2011 into 2013 and has firm orders for eight B777-300ERs to be delivered in 2012-13. It also has plans to acquire 42 B787 Dreamliners, to be delivered in late 2014, with options for 58 more.



Tu-134s and An-24s to be withdrawn from service

Russian Deputy Prime Minister Sergei Ivanov has announced that from January 2012, the Tupolev Tu-134 and the Antonov An-24 are to be withdrawn from scheduled passenger services within Russia, the announcement following two recent fatal accidents.

While operator RusAir has been suspended, the latest steps to ground the Tu-134 have been spurred on by a recommendation from both the Russian Transport Ministry and Tupolev itself. Along with its larger version, the Tu-154, the Tupolev type has formed the backbone of Russian air transport since the 1960s and while Aeroflot disposed of its fleet in 2008, this was blamed on non-compliance with strict international noise requirements and poor fuel economy, rather than airworthiness issues.

With the Transport Ministry estimating that 90 Tu-134s and 180 An-24s remain active, the grounding has caused widespread concern throughout the Russian aviation sector, with airlines looking for find suitable replacements. The intended replacement of the Tu-134 is the Sukhoi Superjet 100, though only two aircraft are currently in service and the production line is yet to pick up momentum.

Shenzhen Airlines to join Star Alliance

Air China’s subsidiary Shenzhen Airlines signed a memorandum of understanding with Star Alliance on 6 July 2011 with the intention to join the global grouping during the second half of 2012. According to Jaan Albrecht, CEO of Star Alliance “bringing Shenzhen Airlines into the alliance is part of a long-term strategy to expand the Star network into the future growth markets, thus providing the international traveler with optimal flight options. Shenzhen Airlines is the fifth largest carrier in China operating from the fifth busiest airport in the country. In conjunction with Air China, we will be growing our presence, especially in the southern part of China.”

Feng Gang, President of the Chinese airline said, “joining the Star Alliance will help us in our mission to build on the strength of the national carrier, Air China while implementing our own strategy to establish the carrier as a strong brand across the Asia-Pacific region and beyond.”



New Laos Airline

Phongsavan Airlines, Laos’ first privately owned airline, is planning to begin service by end-2011. It is aiming to launch services in September with an initial rotation to Bangkok from its base in Vientiane and also plan routes to Hanoi and Siem Reap, rendering it in competition with the national carrier Lao Airlines. Phongsavan is positioning itself as a ‘premium low-cost carrier’, offering both business and economy class options to passengers.

Northrop Grumman and Selex Galileo in DIRCM MoU

Northrop Grumman and Selex Galileo have signed a memorandum of understanding aimed at jointly pursuing the international directional infrared counter measures (DIRCM) market. For almost 20 years, Northrop Grumman and Selex Galileo have been the “preferred supplier” of DIRCM systems to the United States, United Kingdom and close allies. With over 750 DIRCM systems delivered and supported, this “unmatched capability and associated experience and expertise will be brought to the international community

Kongsberg systems for Dutch submarines

Kongsberg has signed a contract for supply of new Passive Sonar Processing Systems (PSPS) as part of the Sonar Suite Modification Project for the four *Walrus*-class submarines of the Dutch Navy. The contract was made between the Dutch Defence Material Organisation (DMO) and Kongsberg, represented by the Naval Systems and Surveillance division. The Passive Sonar Processing System (PSPS) integrates hydrophone data from all the passive sonars aboard into one processing system. This PSPS integration technology has proven to produce more accurate target solutions in shorter time by utilising full potential of the sonar suite, and giving the sonar operators flexibility to use passive sonar data from any combination of sonars to solve their tasks.

Construction begins on future USS Jackson

The US Navy authorised the first cutting of aluminum for the sixth littoral combat ship, the future USS *Jackson* on 1 August 2011. A fast, agile and networked surface combatant, LCS's modular, focused-mission design will provide combatant commanders the required warfighting capabilities and operational flexibility to ensure maritime dominance and access for the joint force. LCS will operate with focused-mission packages that deploy manned and unmanned vehicles to execute missions as assigned by combatant commanders.



Tomahawk programme milestone

On 20 July 2011, the US Navy marked 500 test flights of the Tomahawk Weapons System, in service for more than 30 years. A Tactical Tomahawk (TLAM/E) missile, T-7520, was launched from the USS *Normandy* (CG-60) off the southern coast of Florida and navigated through the Gulf of Mexico to impact a target in the Eglin Air Force Base weapons range. The ability of the Tomahawk to be launched from over 140 US Navy ships and submarines has led to its use in every major combat operation since *Operation Desert Storm* in 1991. Recently, the 2,000th combat missile was launched against Libyan air defences during *Operation Odyssey Dawn*.



Navantia's 'Meteoro' commissioned

The first Maritime Action Ship (BAM), *Meteoro*, for the Spanish Navy has successfully completed the last of its sea trials and has been commissioned by the Spanish Navy recently. The commissioning ceremony was presided by the Minister of Defence, Carmen Chacón, who also announced a new contract with Navantia for five additional units of this class. The *Meteoro*, launched on 16 October 2009, is a moderately sized, “high performance ship with great versatility” and has a high level of system commonality with other Spanish Navy ships and has low acquisition and life cycle costs.



