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VI/2015

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Indian Navy P-8I of INS 312A at INS Rajali, Arakkonam (photo : Angad Singh)

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In Vayu's exclusive interview, Admiral RK Dhowan, Chief of the Naval Staff reviews the Indian Navy's determined modernisation process and projected capabilities. The CNS highlights the multitude of opportunities offered to India's aspiring classes looking to the Navy for a way of life.

39 Exercise Malabar 2015



Warships and submarines from the Indian, Japanese and US Navies converged in the Bay of Bengal for a weeklong joint exercise in October 2015. Vayu's Angad Singh was on hand to file this first hand report from Chennai as well as from on board the US Navy's Nimitz-class supercarrier, USS Theodore Roosevelt.

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48 Boeing P-8I : Enhancement for the IN



Dedication ceremony at INS Rajali, home base of INAS 312A which operates the Navy's Boding P-8I fleet took place in October 2015 even as 5000 flight hours of the P-8I fleet was celebrated.

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The Indian Navy's MiG-29K/KUB was commissioned with INAS 303 some years back and in this update, Sayan Majumdar writes about its key systems and its primary role in establishing local air superiority (photos by Angad Singh).

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After visiting the guided missile stealth destroyer INS Kochi (D64) earlier this year and being briefed on its features and technology, Vishnu Som of NDTV presents a possible naval scenario involving the Indian Navy's latest and most lethal warship.

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Vayu's Angad Singh spent time with the Indian Navy at INS Dega in Visakhapatnam and reports on the Navy's advanced jet training squadron INAS 551 Phantoms.



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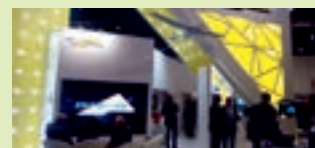
Vayu's UK Editor Richard Gardner reports from Seville, Spain, after the Airbus Defence and Space annual Trade Media Briefing (TMB'15), with focus on various programmes, many of them of interest and relevance to India.

84 Surya Kirans New Avatar



The Indian Air Force's Surya Kirans aerobatic display team has been re-established with new BAE Hawk Mk.132 aircraft. In an exclusive, Vayu's Angad Singh reports on their current and future plans.

88 DSEI 2015



The biennial Defence and Security Equipment Exhibition (DSEI) in September 2015 is covered in detail by Vayu's Editorial team, led by UK Editor Richard Gardner, with an overview of the 1600 exhibitors that took part, with national pavilions from 42 countries and 8 visiting warships. Indian capabilities were also on display, both from the public and private sectors.

Also: EMALS; World Market for Conventional Submarines; Admiralty Shipyards; DCNS sails ahead !; Rolls Royce and IN; The Yak-13; Turkish Coast Guard Aviation; Flying the 'Hump'; Along the Aluminium Trail.

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The Sense of Shock and Awe

The downing of a Russian aircraft by Turkey is the latest twist in centuries of tangled relations between two great powers with a long history of tension and rivalry, one that dates back to the Crimean War (1856). Contextualised with the past, the targeting of the Su-24 jet will be recorded as the first time since the Cold War that a NATO member has shot down a Russian military aircraft. Lessons of history would suggest that such incidents have the potential to ignite deadlier confrontation and not least in the context of Syria that has reached boiling point. On the face of it, Turkey has bared its angst over continued breaches of its airspace over the past two months, more accurately ever since Russia began its air-strikes on Syria on 30 September, as much against the rebels as against ISIS.

On this day, however, as a Turkish map has indicated, the plane had entered its airspace only briefly as it crossed a piece of Turkish territory that projects into Syria. Transcending the map-pointing conclusions, the Syrian factor is pivotal in the evolving game theory. The government in Ankara is acutely aware that its attempt to get rid of President Assad has come a cropper, and that it now has diminishing influence over developments in Syria. The international power-play now includes Russia, the USA, and France and the military involvement might in due course of time include Britain as well.

While the response of NATO is awaited, its member-nations will almost certainly lend rhetorical support to Turkey, a fellow-member. That said, the Western alliance cannot afford to be impervious to President Vladimir Putin's accusation that Turkey is the "accomplice of terrorists". Ankara has been known to lend its support to the Syrian armed opposition, including extreme groups like Jabhat al-Nusra and Ahrar al-Sham, over the past three years. At another remove, it is said to have allowed the self-declared Islamic State to sell oil through Turkey.

Altogether, geopolitics has assumed a lethal dimension in the midst of the international power-play, and the downing of the Russian plane is but a symptom of the overwhelming crisis that confronts Europe and the Arab world. Both President Putin and his Turkish counterpart, President Recep Tayyip Erdogan, will have to countenance a daunting challenge. Of course, the latter is on a robust domestic wicket, having won a sweeping victory in the parliamentary elections on 1 November. Foreign policy is a different kettle of fish, however. His strong position in

the wake of the Arab Spring (2011) has declined over the years. And at this juncture, it can be damaging for Turkey if its relations with Russia and Iran deteriorate - powerful neighbours both. On its part, NATO can be expected to prevent further Russian-Turkish hostilities... in the interest of Russian cooperation in combating ISIS and ending the Syrian conflict.

The sense of shock and awe is frightfully overwhelming.

From The Statesman

The Dragon sets sail

China has signed a 10-year agreement that will allow it to set up and use a naval logistics base in Djibouti, an enclave-sized African nation near the strategic maritime chokepoint connecting the Red Sea to the Gulf of Aden. With this, Beijing has overturned its long proclaimed policy that China would never set up overseas military bases.

Chinese military bases are sprouting all over the South China Sea, which Beijing claims as its own. The Djibouti base will be overseas even by China's own definition. China has drawn a thin veil over its Indian Ocean base by claiming it is designed to support anti-piracy activities. But no one should take that claim seriously. The Somali pirates' problem has almost disappeared.

New Delhi has accepted Beijing has legitimate security concerns and interests regarding the Indian Ocean. India has also urged a multilateral dialogue on China's other concerns about the Indian Ocean.

China, however, has declined to discuss the issue and preferred to woo littoral countries, while developing maritime capacities in and around the ocean. India can only presume that China sees their respective military and political influence in this region as a zero sum game.

Beijing's strategists argue that the slow but steady withdrawal of US naval power from the Indian Ocean means that China must take up some of these policing activities. They also argue India is not up to the task. The sorry record of India's investment in naval power makes it difficult for New Delhi to argue otherwise.

Ultimately, however, India must do a lot more to expand its influence in the ocean that bears its name. This is not merely about warships. It is also about cementing political and economic ties with strategically important littoral countries. China had claimed it would not be a great power in the Western imperial tradition. With each passing year this is being shown to be untrue. If anything,



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COMMENTARY

Beijing is an imperial nation on steroids. Even though the Indian Ocean is a tertiary theatre for Beijing, the Djibouti agreement is a reminder that New Delhi should not presume that will last much longer.

From Hindustan Times

Right to Fight

In a much awaited announcement, the defence ministry has said that the first women fighter pilots will be selected from the batch currently undergoing training at the Air Force Academy. The selected pilots will enter a fighter cockpit by 2017. This heartening development comes on the heels of the Delhi high court recently noting that “sexist bias or service bias” cannot be allowed to block the progress of female naval officers who have been demanding permanent commissions – which women in the army and air force won in 2010.

Women in the IAF have so far been working in fields like logistics and administration or flying transport planes and helicopters. But elsewhere in the world, they are already active in combat roles. They have been flying fighter jets across the US, Israel, France, Pakistan, China, Turkey and Russia. Once upon a time, women were confined to nursing and support roles in these countries too. But modernisation of the armed forces has to do with its human resources as much as technology. And if India's lag on the second frontier is much discussed, fixing the lag on the gender frontier is important as well. In green lighting the induction of women into the combat stream of IAF, the defence ministry correctly noted that this progressive move is both in keeping with the aspirations of modern Indian women and in line with contemporary trends in armed forces of developed nations. But equally importantly, it follows from proven performance, for example from the fact that since their induction into IAF's transport and helicopter streams women have performed on par with their male counterparts. Their victory today marks an important step on the road of equal opportunity.

From The Times of India

A Sky More Open

The government has unveiled a draft aviation policy that features a regional connectivity scheme (RCS) aimed at improving access to remote areas, fiscal and other concessions aimed at helping airlines and operators to lower their operational costs, a 2 per cent levy to ensure an

all inclusive airfare not exceeding Rs 2,500 per passenger for one hour of flying on some regional routes and plans to revive at least 300-odd airports in various parts of the country that are not in use by upgrading their infrastructure to equip them as no-frills airports at an investment of Rs 50 crore each. It also talks of allowing higher foreign direct investment, of up to 50 per cent, and a review of the rules on allowing Indian carriers to fly abroad. Some of these proposals, such as those designed to encourage the building of airport infrastructure and concessions or incentives, both fiscal and regulatory, are sensible, considering the investment in the sector over the last decade, which has seen a rise in passenger traffic in India. This would also mean building airport infrastructure beyond Mumbai, Delhi, Kolkata, Chennai and Hyderabad to keep pace with growth in a market projected to emerge as one of the top five over the next few years, in line with the broader growth of the Indian economy. This is where roping in states as stakeholders could help. Kerala's experience in building its airport in Kochi is a case in point.

The industry may have a point in being sceptical about the RCS which the government hopes to kick-off by April 1, 2016, by subsidising air travel to underserved and unserved destinations. This is because of the track record of airlines, many of which have folded up after having positioned themselves as regional operators, keen on serving India's growing tier-two cities and towns. It may not be easy to justify such a cross subsidy unless it is to link areas such as the Northeast with a larger policy goal in mind. As in the case of many other industries, in a price-sensitive market such as India, the big players would prefer to operate on key trunk routes in a business that is fragmented and cash-guzzling.

A higher FDI of 50 per cent, linked to open skies, should help boost operations and profitability, besides ensuring competition. But it falls way short of the 100 per cent foreign investment that an expert committee had recommended a few years ago. It may be of some comfort that globally, airlines will collectively end up with a net profit of \$25 billion — half of it coming from North American carriers, according to estimates of the International Airport Transport Association. To ensure sustained growth, India's policymakers at the Centre and in the states will have to focus more on lowering operational costs while building infrastructure.

From The Indian Express

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World War III ?

The recent attacks on Paris by the so-called Islamic State may not mark the beginning of a “piecemeal World War III”, as Pope Francis called it, but there are parallels to previous global conflicts. For one, we are seeing several nations, including some fierce rivals, come together to defeat a totalitarian organisation. If the United States, Russia, France and other NATO powers can effectively mobilise their military power and secure the active participation of Arab countries, Islamic State (commonly known as Daesh) can be destroyed, but not the transnational menace it poses. Eliminating the perverted ideology that has attracted many disaffected youth worldwide will be a much harder, longer-term challenge.

The double shock of 129 innocent, mostly young people dead in Paris and 224 passengers in a Russian jet blown out of the sky has jolted countries into action. France’s hitherto soft-spoken President François Hollande pledged “merciless” response to the terrorists and immediately intensified bombing in Syria. President Vladimir Putin vowed that, “We will find them anywhere on the planet and punish them.” The G-20 meeting in Turkey allowed President Barack Obama and Putin, who have not been on the best of terms since Russia’s invasion of Crimea and Ukraine, to meet and coordinate action against Daesh. Moscow’s surprise intervention in Syria in support of Bashar al-Assad angered the White House, but now Obama has asked Putin to direct his bombers against Daesh targets. Mobilising air power against Daesh infrastructure, especially oil fields and oil tankers could substantially reduce its revenue and thus ability to buy weapons and pay its fighters’ salaries.

Aerial bombing alone, though, would not destroy Daesh: Ground troops would be needed to clear and hold territory pending a political solution. Despite this fact, no Western country would even consider sending combat troops into Iraq or Syria. The harsh lessons of

US and NATO intervention in Iraq and Afghanistan, respectively, are too fresh in the public memory. This leaves only Kurdish forces in Syria and Iraq who have shown great determination and courage in fighting Daesh, and Iranian proxies like Hezbollah and Shiite Iraqi militias.

However, relying on these irregular and largely unaccountable forces would require some fundamental revisions in the foreign policy approaches of regional powers. To cite just one example, Turkey, whose participation is critical (it shares a 500-mile border with Syria) is opposed to helping Kurdish forces whose affiliates have been fighting Ankara for autonomy. Similarly, the deep animosity between Iran and Saudi Arabia makes it hard to imagine any Gulf Arab support for an Iranian role in fighting Daesh. In a speech this week Secretary of State John Kerry praised growing international cooperation against Daesh, but noted the deeper ideological problem. Hinting at the age-old Shia-Sunni conflict, he said, “There are forces at play that have been at play long before the United States of America became a country.”

Even if joint pressure by Russia and the US secured Saudi Arabia’s acquiescence in an Iran-backed Shiite militia’s role in fighting Daesh, that would not be the end of the problem. The group’s so-called headquarters in Raqqa may be in ruins, but terrorist affiliates have declared that ungoverned territory in Egypt, Libya, Afghanistan and Nigeria

comprise “wilaayat”, or provinces, of Daesh’s proclaimed caliphate.

The geographic spread aside, the assaults on Paris show that Daesh has metastasised into a new type of multinational terror group. For the first time, European suicide bombers have blown themselves up signalling a radical change in the type of indoctrination they have undergone. Their act of self-sacrifice for an apocalyptic cause raises serious new concerns that cannot be addressed by bombing buildings in Syria.

The thrill of violence, the seduction of sex and the promise of a meaningful life as a jihadi have drawn tens of thousands of young Muslims to Daesh. Other recruits have less worldly objectives in mind: French researchers who have interviewed terrorists say some long to take immediately satisfying radical steps to obtain meaning through self-sacrifice. They believe in the self-anointed Caliph al-Baghdadi’s call to create “a new-old world of universal justice and peace under the Prophet’s banner”.

And it is precisely here that the parallels with previous World Wars fall short. Multinational military strikes and ground troops mobilising against Daesh can certainly destroy weapons depots and revenue-generating oil infrastructure. But they stand little chance of discouraging thousands of young Muslims eager to die for an incomprehensible millenarian cause.

Nayan Chanda in The Times of India

‘Most Critical Moment since End of the Cold War’

With Russia warning Turkey that “inevitable consequences” will ensue as a result of the incident, the official Chinese Community Party mouth piece (*Global Times*) asserts that the situation, “Could be one of the most critical moments since the end of the Cold War.”

“Ankara must be well aware of what it means to shoot down a Russian warplane ...next it will be careful enough not to give Russia a chance to down one of its warplanes in retaliation. Moscow probably has to cross the Syrian-Turkish border to implement retaliation, which however risks escalating military confrontation.”

“If Russia strikes down a Turkish warplane in Turkish airspace, or strikes a Turkish air base, it will touch NATO’s nerve. If NATO takes no action, its pledge to protect smaller alliance members will be discredited. However, if NATO adopts substantial action toward Russia, Europe will confront an unprecedented turbulent situation not seen since World War II.”

Paul Joseph Watson in INFOWARS

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Two big powers supporting different factions in the Syrian civil war clashed with each other on 24 November 2015 when Turkish fighters shot down a Russian combat aircraft that Turkey said had strayed into its airspace. The tensions immediately took on Cold War overtones when Russia rejected Turkey's claim and Ankara responded by asking for an emergency NATO meeting, eliciting more Russian anger and ridicule. After the meeting, the NATO secretary general, Jens Stoltenberg, called for "calm and de-escalation" and said the allies "stand in solidarity with Turkey."

It was thought to be the first time a NATO country has shot down a Russian aircraft in half a century. And while few expect a military escalation, with neither Russia nor NATO wanting to go to war, the incident highlighted the dangers of Russian and NATO combat aircraft operating in the same theatre and has soured chances for a diplomatic breakthrough over Syria.

As President François Hollande of France met with President Obama in Washington to urge a closer and more aggressive alliance with Russia against the Islamic

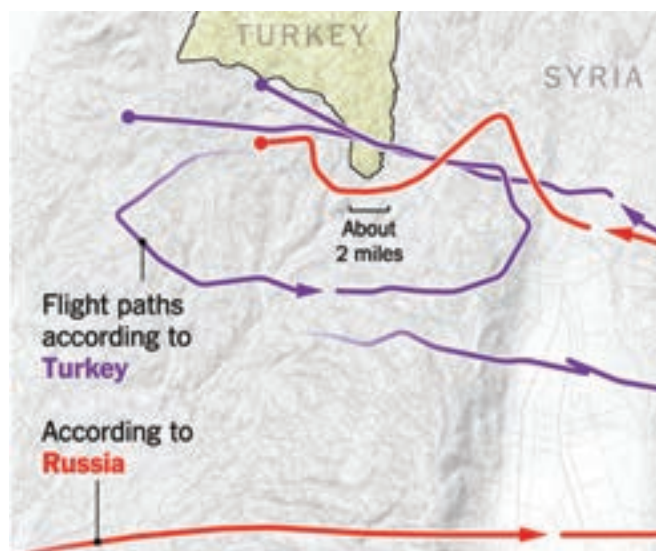
State, Turkey's decision to fire on a Russian warplane attacking targets in Syria has raised tensions between Moscow and NATO and undercut efforts to persuade Russia to drop its support for President Bashar al-Assad of Syria.

Turkey wants President Assad of Syria gone, and has allowed its border with Syria to be an easy crossing point for Syrian rebels, including those whom the West regards as terrorists or radical Islamists; Russia wants to prop up Assad and his government. While Moscow says it is attacking the Islamic State, for the most part Russian

aircraft and troops have been attacking the Syrian rebels, some of whom are supported by the United States and the West, who most threaten Assad's rule. Obama has said that Russian air attacks on moderate opponents of Assad had only helped him and that they should be directed at the Islamic State (IS).

Hollande and Obama clearly hoped that the sabotage of a Russian passenger airliner over Egypt, claimed by the Islamic State, would cause Moscow to make defeating the jihadists more of a priority than propping up Assad. But events of 24 November will make that a tougher sell, for President Vladimir V. Putin of Russia wants to be seen as an equal player in the conflict, not beholden to Western policies.

Turkey, especially under the increasingly authoritarian rule of its nationalist president, Recep Tayyip Erdogan, has been fierce in defending its airspace, shooting down Syrian jets that have strayed in the past. Turkey insisted that it issued 10 warnings over a five-minute period to the Russian pilot of the Sukhoi Su-24 to pull away. But Putin, clearly angry, responded that the Russian jet had never violated Turkish airspace and was shot down over Syria.



Conflicting versions of the events

Speaking in Sochi, he called the downing of the aircraft a “stab in the back delivered by the accomplices of terrorists,” warning that it would have “serious consequences for Russian-Turkish relations.”

Putin said that instead of “immediately making the necessary contact with us, the Turkish side turned to their partners in NATO for talks on this incident. It’s as if we shot down the Turkish aircraft and not they, ours. Do they want to put NATO at the service of the Islamic State?”

A United States military spokesman, Col. Steven Warren, said that Turkish pilots had warned the Russian pilot 10 times, but that the Russian pilot ignored the warnings. Colonel Warren also stated that American officials were analysing radar track data to determine the precise location of the aircraft when it was shot down.

At the emergency NATO meeting, Turkish officials played recordings of the warnings Turkish F-16 pilots had issued to the Russian aircraft. The Russian pilots purportedly did not reply. The Turkish account of the episode was described by several diplomats, who asked not to be identified because they were discussing a closed-door session at the alliance’s headquarters in Brussels. After Turkish representatives presented their side of the encounter at the meeting, they received expressions of support for their country’s territorial integrity, according to the diplomats’ account.

The Russian Su-24 that was struck was over the Hatay region of Turkey for about 17 seconds, according to one diplomat who attended the NATO meeting. But the aircraft re-entered Syrian airspace after being hit and therefore crashed in Syria. Tensions between Russia and Turkey had increased lately over Russian bombing of Turkmen tribesmen in northern Syria, whom Turkey regards as under its protection and who are fighting to oust Assad. Recently, Turkey summoned the Russian ambassador in Ankara to demand that Moscow stop targeting Turkmen tribesmen in Syria. “It was stressed that the Russian side’s actions were not a fight against terror, but they bombed civilian Turkmen villages, and this could lead to serious consequences,” the Turkish Foreign Ministry said.

What may make matters worse is that those same tribesmen said they shot both Russian pilots as they floated to

earth in their parachutes, having apparently ejected safely after the plane was hit by air-to-air missiles. The navigator of the aircraft was later rescued by Syrian and Russian special forces, but that the pilot had been killed by ground fire. The tribesmen also reportedly destroyed a Russian helicopter with a TOW antitank missile as it tried to rescue the airmen. The Ministry of Defence confirmed that a marine deployed on the search-and-rescue helicopter died but that the rest of the crew had escaped.

NATO countries have been concerned about Mr. Erdogan’s increasingly authoritarian tendencies for some time, and NATO officials acknowledge that Turkey’s agenda in Syria does not always match that of Washington, Britain or France - let alone Russia. And while he has recently allowed American aircraft to use Incirlik air base for sorties into Syria, Erdogan’s own troops have largely turned their fire on the Syrian Kurds, whom Washington regards as its best local ally so far against the Islamic State. Turkey has been in a struggle for decades with Kurdish separatists in Turkey, labeling them terrorists, and regards the Kurds in Syria and Iraq as sharing the same desire to break away and form a Kurdish state. Erdogan has said in his speech on the same day as the strikes that there would have been more incidents if Turkey had not exercised such restraint.

While Hollande is pressing Obama for tougher action against the Islamic State and plans to travel to Moscow on 26 November to meet Putin, Washington-Moscow tensions, high over Russia’s annexation of Crimea, were highlighted again when Obama complained that Russian airstrikes against moderate opposition groups in Syria were bolstering the Assad government instead of trying to destroy the Islamic State.

But the United States and Russia have different interests in Syria, and Putin has been clear about the need to preserve the existing Syrian government, if not Assad himself as leader. Obama, like Hollande, is committed to the ouster of Assad and believes that the Syrian strongman is complicit with the Islamic State, from which his government buys considerable amounts of oil, as a means of dividing his own opposition.



Russian aircrew with their Sukhoi Su-34 strike aircraft, seen at Latakia, Syria. [photo: Russian Defence Ministry]

In a news conference in Washington with Hollande, Obama said, “I do think that this points to an ongoing problem with the Russian operations in the sense that they are operating very close to the Turkish border and they are going after moderate opposition that are supported by not only Turkey but a wide range of countries.”

Russia’s retaliation so far has been largely symbolic. Foreign Minister Sergey V. Lavrov canceled a visit to Turkey, and a large Russian tour operator, Natalie Tours, announced it was suspending sales to Turkey. Russians accounted for 12 percent of all tourists to Turkey in 2014.

The two countries are also significant trade partners. But “Russia-Turkey relations will drop below zero,” Ivan Kononov, director of the Centre for Strategic Trends Studies, said on the state-run Rossiya 24 cable news channel.

Washington is not interested in getting deeper into Syria with ground troops or having a conflict with Russia. So cautious are the NATO countries about Article 5 of the NATO Treaty, which calls for mutual self-defence, that when Hollande declared “war” on the Islamic State after the Paris attacks, he invoked the European Union’s toothless Lisbon Treaty and sidestepped NATO. Hollande was also, French officials have said, eager not to offend Putin by making Syria a NATO issue.

Reported by Neil MacFarquhar from Moscow and Steven Erlanger from Paris. Contributed by Ceylan Yeginsu from Istanbul, Ivan Nechepurenko from Moscow, and Peter Baker, Eric Schmitt and Michael R. Gordon from Washington DC.

French President Chief Guest at R-Day

The President of France, Francois Hollande, will be Chief Guest at the forthcoming Republic Day celebrations in India during January 2016, his second state visit to the country in three years. There is intense speculation about the timing of this event, which is considered as culmination of the decision to order 36 Dassault Rafales for the Indian Air Force, as announced by Indian Prime Minister Narendra Modi visiting Paris in April 2015.



It is reported that the formal contract for the Rafales will be signed preceding President Hollande's arrival in India, this government-to-government deal having been worked upon over the past eight months. According to reliable sources, the first batch of the 36 Rafales would be delivered to the Indian Air Force three years after contract and the last of the aircraft, within seven years. It has been "rumoured" that the two IAF Squadrons selected for conversion to the Rafale are Nos. 3 and 4, presently operating the MiG-21 Bison.

India, Japan poised to finalise US-2 agreement

Reliable reports have it that the Governments of India and Japan are shortly to sign an agreement for joint production of the Shinmaywa US-2i amphibious military aircraft during the upcoming visit of Japanese Prime Minister Shinzo Abe. This would be the first major defence deal between the two countries.

While the Indian Navy has an initial requirement of 12 aircraft, more orders are anticipated in the future, including from the Indian Coast Guard, as well as for export customers in the region. Japanese manufacturer ShinMaywa have reportedly sent the Indian government details of plans to make the aircraft in India in collaboration with Pipavav, which is now controlled by the Anil Ambani group.

It is understood that the Rs 7,440 crore US-2 proposal was also discussed during the recent visit of Prime Minister Narendra Modi to Kuala Lumpur, where he met Shinzo Abe, and it was jointly



agreed to take the initiative forward. A report on the necessity and scope of operations of what would be the Navy's only amphibious platform has been requested by the ministry. The report has since been submitted by the navy in consultation with the Coast Guard and has been given the go-ahead as part of the 'Make in India' initiative.

Elta EL/M-2052 AESA for Tejas LCA

The IAF has reportedly cleared specifications of an improved Tejas LCA – termed Standard of Preparation-2018 (SoP-18) – with a view to ordering around 100 LCAs built to this standard. A key capability of the new SoP-18, will be incorporation of an Israeli AESA radar, "to be jointly developed with India." The Tejas is currently equipped with the Elta EL/M-2032 mechanically scanned radar, while the new AESA is to be based on the company's EL/M-2052 electronically scanned offering. Earlier, HAL Chairman T Suvarna Raju had stated that the IAF's Jaguar DARIN III upgrade would include fitment of the EL/M-2052 radar, and hinted that other aircraft in the Air Force inventory, such as the Mirage 2000, may eventually receive the radar as well. Other aspects of the SoP-18 Tejas are air-to-air refuelling, a podded self-protection jammer (SPJ) and "improved maintainability."



LCH close to certification

The HAL Light Combat Helicopter (LCH) has completed its performance trials, paving the way for finalisation of basic (IOC) configuration. Defence Minister Manohar Parrikar visited HAL's Helicopter Complex in Bangalore on 16 October, where he was briefed on the programme and its impending operational clearance from CEMILAC, the Centre for Military Airworthiness and Certification. G Gouda, Officiating Chief Executive of CEMILAC handed over a letter on completion of performance flight trials of LCH to Dr M Vijaya Kumar, General Manager, HAL during the Defence Minister's visit.



LCH performance trials have involved development testing at Bangalore, and also under extreme environmental conditions such as cold weather trials at Leh, hot weather at Jodhpur and 'hot and high' tests at Leh (see *Vayu V/2015*). With these tests complete, the helicopter can be cleared for weapon trials, after which HAL can commence production of the LCH. "LCH is the only attack helicopter which can operate above 10,000-12,000 feet altitude with considerable load of armament," observed T Suvarana Raju, CMD HAL.

India to transfer Mi-35 attack helicopters to Afghanistan?

According to reports in New Delhi, Afghanistan is "poised to acquire" four Mi-35 attack helicopters from India to fight the growing Taliban insurgency. The reports presume that necessary



steps have already been taken for India to transfer the rotorcraft from its fleet to Afghanistan. Meanwhile, Afghan military forces have stated that US-supplied light helicopters have proved "ineffective" in anti-Taliban operations, and sanctions against Russia prevent the USA, or indeed any Western powers, from providing Russian-built helicopters as aid to Afghanistan. This significant deal would mark a shift in Kabul's recent approach in the region.

The Indian Air Force presently operates some 20 Mi-25/35s in two Squadrons, and is to receive 22 Boeing AH-64E Apaches, which will reportedly replace the Soviet-origin attack helicopters.

Pilatus completes PC-7 Mk.II deliveries

On 10 November 2015, Pilatus announced that the 75th and last PC-7 Mk.II basic trainer aircraft (BTA) procured by the Indian Air Force under a Rs 4,000 crore contract signed in May 2012 had been delivered. The aircraft (P175) was delivered bearing special markings to commemorate the milestone. The first trainer was delivered in February 2013, with delivery of the entire contract completed in 42 months.



Since commencing operations with the IAF, the PC-7 Mk.II fleet "has flown more than 40,000 hours and accumulated well over 80,000 landings," while the reliability of the platform versus legacy types has allowed the IAF to "increase the basic training syllabus in terms of flight hours by 220 per cent, and also increase the solo flying content from 1 to 14 sorties." Under an option clause that was part of the original contract, the IAF is likely to order another 38 PC-7Mk.IIs, at a price estimated to be around Rs 1,550 crore. Although the defence ministry has already cleared this purchase, the Cabinet Committee on Security (CCS) will need to give formal sanction.

194 Pipistrel aircraft to IAF, IN and NCC

Slovenian light aircraft manufacturer Pipistrel will equip the Indian Air Force (IAF), Indian Navy (IN) and National Cadet Corps (NCC) with a modern, carbon-fibre microlight aircraft, the Virus SW 80 'Garud,' which was selected as the winning bidder in



a tendering competition among eleven international manufacturers. The SW 80 is a two-seat light trainer, capable of take-off and landing on standard as well as semi-prepared surfaces. Pipistrel will begin deliveries in eight months, with contract completion 30 months from the signing date of 12 October 2015. The contract also has options for a further 100 aircraft after the third year.

Ukraine completes delivery of upgraded An-32REs

Ukraine's state-owned defence conglomerate Ukroboronprom has delivered the eighth (and final) batch of 5 refurbished Antonov An-32RE aircraft to the Indian Air Force, completing the Ukrainian portion of the \$400 million upgrade programme.



Upgraded AN-32RE departing Kiev (photo: Oleg Belyakov)

The remaining 64 aircraft were to have been upgraded in India, but no contracts have been awarded for local companies to carry out the work, and the conflict in Ukraine has led to unavailability of the required parts or Ukrainian specialists. The status of the upgrade of the remaining An-32 fleet remains nebulous at the moment, with recent reports suggesting that the work could be carried out either by HAL or the IAF at one of its Base Repair Depots (BRDs).

Indian, US and Japanese Navies in Exercise Malabar 2015

Naval ships, aircraft and personnel from India, Japan and the USA took part in *Exercise Malabar 2015*, held off the east coast of India from 14 to 19 October 2015. The exercise featured extensive joint training, both ashore and at sea, with participants from the US Navy including the *Nimitz*-class aircraft carrier USS *Theodore Roosevelt* with embarked Carrier Air Wing 1, *Ticonderoga*-class guided-missile cruiser USS *Normandy*, *Freedom*-class littoral combat ship (LCS) USS *Fort Worth*, a *Los Angeles*-class attack submarine USS *City of Corpus Christi*, and a Boeing P-8A patrol aircraft from VP-45 'Pelicans' currently forward deployed to Kadena in Japan. Indian participation included two indigenous guided missile frigates INS *Shivalik* and INS *Betwa*, *Rajput*-class guided missile destroyer INS *Ranvijay*, fleet support ship INS *Shakti*, *Sindhugosh*-class submarine INS *Sindhudhvaj*, and Boeing P-8Is from INAS 312A. The Japanese Maritime Self Defense Force sent a single *Akizuki*-class guided missile destroyer, JS *Fuyuzuki*.



The *Malabar* series of joint exercises, which commenced in 1992, is seen as a key enabler of enhanced interoperability between the US and Indian Navies, along with regional allies (*see exclusive feature in this issue*).

INS Sahyadri to NW Pacific and South China Sea

The indigenous *Shivalik*-class guided missile frigate INS *Sahyadri*, commanded by Captain Kunal Singh Rajkumar, conducted a long-range deployment to the South China Sea and North West Pacific, in keeping with the Indian Government's





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'Act East' policy. The vessel called at various ports including Da Nang in Vietnam, Sagami Bay in Japan, Incheon in South Korea and Manila in the Philippines. The warship, spent several days at each port, carrying out various activities aimed at enhancing Indian cooperation with these important Indo-Pacific nations. In Japan, INS *Sahyadri* participated in an International Fleet Review conducted by the Japanese Maritime Self Defence Force (JMSDF).

International Fleet Review announced, China to participate

Chief of the Naval Staff Admiral RK Dhowan has announced the Indian Navy's plan to conduct an International Fleet Review (IFR) on the Eastern Seaboard at Visakhapatnam from 4 to 8 February 2016. The CNS said that over 50 navies from across the globe – including the Chinese PLA Navy – are expected to be represented at this event, which will be reviewed by President Pranab Mukherjee on 6 February.

Admiral Dhowan said, "During the International Fleet Review, the navies of the world will come together at Visakhapatnam to strengthen bridges of friendship. We may be separated by geography, but we are certainly united through oceans. The visiting navies will also have the opportunity to display their professional skills as they sail together for exercises to increase mutual cooperation and interoperability, with the underlying theme of keeping the global commons safe and secure in the 21st century."

Shipwright School commissioned as INS Vishwakarma

The Navy's Shipwright School, a technical establishment to train Naval Architect Officers, Shipwright Officers and Shipwright Sailors, was commissioned as Indian Naval Ship *Vishwakarma* by Admiral RK Dhowan, Chief of the Naval Staff, at a ceremony on 14 November 2015 in Visakhapatnam. Vice Admiral Satish Soni,



FOC-in-C ENC, Vice Admiral Sunil Lanba, FOC-in-C SNC, and other senior naval officers were present. Commodore Ajay Ghule is Commanding Officer (Designate) of INS *Vishwakarma*.

Speaking at the event, Admiral Dhowan emphasised that the commissioning of INS *Vishwakarma* would enhance the Navy's in-house design and maintenance capabilities, and would go a long way in transforming the Indian Navy to a designer's and builder's Navy in keeping with the 'Make in India' vision.

CSL delivers ICGS Arinjay FPV ahead of schedule

On 12 October, Cochin Shipyard Limited (CSL) delivered ICGS *Arinjay*, the fifteenth Fast Patrol Vessel (FPV) in a series of twenty under construction for the Indian Coast Guard. The Protocol of Delivery and Acceptance was signed between Sunny Thomas, Director (Technical), CSL and Commanding Officer of the vessel Cmdt Ajay Kumar Mudgal, some 2 months ahead of contract schedule. The vessel will be operated from the Coast Guard Station at Okha, Gujarat.

Launch of the 18th FPV and keel-laying of the 19th FPV were carried out on 28 September, and while the contract calls for the last vessel of the order to be delivered by March 2017, the current pace of construction at CSL will likely see this accomplished by mid-2016, nearly a year sooner than planned.

INS Kalvari commences sea trials

The first of six *Scorpena*-class diesel-electric attack submarines on order for the Indian Navy was floated out at Mazagon Dock Limited (MDL) in Mumbai on 29 October 2015. The submarine INS *Kalvari* was 'undocked' in April this year (see *Vayu III/2015*) in the presence of Defence Minister Manohar Parrikar, and has since been berthed at MDL for shore trials. With the submarine now finally having set out under its own power, it will commence sea trials that will continue for around 10 months, following which the vessel will be formally commissioned into service.

The \$3.6 billion Project-75 contract for six conventional attack submarines was signed in October 2005, but has been marked by significant cost and time overruns. However, with INS *Kalvari* scheduled to enter service by September 2016 and the remaining submarines on order expected to be delivered at nine-month intervals, the MoD has stated that Project-75 will be complete by 2020, forming "the core of the Navy's submarine arm for the next two decades."



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New Indian Navy Commands in Gujarat and Maharashtra

The Indian Navy has carved out a separate command dealing exclusively with the 1,214 km Gujarat coast and will station four warships at the newly set up base INS *Sardar Patel* in Porbandar. Until now, the Maharashtra and Gujarat Naval area had been under one command under a FOMAG (Flag Officer Maharashtra and Gujarat Area) and has now been divided under Flag Officers of Maharashtra and Gujarat.

The division of the Naval areas took place on 21 October 2015, as Rear Admiral Satish Namdeo Ghormade, assumed charge as Flag Officer Maharashtra Area. Rear Admiral Murlidhar Sadashiv Pawar will officiate as Flag Officer Gujarat Area and will be stationed at Ahmedabad while the Naval Officer in charge for operations will be based in Porbandar.

'Defence of Gujarat' exercise conducted

The Western Naval Command's annual operational 'Defence of Gujarat Exercise' (DGX) was conducted in the first week of November "to test operational readiness of the littorals of Gujarat and Maharashtra." The aim of the exercise was to practice combat manoeuvres to defend coastal areas as well as vital offshore assets such as oil refineries from a potential threat.

Over 30 warships, including frontline destroyers, stealth frigates and submarines, as well as a number of fighters, maritime patrol aircraft, helicopters and drones took part in the intensive manoeuvres that extended all along the coasts of Gujarat and Maharashtra. Maritime strike Jaguars and Su-30MKIs of the IAF also took part in the exercise, firing PGMs and other ordnance at simulated targets.

Brahmos test-fired from INS Kochi

On 1 November 2015 a BrahMos cruise missile was test-fired from the second *Kolkata*-class destroyer, INS *Kochi*, successfully hitting a decommissioned target ship (*Pondicherry*-class minesweeper INS *Alleppey*) in the Arabian Sea. The test was part of acceptance drills conducted off the west coast. Two similar test firings were carried out in June 2014 and February 2015 from INS *Kolkata*.

INS Astradharini commissioned

INS *Astradharini*, an indigenously-built Torpedo Launch and Recovery Vessel, was commissioned into the Navy on 6 October 2015 by Vice Admiral Satish Soni, FOC-in-C Eastern Naval Command, at Visakhapatnam.

The design of *Astradharini* was a collaborative effort between NSTL, Shoft Shipyard and IIT Kharagpur, which has a unique catamaran hull form that significantly reduces power requirements. Built with indigenous steel, the vessel has a length of 50 m and is



capable of speeds up to 15 knots. It can operate at high sea states and has a large deck area for deploying and recovering various kinds of torpedoes.

INS *Astradharini* will be used to carry out technical trials of underwater weapons and systems developed by NSTL, a naval systems laboratory of DRDO. It is an advanced replacement for INS *Astravahini*, which was decommissioned on 17 July 2015.

Naval Commanders' Conference

The biannual Naval Commanders' Conference 2015 took place in New Delhi from 26 October, to discuss issues of operational relevance, identify capability gaps and to review the future plans of the Navy, and was inaugurated by Defence Minister Manohar Parrikar, who also interacted with Chief of the Naval Staff Admiral RK Dhowan, Commanders-in-Chief of various Naval Commands and other Navy commanders.



Parrikar emphasised the need for continuous readiness to respond to contingencies in India's area of interest and took note of the numerous long-range deployments, from the South China Sea and Sea of Japan in the East to the Persian Gulf and the Atlantic Ocean in the West, expressing "satisfaction at the high operational tempo maintained by the Indian Navy." He also appreciated the Navy's proactive anti-piracy operations off the Gulf of Aden, which recently resulted in a decision by CGPCS (the Contact Group on Piracy off the Coast of Somalia) to shift the eastern limit of the High Risk Area from 78 degrees East to 65 degrees East, further away

from Indian shores. There have been no piracy incidents involving Indian-owned ships since 2008.

The Defence Minister also stressed on indigenous development of naval capabilities, highlighting strides made by Naval Designers, and urging for increased the indigenous content in high-technology areas such as weapons and propulsion. He accepted that there are capability shortfalls in areas such as ship borne helicopters, mine countermeasures vessels (MCMVs) and submarines, but assured the Conference of the support of the Government in addressing these issues. Released at the Conference was the follow-on edition of the Navy's strategic guidance document titled 'Ensuring Secure Seas: Indian Maritime Military Strategy'.

34th ICG Commanders' Conference

Defence Minister Manohar Parrikar inaugurated the 34th Coast Guard Commanders' Conference at Coast Guard HQ, New Delhi on 28 September. The conference was attended by senior officers of the Ministry of Defence, Indian Coast Guard (ICG) as well as the ICG Director General and Additional Director General.



Speaking on the occasion, the Defence Minister said, "India's unique geographical disposition affords us a unique leverage in the Indian Ocean, one that must be pursued for our national objectives and more importantly one that needs to be safeguarded diligently." He also promised all help from the MoD in pursuing critical cases of the Service.

ICGS Samarth commissioned

Indian Coast Guard Ship (ICGS) *Samarth*, the first in a series of six 105-metre Offshore Patrol Vessels (OPVs) was commissioned at Goa by Defence Minister Manohar Parrikar on 10 November 2015, in the presence of Vice Admiral HCS Bisht, Director General Indian Coast Guard, and CMD Goa Shipyard (GSL) RAdm Shekhar Mittal (Retd). ICGS *Samarth* will be based at Goa, and will be deployed extensively for EEZ surveillance and other related duties.

The *Samarth*-class has been designed and built indigenously at GSL and fitted with advanced navigation and communication equipment, sensors and machinery. The class incorporates an Integrated Bridge System (IBS), Integrated Machinery Control System (IMCS), Power Management System (PMS) and high power external fire fighting system. The ship is designed to carry a twin-engine light helicopter and five high-speed boats including two QRIB's for VBSS operations, search and rescue, law enforcement



and maritime patrol. The ship is also capable of carrying pollution response equipment to contain oil spills at sea. *Samarth* displaces 2,450 tonnes and is propelled by two 9,100 kW diesel engines that allow it to attain a maximum speed of 23 knots. It has an endurance of 6000 nm at economical cruising speeds.