DCNS Gowind OPV begins sea trials

The Gowind offshore patrol boat *L'Adroit* has begun sea trials to validate the seakeeping and other nautical qualities of the vessel. These initial sea trials mark the beginning of the next phase of the Gowind OPV programme, which spearheads DCNS's efforts to win a larger share of the markets for small and medium displacement surface ships. The sea trials are beginning in line with the contract schedule, just 14 months after construction started on the Gowind *L'Adroit*, an innovative offshore patrol boat designed for maritime safety and security missions. OPV *L'Adroit* has a length of 87 metres, an at-sea endurance of three weeks and a range of 8,000 nautical miles. With a top speed of 21 knots, the vessel has a helicopter flight deck and can accommodate UAV (unmanned aerial vehicle) operations. It is designed for reduced crew, with a complement of 30 and room for 30 passengers.



Finmeccanica wins orders from US Army

Finmeccanica, through its company DRS Technologies, has been awarded a contract valued at \$ 514 million by the US Army to supply the Small Tactical Optical Rifle Mounted Micro-Laser Range Finder (STORM-mLRF). The five-year indefinite-delivery, indefinite-quantity (IDIQ) contract calls for qualification and manufacturing of a minimum delivery of 150 and a maximum of 32,000 micro-laser range finders. DRS' STORM sight combines a laser range finder with a digital compass and a processor that computes and displays targeting data, an infrared aiming laser, a visible pointer and illuminator, and the Multiple Integrated Laser Engagement System (MILES) to simulate tactical engagement in training exercises.

Saab receives new orders for Carl-Gustaf

Saab has received an order for components to the Carl-Gustaf man-portable weapon system at a value of MSEK 362. "This is very positive and it further proves the capability of the Carl-Gustaf system which until now has been exported to more than 40 customers around the world", said Tomas Samuelsson, Senior Vice President and Head



of Saab's business area Dynamics. Delivery will take place during 2011-2012. The Carl-Gustaf system has a long and successful history, and remains a highly modern and capable Ground Support weapon. The system has successively been modernised and adapted to meet new requirements and with the Carl-Gustaf M3 version, Saab offer state-of-the-art capability for demanding customers investing in the future.

The Indian Army has been a long term user of the Carl-Gustaf 84mm weapon, used in operations ranging from high mountains to desert terrain.

Raytheon and Rafael to market 'Iron Dome'

Raytheon and Rafael Advanced Defence Systems Ltd have teamed to market the Iron Dome weapon system in the United States. Rafael developed the original Iron Dome to provide protection against rockets, artillery and mortar attacks. The programme has completed flight test trials and the weapon system is currently used around Israeli population centres to protect against terrorist rocket attacks. Raytheon and Rafael are also teaming on the 'David Sling' Weapon System, which is a mobile, land-based missile defence programme plus the Blue Sparrow missile defence targets system.

IAI/ELTA to supply radars of STAR product line

ELTA Systems Ltd., an IAI group subsidiary, has been awarded a \$17 million contract to supply Surveillance & Air Defence Radars of the STAR product line to an 'undisclosed customer'. The STAR radar family, designated ELM-22X8, comprise 3D multi-purpose radars operated from ground and naval platforms and providing superior performance in air defence, air traffic control and also sea surface search as well as threat identification and alert. The STAR radars are designed to support air defence mission including networked Anti-Air Missile (AAM) weapon systems and sea surface gunnery engagements.

An Act of War?

The Gujarat Beechcraft Incident

“It is a twin-engined, twin-tailed aircraft...with four side windows, probably an eight-seater...it is flying at 3,000 ft amsl. Request further instructions.” Flg Off Qais M Hussain, who had been scrambled from the PAF airbase of Mauripur to check a suspicious radar contact south-west of Bhuj, was reporting to the Ground Controlled Interception (GCI) controller at Badin’s FPS-20 radar.

“Standby,” replied the GCI controller Flg Off Aziz A Khan, hesitantly, as he decided to consult the higher authorities.

Qais, a ‘rookie’ who had completed his conversion on F-86s from USA only four months earlier, belonged to

Somewhere during the descent, Qais lost radio contact with Badin but Kazmi’s F-86 came in handy as a useful radio relay. Looking around intently, Qais caught a glint of bare metal in the afternoon sun. After having closed in and having examined his quarry thoroughly, Qais passed his initial report to Badin via Kazmi. He then started orbiting over and around what was only later confirmed as a Beechcraft Model 18 executive transport aircraft.

“When I saw this aircraft, I asked myself what was I to do with it,” recalls Qais. To his surprise, the Beechcraft pilot reacted to the interceptor’s presence by climbing up from its cruise altitude of



The Beechcraft 18, similar to the aircraft shot down on 19 September 1965

right wing in flames. Moments later, the Beechcraft nosed over into a near vertical dive and exploded in a ball of fire near the village of Suthali, about half a mile from the coast (about 45 nautical miles WSW of Bhuj). Just then, Kazmi called out that Badin radar was reporting several aircraft – possibly Vampires from Jamnagar, it was thought – heading towards the scene of shooting.

Having flown a good 210 nm from home base and, been airborne for 30 minutes, the fuel state of the F-86 was low and precluded possibility of escape while hugging the ground. Qais was, however, fortunate to stumble onto a towering coastal cloud bank that he could hide behind, while climbing away. Reaching 15,000 ft over the border, Qais started a slow descent for Mauripur. His fuel tanks bone dry, Qais landed through a precautionary flame-out landing pattern.