Navy Chief visits Sri Lanka

Admiral RK Dhowan visited Sri Lanka between 23 and 25 November 2015 to participate in the sixth edition of the Annual International Maritime Conference, or 'Galle Dialogue' which event is aimed at bringing together a host of professionals to discuss matters of maritime interest, and hosted by the Sri Lankan Navy in the historical port city of Galle. Over 105 delegates from 36 countries attended the event, whose concept was 'Secure Seas Through Greater Maritime Cooperation.' The Indian CNS shared his views on the 'Significance of Developing Mutually Beneficial Architectures and Partnerships for Maritime Security' during the first session of the event. Admiral Dhowan also called on Sri Lankan PM Ranil Wickramasinghe, the Defence Secretary Karunasena Hettiarachchi, and Vice Admiral RC Wijegunaratne, Commander of the Sri Lankan Navy.

South China Sea dispute: India urges "peaceful resolution"

Speaking at the South-East Asian Defence Ministers meet in Kuala Lumpur on 4 November 2015, Defence Minister Manohar Parrikar said that "India hopes all parties to the disputes in SCS [South China Sea] will abide by the 2002 Declaration of the Conduct of Parties in SCS." The Minister urged that nations in the region must strive to resolve territorial disputes in a peaceful manner in accordance with international laws. The declaration was signed in 2002 by China and the ASEAN countries for peaceful resolution of disputes in the South China Sea.

Though the meet did not result in the release of a planned joint declaration due to China's objection to any mention of South China Sea disputes, Defence Minister Parrikar made it a point to voice India's concern by stating that "The seas and oceans in our region are critical enablers of our prosperity."

President's Standards for Nos. 18 and 22 Squadrons

President Pranab Mukherjee awarded President's Standards to No.18 and No.22 Squadrons in a ceremonial parade held at Air Force Station Hasimara on 28 November 2015. Group Captain KJ Singh, Commanding Officer of No.18 Squadron and Group Captain Sandeep Singh, Commanding Officer of No. 22 Squadron, received the Standards. Both Squadrons are currently equipped with the HAL-MiG-27ML, which type is due to be phased out over the next few years.



IAF to induct women fighter pilots

Following Air Chief Marshal Arup Raha's remarks on Air Force Day 2015, stating that women would shortly be allowed to fly frontline combat aircraft in the IAF, the MoD has since confirmed that the first Indian women combat pilots could possibly be cleared to fly combat aircraft in the Air Force from 2017 onward. Presently, flying roles for women in the IAF are limited to the 'non-combat' transport and helicopter streams.

MoD spokesperson Sitanshu Kar said that first women fighter pilots would be selected from the batch presently undergoing training at the Air Force Academy. "Those selected will begin to train as fighter pilots early next year, and after successful completion of training, will join operational squadrons in June 2017."



Women pilots in the Navy

Following the IAF's announcement, the Navy has decided to accept women pilots in service, with the caveat that "they remain shore-based until necessary infrastructural needs are addressed." The Navy does not permit women to serve aboard ships and submarines, so the Navy's female pilots would perforce be restricted to flying with the Navy's land-based SAR and maritime patrol squadrons. Women aircrew have been operational with the Indian Coast Guard for well over a decade.

Speaking at the Naval Commanders' Conference held in New Delhi in October, Defence Minister Manohar Parrikar said, "We want to give women equal status as long as there are no logistical, infrastructure and training issues."

IAF Exercise 'Livewire'

The Indian Air Force commenced its annual large-scale combined force exercise, *Livewire* on 31 October 2015, involving utilisation of all types of IAF air assets across the country. "The aim of the exercise is to validate the full spectrum of IAF capability in undertaking operations in response to likely future threats and operational contingencies, and also to exercise its latest acquisitions effectively in a network centric environment," as per the spokesperson



This year's edition of *Livewire* concluded on 8 November, with the IAF having flown hundreds of missions at various air bases around the country. The operational philosophy of the IAF was validated after numerous tactical and strategic missions conducted in a dynamic warfare environment, including joint operations with the Indian Army and Navy. Some of the missions flown included long-range strikes, air-to-air refueling, air defence in a network-centric environment, counter surface force operations and operations in varied kinds of terrain.

Walong ALG becomes operational

Air Marshal C Hari Kumar, AOC-in-C Eastern Air Command inaugurated the reconstructed Advanced Landing Ground (ALG) at Walong in Arunachal Pradesh on 23 October 2015. Walong ALG was used during 1962 Chinese operations, but was disused thereafter, until the decision in 2013 to reconstruct it.

Despite the remote location and natural obstacles in sustaining supply of material and machinery, the project was completed in a



record time of 21 months. The ALG will now support air operations in the area and facilitate civil administration in management of border areas. Walong ALG will also provide air support in responding to natural calamities, casevac, humanitarian assistance and supply of equipment to troops posted in far flung areas.

CAS cautions on China

In a speech read by Air Marshal KK Nohwar (retd), ADG Centre for Air Power Studies, at the 12th Subroto Mukerjee Seminar, Air Chief Marshal Arup Raha wrote that China was making “strategic moves” in order to “contain India.” The Air Chief cited various developments, such as the world’s highest airport (Daocheng Yading) and rail link in the Tibet Autonomous Region, development of Gwadar port in Pakistan, an economic corridor through PoK, and increasing economic and military ties with Sri Lanka, Bangladesh, Nepal, Bhutan and Myanmar as examples. He also pointed out that China is making “efforts to make its presence felt in the Indian Ocean Region.” He described the PLAN deployment of submarines in the area, ostensibly for anti-piracy operations, as “strange logic.”

ACM Raha visits Brazil

Air Chief Marshal Arup Raha made a four-day official visit to Brazil from 25 October 2015, visiting various establishments of the Brazilian Armed Forces, and met with the Chiefs of the Brazilian Army and Air Force, the Chief of the Joint Staff of the Armed Forces, and the Defence Minister of Brazil, Jose Aldo Rebelo Figueiredo.

In Sao Paulo, the Air Chief Marshal Raha visited the headquarters of Brazilian aircraft company Embraer, and the Department of Aerospace Science and Technology. At Manaus, he visited the Centre for Jungle Warfare Training and the Amazon Military Command Headquarters, where he saw riverine operations by the Brazilian Navy and Marines on the Amazon River. At the end of his tour, the Air Chief visited the Superior War College at Rio de Janeiro, the Brazilian equivalent of India’s National Defence College.

The visit was aimed at enhancing the bilateral cooperation between the two countries in defence related matters. The Indian Air Force presently operates the Embraer 135 business jet in the VIP transport role, and the indigenous AEW&C programme, which is nearing completion, uses the Embraer 145 platform. The CAS was reportedly briefed by Brazilian officials on a range of operational matter, including selection of the Gripen E/F multirole fighter by the Brazilian government.

IAF Commanders’ Conference

The 2015 Air Force Commanders’ Conference commenced at Air Headquarters in New Delhi on 13 October, and was inaugurated by Defence Minister Manohar Parrikar. Other MoD leadership present included Minister of State for Defence, Rao Inderjit Singh, G Mohan Kumar, the Defence Secretary and AK Gupta, Secretary Defence Production.

Air Chief Marshal Arup Raha, Chief of the Air Staff updated the Defence Minister on operational status of the IAF, highlighting efforts to enhance serviceability of aircraft, especially those of the combat fleet. The Air Chief lauded the work done by IAF personnel during the humanitarian assistance mission in Nepal and in the



Yemen evacuation operations this year. He also stated that after the successful landing of a Mirage 2000 fighter on the Delhi-Agra Expressway in May this year, the Air Force was looking to expand its range of operations from such surfaces in the near future. Prominent issues that were discussed during the Conference included induction plans for the LCA, helicopters and other combat systems being procured, infrastructure creation and enhanced training.

DAC clears proposals worth Rs 12,000 crore

On 29 October, the Defence Ministry approved proposals worth around Rs 12,000 crore for military modernisation. Key among these were pending proposals to procure four multi-purpose vessels for the Navy, each worth Rs 700 crore, and procurement of two Deep Submergence Rescue Vessels (DSRVs) for Rs 750 crore each.

For the IAF, a proposal to upgrade the avionics and engines of the Il-76 transport and Il-78MKI mid-air refueler fleets was also



cleared, at a cost of around Rs 4,300 crore. Upgrade of air defence systems and digitalisation of the Pechora surface to air missiles currently in service was also approved.

The DAC also cleared purchase of two additional Pinaka multi-barrel rocket launcher regiments (the 3rd and 4th such regiments in the Army) at a cost of around Rs 3,300 crore, as well as 149 BMP-2 armoured vehicles and associated training simulators worth a total of Rs 1,000 crore.

Su-30MKI ROH facility at HAL Nasik

Air Chief Marshal Arup Raha inaugurated the structural repair shop for Su-30MKI, ROH (Repairs and Overhaul) at HAL's Nasik Division on 25 November, with HAL Chairman T Suvarna Raju in attendance. HAL plans activities such as aircraft handling, airframe structural repair, overhauling of hatch covers, repair and servicing of looms and repair and overhaul of mechanical rotables at this facility.

During his visit, the Air Chief also inaugurated a seminar on 'Challenges for Make in India Initiatives' as part of HAL's platinum jubilee celebrations. Congratulating HAL in the landmark year, the CAS urged HAL to turn challenges into opportunities as "the IAF depends on HAL for its various platforms."



Speaking at the event, HAL Chairman Suvarna Raju dispelled the notion that "defence PSUs come in the way of the private sector." He pointed out that HAL has "developed an eco-system by hand-holding more than 2,500 business partners across India. Under 'Make in India,' core capabilities should be developed through PPP to create a vibrant domestic industry."

"India possesses 75-125 nuclear weapons"

US-based think tank Institute of Science and International Security, has released a report stating that India has enough weapons grade plutonium to possess an estimated arsenal of 75 to 125 nuclear weapons. The report states that "an estimate of India's nuclear arsenal can be derived by considering its weapons-grade plutonium stock. The resulting estimate has a median of 138 nuclear weapons equivalent with a range of 110 to 175 weapons equivalent."

"However, the actual number of nuclear weapons India built from its stocks of weapons-grade plutonium must be less. When accounting for the amount of plutonium in the weapons production pipelines and in reserves, it is reasonable to assume that only about 70% of estimated stock of weapon-grade uranium is in nuclear weapons," the report adds. The report, co-authored by David Albright and Serena Kelleher, concludes that "the predicted number of weapons grade plutonium at the end of 2014 is about 97 with a range of 77-123."

Future defence programmes with Russia

On 1 November 2015, during his visit to Moscow, Defence Minister Manohar Parrikar reportedly discussed several military projects with his Russian counterpart Sergei Shoigu. This meeting of the Indo-Russian Inter-Governmental Commission on Military-Technical Cooperation (IRIGC-MTC) is in advance of expected agreements during the Modi-Putin summit in Moscow in early December.



File photo of the S400 Triumph air defence system

India is reportedly finalising the procurement of ten S400 air defence systems at an estimated cost of \$5 billion, in addition to a \$1 billion project for the manufacture of around 200 Russian Kamov Ka-226T light utility helicopters under the 'Make in India' initiative. Also under consideration is lease of a second nuclear-powered submarine.

A key topic of discussion was the fifth generation fighter aircraft project, which has appeared to have stalled both in India and in Russia, with the latter having restricted initial orders to a single squadron of the type (*see Vayu VI/2015*).

BEL Defence Systems Integration Complex

Defence PSU Bharat Electronics Limited (BEL) is setting up a Defence Systems Integration Complex at Palasamudram in the Anantapuramu district of Andhra Pradesh, which will be the largest such facility in the country covering an area of over 900

acres. As part of diversification and business growth, BEL is looking towards major expansion into new generation SAM systems, high-end image intensifier tubes and thermal imaging detectors for night vision devices, inertial navigation systems, electronic ammunition fuses, air traffic management radars, intelligent traffic management systems and solar power plants.

The proposed complex will feature automated vehicles and industrial robots for material movement and handling. The facility will be built in stages as various projects mature and the estimated investment will be about Rs 500 crore over 3 to 4 years. BEL also plans to expand this facility for the creation of a 'military industrial complex' to set up the necessary ecosystem for manufacture of electronic components and equipment for various upcoming defence projects in collaboration with SMEs as part of the Government's 'Make in India' initiative.

BEL pays Rs 139.23 crore dividend

Bharat Electronics Limited (BEL) has paid a dividend of 292% to the Government of India for the 2014-15 financial year. BEL CMD SK Sharma presented the 232% final dividend cheque of Rs 1,392,329,672 to Defence Minister Manohar Parrikar at New Delhi on 21 October 2015. BEL had already paid a 60% interim dividend for the year 2014-15 in February.



BEL CMD SK Sharma presenting the final dividend cheque to the Defence Minister in the presence of (left to right) Anandi Ramalingam, BEL GM (National Marketing), AK Gupta, Secretary Defence Production and PC Jain, BEL Director (Marketing)

MKU unveils 'Instafloat'

During trials for an Indian Coast Guard tender, MKU's Flotation Ballistic Jacket successfully cleared not only the ballistic evaluation trials but also remained afloat in seawater conditions with an 80 kg load after firing trials. There has been a spate of incidents in which coastal police have come under fire while engaging with 'parties of interest' in Indian and international waters, bringing focus on the safety of security personnel on board naval vessels. Understanding the need for equipping marine forces with essential protection gear suited for the marine environment, the Government of India initiated steps for the procurement of a suitable Flotation Ballistic Jacket.

MKU, a leading manufacturer of ballistic protection solutions for both personnel and platforms, recently showcased an indigenously developed and manufactured Flotation Jacket called 'Instafloat.' Developed for the Navy, Coast Guard and other marine law enforcement agencies, these vests "not only provide ballistic protection but also help keep the wearer afloat in water, a central requirement for marine operations. The vests come with a patented quick release mechanism that enables the person wearing it to divest the vest with a single pull."



India-China Joint Exercise Hand in Hand

The 10-day India-China Combined Military Training Exercise *Hand in Hand* 2015 took place from 12 October at Kunming Military Academy, Yunnan, China, also participating in mixed groups. A joint field exercise depicting counter terrorist operations on India-China border areas was held 21-22 October, to validate the exercise objectives.



Lt Gen AL Chavan, head of the Indian Observer Group addressed the gathering at the closing ceremony, while Maj Gen Zhang Bing, Deputy Chief of Staff of the Chengdu Military Command and head of the Chinese Observer Group stated that the exercise "highlights the determination and vision of both countries to maintain regional security, stability and develop a conducive environment for development."

India-Sri Lanka Exercise Mitra Shakti

The third India-Sri Lanka Joint Training Exercise *Mitra Shakti*-2015 culminated on 12 October 2015 at Aundh Military Camp, Pune. The 14-day joint exercise reviewed transnational terrorism, developing interoperability and conduct of joint tactical operations controlled by a Joint Command Post. "The exercise demonstrated the determination of the two Armies in working closely with each other to eradicate the menace of terrorism in all forms." The joint training culminated with a parade, jointly reviewed by Brigadier Tapan Lal Sah of the Indian Army and Brigadier KP Aruna Jayasekera of the Sri Lankan Army.



Indo-Russian Exercise Indra

A 14-day Indo-Russian joint training Exercise *Indra* commenced on 7 November at the Mahajan Field Firing Ranges near Bikaner in Rajasthan. The exercise was focussed specifically on 'Counter terrorism operations in desert terrain under a United Nations Mandate,' and was conducted in two phases. The first phase involved combat conditioning and tactical training, which was then put into practice in the second phase. Both the contingents jointly took part in a validation exercise, which included clearing of an axis, establishment of observation post, cordon and search operations and house clearing drills.

This year's Exercise *Indra* involved a total of 500 military personnel from a Russian Motorised Brigade and an Indian Mechanised Infantry Regiment, and was intended to train soldiers to defeat current and future terrorist threats. The exercise "aimed at strengthening and broadening the inter-operability and co-operation between both the Armies."



Industrial Licences for Reliance Defence approved

On 6 November, the Department of Industrial Policy and promotion (DIPP) approved 12 industrial licences for eight subsidiaries of Reliance Defence (R-Defence). Eight subsidiaries of Reliance Defence which got licences for 'full-spectrum' manufacturing, were for aircraft, helicopters, missiles, night vision, naval and land systems.



"New defence projects by R-Infra subsidiaries will cover all critical requirements of the Indian Armed Forces under the 'Make in India' programme." These projects are to be located in Gujarat where R-Infra has acquired Pipavav Defence and Offshore Engineering Company Limited together with sole management control.

Of particular importance is the Reliance plan to establish an aerostructures production facility near Nagpur in Maharashtra which is reportedly part of the plan to fulfill the Dassault commitment for fulfilling the 50% offsets required under the Rafale programme. Air Marshal (retd) M Matheswaran (*see photograph*) has been appointed as President Aerospace Business for Reliance.

Tata to produce Apache parts for Boeing

Boeing and Tata Advanced Systems Limited (TASL) have announced a joint venture to manufacture aerostructures for the AH-64 Apache attack helicopter and collaborate on integrated systems development opportunities in India. The JV will initially create a manufacturing 'centre of excellence' to produce Apache parts, and to compete for additional manufacturing work packages across Boeing platforms, both commercial and military.



"This partnership will capitalise on India's industrial capability, innovation and talent to contribute to Boeing's long-term competitiveness and position us for future growth in the global marketplace," said Chris Chadwick, president and CEO of Boeing Defence, Space & Security. "It is a demonstration of our commitment to further accelerate our partnership with one of the world's fastest growing economies."

Airbus BizLab expands to Bangalore

Airbus has inaugurated a BizLab in Bangalore, its third after similar facilities in Toulouse, France and Hamburg, Germany, as part of a strategy to establish a global network of aerospace business accelerators. In parallel, Airbus has opened a first round of applications for start-ups seeking support in the region. Applications are open until 9 December 2015 and can be accessed from the Airbus BizLab website. A screening committee, which includes Airbus's Chief Innovation Officer Yann Barbaux and the Head of the Airbus BizLabs, Bruno Gutierrez, will select the most promising ideas.

Airbus BizLab in India will be co-located with NUMA, France's biggest business accelerator and one of the most active in Europe. Both will create strong synergies between their accelerators, from start-up selection to specific events to benefit from their respective ecosystem (mentors, experts, investors).

Tata delivers Cobham 908E refueling pod structures



At the Tata Advanced Systems Limited (TASL) facility in Hyderabad, are seen, Russ Bradley (Senior VP, Strategic Sourcing, Cobham Plc), Alan Ephgrave (VP, General Manager, Cobham Mission Systems), Sukaran Singh (CEO & MD, TASL) and Masood Hussaini (VP & Head Aerostructures, TASL), at the handover ceremony of the first two 908E pod structures assembled by TASL and destined for use on the Airbus A400M.

CAE A320 full-flight simulator for Air India

Air India has ordered an A320 full-flight simulator from CAE, the 7000XR Series full-flight simulator being equipped with the latest CAE Tropos 6000XR innovative visual systems. The CAE 7000XR FFS will be delivered in the first quarter of 2016 at the airline's Central Training Establishment (CTE) in Hyderabad. Air India ordered its first simulator from CAE in 1971. "We are pleased to be ordering a third full-flight simulator from our long-standing training partner CAE. The state-of-the-art all-electric motion system provides more accurate and authentic cues for pilot training", said AS Soman, Air India's Executive Director. "By adding this new generation simulator, Air India will now be able to put on fast track the comprehensive training provided to its pilots with the latest technology."

"India's Time to Fly" : Boeing Chairman

Speaking at the inauguration of 'India's Time to Fly,' an aerospace innovation summit in New Delhi on 16 October, Boeing Chairman Jim McNerney said India is poised to play a pivotal role in the evolution of the global aerospace and defence industry. "We live in a world that's demanding more for less. Companies like Boeing are always on the lookout for the competitive advantages that come with innovative new technologies and long-term partnerships. India, with its broad, deep engineering capability and skilled workforce, is a natural partner that offers us the long-term opportunities that can differentiate us in the marketplace and bring mutual success to the company and the country," he said.



Boeing Chairman Walter James McNerney Jr speaking at the summit

Boeing organised the summit in collaboration with IIT-Bombay as part of Boeing's centennial celebration. Participants included government officials, industry leaders, and academia and research institutions. It showcased the ideas and innovations "that are changing the industry and the people in the Indian aerospace industry who are creating them."

Global Vectra Smart PBH for H130

Global Vectra Helicorp (GVHL), India's largest private helicopter company, which inducted the first Airbus H130 light helicopter in India (see *Vayu II/2015*), signed a 'Power By the Hour' (PBH) contract with Airbus for its sole H130. Airbus Helicopters' redefined customer service offer, called HCare, was introduced early this year and has been developed with consideration of the support required by operators of light helicopters.

Thales partnership with IndiGo

Indian low-cost carrier IndiGo has extended its long-term maintenance agreement with Thales for its growing fleet of Airbus A320 aircraft. The contract will cover avionics maintenance for a fleet of up to 250 aircraft, including the A320neo, first deliveries of which will begin in late 2015.

Thales has been a partner to IndiGo since the airline took delivery of its first Airbus A320-200 aircraft in 2006. Through this agreement Thales provides spares availability and replenishment to IndiGo with stocks located onsite at their main hub in New Delhi, the airline's main base. Thales also offers IndiGo direct access to a pool of spare parts located in Thales' Asia-Pacific repair hub in Singapore.

Lady Aviator re-creates history in Iconic Boeing Biplane



Tracey Curtis-Taylor with men and women pilots of the IAF and the Boeing team in front of the Boeing Stearman vintage biplane and Boeing C-17 Globemaster III at Hindan. (photo: Boeing)

Adventurous British female aviator Tracey Curtis-Taylor landed at Hindan Air Force Base near Delhi in her classic 1942 Boeing Stearman on 24 November 2015. Having successfully flown from Cape Town to Goodwood in 2013, Tracey Curtis-Taylor has taken on the challenge of flying beautiful open-cockpit vintage biplane from the UK to Australia with stops at 50 locations along the way. US aerospace and defence giant Boeing is a sponsor of this incredible 21,000-km journey that will take Tracey through 23 countries.

Curtis-Taylor has undertaken the flight to celebrate the pioneering days of early aviation in the 1920s and 1930s, and especially the achievements of revolutionary British aviator Amy Johnson. A celebrity of her time, Amy Johnson became the first woman to fly solo from Britain to Australia in 1930. Speaking on arrival in New Delhi, Tracey Curtis-Taylor said, "For my whole life, I have been moved by the achievements of pioneers like Amy Johnson. My own flight to Australia is the realisation of a burning desire to fly my beloved Boeing

Stearman 'Spirit of Artemis' around the world, following in their footsteps."

"I am delighted to have arrived in New Delhi. The flight has already exceeded all my expectations and delivered unforgettable moments and incredible challenges. From nasty European weather delaying us across Romania to the beauty of flying at 100 feet over the desert, and vibrant cities of India, every moment is an extraordinary experience."

"We are proud to welcome Tracey Curtis-Taylor to India. Boeing's sponsorship of Tracey's adventure stems from an admiration for history and spirit of accomplishment captured in this epic journey, which is an example to a new generation of aviation enthusiasts," said Pratyush Kumar, president for Boeing India. "Tracey's flight in the 1942 Boeing Stearman will reach Australia in early 2016, a year in which we will celebrate our centennial and our own onward journey of achievement into Boeing's second century of aviation," remarked Kumar.

"It's fitting that Tracy landed at Hindan Air Base where the C-17 Globemasters of the Indian Air Force are stationed. This is a unique moment where one of the oldest and one of the newest Boeing aircraft are together at the same base. Tracy's visit to Hindan also highlights the long relationship that Boeing shares with the Indian Air Force which began when the Harvard trainer was used to train pilots," said Dennis Swanson, vice president, Boeing Defense, Space & Security India.

Throughout the flight to Australia, Tracey Curtis-Taylor will be stopping in a number of cities to engage with the local communities, with a particular focus on women and women aviators. Commemorating the fact that Amy Johnson was the first president of the Women's Engineering Society, she will promote the achievements of women in every sphere around the world, especially their historic and contemporary role in aviation and engineering. Later, Tracy interacted with women officers and pilots of the Indian Air Force at Hindan Air Force Base and also conducted a fly past in formation with the IAF Vintage Flight's Tiger Moth.



The Stearman and Tiger Moth in formation over Hindan (photo: IAF)

Draft of new Indian Civil Aviation Policy

The Indian Ministry of Civil Aviation released the draft of its new policy on 30 October with various schemes which would liberalise bilateral rights and allow India to enter reciprocal agreements with South Asian nations and other countries beyond 5,000 km. This will result in unlimited flights to and from Europe and the SAARC (South Asian Association for Regional Cooperation).

While proposing to liberalise rules that allow foreign airlines to enter India, the draft has kept options open on the controversial 5/20 policy. Fledgling airlines like Vistara and AirAsia have been seeking abolition of this rule, which prevents domestic airlines from flying abroad before they have completed five years of operations and own 20 aircraft. Vistara chief executive Phee Teik Yeoh stated, "The 5/20 policy has to be abolished without condition, as it is detrimental to the interests of Indian carriers. India is the only country that penalises its own carriers. Dubai airport alone handles 150 airlines. Dubai's gain is India's loss."

The draft proposals seek to improve regional connectivity, bring down fares for short-haul flights and facilitate higher foreign investment. The government has also drawn up plans to boost air cargo, maintenance, repair and overhaul activities through tax incentives and favourable policies. However, there are major issues which the policy does not address such as the future of Air India. "We would have liked to have seen more emphasis on addressing the negative fiscal environment airlines face, like sales tax on jet fuel, service tax on fares, airport charges, and withholding tax on aircraft leases. There is no reference to the future of Air India. The government's ownership of the national carrier negatively influences policy decisions and has cost Indian taxpayers billions of dollars," observed Kapil Kaul of the Centre for Asia Pacific Aviation.

The government plans to revive 476 airstrips/airports in the country, of which 75 are in use. No-frills airports would be built at a cost of Rs 50 crore, depending on the demand in the sector. Scheduled commuter airlines would get viability gap funding (VGF), which would be indexed to jet fuel prices and inflation. The VGF would be shared by the centre and states in 80:20 ratios.



Airbus facility in Uttarakhand

Airbus is planning to set up a manufacturing facility at Sitarganj in Uttarakhand, with an investment of Rs 1,000 crore. Meeting commitments made during Prime Minister Narendra Modi's April visit to the Airbus facility at Toulouse in France (see *Vayu III/2015*), the European aircraft manufacturing company is planning to acquire 100 acres of land at the Sitarganj Industrial Estate in the Kumaon region of Uttarakhand.

Jet Airways orders 75 Boeing 737 MAX

Jet Airways placed an order for 75 Boeing 737 MAX-8 aircraft and this was announced at the Dubai Air Show 2015. "This marks the largest order in Jet Airways' history and supports the airline's replacement strategy to have the most modern and environmentally progressive airplane fleet. The order, previously attributed to an unidentified customer, includes conversions of 25 Next-Generation 737s to 737 MAX 8s, as well as options and purchase rights for an additional 50 aircraft," a Boeing executive said.



"Incorporating the latest design and technology features, the highly efficient 737 MAX will allow us to drive our operational efficiency and reaffirms our commitment to providing a best-in-class full service travel experience to our guests," said Naresh Goyal, chairman of Jet Airways. "This order is an endorsement of our confidence in the long-term prospects of the Indian aviation sector, which reflects the positive forecast for the country's economy and offers tremendous potential for growth and development." The 737 MAX incorporates the latest technology CFM International LEAP-1B engines.

Jet Airways orders 150 LEAP-1B engines

Jet Airways has also placed an order for 150 LEAP-1B engines to power its 75 Boeing 737 MAX 8 aircraft, the largest order in the airline's history. Jet Airways began operation in May 1993 with four CFM56-3-powered Classic Boeing 737. Jet Airways presently operates



AVIATION & DEFENCE In India

a fleet of more than 70 CFM56-7B powered Next-Generation 737 aircraft. "Jet Airways is an impressive airline," said Jean-Paul Ebanga, president and CEO of CFM International. "We are excited to launch this new phase of our relationship with them and look forward to introducing all the benefits of our advanced LEAP engine into their fleet."

SpiceJet to order 150 aircraft

SpiceJet is in talks with aircraft manufacturers to place orders for around 150 aircraft, according to Ajay Singh, chairman of SpiceJet. He said that SpiceJet is looking to purchase 100 narrowbody aircraft (Boeing 737 MAX or Airbus A320neo) and 50 turboprop aircraft, and is hopeful that the orders would be placed by the end of this financial year. SpiceJet currently operates a fleet of 20 Boeing 737s, one Airbus A320 and one A319 (on wet lease from BH Air) and 14 Bombardier Q400 turboprops.



Ajay Singh confirmed that a decision to change SpiceJet's chosen aircraft type from Boeing to Airbus would be based on the aircraft type that benefits the carrier most in the future.

Delhi is debut destination for British Airways 787-9

British Airways elected to make Delhi the first destination for scheduled services with the new Boeing 787-9 Dreamliner, the first flight arriving at Delhi on 26 October, with the call sign 'Speedbird 257.'



(photo: Alan Wilson)

On the occasion, St. John Gould, India Director of UK Trade and Investment (UKTI) said that tourism and trade between the UK and India is "booming," and that he was "confident that traffic between [the] two great nations will continue to expand at a rate of knots." Robert Williams, Head of Asia Pacific Sales at British Airways echoed this, saying, "This expansion reinforces our strong focus on India as a market, which already enjoys the second largest position for us globally, after the US and outside the UK."

AI raises Rs 7,000 crore via sale and leaseback of Dreamliners

Debt-ridden national carrier Air India has raised almost Rs 7,000 crore by selling nine of its 21 Boeing 787-8 Dreamliners to a Singapore-based lessor and then leasing the aircraft back. AI had earlier sold and leased back 12 Dreamliners, which now means the entirety of the carrier's Dreamliner fleet is being operated on lease.



Approximately Rs 6,000 crore of the total amount raised from this transaction will go toward reducing the airline's aircraft purchase loans. Air India has a combined aircraft purchase and working capital loan of Rs 40,000 crore, apart from accumulated losses of Rs 30,000 crore.

Alliance Air to operate short-haul flights

Alliance Air, an Air India subsidiary, is to operate flights to connect major cities to small towns in the near future. A number of states are planning to bridge the airline's expense-revenue gap through viability gap funding (VGF), enabling the airline to operate on a 'no-profit, no-loss' basis.

Services are reportedly to start soon from Delhi to Bhuj, Jamnagar and either Keshod or Kandla under a VGF arrangement with the government of Gujarat. Similar arrangements are likely to be made with the governments of Uttar Pradesh, Madhya Pradesh, Uttarakhand, and Rajasthan, and the Andaman & Nicobar Islands. The present Alliance Air fleet of 10 ATR-72s will be augmented with an additional 10 ATR-72s.

60 Airbus A320s "operational" with Air India



According to Air India's chairman and managing director Ashwani Lohani, Air India has certified 60 Airbus airliners from its fleet of 66 as "operational", surpassing the national carrier's target and giving a boost to its effort to increase on-time performance. Meanwhile, Air India's engineering subsidiary is also seeing business growth after the announcement of the new civil aviation policy which proposes waiver of service and value-added tax for the maintenance repair and overhaul sector. "If these tax incentives are implemented, the servicing cost of an aircraft in India will get about 30 per cent cheaper than now and would make us as competitive as our peers in Colombo or Singapore," stated an official of Air India Engineering Services Ltd, a subsidiary of Air India.

Rockwell Collins expands India operations

Rockwell Collins has opened a new, expanded facility in Bangalore that bolsters the company's presence in India. "The opening is a reflection of our commitment to India, as well as the increasing demand for services from our India Design Centre (IDC) in Hyderabad," said Sunil Raina, Managing Director of



Company Executives at opening of the Bangalore office

Rockwell Collins India. "We chose Bangalore because of the high concentration of engineering talent there and the fact that it is an aerospace hub."

Rockwell Collins has also appointed Sunil Raina as Managing Director of Rockwell Collins India. In this role, Sunil's experience in building solid customer relationships in India, his proven success in developing strategies that deliver winning results, and his commitment to meeting the needs of our growing customer base in the region make him well-suited to lead our operations," said Jim Walker, Vice President and Managing Director, Asia Pacific for Rockwell Collins.

Zen Technologies unveils 'ShootEdge'

Zen Technologies, a pioneer in simulation technology has unveiled its latest product, the ShootEdge, a weapon system that encases a pistol, revolver or similarly-sized handgun and allows firing from an angle. ShootEdge enables shooting at an adversary without risk of exposure to retaliatory fire, providing the ability to fire from behind protective cover. Such systems are seen as necessary in encounters with terrorists and insurgents in operations ranging from close combat in built up areas to hostage situations. ShootEdge can be used by day and night and comes with a camera and standard sight



MKU showcases future personal armour in France

MKU, a leading Indian manufacturer of armour solutions and night vision devices, showcased future generation personal armour solutions for defence and security personnel at Milipol 2015, a defence exhibition held in Paris. The company claims that the armour showcased is over 40% lighter and stronger and features most of the capabilities desired by current and future generation soldiers.

Neeraj Gupta, MD of MKU explained that the weight carried by a soldier is of critical importance as it impacts his performance and survivability in a theatre of operation. The scientists and



designers at MKU have combined the capabilities of ultra-lightweight 6th generation 'Ammoflex' armour with the versatile and comfortable quick release 'Instavest,' making the Instavest G6 one of the lightest advanced tactical vests in its category.

ISRO launches Astrosat, six other satellites

On 28 September 2015, ISRO successfully launched India's first astronomy satellite, Astrosat, eleven years after the government cleared the project. A Polar Satellite Launch Vehicle (PSLV-C30) carrying Astrosat and six other satellites lifted off from the Satish Dhawan Space Centre in Sriharikota and then injected Astrosat and the other satellites — four US nano-satellites, a microsatellite from Indonesia and a nano-satellite from Canada — into their respective orbits. This was the first time India launched an American satellite.

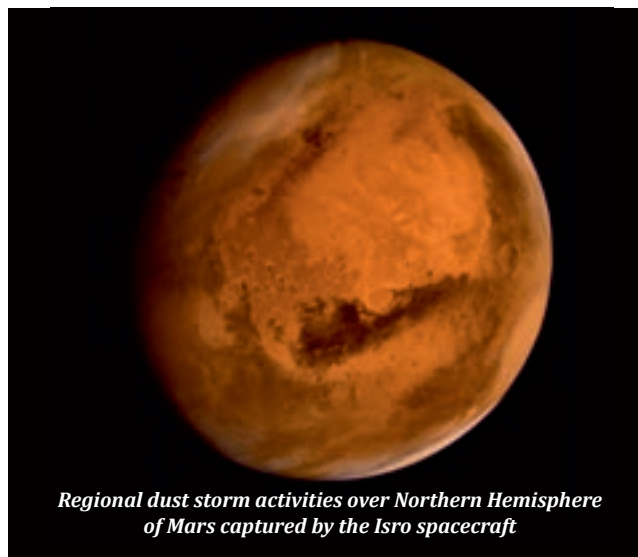


Astrosat prior to being integrated with the PSLV

Astrosat, which had a lift-off mass of 1,513 kg, will now embark on a five-year astronomy mission studying distant celestial objects. It will observe the universe in the optical, ultraviolet, low and high-energy x-ray regions of the electromagnetic spectrum, compared to most other scientific satellites that are capable of observing a narrow range of wavelength band. The two telescopes on the Ultraviolet Imaging Telescope (UVIT) on board Astrosat are designed to achieve an excellent image resolution. The other payloads are a Large X-ray Proportional Counter (LAXPC), Soft X-ray Telescope (SXT), Cadmium Zinc Telluride Imager (CZTI) and Charge Particle Monitor (CPM).

ISRO marks one year of Mars Orbiter Mission

The Mars Orbiter spacecraft has completed one year of its life around the red planet. After successfully completing one year of the mission around Mars, a large data set has been acquired by all five payloads of the Mars Orbiter Mission (MOM). To commemorate the first anniversary of the orbital insertion, ISRO released an atlas containing photos taken by the colour camera on



Regional dust storm activities over Northern Hemisphere of Mars captured by the Isro spacecraft

board the spacecraft, along with results obtained by the spacecraft's scientific payloads.

The Mars Orbiter was designed, built and launched in a record period of under two years, and carried five scientific instruments for collecting data on surface geology, morphology, atmospheric processes, surface temperature and atmospheric escape processes. The Mars Orbiter Mission began its nine-month journey to the Red Planet on an indigenous PSLV rocket that launched from Sriharikota on 5 November 2013.

Prithvi II tested fired

The Strategic Forces Command test-fired another nuclear-capable Prithvi-II missile, with a strike range of 350 km, on 26 November, missile test carried out from a mobile launcher from Launch Complex-3 of the Integrated Test Range (ITR) at Chandipur in Odisha. The missile was randomly chosen from a production batch and launch trajectory was tracked by DRDO radars, electro-optical tracking systems and telemetry stations located along the coast of Odisha. Downrange teams on board a ship deployed near the designated impact point in the Bay of Bengal monitored the terminal events and splashdown.

GSAT-15 launched on Ariane 5

The ISRO GSAT-15 satellite was successfully launched into orbit on 10 November 2015, by an Arianespace Ariane 5 rocket. This was the tenth launch of the year from the Guiana Space Center (CSG) in Kourou, French Guiana, and the sixth with the Ariane 5 heavy launcher. It was also the 69th successful Ariane 5 launch in a row.

GSAT-15 is the 19th satellite to be launched by Arianespace for ISRO. The two companies have a 30-year relationship, with Arianespace having launched 91% of ISRO geostationary satellites that used non-Indian launch systems, dating back to the launch the experimental satellite APPLE on Ariane Flight L03 in 1981.

Vice Admiral Karambir Singh is Deputy CNS

Vice Admiral Karambir Singh, AVSM, assumed charge as Deputy Chief of the Naval Staff on 31 October 2015. Commissioned into the Indian Navy in July 1980, the Admiral earned his wings as a helicopter pilot in 1982 and has flown extensively on the Chetak, Kamov Ka-25 and Ka-28 Anti-Submarine Warfare (ASW) helicopters. He is a graduate of the DSSC, Wellington; College of Naval Warfare, Karanja and has served as Directing Staff in both these Institutions.



In his 35-year career, the Admiral has commanded ICGS *Chandbibi*, INS *Vijaydurg* as well as the destroyers INS *Rana* and *Delhi*. He has also had the privilege of being the Fleet Operations Officer of the Western Fleet. Ashore, the Admiral has served as Joint Director Naval Air Staff, Captain Air and Officer-in-Charge Naval Air Station *Kunjali* and as a member of the Aircrew Instrument Rating and Categorisation Team (AIRCATS). His other appointments include Chief of Staff, Eastern Naval Command, Chief of Staff of the Unified Command at Andaman & Nicobar Islands and Flag Officer Maharashtra and Gujarat Area (FOMAG). As Vice Admiral, he has been the Director General of Project *Seabird*, the naval base at Karwar. He is presently the 'Grey Eagle' (senior-most serving Naval Aviator) of the Indian Navy.

Rear Admiral Ravneet Singh is FOC Western Fleet

Rear Admiral Ravneet Singh, RNM assumed command as Flag Officer Commanding Western Fleet (FOCWF) on 12 October 2015, which took place at sea on board INS *Viraat*. A fighter pilot and qualified flying instructor, Rear Admiral Singh has over 2,500 hours of flying experience on ten different types of aircraft.



Commissioned into the Indian Navy on 1 July 1983, he has commanded *Rajput*-class destroyers INS *Ranvijay* and *Ranvir* as well as the *Nilgiri*-class frigate INS *Himgiri*. Rear Admiral Singh has also commanded INAS 300 'White Tigers,' and later also the unit's home base, INS *Hansa*. He has been posted at Naval Headquarters as Assistant Controller Carrier Projects (ACCP) and Assistant Controller Warship Production and Acquisition (ACWP&A), during which time INS *Vikramaditya* was inducted and commissioned. Before taking over as FOCWF, he was Flag Officer Goa Area and Flag Officer Naval Aviation.

Rear Admiral Sanjay Jasjit Singh is ACNS (CS&NCO)

Rear Admiral Sanjay Jasjit Singh has assumed charge as Assistant Chief of Naval Staff (Communication Space and Network Centric Operation), which focusses on the Indian Navy's drive towards networked operations and utilisation of space-based assets. He is the second officer to hold the post and takes over from Rear Admiral Kishan K Pandey who has moved as the Flag Officer Fleet Review, in charge of planning for the forthcoming International Fleet Review.

Rear Admiral Sanjay Jasjit Singh is a specialist in Navigation and Direction, and also attended the Advanced Command and Staff Course at UK. He has undergone the Naval Higher Command Course at Naval War College, Mumbai, and the National Security Strategy Course at the National Defence College, Delhi.

His sea command appointments include command of frigates INS *Taragiri* and INS *Trishul*. In staff appointments, he has served as the Joint Director of Personnel, Indian Naval Attaché at Iran, Principal Director of Naval Operations and Principal Director Strategy, Concepts and Transformation, wherein he was responsible for drafting the revised 'Indian Maritime Security Strategy' and the 'Strategic Guidance to Transformation,' both of which were released recently.