The same evening it was learnt through All India Radio that the eight people on board the Beechcraft, including the Chief Minister of Gujarat State, Balwantrai Mehta, had been killed; also on board were the Chief Minister’s wife, Mrs Sarojben Mehta, three members of the Chief Minister’s personal staff and a press reporter from the daily *Gujarat Samachar*. The crew of two included an ex-IAF pilot, Jehangir M Engineer, one of IAF’s four famous Engineer brothers (The Times of India, Ahmedabad). He was the chief pilot of Maharashtra State Government but was on loan to Gujarat. The aircraft had taken off from the Gujarat capital of Ahmedabad and was on its way to the small town of Mithapur that lay 200 nm WSW, at the mouth of the Gulf of Kutch. The aircraft had apparently drifted off-course considerably, for the crash site is almost 40 nm north of the intended destination.

An Indian inquiry into the incident submitted the facts four months later. According to the inquiry report, the IAF authorities at Bombay had refused to let



Pakistan Air Force F-86F Sabre off what could well be the Makran Coast

No.18 Squadron and was part of a small detachment of pilots being rotated at Mauripur, while the rest of the squadron operated out of Sargodha. While on alert duty on 19 September, his F-86F pair was scrambled around 1545 hrs (PST). Qais, however, had to take off as a singleton since his leader, Flt Lt AI Bukhari, had aborted due to a starting problem. Another standby aircraft, flown by Flt Lt A S Kazmi, took off after a delay of 6-7 minutes, but never caught up with Qais and continued to hold over the border at 20,000 ft.

Initially, Qais had also been told to climb to 20,000 ft to conserve fuel, but was later directed to descend lower and try to spot the reported contact visually.

3,000 ft. Qais thought to himself that if shooting orders came, it would only make his job easy, compared to the trickier high-to-low shooting from stern, had the aircraft ducked down to low level.

“During the anxious wait of several minutes, I was wishing and hoping that I would be called back immediately, without firing any bullets,” recalls Qais pensively. However, the stark orders from Badin were relayed by Kazmi: “You are clear to shoot.” Adjusting himself behind the doomed Beechcraft, Qais fired a short burst from about 1,000 ft and saw a splinter fly off from the left wing. Speeding past the stricken aircraft, Qais readjusted for a second firing pass. Firing a long burst this time, he saw the

the aircraft proceed on the flight. When the Gujarat government pressed for clearance, the IAF authorities agreed reluctantly, giving clearance for the pilot to proceed “at his own risk”.

The purpose of the risky visit to Mithapur remains unclear. One could speculate, though, that the Chief Minister may have sought to publicly demonstrate solidarity with his coastal constituency in the wake of Pakistan Navy’s earlier attack on Dwarka which, while tactically insignificant, was wholly morale-shattering. After all, the Chief Minister had, only earlier that morning, presided over a mass National Cadet Corps rally in Ahmedabad “to boost the country’s defence effort. (Express News Service, Ahmedabad)”

Regrettable as the news of civilian deaths were, no one at Headquarters No.2 Sector at Badin had feared that civilians would be on board an aircraft in the thick of the war zone. The Sector Commander, Wg Cdr Mehmood Hassan and the Officer Commanding of the Operations Wing, Sqn Ldr Abdul Moiz Shahzada had hastily surmised that the aircraft was proceeding on some sort of a reconnaissance or air transport mission. Shooting down of the aircraft was, thus, deemed an indisputable answer to the prevailing quandary. The niceties of territorial inviolability had obviously no room for debate, for this was clearly not a peace-time situation.

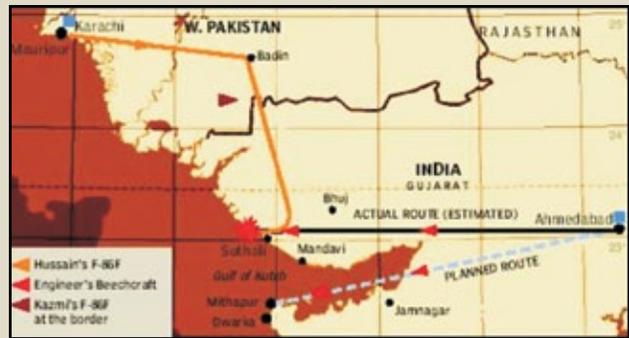
Both India and Pakistan had utilised civilian registered aircraft for transportation of military supplies, equipment or manpower and for maritime reconnaissance during the 1965 War (as well as 1971 War). The inherent military potential of any aircraft was well understood and was suitably exploited. The onus of safety of these platforms lay on the host country, as the lines between their civilian and military usage were blurred during hostilities. Except for United Nations or Red Cross / Red Crescent aircraft whose identity is unmistakably displayed, all other aircraft could be construed as liable to serving military objectives, not withstanding their civilian registration markings. Proper codification of aviation law to remove any doubts on the issue did not exist in the 1965 era and, in fact, was first made part of the Geneva Convention as late as 1977.

It would be worthwhile to study a portion of ‘Protocol Additional to the Geneva Conventions’ of 12 August 1949, and ‘Relating to the Protection of Victims of International Armed Conflicts (Protocol I) Article 52’ of 8 June 1977. Even a cursory reading reveals that total or partial destruction, capture or neutralisation of those ‘objects’ that can make effective contribution to military action by virtue of their nature, location, purpose or use, is defensible. The statute clarifies that while civilian ‘objects’ per se shall not be the attacked, it clearly makes an exception ‘if these objects serve military objectives.’



Flg Offr Qais M Hussain on Sabre wing

Rather than attempting to seek cover of a later legislation through retroactive application, it would be instructive, purely from an academic standpoint, to see how the incident stands up to contemporary international legalities. It can be seen that the object under discussion namely, the Beechcraft aeroplane, by its nature, was capable of transporting military stores/personnel as well as performing land or maritime reconnaissance (visually at least); its location was also in an area contiguous to the land and maritime war zones. The actual purpose of the flight – which, in the event, turned out to be VIP movement – borders on the suspect when seen in the light of the other



provisions mentioned heretofore, which unequivocally qualify the aircraft as ‘serving military objectives.’

Unfortunately, the safety of the aircraft stood compromised from the outset. Worse, the IAF failed to appreciate that the PAF had, time and again, carried the battle to the enemy and the fate of hapless Beechcraft should have been a foregone conclusion. Sadly, the loss of innocent lives has cast a shadow under which, more than anyone else, Qais has had to live for over four decades. He looks back ruefully, though he has no doubt that he was doing his duty.

Author’s Notes: Based on his familiarity with the ‘scramble-identification-shooting’ loop, and the not infrequent pilot-controller miscommunication during interceptions especially on a faulty radio, the author is inclined to consider the intriguing possibility of a case of mistaken identity. In such a scenario, the staff at HQ No 2 Sector would have found Qais’ initial report broadly matching the description of a C-119 Packet transport aircraft of the IAF, to the extent of being ‘twin-tailed, twin-engined, with four side windows.’ In all likelihood, no one knew what a civilian Beechcraft Model 18 looked like, whereas the unique C-119 military transport aircraft was a recognisable silhouette in Aircraft Recognition charts and manuals readily available in all Ops Rooms. The prompt shooting orders may have, thus, come straightforwardly, not withstanding the civilian registration number called out by Qais earlier. However, in view of lack of irrefutable evidence to this effect, this contention is not wholly supportable.

Air Commodore (Retd) Kaiser Tufail, PAF
 Acknowledgement is made to Air Cdre (R) Abdul Moiz Shahzada, Wg Cdr (R) Aziz A Khan and Flg Off (R) Qais Mazhar Hussain for their description of the incident.

Act of War-II

MiG-21 of No.45 Squadron over the Saurashtra coast.

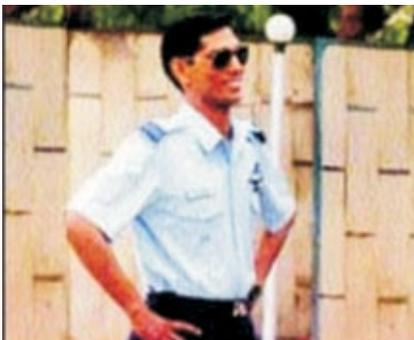


P.N. Atlantique shot down

On 10 August 1999, just weeks after the Kargil operations had ceased, an Indian Air Force MiG-21M of No.45 Squadron, scrambled from the Air Force Station at Naliya in Saurashtra, intercepted and shot down a Pakistan Navy Breguet Atlantique maritime patrol aircraft of No.29 Squadron with 16 people on board, after it violated Indian airspace. Curiously the location was not far from where the PAF had shot down the Beechcraft 18 with the Gujarat Chief Minister on board some 34 years earlier.

the engine on the port side of the aircraft which then lost control and spiralled down towards a crash at an approximate

location 23°54N 68°16E, killing all 16 on board including five officers of the Pakistan Navy.



Sqn.Cdr. PK Bundela

The PN aircraft took off from PNS Mehran (near Karachi) and as it approached the international border, two IAF MiG-21s were scrambled to monitor the intruder. After a series of manoeuvres - and a conflicting version of events from both sides - clearance was given to shoot down the Atlantique and an infrared homing R-60 air-to-air missile was launched at it by Squadron Leader PK Bundela, hitting



File photo of PN Breguet Atlantique of No.29 Squadron over the Makran coast



REQUIEM FOR A RANK

Post Independence, the Indian defence services, having evolved out of their British forbears, continued with the same nomenclature of commissioned officer-ranks and a similar hierarchical structure. In the Indian Air Force (IAF), the entry level at commissioning was in the rank of 'Pilot Officer'. A few years ago, primarily as a recruitment incentive, all three services decided to bypass the first rank and commission new officers directly into the second rank. In the IAF this was 'Flying Officer' and thereafter the term 'Pilot Officer' was heard of no more.

Those of us who were commissioned in the rank of Pilot Officer (Plt Offr) recall with nostalgia the great attraction this very first rank held for us. It marked not merely the end of (unpaid) trainee status, but bestowed a new identity, a salary and signified an initial fulfillment of a professional ambition. In the Flying (Pilot) branch, this rank described accurately twin attainments: qualification as a pilot (denoted by the wearing of wings on the chest) and as a commissioned officer in the IAF identified by wearing of the narrow (quarter-inch) blue-black rank badge of a Plt Offr on the shoulders. Newly commissioned officers of the non-flying branches (Technical/Administration) took equal pride as rank of Plt Offr identified them as commissioned officers in the air force.