Rear Admiral SV Bhokare is FOC Eastern Fleet

Rear Admiral SV Bhokare, YSM, NM, took over command of the Navy's Eastern Fleet from Rear Admiral AB Singh, VSM on 6 October at Visakhapatnam. Rear Admiral AB Singh has moved



to HQ Strategic Forces Command in New Delhi. Rear Admiral Bhokare is a specialist in Navigation and Aircraft Direction and a graduate of National Defence Academy, Khadakvasla and the Defence Services Staff College, Wellington.

Rear Admiral Bhokare is a submariner, and has commanded three *Kilo*-class boats, *INS Sindhughosh*, *Sindhudhwaj* and *Sindhushastra*, and the Navy's Western submarine base, *INS Vajrabahu* in Mumbai. He has also commanded the *Brahmaputra*-class frigate *INS Beas*. His various Staff and Operational appointments include Command of Submarine Squadron as Commodore Commanding Submarines (West) and Chief Staff Officer (Operations) at Eastern Naval Command. Prior taking over as FOC Eastern Fleet, he was serving as Flag Officer Submarines.

Rear Admiral PK Bahl is FOGA, FONA

Rear Admiral Puneet Kumar Bahl, VSM, assumed charge as Flag Officer Naval Aviation and Flag Officer Goa Area from Rear Admiral Ravneet Singh on 6 October 2015. Rear Admiral Bahl was commissioned into the Indian Navy on 1 July 1984 and is alumnus of NDA, Khadakvasala. He has undertaken the staff course at DSSC Wellington and the Naval Higher Command Course at The College of Naval Warfare, Mumbai. An experienced maritime reconnaissance pilot, he has flown six different types of aircraft. His operational experience includes active participation in Operations *Tasha* and *Vijay*. He is also a qualified diver.



Prior to his elevation to Flag Rank, he was the Commanding Officer of *INS Rajali*, the premier maritime reconnaissance air station of the country (see *Vayu* VII/2014), from October 2011 to January 2015. During this assignment he successfully oversaw the smooth induction and operationalisation of Boeing P-8I MR/ASW aircraft. He has also commanded the guided missile frigate *INS Betwa* and offshore patrol vessel *INS Sujata*.

Air Marshal SRK Nair is AOC-in-C Training Command

Air Marshal SRK Nair, AVSM, VM, took over as Air Officer Commanding-in-Chief, Headquarters Training Command, in Bengaluru on 1 September 2015. A Qualified Flying Instructor and an Air Force Examiner, the Air Marshal has over 7,000 hours of flying experience in transport and trainer aircraft.



His appointments include : Chief Operations Officer of a Transport Base, Commanding Officer of a strategic Airlift Squadron, Director Operations (Transport), at Air Headquarters, Air Officer Commanding of Air Force Station Chandigarh, Assistant Chief of Air Staff (Personnel Airmen and Civilians) and Assistant Chief of Air Staff Operations (Transport and Helicopter) at Air HQ. He was Senior Air Staff Officer of Headquarters Training Command prior to appointment as Air Officer Commanding-in-Chief.

He was instrumental in commencing An-32 and C-130 Hercules operations at the extreme altitude airstrip of Daulat Beg Oldi near the Karakoram Pass. The Air Marshal was at the helm of affairs the Operation *Rahat* disaster relief effort in Uttarakhand. He is the Commodore Commandant of No. 44 Squadron 'The Mighty Jets.'

Air Marshal Virender Mohan Khanna is AOM

Air Marshal Virender Mohan Khanna, VSM, AVSM, took over as Air Officer-in-charge Maintenance (AOM) at Air Headquarters, on 1 November 2015. He was commissioned in the Mechanical stream of Aeronautical Engineering branch in IAF on 25 July 1977.



During his 38-year career the Air Marshal served as Director General (Aircraft) and Assistance Chief of Air Staff Engineering (Transport and Helicopters) at Air HQ, Senior Maintenance Staff Officer and Chief Engineering Officer at HQ Eastern Air Command. The officer has also served at various Base Repair Depots as Chief of Aircraft, Chief of Production and Planning and Commanding Officer. He was instrumental in successful induction of large number of Mi-17V5 helicopters, Hawk AJT and Pilatus Pc-7 aircraft.

New Director of ADE

MVKV Prasad, Outstanding Scientist, has been appointed as Director of the Aeronautical Development Establishment (ADE). He took charge from MZ Siddique, Director of GTRE, who had been heading ADE as an additional charge after the retirement of the previous Director, P Srikumar.

MVKV Prasad has a B.Tech in Electronics and Communication Engineering from JNTU, Anantapur and M.Tech in Instrumentation and Control System from Shri Venkateswara University, Tirupati. He joined DRDL, Hyderabad in 1984, serving in various capacities for 28 years. In May 2012, he took over as Director of the Integrated Test Range (ITR) at Chandipur.



New Director at DARE

Dr K Maheswara Reddy has been appointed as Director of the Defence Avionics Research Establishment (DARE), a DRDO establishment carrying out research on airborne electronic warfare and avionics systems. Dr Reddy has a B.Tech from SV University, Tirupati and an M.Tech from IIT-Delhi and initially joined DRDO with LRDE, Bangalore. He obtained his PhD in the field of Direction of Arrival (DOA) estimation and array processing in 1998 from IISc, Bangalore. Dr Reddy is responsible for developing various radar, laser and missile warning systems, and electronic support and electronic attack systems for fighter, transport and helicopter platforms.



Air Marshal Harjit Singh Arora is DG (I&S)

Air Marshal Harjit Singh Arora has taken over as Director General (Inspection and Safety) at Air Headquarters. Commissioned

in the IAF as a fighter pilot in December 1981, he has over 2600 hours of operational flying on MiG-21, MiG-29 and other aircraft including helicopters. He has served as Directing Staff at 'Tactics and Air Combat Development Establishment' (TACDE) and as a Flying Inspector in the 'Directorate of Air Staff Inspection' (DASI). He commanded 45 Squadron as a Wing Commander and as a Group Captain he was Commander of Air Defence Direction Centre and Station Commander of a Signal Unit based at Jodhpur. As an Air Commodore he commanded Air Force Station Adampur in Punjab and as an Air Vice Marshal he was Air Defence Commander at Headquarters of Western Air Command as well as Eastern Air Command.



HAL CMD receives CEO of the Year Award from IIMM

TSuvarna Raju, CMD, HAL was given the CEO of the Year Award 2015 in the Central Public Sector category by the Indian Institute of Materials Management on 27 November.

Speaking on the occasion, Raju called for strengthening of supply chain system from the planning to delivery stage. "The vendors are actually business partners and together we grow.

IIMM is doing yeoman services by organising programmes that transform organisations through supply chain management."



D. K. Venkatesh is Director (Engg. and R&D) of HAL

Mr D. K. Venkatesh has taken over as Director (Engg. and R&D) of Hindustan Aeronautics Limited, Bengaluru. The post of Engineering and R&D is newly created as a part of restructuring of HAL's Board, that came into effect from 1 April 2015. Mr Venkatesh has more than 35 years of experience in aerospace industry in manufacturing, assembly, repair, overhaul, prototype development, quality management, projects, design, customer support of aircraft, helicopters and gas turbine engines.



'An Ocean of Opportunities'

VAYU Interview with

**Admiral RK Dhowan PVSM, AVSM,
YSM, ADC, Chief of the Naval Staff**

VAYU : *In its determined modernisation process, the Indian Navy continues to induct assets such as multi-role destroyers, stealth frigates, replenishment tankers and so on. Yet there remain shortfalls in certain areas: what is the Navy's immediate 'wish list' essential for it to become a veritable 'blue water' force to face future challenges?*

CNS: The Indian Navy is already a blue water force, as may be seen in its wide operational footprint and full-spectrum capabilities. Today, the Indian Navy operates a balanced force comprising aircraft carriers, multi-role destroyers and frigates, fleet tankers, offshore patrol vessels, amphibious ships and a multitude of aviation and underwater combatants, capable of both blue water and littoral operations. These enable the Navy to undertake multiple activities under its military, diplomatic, constabulary and benign roles, to promote and protect India's maritime interests.

The Navy's roles and responsibilities have expanded significantly over the years, in response to changing geo-economic and geo-strategic circumstances. In order to meet the entire spectrum of challenges, our force structure planning is dictated



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WHEN RESULTS MATTER

primarily by capabilities to be achieved, threat perceptions in the prevailing maritime security environment, emerging technologies, and the availability of funds.

In overall terms, our fleet is young, while there are some gaps in certain niche areas such as minesweepers, submarines, and multi-role and utility helicopters. The Government is seized of these issues and impetus has been accorded to overcome the delays and progress all pending cases in a time-bound manner. We have 47 ships and submarines under construction, which will be inducted progressively into the Navy.

VAYU : *In the context of nearer-term programmes, have there been any significant developments with regard to design and configuration of the second indigenous aircraft carrier (IAC-2)? Can any details be shared from the Carrier Working Group that toured facilities in the USA this summer?*

CNS: IAC 2 is still in its conceptual stage and various facets of the aircraft carrier and newer technologies are still being evaluated. The Joint Working Group for Aircraft Carrier Technology Cooperation, formed under the ambit of the US-India

Defence Technology and Trade Initiative framework, aims at information exchange on such technologies. In addition, the Joint Working Group is also exploring other areas of cooperation such as carrier design and construction. The Indian delegation that toured US facilities in August this year benefited from the exchange of views with their US counterparts on these issues.

VAYU: *Even though there has been some headway with Project-75(I), the DAC has repeatedly deferred decisions on the programme. Is this a financial issue or a technical one? Has the Navy formally identified suitable Indian yards with the capability to execute this ambitious project, and if so, which are these?*

CNS: A case for procurement of six state-of-the-art conventional submarines with Air Independent Propulsion (AIP) under Project 75(I) is being progressed by the Indian Navy. All six P75(I) submarines will be constructed at a suitable Indian yard, in collaboration with an identified foreign collaborator under Transfer of Technology. A core committee was constituted by the MoD for identification of suitable Indian shipyards, both public and private, for construction of the six submarines. The core committee has submitted its



Kilo-class submarines (INS Sindhurakshak pictured here) are presently the mainstay of the Navy's submarine arm, and will be supplemented by P-75 and P-75(I) boats in the future (photo: Brian Burnell)



The IN's two carriers, INS Vikramaditya and Viraat steam in formation in the Arabian Sea (photo: Indian Navy)

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report to the MoD, and the same is being processed expeditiously in accordance with comprehensive guidelines.

VAYU: *The shortage of integral ship-borne helicopters appears to be reaching a critical point, with a large number of ships commissioned without organic air assets, and many vessels sailing without embarked rotorcraft. The 16-helicopter MRH contract has been hanging fire for years now, even after selection of a suitable platform. Similarly, the larger Naval Utility Helicopter (NUH) programme has been repeatedly delayed. How is the Navy dealing with its rotorcraft issues in the short term, and what are the plans to rectify delayed acquisitions?*

INS Arihant tests missile ejection

The first indigenous nuclear-powered ballistic missile submarine, INS *Arihant*, has successfully tested underwater ejection of an unarmed missile during its ongoing sea trials in the Bay of Bengal. This test, crucial for validating operational capability of the submarine's missile silos, was conducted by the Strategic Forces Command on 25 November.

The submarine has also successfully completed a range of surfaced and submerged open water tests, including deep diving trials, and has reportedly met nearly all design parameters, including maximum power tests on the indigenous pressurised water nuclear reactor. The final step before the submarine enters operational service will be a full-range test firing of an operationally representative ballistic missile.



The Kamov Ka-31 is the Navy's only relatively new rotorcraft acquisition in recent years (photo: Angad Singh)

CNS: Yes, there is a capability gap that has arisen from the shortage of helicopters in the Indian Navy. However, this is being mitigated in a systematic manner through upgrade of existing helicopters as well as acquisition of new platforms, such as the ALH, MRH and NUH. The case for procurement of additional ALH is in the final stages of negotiations with HAL. Further, the case for Mid-Life Upgrade (MLU) of 10 Kamov-28 helicopters is also likely to

be concluded shortly. The Indian Navy is also actively pursuing the procurement of additional Chetak helicopters, NUH and Naval Multi Role Helicopters, to meet its current and future operational requirements.

VAYU: *In Vayu's 2014 Navy special issue (VI/2014) you had said with reference to the MRMR programme, that you were "targeting contract conclusion in or about a year's time." Does that timeline still stand? Has a platform been selected as yet?*

CNS: As you are aware, the Request for Proposal (RFP) for procurement of nine Medium Range Maritime Reconnaissance aircraft was issued in 2013. However, with lesser numbers of bids being received, the case became a single vendor case at the Technical Evaluation stage. This resulted in the RFP getting retracted earlier this year. The acquisition case for the MRMR aircraft would have to be re-initiated post deliberations on the options available.

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Kolkata-class destroyers are being commissioned at one-year intervals, with two ships in service and the third expected next year (photo: Indian Navy)

VAYU: *The Navy has been at the forefront of international military engagement, flying the flag far from domestic shores and conducting a range of international maritime exercises. How important are*

these bilateral/ multilateral exercises in your view, and what are the important lessons?

CNS: The Indian Maritime Security Strategy is centred on shaping a favourable

and positive maritime environment to effectively overcome the wide array of maritime challenges spread across the Indian Ocean. This needs enhanced presence, and a cooperative and coordinative framework. Accordingly, the Indian Navy has expanded its presence and operational footprint in recent years. In the last one year, our ships have deployed as far East as the Western Pacific, and as far West as the Northern Atlantic, whilst also covering the Persian Gulf, the islands of the South-West Indian Ocean, and regions as far South-East as Australia. In addition, we regularly undertake bilateral as well as multilateral naval exercises with many countries. These serve to enhance mutual understanding, develop cooperation, and build interoperability between the maritime forces. They also help us in benchmarking our capabilities and exchanging best practices. The cooperation and interoperability generated in the process is a valuable tool, both in coordinating efforts towards safe and secure seas for all-round benefit, as also in advancing our maritime cooperation initiatives in the region.

VAYU: *One has seen and been impressed with the Indian Navy's image projection campaigns, particularly during the current year, to attract candidates to join the Navy in order to bridge the gap between the desired and actual strength of personnel. Could you please indicate the degree of success achieved and its impact on the human resources of the Navy?*

CNS: A particularly strong thrust has been given to the enhancement of awareness amongst the youth, with regard to the Navy as a career option, and this is bearing excellent results. Extensive publicity campaigns are being undertaken to attract the right kind of youth to join the Navy. The Indian Navy's advertorial campaign titled 'An Ocean of Opportunities' was very well received by the youth. The naval recruit today comes from India's aspiring classes and looks to the Navy for a way of life that provides high professional and personal growth. Therefore, the theme highlights the multitude of opportunities offered by the Navy to the aspirants. As a result, the Navy is getting adequate response to its recruitment drives from the youth of the country, with a substantial increase in applicants for both officers and sailors. Therefore, the Navy is able to select the best amongst a larger resource pool and eligible volunteers.



The Navy Chief in his office (photo: Indian Navy)

Vayu on board for *Exercise Malabar 2015*

Multilateralism in action — Indian Navy tanker INS Shakti conducting simultaneous replenishment training with USN carrier USS Theodore Roosevelt; and JMSDF destroyer JS Fuyuzuki (photo: USN/Mass Comm Specialist Seaman Chad M Trudeau)

Warships and submarines from the Indian, Japanese and US Navies converged in the Bay of Bengal for a weeklong joint exercise in October 2015. Vayu's Angad Singh was on hand to file this first hand report from Chennai as well as from on board the US Navy's *Nimitz*-class supercarrier, USS *Theodore Roosevelt*.

The turboprop drone becomes relaxing – almost somnolent – after an hour aloft, and indeed I might have even been able to snatch a few winks if not for the giddy anxiety that had taken up residence in my stomach. The Grumman C-2 Greyhound I am currently strapped into is about to make an arrested landing aboard its carrier, USS *Theodore Roosevelt*, cruising in the Bay of Bengal some 250 km east-southeast of Chennai. There is a light rumble as we pass through the stream of turbulent air – known as the ‘burble’ – trailing in the wake of the carrier’s immense superstructure and a split-second later, we slam onto the deck. The deceleration is tremendous as the 20-tonne aircraft goes from around 200 km/h to a complete standstill in a hundred metres. It feels like little more than a barely-controlled crash! And just like that, I am a ‘tailhooker’



The C-2 Greyhound that brought Vayu to and from the carrier being towed on the flight deck of USS Theodore Roosevelt



A Sikorsky HH-60H Rescue Hawk from Helicopter Antisubmarine Squadron HS-11 'Dragonslayers' coming in to land on USS Theodore Roosevelt while the cruiser USS Normandy conducts a PASSEX in the background



Aircraft from Carrier Air Wing One (CVW-1) parked on board the carrier as the JMSDF destroyer JS Fuyuzuki conducts a PASSEX

– part of an exclusive group of people to have experienced an arrested landing aboard an aircraft carrier at sea !

‘The Big Stick’

USS *Theodore Roosevelt* (CVN-71) is usually referred to simply as ‘TR,’ and sometimes as ‘the Big Stick,’ in reference to President Roosevelt’s famous proverb

“Speak softly and carry a big stick; you will go far.” The 29-year old carrier is currently executing an around-the-world deployment as part of a three-carrier base swap initiated by the departure of USS *George Washington* (CVN-73) from Yokosuka in Japan to Norfolk, Virginia on the US East Coast in preparation for a scheduled Refueling and

Complex Overhaul (RCOH), akin to a comprehensive mid-life refit and upgrade.

USS *Ronald Reagan* (CVN-76) has departed her homeport of San Diego to replace CVN-73 at Yokosuka, and TR has given up her place in Norfolk to move to San Diego. The ship’s commanding officer, Captain Craig Clapperton, noted that the lengthy deployment has afforded the ship and her crew



A Northrop Grumman E-2D Advanced Hawkeye taxiing next to some of the fighter types that it controls in the air

a number of unique opportunities to conduct various engagements along the way, including *Operation Inherent Resolve* against the Islamic State, during which the ship operated from the Persian Gulf, as well as this first-time participation in a *Malabar*-series exercise.

The 70 aircraft on board USS *Theodore Roosevelt* are provided by Carrier Air Wing One (CVW-1), which consists of 9 squadrons, which are:

- ✦ Three Strike Fighter Squadrons, VFA-11 'Red Rippers,' VFA-136 'Knighthawks,' and VFA-211 'Fighting Checkmates' with Boeing F/A-18E/F Super Hornets.
- ✦ Marine Fighter Attack Squadron VMFA-251 'Thunderbolts' with F/A-18C/D Hornets.
- ✦ Carrier Airborne Early Warning Squadron VAW-125 'Tigertails' with Northrop Grumman E-2D Advanced Hawkeyes.
- ✦ Electronic Attack Squadron VAQ-137 'Rooks' with Boeing EA-18G Growlers.
- ✦ Fleet Logistics Support Squadron VRC-40 'Rawhides' with Grumman C-2 Greyhounds.
- ✦ Helicopter Anti-submarine Squadron HS-11 'Dragon Slayers' with a mix of Sikorsky HH-60H and SH-60F Seahawks.
- ✦ Helicopter Maritime Strike Squadron HSM-46 'Grandmasters' with Sikorsky MH-60Rs.



Dramatic high speed pass by a VFA-136 'Knighthawks' F/A-18E Super Hornet

During my day aboard the 100,000-tonne floating airfield on 17 October, we were able to witness a small part of the larger *Malabar* 2015 exercise that would run for another three days : from perfectly choreographed flight operations on TR, to a passing exercise (PASSEX) conducted by the various participating warships, and detailed briefings by key US Navy officials. A number of Indian Navy officers and sailors were also on board the carrier, including Captain Anil Kumar, who heads the MoD's aircraft carrier project. With the Indian Navy expected to turn to the USA for assistance with its next generation of aircraft carriers (*see article in this issue*), it was clear at the exercise that special measures were being taken to expose Indian personnel to STOBAR technology and operations.

Malabar 2015

The *Malabar* series of joint naval exercises was initiated in 1992 as a bilateral arrangement between the Indian and US Navies. Since then, the exercise has been carried out 19 times, with the scale and complexity of operations steadily increasing, and often expanding to include multiple participating Navies. The most recent of these, *Malabar* 2015, saw the Japanese Maritime Self-Defence Force (JMSDF) join the Indian and US Navies for the fourth time, even in the face of strenuous Chinese protests. Although this is neither the largest edition of *Malabar*, nor the first time Japanese warships have exercised alongside their Indian and American counterparts, Beijing clearly believes that the exercise is aimed at containing its influence in the region, and takes a dim view on the US 'pivot to Asia' and the increasing closeness between Japan, the USA and India.