The first six months of Plt Offr rank was considered as being on 'probation' and hence the rank was treated as 'Acting'. Thereafter, subject to 'satisfactory service and the passing of a promotion exam, a year later one was elevated to the rank of Flying Officer (Fg Offr) which the present generation attains right away at entry level on being commissioned. It was a somewhat strange tradition (inherited from the RAF) that Plt Offrs were not permitted to print



Air Marshal S Mukherjee at AFAC, 1959.

their rank on visiting cards (possession of which was de-rigueur in those days) but were restricted to the ubiquitous 'Mr'. I might add that the very few ladies then in the Air Force were all medical officers and came into service with the rank of Fg Offr.

The initial few weeks in the rank of Plt Offr were spent at specialist training units of our respective professional disciplines, on completion of which, we were posted to various squadrons/units. There we were

eagerly awaited by our erstwhile seniors who, now sporting half-inch rank badges of Fg Offrs, were keen to hand over the less popular duties to their new underlings! In the memorable words of a newly promoted Fg Offr, 'pilot officers are the lowest form of life in the air force and might be seen but certainly not heard'! The first rank was not only a great learning experience but also great fun for the most part. One unexpected bonus of being a newly commissioned young Plt Offr was the great interest it seemed to generate in young ladies (- and their mothers!).

The first year as a Plt Offr passes fast and all too soon one found oneself promoted to Fg Offr, when visiting cards had to be reprinted - this time with rank. For all practical purposes of course, the Fg Offr of today is the Plt Offr of yesterday but with greater benefits. Whatever be the advantages of burying the rank of Pilot Officer, it will continue to live in the memories of generations of us who wore this first rank with great pride in days of yore.

Air Vice Marshal (R) CV Parker, MVC VM



Marshal of the Air Force Arjan Singh at the AFA, 2011

Normally, the man in the street thinks about the Indian Air Force in terms of its lethality, its prowess and capability vis-à-vis the adversaries. In his mindset, the Air Force stands for supersonic fighter aircraft ever ready to be flown by experienced and dynamic young pilots into battle, in defence of the nation. The IAF takes his mental horizon towards daring feats of IAF fighter pilots in the Kargil operations and earlier, in December 1971, annihilation of the enemy's armour at Longewala, besides so many acts of heroism in the air. Thus, when the IAF brings out Coffee Table Books (quite regularly nowadays), one expects its focus to be on war fighting and perhaps peace-time exercises, simulating actual war scenarios.

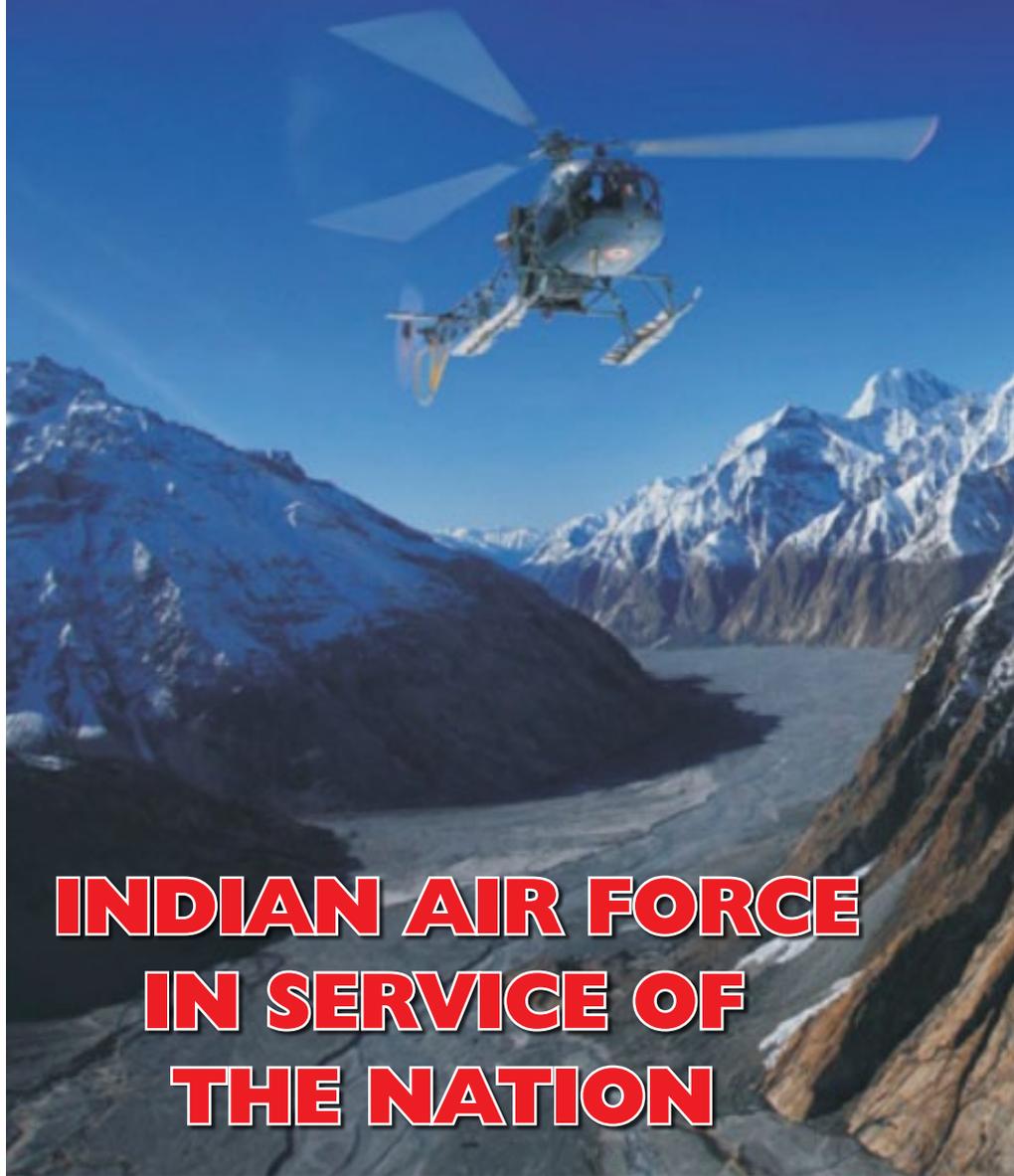
But this Coffee Table Book under review, released by Air Chief Marshal Pradeep Naik, Chief of the Air Staff (since retired), instead focuses on the 'healing touch' that the IAF provides 'during crisis and calamity'. This is the other benign face of the IAF, reflecting its perennial concern for humanity in distress and its resourcefulness in providing quick and effective relief and succour to those people in need.

Paraphrasing the thematic genesis of the book, Air Chief Marshal Pradeep Naik aptly notes in the preface: "As a key element of national power, the IAF strives to achieve national aims. We exist to fight and win wars. That apart, air power bestows immense capabilities. Such missions involving humanitarian aid, disaster relief, aid to civil power and national building present the humanitarian face of the Indian Air Force."

This 'humanitarian face' of the IAF is spread across 215 pages of the book with over 250 brilliant photographs and poignant text graphically describing the spirit behind action etched in the images. *Vayu's* contribution to the Book is easily acknowledged, with the Editor (Pushpinder Singh) having presented a number of historic photographs.

So, the first chapter entitled *The Early Years* features great personalities in annals of the IAF: 'Jumbo' Karun

SO THAT OTHERS



INDIAN AIR FORCE IN SERVICE OF THE NATION

The world's largest helicopter, Mi-26, with bulldozer flown to the world's highest airstrip.



MAY LIVE



HAL Cheetah of the IAF flying above the Siachen Glacier.



Mi-17 positioning Army Commandos during anti-terrorist operations in southern Mumbai.

K Majumdar, Mehar 'Baba', Arjan Singh and the IAF in action during the Second World War, including the siege of Imphal, then Independence and the first missions (evacuation of refugees by Dakotas), the Poonch air bridge, flood relief operations by the first Sikorsky S-55 helicopter, STOL Caribous landing at remote advanced landing grounds in the North East, Mi-4 helicopters in evacuation of casualties and Dakotas engaged in air maintenance tasks.

The second chapter, *Building the Nation*, focuses on the continuing support of the Army in remote border areas with helicopters (Mi-4s and later Mi-8s), the An-32 connecting people of the North East cut off from the rest of the country because of paucity of roads and inclemency of weather. Such operations have created a "strong bond between airmen and the people." Air maintenance in the remote areas is the responsibility of both Western and Eastern Air Command with their weave of DZs, ALGs and forward air bases. Also, centre-staged in this context are the heavy-lift Il-76s and Mi-26s, continuously engaged in ferrying machinery and materials.

Of special interest to those passionately attached to military aviation history are references to the first ever landing at Daulat Beg Oldie, arguably the highest air strip in the world, at some 17,000 feet above sea level. Most aptly worded, it was indeed 'Operating at heights closer to God'. "Nearly half a century ago on 23 July 1962," reads the text, "an IAF Fairchild C-119G, Packet, fitted with an Orpheus engine jet pack, piloted by (then Sqn Ldr later Air Marshal) CKS Raje, landed at Daulat Beg Oldie. DBO strides the Chip Chap River near the line of actual control with China and is barely 10 km from the Karakoram Pass and of profound strategic importance by its sheer geographical location. The landscape is bleak with sand brown earth, blinding white snow and azure blue skies. Not a blade of grass can grow here and temperatures can drop to nearly minus 50°C. For the indomitable soldiers of the Indian Army, the only link with civilisation is via the medium of air. The IAF recently revived



Indian Air Force Mi-8s on duty with the United Nations in Congo.

operations to DBO by landing an Antonov An-32 at a sandy landing strip to offload provisions necessary to sustain the Indian Army.”

A striking highlight of the book is the pictorial depiction of *Operation Black Tornado*, in response to the Mumbai terror attack in which IAF Mi-17 helicopters played a critical role. The image of a Mi-17 helicopter overflying the Taj Hotel on the Mumbai waterfront is evocative and is testimony to the valour and efficiency of the joint operations.

The chapter on national calamities and the role played by the IAF in providing relief and succour is central to the *raison d'être* of the book. One has the flooded plains of Assam awaiting help from the skies, scenes of the Bhuj earthquake, the Tsunami ravaging the Air Force base at Car Nicobar, the December 2004 flash floods in several parts of the country receiving prompt attention from the IAF, conscious that “while the ravaging water cannot be thwarted, their speed of response can beat the river and rescue the flood victims.” A more recent calamity was the cloudburst at Leh where the IAF played an important role. IAF helicopters have often rescued people stranded at the snow-bound Zojila pass. For evacuation of sick mountaineers,

IAF helicopter crews have had to land on mountain ledges, often beyond the theoretical maximum flying altitude of the aircraft.