Based out of Chennai and held between 14 and 19 October 2015, this year's *Malabar* saw a 'modest' total of ten ships exercising in the Bay of Bengal. However, it was noteworthy for two principal reasons : this was the first time the Indian Navy deployed a Russian-origin *Kilo*-class submarine for the exercise, was also the first ever deployment of US Navy Boeing P-8A Poseidon maritime patrol aircraft to India, operating alongside their Indian P-8I brethren from INS *Rajali* at Arakonam.

The Indian Navy was represented by two indigenous guided missile frigates INS *Shivalik* and INS *Betwa*, the *Rajput*-class guided missile destroyer INS *Ranvijay*, fleet



Indigenous guided missile frigate INS Shivalik cruising alongside USS Theodore Roosevelt

support ship INS *Shakti*, and *Sindhughosh*-class submarine INS *Sindhudhvaj*. The ships deployed HAL Chetak and Westland Sea King helicopters, which were joined during some segments of the exercise by Boeing P-8Is of INAS 312A 'Sealions' from ashore.

The US Navy deployed four ships from the 7th Fleet, which is based at Yokosuka, Japan. These were the *Nimitz*-class aircraft carrier USS *Theodore Roosevelt*, *Ticonderoga*-class guided missile cruiser USS *Normandy*, *Freedom*-class Littoral Combat Ship (LCS) USS *Forth Worth*, and *Los Angeles*-class nuclear powered attack submarine (SSN) USS *City of Corpus Christi*. USN airborne assets included the aforementioned P-8A Poseidon aircraft,

various integral helicopters, and a host of combat and support types operated by Carrier Air Wing One (CVW-1) aboard the USS *Theodore Roosevelt*.

The JMSDF sent a lone *Akizuki*-class guided missile destroyer, JS *Fuyuzuki*, with an integral Sikorsky/Mitsubishi SH-60K helicopter. *Fuyuzuki* is equipped with an indigenous battle management system named ATECS, that has been favourably compared to the Lockheed Martin Aegis Combat System, and is sometimes referred to as the 'Japanese Aegis.' *Akizuki*-class vessels serve as air-defence escorts for the JMSDF's larger vessels such as *Hyūga*- and *Izumo*-class helicopter carriers, as well as *Kongō*- and *Atago*-class destroyers, which

are more focused toward the ballistic missile defence (BMD) role. Nevertheless, all modern Japanese warships are multirole, capable of operating in the air defence, anti-surface and anti-submarine warfare roles.

Training together

The exercise began as usual with a two-day shore phase, which saw participating personnel training together at Chennai. The three navies covered topics such as carrier strike group operations, airborne maritime patrol, surface and anti-submarine warfare, explosive ordnance disposal (EOD), Visit Board Search and Seizure (VBSS), and joint Humanitarian Assistance and Disaster Relief (HADR). The shore phase allowed all three Navies to achieve a degree of familiarisation with each other's procedures for various common tasks, as well as to establish protocols for clear, unambiguous communication during the at-sea phase of the exercise. Cultural programmes and sports fixtures were included to build a sense of camaraderie right from the start, so as to ease joint operation, often aboard foreign vessels, in the days to follow.

On 16 October, the ships departed Chennai for international waters off the east coast, and kicked off the at-sea portion with an air defence exercise (ADEX). This first engagement featured cooperation between USS *Theodore Roosevelt*, USS *Normandy* and Indian stealth frigate INS *Shivalik*, who worked together to defend the high-value target (the carrier) from a combined aircraft and missile attack simulated by



An F/A-18F Super Hornet from VFA-211 'Fighting Checkmates' being launched from the waist catapult on USS Theodore Roosevelt

elements of USS *Theodore Roosevelt*'s own Carrier Air Wing. While USS *Normandy* typically serves as the air defence escort for the high-value asset in Carrier Strike Group 12 (CSG-12), that role was handed over to both Japanese and Indian ships during the course of the exercise. The close cooperation in the opening at-sea exercise was welcomed, with one US Navy officer remarking that the ADEX "supports the overall *Malabar* exercise by sharing how we control aircraft and learning how the Indian navy controls their aircraft. We're up on the same voice circuit, so it's a nice opportunity to collaborate and compare and contrast our procedures. We've sent liaison officers to the Indian vessels and welcomed their officers aboard our vessels as well to observe and learn."

Rear Admiral Roy 'Trigger' Kelley, Commander of CSG-12, reinforced this point during *Vayu*'s visit to the aircraft carrier, saying, "the whole idea is to get the three different Navies together, and figure out how we operate differently, and how we can communicate and coordinate in our operations.... We want to make sure that when we operate together, we're comfortable with each other."

The Rear Admiral also indicated that following *Malabar* 2015, the exercise would be expanded to include Japan as a permanent participant. "The Indo-Asia-Pacific, this vast

area of ocean, is very, very important to the rest of the world, mostly because of the commerce that comes through it. If you look at the Straits of Malacca alone, 600 merchant ships travel through that strait every single day. We want to make sure that these lines of communication, the lines of commerce, continue to stay open. Thus, the Navies working together for interoperability helps to make sure that happens," he stated.

While US and Indian officers were careful to reiterate that this exercise was not aimed at countering China or the People's Liberation Army Navy (PLAN), the emphasis placed by all three participating Navies on the importance of open oceans seemed a clear reference to China's various territorial claims in the region and the challenges that Chinese land-reclamation and artificial island building pose to freedom of navigation.

As if to underline this very point, the remaining at-sea tasks were far from the benign HADR and maritime policing activities that one often hears of from exercises such as this. Apart from the usual professional exchanges and cross-embarking of officers on different ships, the ten vessels at sea carried out further joint air defence operations with different combinations of attacking and defending forces, engaged in search and rescue operations, a range of anti-submarine warfare exercises with Indian and

US submarines, surface warfare exercises, medevac, communications exercises, live-fire gunnery, Visit Board Search and Seizure (VBSS), replenishment at sea (RAS) exercises with INS *Shakti*, and a full 'war-at-sea' exercise.

In fact, on 17 October, the day that *Vayu* was aboard USS *Theodore Roosevelt*, and the day after the opening ADEX, a Sikorsky Seahawk helicopter from the carrier flew to INS *Shivalik* to fetch an explosive ordnance disposal (EOD) detachment of Indian Marine Commandos (*Marcos*), led by an IN Lieutenant. Their task was to work alongside a US EOD team to de-mine the area around the carrier – precisely the sort of joint operation that might someday be needed if a recalcitrant regional nation should attempt to deny access to contested waters.

Between the present Indian government's 'Act East' policy and the USA's strategic rebalancing toward Asia, there is no question that the *Malabar* series is only going to grow with each successive edition. The US Navy's assertive posture during 'Freedom of Navigation' operations (FONOPS) conducted around Chinese artificial islands shortly after the exercise seems to have driven this point home, and both Indian and US officials are privately hopeful that future *Malabar* exercises will involve other key regional Navies, such as those of Vietnam, Indonesia, Singapore and even Australia.



A US Marine Marine Corps F/A-18C in asymmetric configuration coming in to land, with Indian Navy frigate INS Betwa and JMSDF destroyer JS Fuyuzuki visible in the distance

Super Carriers Ahoy !



Strategic Partnership with America

In early August 2015, an Indian Navy delegation including senior Flag Officers visited the United States on a three-day mission that could significantly bind together the two Navies in the times to come. A newly-formed 'Joint Working Group (JWG) on Aircraft Carrier Cooperation' held its inaugural meeting in Washington DC following the Agreement between President Barack Obama and Prime Minister Narendra Modi for cooperation in this strategic arena during the former's Republic Day visit to India in January 2015. The JWG has reportedly reviewed on how the US Navy — the world's most experienced and technologically advanced aircraft carrier power — could assist India in building its own fleet of modern aircraft carriers. With India looking to build a 'blue water navy' that can project power across thousands of miles of the Indian Ocean and beyond, the first indigenous aircraft carrier (IAC I), INS *Vikrant*, is already at an advanced stage of construction (see earlier *Vayu* Issues).

Indian naval planners have for long argued on the need to have three aircraft carriers in service. This would allow two aircraft carrier battle groups (CBGs) —

each a self-contained flotilla with air, surface and sub-surface capabilities — to cover the Arabian Sea and Bay of Bengal simultaneously, even whilst the third carrier undergoes routine maintenance or overhaul. Each CBG, which would include an aircraft carrier, escort vessels (multi-role destroyers and frigates), anti-submarine corvettes, missile boats, logistics support vessels and submarines, is charged to engage in intense combat even without support from shore-based fighters.

Still, the three-carrier endeavour remains elusive, even with two carriers, INS *Viraat* and INS *Vikramaditya*, in operational service today and a third, INS *Vikrant*, likely to be completed in Cochin Shipyard Ltd (CSL) by 2018. INS *Viraat*, launched in 1953, already has the dubious distinction of being the world's oldest serving aircraft carrier and will retire when *Vikrant* enters service. India's third aircraft carrier, therefore, would only be *Vikrant*'s successor, whenever that is built. Currently on the drawing board and referred to as INS *Vishal* (a name the Indian Navy has not confirmed) or IAC-2, this could well be the vessel that sees US-India high-tech naval cooperation bearing fruit.

So why does India need the US Navy's help to build IAC-2, even after designing and building INS *Vikrant* at the Cochin Shipyard? This is because India has only operated relatively smaller aircraft carriers which displace less than 45,000 tonnes. The size of a carrier determines how many aircraft it embarks, the ballpark calculation being one aircraft for every 1,000 tonnes. The 45,000-tonne *Vikramaditya* embarks a maximum of 36 aircraft: thirty MiG-29K fighters and six Kamov Ka-31 AEW helicopters. This is not enough. Ideally, a CBG should deploy at least 50-55 aircraft when operating well away from shore-based air support. That calls for at least a 65,000-tonne carrier, something that Indian shipyards have never built.

As important as numbers, is the type of aircraft that the carrier embarks. A crucial element of air battle is 'airborne early warning', delivered by AEW aircraft: radar-equipped, airborne command posts that scan airspace for enemy aircraft and direct friendly fighters towards developing threats. For this task, US Navy aircraft carriers embark the Northrop Grumman E-2 Hawkeye, a relatively large, twin-turboprop aircraft that could never



INS Viraat is to be retired next year, bringing the Indian Navy's carrier force back down to a single carrier as it awaits commissioning of INS Vikrant (photo: USN/ Mass Communication Specialist Seaman Stephen W Rowe)

get airborne from small carriers like the *Vikramaditya* or *Vikrant*. For this purpose, the US Navy has long operated 100,000-tonne 'supercarriers,' which launch aircraft with steam catapults : a steam-driven piston that hooks onto the belly of an aircraft and accelerates it to take-off speed in just 2-3 seconds. The newest American supercarriers, starting

with USS *Gerald R Ford*, which will join the fleet next year, feature the revolutionary Electro-Magnetic Aircraft Launch System (EMALS) that will replace steam catapults. EMALS is smaller, lighter, quicker and more powerful, and allows the take-off speed to be carefully calibrated for different types of aircraft, reducing stress and wear on their airframes. The electric power

requirements of an EMALS system are too large for conventional generators to deliver; so nuclear propulsion is essential for a carrier fitted with EMALS.

This effectively is the Indian Navy's dilemma for its third aircraft carrier. It must choose between what it already has, relatively small, conventionally powered vessels that embark 30-35 combat



USS Gerald R Ford (CVN-78) under construction at Newport News Shipyard, Virginia (photo: USN/ Mass Communication Specialist Second Class Aidan P Campbell)

An F/A-18E Super Hornet prepares to launch during a test of the Electromagnetic Aircraft Launch System (EMALS) at Naval Air Systems Command, Lakehurst, New Jersey (photo: USN)



aircraft that can be launched slowly or, alternatively, a large, nuclear-propelled vessel with EMALS that embarks 50-55 aircraft of varying types including force multipliers like long range AEW aircraft. The benefits of this are attractive, since this greatly enhances the power that a CBG can project. Even so, some strategists believe India would be unwise in investing so much money, capability and symbolism into a single vessel that could be vulnerable in war. Opponents of the 'big carrier' school of thought argue for greater numbers of smaller vessels like destroyers and frigates, covered by land-based aircraft (including those operating from archipelagic bases like the Andaman & Nicobar Islands) with their ranges extended by air-to-air refuelling.

It will be interesting to see in which direction the Indian Navy goes, whether it chooses a conservative, tactical approach, like the Army and the Air Force, or a bolder doctrine based on sea control and extended reach, of the kind that the US Navy imbibed from strategist Alfred Thayer Mahan. Henry L Stimson, US Secretary of War all through World War II, memorably described "the peculiar psychology of the

[US] Navy Department, which frequently seemed to retire from the realm of logic into a dim religious world in which Neptune was God, Mahan his prophet and the United States Navy the only true church."

Regardless of which doctrine evolves in the Indian Navy, their American counterparts already regard them as inevitable long-term allies. The Indian delegation that travelled to the USA in August 2015 was taken to the Virginia shipyard where USS *Gerald R Ford* is being completed, and introduced to EMALS. With the Defence Technology and Trade Initiative (DTTI) touted as the vehicle for easing US restrictions on technology, Defence Secretary Ashton Carter sees US assistance in aircraft carrier building as the lynchpin and the two Navies as torchbearers, of a close defence relationship. Strategist Ashley Tellis has argued that Washington might well assist India with developing a nuclear reactor for powering INS *Vishal* and future Indian aircraft carriers. But for that, a top-level request would be essential (i.e. PM-to-President) along with firmer assurances of strategic alignment. In the US system, every grant of

assistance must be sponsored by the military service it relates to and the US Navy will enthusiastically support the provision of cutting-edge technology to the Indian Navy if it believes that would bring it clear operational benefits.

Despite New Delhi's ambivalence on strategic partnership with America, US vendors are delivering an increasing share of India's arms imports, inexorably easing out Russia's share. India has already spent close to \$10 billion in outright US purchases; most of them government-to-government, while co-developing platforms like aircraft carriers have not gotten off the ground. Very significantly, during a recent speech at the Observer Research Foundation in New Delhi, the US Ambassador to India, Richard Verma, told the audience, "I see no reason why the United States and India cannot build fighter aircraft together, right here in India." While that may be a distant dream, New Delhi could well work with the world's unchallenged aircraft carrier power to retain crucial control over our regional waters.

Ajai Shukla [Adapted from an article in Business Standard]

EMALS: Electro-Magnetic Launch System tested



Test sled 'Ledger Rip' in place on the EMALS track aboard the under-construction USS Gerald R Ford

With successful launch of the first test sled from the starboard bow catapult on 16 June Naval Air Systems Command (NAVAIR) continued to make history with the Electromagnetic Aircraft Launch System (EMALS) aboard the future USS *Gerald R Ford* (CVN 78).

Hurling of the dead-load sleds, which represent different aircraft weights, marks a significant testing milestone for the first new aircraft launch technology employed by the US Navy in more than 60 years.

In a ceremonial gesture, Susan Ford Bales, the ship's sponsor and daughter of the late President Ford for whom the ship is named, gave the launch signal by extending her left arm while on one knee.

"The adrenaline of seeing the speed of the launch was amazing," Bales said.

Dead-load testing is a joint effort among NAVAIR, the Naval Sea Systems Command, the crew of CVN 78, EMALS prime contractor General Atomics, and Huntington Ingalls Industries Newport News Shipbuilding, the shipbuilder. The ship's test data will be compared to land-based test data, and after adjustments, becomes the basis for test launching the first manned aircraft off the ship in 2016.

Before the launch, Bales and other dignitaries signed the dead-load, which was first used on June 5, and nicknamed 'Ledger Rip,' after John D Ledger, the Newport

News lead for NAVAIR's Carrier and Field Service Unit (CAFSU) and had significant role in supporting the EMALS installation on CVN 78. Ledger died in 2012.

"It is truly fitting we recognised John today," said Captain Douglas Belvin, deputy programme manager for future systems in the Aircraft Launch and Recovery Equipment Programme Office (PMA-251). "Behind this event are thousands of talented civilian engineers and technicians who dedicate their life's work to delivering new technologies to the fleet."

An example of NAVAIR's civilian talent, CAFSU is the link between the aviation programme offices and the hands-on work of building, maintaining, and overhauling the Navy's aviation-capable ships.

"CAFSU plays a very important role for NAVAIR," said Robert Puakea, the current CAFSU lead at the Supervisor of Shipbuilding Newport News office. "Not only do we ensure NAVAIR's equipment gets installed and tested correctly, we interface daily with the shipbuilder to make real-time decisions as needed and reach back to the teams at Lakehurst [and Patuxent River], so they know how to adjust designs or procedures to make future aircraft launch and recovery equipment systems work better."

Puakea said EMALS testing is still maturing. "We are very early in collecting

the test data. We have to remember that in terms of EMALS, everything we are doing is brand new. This is the only place on the planet where electromagnetics are going to launch tactical aircraft off a carrier."

Electromagnetics offer several advantages over steam-powered catapults. The newer system has a wider energy range over the current steam-powered catapults. A wider energy range expands the Navy's future aircraft carrier operational capabilities, supporting the launch of the current and planned air wing composition, from lightweight unmanned aerial systems to heavy strike fighters.

EMALS also provides increased sortie rates, more accurate end speed control and smoother acceleration, which reduces stresses on aircraft during launch.

The system automates much of the maintenance and trouble shooting procedures and employs a modular architecture, allowing for easier repairs or component replacements. This then permits a reduction in the human workload required to operate and maintain the system, with a subsequent cost reduction over time.

Removal of a significant amount of steam, hydraulic, and air piping also means that sailors will enjoy cooler and quieter working and living spaces!

Source: US Naval Air Systems Command



Boeing P-8I : Tremendous Enhancement for the Indian Navy

Defence Minister Manohar Parrikar has dedicated the Boeing P-8I long-range maritime reconnaissance and anti submarine aircraft to the nation, at a special ceremony held at INS *Rajali*, Arakkonam, about 70 kilometres from Chennai in October 2015.

As per the release issued by the Ministry of Defence, “the P-8I would boost the firepower and arsenal of the Indian Armed Forces. The P-8Is enhance India’s intelligence, surveillance and reconnaissance capabilities and have been extensively deployed to assist during disaster relief and humanitarian missions for aerial reconnaissance and data gathering.”

The Indian Navy’s P-8I aircraft fleet has demonstrated an excellent record in supporting the missions they have been deployed for, with the Defence Minister and Navy leadership having expressed

satisfaction about the operational readiness of the aircraft. This has been possible owing to the enhanced capabilities of the platform manufactured by Boeing and the focus on timely and affordable services and support.

The dedication ceremony at INS *Rajali*, home base of Indian Naval Air Squadron (INAS) 312A under the command of Commander Venkateshwaran Ranganathan, which operates the Navy’s P-8I fleet (*see Vayu VII/2014*), was held in presence of the Chief of Naval Staff Admiral RK Dhowan, Flag Officer Commanding-in-Chief Eastern Naval Command Vice Admiral Satish Soni, INAS 312A personnel and the Boeing team.

Minister Parrikar, who flew in to INS *Rajali* on board a Boeing P-8I from Port Blair, described the aircraft as “one of the best for maritime surveillance in the world today.” During the flight, Parrikar was briefed on the various sensors and other

sophisticated state-of-the-art equipment and their capabilities. He said the aircraft would provide the Indian Navy the necessary reach and flexibility to undertake extensive surveillance as also to respond swiftly and effectively to contingencies in our areas of interest.

Mr. Parrikar complimented the Navy and its air arm for expeditiously inducting and operationalising this force multiplier, which would enable the nation’s armed forces to dominate the future battle space. The Minister praised the efforts put in by INS *Rajali* and its personnel, taking note of the fact that, even in the short phase of trials and testing, the P-8I aircraft had achieved a number of operational milestones which includes participation in the search effort for Malaysian Airlines Flight MH 370, the first successful firing of air launched Harpoon Block II missile in the world, torpedo firing



Defence Minister Manohar Parrikar and Chief of Naval Staff Admiral RK Dhowan with Navy officials at dedication ceremony of the P-8I at INS Rajali (photo: Indian Navy)



Boeing and Indian Navy officials celebrate 5,000 flight hours of the P-8I fleet at INS Rajali (photo: Indian Navy)

and active participation in major naval exercises (see *Exercise Malabar 2015 report in this issue*).

Tom Bell, senior vice president, Global Sales & Marketing, Boeing Defense, Space & Security, commended the Indian Navy for its high standards of professionalism and said Boeing was proud to support the navy's long range maritime surveillance and anti-submarine requirements.

"The Boeing teams have been committed to building, delivering and supporting this amazing aircraft for our important customer – the Indian Navy," Bell said. "Over the last six years, we have learned together, grown together and cemented a foundation for a long term relationship that will last decades. To see this aircraft come to life at INS *Rajali* and perform the missions it was envisioned to do under the very able handling of the Indian Navy's sailors and officers has been truly amazing. This is a tremendous achievement for the country."