The *Timber Trail Rescue* in October 1992 is already etched in the collective memory of people in Himachal Pradesh. It was supervised by then Group Captain Fali Homi Major who later became Chief of the Air Staff. Tourists in these foothills of Simla were evacuated from a precariously dangling cable car. The operation, skilfully executed, set a new benchmark in the annals of air-rescue operations.

Other humanitarian missions accomplished by men and machines of the IAF over the years relate to *Cyclone Storms in Gujarat* and the *Earthquake in Kashmir* (October 2005). In the latter case, after providing necessary relief, the Indian Air Force ‘adopted’ Urusa and three neighbouring villages of Cherkara, Gwalta and Isham in the Uri region.

The IAF’s humanitarian work is not limited to the boundaries of India. Such missions have been undertaken from time to time, ‘across the Seven Seas’ in Japan (post Second World War); UN Congo missions in Congo (1960), *Operation Poomalai* in Sri Lanka, *Operation Cactus* in Maldives, UNMIS in Sudan; again in Congo under the UN

flag, and in New Orleans (USA) in the wake of *Hurricane Katrina*.

At present, the leading heavy lift aircraft with the IAF is the Il-76 and recently inducted C-130J but soon the IAF will have on its inventory the mega-lift C-17 Globemaster : an exciting future is ahead! But the reviewer, having witnessed IAF transport operations from a vantage point in the decades preceding the induction of the Il-76, is nostalgic about the redoubtable workhorse An-12, which does not feature at all in the book.

All those associated with the conception and production of this commendably attractive Coffee Table Book deserve unstinted kudos. The book proves the versatility of the men in blue, not only as pilots, engineers and administrators, among other roles, but also as editors, photographers, designers, writers and visualisers. Sunil Jain deserves special mention for his contribution of captivating images from his well-known photographic website. The reader will feast his eyes time and again on the cinemascopic pictures of the IAF aircraft operating in terrain, regions and ambiances that are supremely exotic and extraordinary!

Gp Capt (Retd.) JC Malik

25 Years back

From Vayu Aerospace Review Issue V/1986

MiG-29 manufacturing options

India is keeping its options open on manufacturing the Soviet MiG-29, 50 of which are reportedly to be procured for the Indian Air Force directly as 'flyaway' aircraft. Acquisition of the MiG-29 breaks the intervening brief period during which West European combat aircraft (Jaguars and Mirages) were acquired by the IAF. The MiG-29 became an object of Indian interest following the acquisition of F-16s by Pakistan and the Soviet fighter is considered superior to the F-16 in the air superiority role.

Last batch of Mirage 2000s

The last batch of Mirage 2000 fighters on order for the Indian Air Force were delivered by end June 1986.

Mi-26s for the IAF

The Indian Air Force is acquiring the heavy-lift helicopter Mi-26 from the Soviet Union, the heaviest and most powerful helicopter in the world. The IAF has already acquired two Mi-26s to test their operational feasibility both in the high mountains as also the plains and it is proposed to raise a Mi-26 unit in the western sector within this year. India is the first country outside the Warsaw-pact to have acquired the Mi-26 which became operational with the Soviet Air Force in late 1983. In the freight hold of the Mi-26, at least 70 combat-equipped troops or 40 casualty stretchers can be accommodated. As against this, the Mi-17 helicopter acquired by the IAF in 1984 can carry 24 troops or 12 stretchers or about 4 tonnes of freight.

Importance of Defence R&D

Prime Minister Rajiv Gandhi, addressing a meeting of the newly constituted Scientific Advisory Committee (SAC) has stated that the time had come for the Defence Research and Development Organisation (DRDO) to move away from mere import substitution and concentrate on developing major systems. The past attitude of production agencies towards R&D was illustrated by the record of two public sector undertakings Hindustan Aeronautics Limited (HAL) and Bharat Electronics (BEL).

Light Combat Aircraft (LCA) Project

Prime Minister Rajiv Gandhi has defended the Light Combat Aircraft (LCA) and said that if India did not invest in the project now it might not be possible to develop the multi-mission tactical fighter aircraft which would be required for the IAF from the mid-nineties. The Minister of State for Defence, Arun Singh refuted allegations that the Air Force was not enthusiastic about the LCA project; the Air Force fully supported the LCA project as it was aware of the astronomical cost of importing aircraft as an alternative.

ALH mock-up revealed

A full scale mock-up of the Advanced Light Helicopter (ALH) to be manufactured by HAL has been completed at Bangalore. The

model was shown to the Minister of State for Defence Arun Singh and the three Chiefs of Staff during their recent visit to the city. HAL sources have said that ALH prototype fabrication would commence soon and it would be test-flown in 1990; production batches for the three Defence services and civilian users would follow from the mid-nineties.

The Turbomeca TM 333B engine has been selected for the ALH. The ALH would be the principal rotorcraft of the Army, Navy and the Air Force. It would be developed in utility transport and anti-armour versions for the Air Force and the Army and as a SAR/ASW helicopter for the Navy.

Grounding of MiG-21s

The Defence Ministry has officially acknowledged grounding of a variant of the MiG-21 for some time last year. A study team which investigated the matter found evidence of overheating in the rear fuselage area and that such overheating could result in fire and failure of controls in case hydraulic leaks occurred in the heated zones. Remedial action has been taken on the basis of the recommendations of the study team.

INS Virat (Hermes) to be received in 1987

INS *Virat*, formerly the HMS *Hermes* which is being acquired from Britain for the Indian Navy, will be received some time next year. The CNS has stated that a plan was afoot to build larger-size vessels such as frigates at the Garden Reach Ship Building Yard. This would be in addition to the small size ships like Seaward Defence Boats being built at the yard at present.

Pentagon and Indian Defence R&D

A high level team from the US Pentagon which visited India recently has reported that the environment to do business with India was "warm" and has reportedly urged a small but forceful minority within the Pentagon to refrain from hindering Indo-US defence collaborations. Main purpose of their India visit was to explore possibilities of collaborating with India on the Light Combat Aircraft (LCA) project and the *Arjun* main battle tank (MBT) project. The US has already cleared sale of the General Electric F-404 engine for the LCA if so selected. In these two major projects, the team has reported that there are several areas where the US could collaborate with India.

AI to dispose of Boeing 707s

Air India will dispose of its five Boeing 707s, which it plans to phase out from October 1986. The airline has invited global tenders and five parties have so far shown their inclination to purchase the aircraft. Last year two of the earlier phased-out aircraft were ultimately sold as scrap following the airline's purchase of six Airbus A310 aircraft. The first Rolls Royce Conway-powered Boeing 707 joined the Air India fleet in February 1960 and the last, powered by Pratt and Whitney engines, in 1968.

AI, IA Boards to be reconstituted

The government proposes to immediately reconstitute the board of directors of Air India and Indian Airlines. The Government desires that integration of the two airlines be completed within a year which would save the airlines at least Rs.100 crore. The integration will be in operational, maintenance, sales and ground service sectors where better utilisation of joint property could be possible. The phenomenal growth rate in the traffic also warrants search for a new generation of wide bodied, long haul aircraft from the mid-nineties. Vayudoot, the third airline, will function as a separate subsidiary and play its role of what could be termed as "bush operations".

How many Air Forces ?

Five : Readers will be familiar with at least the top three but less so with the lower two. No guesses : number 4 are the pilot's wings of an Indian Coast Guard aviator and the last one adorns the chest of a BSF (Air Wing) pilot.



In fact, there was lively interaction during the recent national seminar marking Silver Jubilee of the Army Aviation Corps where a plucky officer in blue, outnumbered in a sea of olive green Army Aviators, speckled with white (Navy and Coast Guard), argued against having 'too many' Air Forces in the country. The wise man that he is, India's Defence Minister offered to help in any reconciliation process for "perfect synergy" between the Army and the Air Force.

Tales of Akbar Road

Coincidence ? Not even two weeks after Air Headquarters released their Coffee Table book on 23 Akbar Road, 'Air House ... Down the Years', the Grand Old Party of India released their own short history of 24 Akbar Road, across the road where the Congress Party has their Headquarters. Both bungalows with their sprawling gardens are in the heart of Lutyen's Bungalow Zone (LBZ), built in the late 1920s as New Delhi was unfolding. The residential areas of New Delhi flanked the Central Vista, the bungalows with numerous Tuscan colonnades embellishing their deep varandahs.

While 'Air House' hosts gracious events, climaxed by the 'at home' on 8 October every year, 'the Congress home' has an air of continuous politicking by those close to the corridors of power.

Hospitality versus Hostility

The series of events in southern Goa paced around the Golden Jubilee celebrations of INS Hansa had serving and retired Naval Officers as also senior executives from international companies invited to an international symposium, staying in beach resorts on the Arabian Sea. The majority were staying at the Bogmallo Beach Resort, just a short distance from the Naval Air Station at Dabolim. Some others stayed further along the Arabian Sea, at the Park Hyatt Goa.

What a difference in attitude ! While the Bogmallo Beach Resort, which hosted serving Naval Brass at various functions, welcomed guests with traditional Goan hospitality, the Park Hyatt was positively hostile, treating all visitors as if they were potential terrorists. *Bem-vindo* !

Take a seaplane to T-3

The image is self explanatory. This was taken on 16 September after the deluge that day and is of the underpass to the Delhi International Airport Terminal 3.

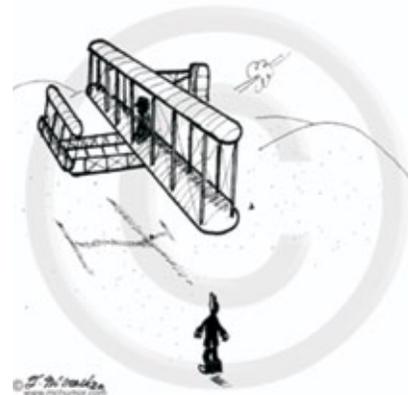


Roads were submerged, vehicles water logged and even roof of the Terminal leaked. Fortunately, the Ministry of Civil Aviation have taken the initiative of evaluating Seaplanes for services in the Island territories.

Best begin at home !

A century plus

In celebrating the 100th anniversary of Civil Aviation in India, the Ministry of Civil Aviation launched a series of events from January 2011 to continue through the year, which include seminars, honouring of veterans and memorial lectures. But, as aviation aficionados have pointed out, 2011 is actually the 101st year after the first flight took place in India. Or the



102nd if records have it right when an unnamed gentleman flew an aeroplane at the Calcutta maidan in December 1909. Actual civil aviation activities really only began in 1930 when the Indian State Air Service linked Karachi with Calcutta.

But then who is counting ?



Yummy ! Reports have it that most members of an Indian delegation to the recent World Economic Forum in China carried their own (vegetarian) Indian food for the duration. No Cantonese or Szechuan for us !

Afterburner