The P-8I aircraft is a variant of the P-8A aircraft that Boeing developed as

a replacement for the US Navy's ageing P-3 fleet. Indian Navy became the first international customer for the P-8 aircraft with the conclusion of an approximately \$ 2.1 billion contract in January 2009 for a total of eight aircraft. The first aircraft arrived in India on 15 May 2013 and as of

date, all eight aircraft have been inducted into the Indian Navy and are fully integrated into its operations.

Dennis Swanson, vice president, Boeing Defense, Space & Security in India, explains that delivering on commitments to the Indian Navy has been one of Boeing's top priorities in India. "The Navy is pleased with the performance of its P-8I fleet and has deployed its aircraft for several missions. This is testament to the hard work of Boeing teams and trust we have built with the customer by meeting their expectations. In 2016 we will continue to focus on delivering training, support and service to ensure the Indian Navy experiences high aircraft availability and mission readiness rates."

The 2009 contract also included options for four additional aircraft. "We're currently in discussion with the Indian Navy about their options for more P-8Is", said Mark Jordan, P-8I programme manager. "The team has done a tremendous job providing those first eight aircraft and we're looking forward to continuing our work together with the Indian Navy."

The P-8I aircraft is equipped for long range anti submarine warfare, anti-surface warfare, intelligence, surveillance and reconnaissance in support of broad area, maritime and littoral operations. The Defence Ministry spokesperson mentioned that the communication and sensor suite includes indigenous equipment developed by Indian defence companies. "With its high speed and high endurance of about 10 hours, the aircraft is capable of thrusting a punitive response and maintaining a watch over India's immediate and extended areas of interest," the statement said.



Indian Defence Minister Manohar Parrikar (seated) is briefed on the P-8I's mission readiness by officers of INAS 312A (photo: Indian Navy)



MiG-29K/KUB: the Indian Navy's 'Super Fighter'

The Indian Navy's latest combat aviation asset, the MiG-29K/KUB multi-role strike fighter were formally commissioned into service with INAS 303 'Black Panthers' on 11 May 2013 (see *Vayu* III/2013). The initial contract for their purchase was signed on 20 January 2004, along with the ex-Russian Navy 'heavy aviation cruiser' *Admiral Gorshkov* which has since been modified

into a STOBAR aircraft carrier in service as INS *Vikramaditya*. The initial contract covered delivery of twelve single-seat MiG-29K and four dual-seat MiG-29KUB fighters, as well as facilities and procedures for training of pilots and technical staff, delivery of simulators, spare parts, and establishment of maintenance facilities at Indian Navy installations. The aforesaid 'super fighters' will be operated from the

45,000-tonne INS *Vikramaditya* as well as the under-construction INS *Vikrant* (IAC-1).

The MiG-29K was initially intended to fulfil the role of a multi-role strike-fighter operable from aircraft carriers like the United States Navy's F/A-18 Hornet but financial troubles at the end of the Cold War temporarily terminated the MiG-29K programme after nearly 450 flights. Test flights of MiG-29Ks were resumed from 2002 in anticipation of export sales to the Indian Navy.

On board INS *Vikramaditya*, the MiG-29K/KUBs will make a 14.3-degree ski-jump assisted short take off following attainment of full power thanks to hydraulic restraining blocks that hold the aircraft in place. Three arrestor cables are fitted on the aft part of the angled flight deck along with navigation and carrier-landing aids including the LAK optical-landing system to facilitate STOBAR (short take-off but arrested recovery) operations.

The MiG-29K's exterior airframe is only slightly different from the standard MiG-29, prominent differences being incorporation of Leading Edge Root Extensions (LERX), an arrestor hook and special Radar Absorbent Material (RAM) coatings. Under the skin, however, it is a different aircraft altogether. The MiG-29K boasts a triplex digital Fly-By-Wire (FBW) Flight Control System (FCS) with multiple-redundancy in all three channels and a mechanical back-up in roll-and-yaw channels. The cockpit is all-glass and features a ShKAl wide-angle monochrome Head-Up Display (HUD) and MFI-10-7 liquid-crystal Multi Function Displays (MFDs). Additionally, the MiG-29K/KUB flight and navigation system is based on an 'open architecture' principle built around the MIL-STD-1553B standard data bus enabling integration of weapons and sensors from a variety of sources, mirroring the architecture of the Sukhoi Su-30MKI.

Enhanced range is a vital attribute of any aircraft carrier based platform and in this respect additional fuel tanks have been accommodated in the dorsal spine and LERX, increasing total fuel capacity by some fifty per cent compared to early variants of the land-based MiG-29. A further combination of 'combat rated' drop tanks, Air-to-Air Refuelling (AAR) capability and the option of a centreline 'buddy refuelling' tank is set to enhance the



range to considerable extent. While Indian Navy MiG-29Ks may be in a position to refuel from the IAF's Il-78MKI AAR platforms, 'buddy refuelling' from fellow MiG-29K/KUBs will likely be the option whilst deployed away from Indian shores.

The main sensor, the on-board radar, is the Phazotron Zhuk-ME, an X-band mono-pulse pulse-Doppler radar, with an

aerial target detection range of 150 km. It can initiate track beginning at 130 km range, against a target with RCS of 5 square metres and can Track-While-Scan (TWS) 20 targets and simultaneously engage four targets. The passive detection kit consists of an Infra-Red Search and Track (IRST) sensor and laser range-finder, an area the Russians are traditionally considered strong

at, and perhaps their answer to the emerging stealth designs, particularly those of the United States.

The only weak link in the system lies in the lack of AEW&C support. The E801M Oko (Eye) pulse-Doppler 6x1 metre planar array radar used by Kamov Ka-31 AEW helicopters are capable of providing the much needed support in detecting fighter-

sized targets at ranges at least up to 110 km, but are unable to guide Indian Navy fighters towards their targets. Lack of endurance of an AEW helicopter platform is also a critical shortcoming. This problem will appear less acute however if the Indian naval planners visualise grand scale naval operations in future as part of Coalition Forces where mutual AEW&C and AEW cover will be available. The aircraft will also feature Sagem's Sigma-95 Inertial Navigation System/Global Positioning System (INS/GPS). In future the aircraft are likely to sport an Active Electronically Scanned Array (AESA) set plus encrypted Intra-Flight Data Link (IFDL) to permit networking of multiple MiG-29K/KUB



platforms effectively providing AEW coverage of respective sectors alongside vectoring appropriate fighters in pursuit.

The MiG-29K/KUB is equipped with two smokeless Klimov RD-33MK turbofan engines producing 9,000 kg thrust in afterburner, a significant increase over the land-based MiG-29's baseline RD-33 engines. The direct benefit is in the area of greater payloads stated to be in the region of 5,500 kg, including Russian RVV-AE BVRAAMs, R-73 CCMs cued by the Thales 'Topsight E' helmet-mounted targeting system, and variants of the Kh-35 anti-ship missile alongside standard air-to-ground munitions such as unguided rockets. However as the MiG-29K/KUB flight and navigation system is built around the MIL-STD-1553B standard data bus, incorporation of the European MBDA Meteor inertial navigation/active-radar homing BVRAAM with 150 km range is a possible option to fulfil the BVR role for 'outer-air battles' alongside the dual-mode solid-fuelled RVV-BD BVRAAM unveiled at MAKS 2011 for the first time. The RVV-BD weighs 510 kg, has a range up to 200 km and is capable of destroying targets with overload up to 8-g at an altitude from 15 m to 25 km. For dogfights the MiG-29K has a handy 30-mm Gryazev-Shipunov GSh-301 single-barrel gun, with a capacity of 150 rounds. A robust combination of Russian, Indian and Israeli Electronic Counter Measures (ECM) suites (including Elta's EL/M-8222 ECM pod) provides a shield around the MiG-29K/KUB platforms against hostile threats.

The primary role of INS *Vikramaditya* will be to establish local air superiority in open oceans even within the range of enemy



fighter and strike aircraft. Thus it will provide the vital integrated air support in terms of fleet area air defence, and also include the strategic oriented defensive postures to protect the Indian Navy nuclear-powered ballistic missile armed submarine (SSBN), in holding areas or 'bastions' in and around the Indian Ocean. If necessary, offensive missions can to be undertaken to sweep aside enemy barrier Anti-Submarine Warfare (ASW) forces in key areas to facilitate transit of Indian Navy SSBN units from one operational theatre to another adequately, to be supported in these roles by *Akula* II-class nuclear-powered attack submarines (SSN).

Enemy operated Long Range Maritime Patrol/Anti-Submarine Warfare (LRMP/ASW) platforms are presently anticipated as the greatest threat to Indian Navy surface units and SSBN platforms especially if guided to their targets by an enemy AWACS aircraft. The MiG-29K/KUBs in conjunction with Kamov Ka-31 Airborne Early Warning (AEW) helicopters will be

instrumental in intercepting and destroying enemy strike and LRMP platforms at great distances effectively debarring them from conducting LRMP/ASW operations or before they can close in and fire anti-ship missiles such as the AGM-84 Harpoon or Exocet AM39.

Also a Combat Air Patrol (CAP) or Quick Reaction Alert (QRA) from a 'forward floating base' in the Arabian Sea can be established to destroy enemy airborne strike platforms in defence of our vital nuclear and oil installations on the West coast. An added advantage of INS *Vikramaditya* is its superstructure profile that has the potential to accommodate powerful planar or phased array radar systems with 'billboard style' antennae first noted in United States Navy cruiser USS *Long Beach* along with extensive command and control facilities to conduct an aerial campaign.

Sayan Majumdar
Photos: Angad Singh



The Hawks of Dega



Vayu's Angad Singh spent some time with the Indian Navy at INS Dega in Visakhapatnam and reports on the Navy's advanced jet training squadron, INAS 551 *Phantoms*.

Over the last few years, the Indian Navy has been feverishly working to augment its infrastructure around the country, and nowhere is this drive more apparent than at INS *Dega* in Visakhapatnam. In addition to a host of improvements to already-existing facilities at the base, as well as construction of all-new infrastructure including additional hangars and aprons, the Navy is also aiming to acquire more land to expand this air station to make it linchpin of the Eastern Naval Command's aviation capability much in the same way as INS *Hansa* in Goa serves the Western Naval Command. Indeed, like its WNC counterpart, INS *Dega* is eventually intended to serve as shore base for an operational squadron of Russian-origin MiG-29K/KUB carrier fighters. Once INS *Vikrant*, the first indigenous aircraft carrier (IAC-1) enters service, the entirety of its air wing will also be based at *Dega*. The station's present commanding officer, Captain Debanil Bhattacharya, noted that the development work underway would also allow an increase in both military as well as civil aircraft operating on India's eastern

seaboard, an important consideration given that the air station also doubles up as the only air link to the ever important city of Vizag.

INS *Dega* got off to a rather modest start, with the formation of a helicopter flight under INS *Circars* adjacent to Visakhapatnam airfield in December 1972. Over a decade later, on 12 March 1986, the airport at Visakhapatnam was transferred from the DGCA/AAI to the Navy and commenced operations as 'Naval Air Station, Visakhapatnam,' with one Chetak flight and a few helicopters disembarked from various

ships. Construction of additional hangars, aprons, maintenance facilities and an operations complex soon followed and on 21 October 1991, Admiral Laxminarayan Ramdas formally commissioned the base as INS *Dega*.

The base is home to some 40-odd aircraft at any given time and hosts a number of Naval Air Squadrons : INAS 311 'Kites,' a patrol and EW squadron operating Dornier 228 aircraft, INAS 321 'Angels,' with HAL Chetak helicopters in the search and rescue (SAR) role, INAS 333 'Eagles,' with anti-submarine warfare (ASW) Kamov Ka-28



An IN Hawk gets airborne at INS Dega for a training sortie



An INAS 551 Hawk taxis out while other aircraft of the squadron prepare for flight in the background

helicopters, INAS 350 'Harpoons,' with the Sikorsky UH-3H Sea King helicopters that came with INS *Jalashwa* (ex-USS *Trenton*), and a flight of DRDO Lakshya unmanned target drones. The station's newest tenant is INAS 551 'Phantoms,' which traded ageing HAL HJT-16 Kiran Mk.IIs for brand new HAL-built BAE Systems Hawk Mk.132 advanced jet trainers (AJTs) and relocated to Vizag from Goa in late 2013.

The Phantoms

In its earliest avatar, the squadron existed as the Naval Jet Flight (NJF), which was set up in September 1957 at Sullur and equipped with four de Havilland Vampire jet aircraft. In mid-1959 the Naval Jet Flight was re-constituted as INAS 550A, and then a little over two years later, was re-designated as an independent squadron and commissioned as INAS 551 on 5 September 1961. The squadron was to train pilots in tactical flying and air combat before they moved on to the operational fighter squadron, INAS 300 'White Tigers.' By 1962, a handful of Hawker Sea Hawks from INAS 300 had been inducted into INAS 551, which was conducting the bulk of training flying on Vampires, and using the Sea Hawks only for conversion training prior to assignment of pilots to INAS 300.

In 1970, the squadron switched to HAL HJT-16 Kiran trainers, with all subsequent



Taxiing to the runway amid the lush greenery of INS Dega

Navy fighter training carried out on these aircraft. An improved variant, the Kiran Mk.II, was inducted in 1986. In 1990, the Sea Harrier Operational Flying Training Unit (SHOFTU) was set up and INAS 551 was bifurcated into two flights. INAS 551A operated Kirans while INAS 551B operated Harrier trainers, conducting conversion training onto the aircraft for pilots joining INAS 300. In May 1995, INAS 551A and 551B parted ways and the latter squadron began to function independently, under the moniker 'The Braves.' INAS 551B was formally commissioned as INAS 552

on 7 July 2006, conducting Sea Harrier Conversion Courses (SHCC) for Sea Harrier pilots and re-familiarisation of aircrew returning to Sea Harriers after a break in flying.

Meanwhile, in May 2003, the *Phantoms* made history as the parent unit of the Naval Aerobatic Team 'Sagar Pawan' (Sea Breeze). The Indian Navy became only the second Navy in the world (after the US Navy) to establish a fixed-wing display team, and the *Sagar Pawan* aircraft enthralled millions in their distinctive dark-blue-and-white paint scheme.



INAS 551 Hawk getting airborne after a touch-and-go



Hawk coming in for a missed approach with hills and buildings of Vizag in the background

Over the years that followed, the squadron continued to receive nascent naval aviators, strength from the Indian Air Force's flying training pipeline and moulded them into naval fighter pilots before sending them to convert to Sea Harriers with INAS 552 just across the apron at INS *Hansa*.

Transition

For half a century, the *Phantoms* were the bedrock of the Navy's fighter stream, but in the 2000s, some cracks began to show as HAL Kirans in service with both the Navy and IAF started approaching the end of their service lives, the HAL HPT-32 basic trainer was grounded (and

eventually phased out), and the IAF's badly stove-piped training system struggled to provide enough training slots for Navy cadets to carry out basic flying and Stage-2 training, let alone crucial Stage-3 'combat' training that was to be conducted before they were posted to INAS 551. With new MiG-29K fighters already in service (albeit



without a parent squadron being formally commissioned), the situation appeared particularly troublesome.

From around 2005 onward there were increasingly limited vacancies in the IAF pipeline, particularly at Stages 2 and 3, owing to shortage of aircraft. At this time, the Navy was accepting approximately 34 pilots per year, but Naval Aviation was expanding at a rapid rate and the IAF had made clear that accommodating the burgeoning number of Naval cadets in the Air Force training pipeline would continue to be a problem. Therefore, the Navy began sending pilots to train in the USA that same year, with 32 pilots having been trained with the US Navy by 2013. A fresh case for an additional 24 pilots to undergo the same training was moved in 2012, and the first pilots of this batch departed in February 2014.

For selection to train in the USA, the Navy picks two pilots who have showed most promise at the end of Stage-1 flying, so as to maximise the value of this admittedly expensive endeavour. The tempo of Stage-1 training with the IAF means that one pair of pilots is sent to the USA every six months. Once in America, these pilots start from

scratch, doing all three training stages again (1-2-3) on Beechcraft T-6 Texan IIs, Northrop T-38 Talons, and finally McDonnell Douglas T-45 Goshawks for carrier qualifications (CQ). The US Navy requires a minimum of 10 ‘traps’ (arrested recoveries on board a carrier) to qualify a pilot for aircraft carrier operations. In addition, once the aircraft have successfully landed on deck, they have to be catapulted for their subsequent traps, so there are a large number of Indian naval aviators now with requisite catapult experience.

In the meantime, a number of fortuitous events allowed both the IAF and IN to begin to remedy the training situation at home. In 2013, Pilatus PC-7 Mk.II basic trainers were inducted for Stage-1 training, with the IAF with successive deliveries over time relieving pressure at this critical phase of flying instruction. Meanwhile, the Hawk production line at HAL Bangalore was able to finally fulfil the IAF’s longstanding demand for a contemporary advanced jet trainer. Moreover, the Indian MoD had signed a supplementary contract that called for part of HAL’s Hawk production – 17 aircraft – to be supplied to the Navy, to re-equip INAS 551.

The only hurdle that remained (and still does) was Stage-2 training, hamstrung by its reliance on Kiran Mk.IIs and the fact that HAL’s IJT programme, intended to replace the Kirans, has been mired in problems almost since inception.

Today, the training conducted by INAS 551 at INS *Dega* involves 3 broad categories of pilots: the first of these have completed the aforementioned training syllabus in the USA (i.e. Stages 1 through 3, including CQ) and arrive at *Dega* simply to do a ‘naval orientation’ on the Hawks. They have never actually flown with the Indian Navy, and therefore need time to “familiarise” themselves with Indian procedures, tactics, doctrine and so on. These pilots typically conduct 60-70 hours of flying with INAS 551 to get used to “fighting with the Navy,” even though they already have over 200 hours of cumulative flying time on various training aircraft by this point. After this familiarisation course, the pilots move onward to Goa to convert to the bisonic MiG-29K/KUB.

Pilots of the second category are those that have done Stage-1 training at the Air Force Academy in Dundigal, Stage-2 on Kirans at Hakimpet and have now been



sent to INS *Dega* to complete Stage-3 training before operational conversion in Goa. In the past, Stage-3 training was also done with the IAF, and pilots came to INAS 551 only to learn how to do things “the Navy way,” as is the case with the first category. After the transition to Hawks, however, the Navy has elected to move the entirety of Stage-3 flying in-house, adapting the IAF’s existing syllabus for their needs. This stage calls for approximately 150 flying hours, and even includes weapons training (gun and rocket pod attacks) at sea. After graduation from this particular category, pilots will typically have a cumulative 350 hours of flying on various types.

The final category covers pilots with prior experience with the Navy’s fighter squadrons. These are former Sea Harrier pilots who play a largely ‘supervisory’ role at INAS 551, and are there so that their experience in operational units can inject a touch of “fighting spirit” into the unit. Nearly all the senior officers in INAS 551 are former Sea Harrier pilots, and with Sea Harrier training having stopped in 2014, the younger pilots will probably move laterally to MiG-29s, while older pilots will continue to come to INS *Dega* to train and oversee the nurturing of the new generation of naval fighter pilots.

Although the bulk of the Navy’s Hawk training at INS *Dega* appears similar to the IAF’s Stage-3 training at Bidar, there are some key differences in procedures and syllabus. For instance, the survival kit in the Navy Hawks is geared toward survival at sea for extended periods of time, because of the differences between land-based and maritime SAR. One of the fundamental operational disparities between IAF and IN Hawk training is the large amount of low-level flying that pilots are required to conduct over the sea. Although seemingly trivial, training for low-level flight over the sea off the



INAS 551 Commanding Officer Capt Dalip Singh with a young Lieutenant about to depart for a training sortie

Eastern Coast of India is a far cry from flying from the relatively benign environs of AFS Bidar: there are no visual terrain references out at sea, and atmospheric conditions often throw up visibility challenges as well. Maintaining orientation and awareness during missions over water is a central element of naval aviation, and is dealt with accordingly at INAS 551.

Fleet Support

As of September 2015, there were 11 Hawks in service with INAS 551 at INA *Dega*. Three more are expected by the end of 2015, with the final three aircraft of the 17-aircraft order to be delivered in 2016. Under present projection, these numbers are expected to be sufficient for the Indian Navy's needs, covering both training and the squadron's role as a 'Fleet Support Unit' (FSU) or 'Fleet Requirement Unit' (FRU).

While the Hawk is a hugely capable trainer in the Navy's estimation, and has finally allowed the IN to take greater control of the final (and arguably most crucial) phase of combat flying training, this aircraft has an additional purpose, as it helps in

training the crews of Indian warships as well. The Hawks of INAS 551 simulate enemy assets that allow ship-board personnel to hone their skills at operating radar and other sensors, conducting air defence operations and so on. The aircraft are also invaluable for calibration of sensors, fire control and gunnery. In short, INAS 551 supports any sort of maritime training that might require an aircraft or an aerial platform.

The Final Stretch

Once a pilot graduates from INAS 551, he will head to Goa to convert onto the MiG-29K. Although MiG-29Ks do deploy to INS *Dega* on frequent detachments, the Shore-Based Test Facility (SBTF) is located with INAS 303 'Black Panthers' at INS *Hansa* in Goa, so all conversion training for the foreseeable future will be conducted there. At INS *Hansa*, pilots receive between 85 and 100 hours of shore-based flying training, operating from the runway, the SBTF ramp and even practice arrested recovery on the SBTF's two arrestor wires. At the end of this conversion training, pilots are declared 'ops' for air defence, and are

ready for carrier qualifications. All pilots, including those already CQ after training in the USA, must nevertheless make a fresh series of traps in the MiG-29K before they are qualified to operate from the carrier. Following CQ, routine additional training (strike, night ops, etc) is conducted as needed within INAS 303.

Still, it is important to note that even with INAS 551 operating with only 11 Hawks out of a total of 17 ordered, the primary bottleneck in Indian military flying training remains at Stage-2. It is estimated that if four naval aviators were able to enter Stage-2 training every six months, all flying training could be moved back to India. Even as PC-7s and Hawks have taken pressure off at either end of the training pipeline, the ageing Kiran fleet has created significant problems in the middle. As of this writing, the IAF is trialling a plan (*see Vayu V/2015*) to have a handful of pilots conduct their Stage-2 syllabus with additional flying hours on the PC-7 Mk.II. Whether this plan is practical or not remains to be seen, but as ever, the Navy is making the most of the resources available.

Photos and text by Angad Singh



Cmde Sujeet Samaddar reviews

The Imperatives of Amphibious Aircraft



In what could have been another attempt to unleash havoc on Indian shores along similar lines as the 26/11 terror strikes, the Indian Coast Guard intercepted a suspicious Pakistani fishing boat, laden with explosives, in the Arabian Sea in the early hours of 1 January 2015. Detected almost 24 hours earlier by a Coast Guard Dornier aircraft, it took a nearby patrol vessel some 14-16 hours to intercept the boat. Despite warning shots the boat did not surrender and apparently blew itself up with the crew and any hard evidence of terrorist complicity in conducting this operation was lost. An amphibious aircraft would have provided the capability of rapid and simultaneous surveillance and arrest, leaving no time for scuttling or obtaining directions from 'handlers.' An arrest effected by an amphibious aircraft would have been a huge deterrent to any future such operations.

During the evacuation of Indians stranded in Yemen an expensive military force of three warships, two Indian Air Force C-17 aircraft and two passenger ships were utilised, in addition to Air India airliners. The C-17s and the Air India

flights operated from Djibouti while the ships ferried evacuees from Sanaa. A total of about 4,000 Indian were evacuated over a period of a month at substantial cost and risk. With a transit time direct to the Yemen coast of about 4 hours, amphibian aircraft operating from Mumbai would have achieved the evacuation in perhaps 100-120 sorties conducted over a period of 5-7 days by landing directly in Yemeni coastal waters. The cost savings and the operational flexibility that amphibian aircraft provide by way of access, airspace, sea landing capability and immigration control are apparent.

On 14 August 2013, INS *Sindhurakshak* was lost to a fire on board. Whilst alongside several rescue systems are in place the Indian Navy would not have been able to organise a rescue effort had the incident occurred at sea. Only an amphibious aircraft could have been dispatched with divers, welding sets and experts to save the submarine and more importantly, its crew. A few decades ago, the world was witness to the tragedy of 7 April 1989, wherein forty-two submariners of a Soviet nuclear-powered submarine died in

the Barents Sea, while rescue aircraft circled powerlessly overhead watched freezing submariners perish literally before their eyes since the rescue ships had not yet reached the location. Just one capable amphibious aircraft would have averted the tragedy. Most importantly, the human tragedy of the loss of the highly trained and specialised submariners far exceeded the cost of the submarine. This is a lesson of history that India can learn, and amphibious access is a contingent capability that India must possess.

MV *Pavit*, a derelict, washed up undetected on a Mumbai beach in the early hours of 31 July 2011. About six weeks earlier, another merchant vessel, MV *Wisdom*, broke tow and ended up on Juhu beach after drifting dangerously close to the Bandra-Worli Sea Link bridge. Had the ship collided with the Sea Link, there would have been a massive disaster. Both ships had pierced the coastal surveillance envelope undetected. Such derelicts are not only hazardous upon beaching but also are a menace to navigational safety at sea. Within a fortnight, MV *Rak*, sailing from Indonesia

to Dahej in Gujarat with 60,000 tonnes of coal, sank barely 20 nautical miles off the Mumbai coast after developing two holes in its hull. Aircraft, helicopters and ships were unequal to the task of salvaging it. Advanced technology amphibious aircraft operating even in rough sea conditions, ferrying sophisticated damage control equipment and a specialist and experienced naval team rapidly and directly to the stricken ship would have easily averted this disaster.

The most suitable amphibious aircraft that can conduct a near all-weather, high-speed rescue operation for the entire crew of a ditched aircraft is of particular relevance to the Indian Navy, and in

faster and surer with amphibious aircraft than using ships or even helicopters. Combat missions may also be undertaken by suitable amphibious aircraft. Rapid and precision insertion and extraction of troops along undefended coastlines for covert or force projection operations is one example. Such an asset builds confidence in the crew that they have a very good chance of recovery even at sea – a capability that does not exist as of now.

Amphibious aircraft are also being used as airborne firefighters, carrying several tonnes of seawater to douse fires ashore or on oil rigs. Amphibious aircraft can also support remote communities in distant

The Amphibian Century

Amphibian aircraft made their debut on 28 March 1911 when the Fabre Hydravion took-off from water at Martigues. By end of World War I, amphibians had completed transcontinental flights and in some instances even been refuelled by ships and submarines at sea. Post-1918, amphibian aircraft were at their zenith. After World War II, however, these aircraft lost their charm somewhat, although limited civil and commercial applications continued.

Today, modern technological advances have made it possible for amphibian aircraft to conduct a variety of naval missions ranging from benign to constabulary and



fact all Services that operate long range missions over water with aircraft such as the Boeing P-8I long range maritime patrol aircraft and MiG-29K deck-based fighters of the Navy, to the IAF's shore based AWACS and MiG-29, Su-30MKI and Jaguar maritime interdiction fighters. An aircraft is more easily replaced than its highly trained aircrew. Similarly, the rescue of a crew of distressed ship or submarine is

islands or remote land frontiers – those in proximity of deep lakes and rivers – with logistics and medical support.

Amphibious aircraft therefore have multifarious applications for naval forces and as the technology is maturing these aircraft are under induction by several navies including China, which would possibly put a 60 tonne amphibian aircraft in the IOR waters by next year.

even to military operations. Indian Naval Aviation, which formally 'took off' at Cochin on 11 May 1953, began operating the Short Sealand, an amphibian aircraft, as the first Indian Naval Aircraft. However, the capability of operating such aircraft faded thereafter, as the Indian Navy progressed to induct conventional aircraft and developed a carrier-borne capability. With the advent of modern technology in amphibian aircraft,

it is only natural that Indian Navy has now sought to re-acquire this unique capability, to truly realise its 'blue water' ambitions.

Amphibian aircraft combine the capabilities of broad surveillance and prompt response, whether for relief or arrest, in a single platform. Such capability is not available on any other type of aircraft. The modern amphibian aircraft is thus a veritable force multiplier since it fulfils a multitude of missions in a single platform. Unlike helicopters and conventional aircraft, amphibian aircraft can land at almost any location to enforce both the will and the law of the country and thus are a platform of choice for benign and constabulary missions. Unlike ships, amphibians can reach an area of interest faster, preventing destruction or dumping of contraband and evidence.

Amphibian multi-utility cargo and transport aircraft are today capable of a variety of missions. Under Article 98 of the United Nations Conventions on the Law of the Seas (UNCLOS), "every coastal State shall promote the establishment, operation and maintenance of an adequate and effective search and rescue service regarding safety on and over the sea and, where circumstances so require, by way of mutual regional arrangements cooperate with neighbouring States for this purpose." Amphibian aircraft fit this purpose completely.

As regards Piracy, one of the most pressing international problems facing the seafaring community today, as per the United Nations Convention on Law of the Seas (UNCLOS), military aircraft are "entitled to seize (Article 107)," enjoy "right of visit (Article 110)" and "right of hot pursuit (Article 111)." Amphibian aircraft can thus be very useful in conducting anti-piracy missions and efficient, effective and economic policing operations for safe and secure seas. Once the deterrence value of amphibian aircraft is clearly established by conducting a few successful operations that bring culprits to book, seas will become far safer and more secure in the future and at lesser operating cost.

Multifarious Missions

These aircraft can now therefore be tasked for multifarious naval and maritime missions such as:

- ◆ Long range naval logistic and maintenance support through ferrying of specialised dockyard personnel and spares to a Fleet during overseas deployment
- ◆ Long Range and Rapid Visit, Board, Search and Seizure (VBSS) operations
- ◆ Mainland to distant island and inter island logistic support without need of a runway
- ◆ Long range fleet support including crew rotation on high seas
- ◆ Oceanic Search and Rescue (SAR) and casualty evacuation (CASEVAC) from ships, submarines and oilrigs
- ◆ Monitoring, servicing and protection of offshore assets
- ◆ Controlling of derelicts and abandoned vessels
- ◆ Humanitarian assistance and disaster relief operations in the Indian Ocean Region
- ◆ Countering small arms, shoulder launched weapons and drugs trafficking and terrorism at sea
- ◆ Countering illegal human migration
- ◆ Prevention of poaching and illegal fishing
- ◆ Prevention of toxic cargo dumping at sea and pollution control
- ◆ Anti-piracy missions
- ◆ Anti terrorism
- ◆ Support for deep sea mining activities, offshore cable laying and hydrocarbon prospecting
- ◆ Recovery of ditched aircrew at sea
- ◆ Direct and rapid access to the Indian outpost 'Bharati' in Antarctica.

For India, aspiring to regional power status, its Navy must not only be able to address the immediate security needs of the country and defeat the enemies of the state but must also contribute in benign and constabulary operations in its area of interest and influence for the regional good. From a maritime perspective this power status contributes to burden sharing towards protection of global public goods and the oceanic commons to achieve firstly, freedom of navigation and safety at sea; secondly, promote regional stability through an open and participative security architecture; thirdly, proactively alleviate suffering during disasters in the littorals of

friendly nations; and, finally a constabulary capacity to maintain order at sea for the common good of the region. Whilst ships, submarines and aircraft are all qualified in some way or the other for fulfilling the above missions each of these platforms are also limited by some capability gap or the other. Modern amphibious aircraft make possible a range of options not achievable by any one type of platform. It's unique multi-modal design permits airborne, seaborne and land operations in a single platform and thus is a highly effective force multiplier for the Indian Navy.

The Strategic Dimensions

Strategically, India must bear in mind that China is also in the process of designing and manufacture of the 'Jialong' (Water Dragon) AG600 amphibian aircraft. This aircraft is potentially the largest amphibian aircraft in the world. Media reports suggest that final assembly of the aircraft would be completed by end-2015 and first flight tentatively scheduled for mid-2016. The aircraft is expected to service the many artificial islands being built by China in the South China Sea and to increase China's presence in the Indian Ocean Region. It is also aimed at tapping the potential global commercial amphibian market.

In addition to requirements of the Indian Armed Forces and various military users of amphibious aircraft, it is also worth considering the applications of such a platform in the commercial sector. As per latest reports of IATA and other aviation professional agencies, annual air traffic growth rate of 10.5% and higher has been almost constant over the last decade and is expected to be even higher in the coming years. Consequently, the capacity overload of current airports and the demand for point-to-point connections need serious consideration. The Government's *Draft Civil Aviation Policy, 2015*, has listed several initiatives and policy directions for the growth of the commercial aviation sector in India. The aim of the Indian Government is to provide an eco-system and level playing field to various aviation sub-sectors, i.e. airlines, airports, cargo, maintenance repairs and overhaul services, general aviation, aerospace manufacturing, skill development, and so on. The Government has also proposed to take "flying to the masses" by making it more affordable. For example, if every Indian in the middle-class



income bracket were to take just one flight per year, it would result in a sale of 300 million tickets, a big jump from the 70 million domestic tickets sold in 2014-15. This will be possible if airfares, especially on regional routes, are brought down to an affordable level. The growth in aviation will create a larger multiplier effect in terms of investments, tourism and employment generation, especially for unskilled and semi-skilled workers.

Based on this policy and the vast coastline and several exotic islands in the Lakhshadweep and Andaman Seas that India is endowed with the stage is set to create a positively buoyant market for seaplanes or amphibians as a mode of civil air transportation in the future. With the anticipated growth in civil aviation, land-based airports would be bursting at the seams to accommodate increased passenger and freight traffic. Moreover, new airports would require additional real estate, with attendant land acquisition issues and substantial capital expenditure toward associated infrastructure development. Induction of amphibious aircraft in the commercial segment would not only decongest existing airports loads but would also allow the use of sea ports as an alternate operating area for civil aviation.

Various market segments for potential use of amphibian aircraft in the civil application are:

- Leisure and tourism/ semi-commercial segment, which is presently the largest segment for seaplanes/amphibian aircraft.
- Commuter market segment: while the traditional commuter traffic offers scheduled flights from smaller airports to the hubs or point-to-point connections between smaller airports, the amphibian aircraft could provide three alternative variants in the local passenger transportation segment:-
 - Flight from the nearest major land airport to the seaport or return.
 - Flight between two water landing fields.
 - Flight between a land airport and sea port located at a far distance (flight between selected large airports and island tourist resorts)
- Special markets for cargo movement and fire-fighting capability could use amphibious capabilities very effectively.

At the international level, commercial applications of seaplanes are already enjoying great success in the Maldives and Mauritius islands, as also in Polynesia, the Mediterranean and the North Atlantic region including the Great Lakes, where local operators are using more than 70 seaplanes. However, these aircraft are limited to less than 19 passengers, and cover short distances at low speeds. Longer

endurance and higher speed seaplanes with the ability to tackle rough seas are likely to be a favoured mode of transportation for tourist traffic, particularly since the demand for exotic and distant locales are on the rise. This would also spur a demand for freight and cargo to sustain these resorts.

With the growth of such platforms, new traffic routes can be developed with the advantage of short flights, including point-to-point connections to national and international airports using natural landing strips on the sea. Scheduled commuter seaplane/amphibian operations are non-existent in the Indian market though they proliferate in Canada, Malta and the Pacific islands already. Very limited seaplane services are being used in the Andaman Islands, Kerala and Maharashtra, as the current Indian market and aircraft operators not only lack a modern seaplane of international standards and regulations they also face non-existent infrastructure and complete lack of expertise in maintenance and operations of mid-size amphibians as regional transport aircraft.

An Indian Amphibian

With such capability already on the verge of induction into the Indian Armed Forces, in the recent future, it would be worth a measured guess that the necessary infrastructure, operating philosophy and



maintenance infrastructure including MRO technology of such aircraft would also be created in India. The Government has been in the process of developing India's own Regional Transport Aircraft (RTA) under the aegis of NAL and HAL. It would be worthwhile therefore to carry out a cost benefit analysis and explore the feasibility of an indigenously-designed amphibian aircraft as the Indian regional transport aircraft for meeting both domestic and export demand. This may make good business sense since the RTA market is already overcrowded with the lead players such as Bombardier, Embraer, ATR and more recently some Chinese and Russian entry level aircraft for this segment with multifarious product profiles.

These considerations certainly create the possibility of a potential business opportunity with new technology and innovative applications that can find a sufficiently vibrant potential customer base. It may therefore be a viable option for the Government to consider a technical collaboration or partnership with an established amphibious aircraft manufacturer to develop the RTA as an amphibious platform for commercial applications which is a niche market with very limited players in both the domestic and global market and thus may offer substantial opportunity for India to be an exporter of amphibious aircraft.

In addition to the obvious benefits of low infrastructure requirements, point-to-point connectivity and decongesting of present airports, with adequate numbers, commonality of platform and maintenance infrastructure even the operating cost of such a platform could be reduced to a great extent for both military and civil operators. It must be understood that there are many island territories in the Indian sub-continent with poor accessibility. Accessibility can be improved drastically by introduction of amphibian air traffic. Such operations that would connect distant islands with the mainland will have several downstream benefits of developing these areas and relocating populations, enhancing tourism revenues and creating a modern aerospace industry in India.

The market demand is promising if amphibian aircraft/seaplanes could provide competitive flights to inaccessible island areas or coastal locations or to industrial/business areas by saving valuable time compared to other available means of transportation. For many passengers, amphibious/seaplane operations may offer that 'unique' or 'special' type of journey and also provide aeronautical culture opportunity to people who do not live close to the established airports. Last but not least, amphibious aircraft/seaplanes may provide a 'sense of freedom' for passengers to move outside the artificial

world of airports, controlled airspace and aeronautical bureaucracy.

So, while the amphibious aircraft is a force multiplier for maritime forces the time has come for India to carry out a serious study towards the relevance of 'flying boats' in easing the ever-increasing demand of air traffic in the near future. The opportunities are many but options are limited. Civil operations of a credible amphibian platform designed to suit Indian market could surely be one solution. Of course key operational parameters such as Short Take Off and Landing (STOL) ability, high sea state operations, good payload, long range and high-speed flight is a necessity for successful operations.



Cmde Sujeet Samaddar, NM (Retd)

Battle Stations !

A chilling but plausible scenario in the South China sea

Vishnu Som of NDTV, after visiting the guided missile stealth destroyer INS Kochi (D64) earlier this year and being briefed on its features and technology, presents a possible naval scenario involving the Indian Navy's latest and most lethal warship.

On a dark but moonlit night, an Indian warship pierced the waters of the South China Sea at a brisk 25 knots. The only sound to be heard was of waves slapping the sides of her sleek hull. To the untrained eye, she was all but invisible. Her sleek silhouette and her grey paint scheme ensured she blended in with the sea around her. And her distinct, angular lines were meant to make it difficult, if not impossible, for enemy radars to track her : she was, after all, a stealth warship.

But tonight would be different. Tonight, INS *Kochi*, a state-of-the-art Indian Navy destroyer, built in India over a decade, would be challenged by a worthy adversary : another stealth ship, a Type 052D destroyer of the Chinese Navy, the *Changsha*. Commissioned just a month ahead of the *Kochi* in August 2015, the *Changsha* represented the pinnacle of Chinese naval design and engineering, carrying a world class load of surface-to-air and anti-ship missiles.

Inside the *Kochi*, there was tension. Men moved around purposefully and silently. They had been briefed about the situation they were in. For several days, the *Kochi* and two other ships of the Indian Navy, the frigate *Shivalik* and the fleet tanker INS *Shakti*, had been repeatedly challenged. Unlike the *Kochi* and the *Shivalik*, the *Shakti* was not armed but her role in this mission was essential :



INS Kochi's 76mm Oto Melara Super Rapid Gun Mount in the foreground with the large IAI Elta EL/M-2248 MF-STAR phased array radar visible on top of the mast

she would refuel the Indian task force through the course of their journey.

"You have entered Chinese waters," announced the radio transmission broadcast on an international maritime alert frequency. "Please change course. You are now in Chinese waters. Alter course now or you will be challenged."

And on the instructions of the Indian fleet Commander, an Admiral on board the *INS Kochi*, the Indian Navy had replied, politely but with a firm resolve. "We are operating in international waters en route to Japan for joint exercises. It is our intention to remain on course."

But the Indian task force commander knew that he was being monitored. His long-range Russian-built surface search radar had picked up intermittent contacts, at least two of which matched the profile of Chinese warships. But no one could be sure. The contacts were at the very end of the radar's range. For now, the Indian task force Commander would wait and watch.

Who would blink first in this game of high stakes Naval brinkmanship? The Chinese Navy, which considered much of the South China Sea as its personal fiefdom, or the warships of the Indian Navy, now operating far from their own waters?

The answer would come very shortly.

Deep inside the *Kochi*, several decks below her bridge, her Commanding Officer, his XO (Executive Officer) and 15 of his most skilled weapons and sensor experts manned their stations in the Operations Centre of the 7,500-ton destroyer.

The *Kochi* was at battle stations, alert to any hostile Chinese presence, her leading officers using radars and sonars to search for hostile contacts: enemy aircraft, missiles or submarines. Spread across 17 metres, the width of the entire warship, the Ops Centre was the nerve centre of the *Kochi*, a rectangular, windowless, black room dimly lit by blue lights that added to the illumination of more than a dozen colour multi-function displays.

Officers scanning the airwaves for electronic emissions from enemy warships manned the Electronic Warfare (EW) suite. Equipped with an Indian EW suite called the 'Ellora', the *Kochi's* sensors mounted on her mast behind both sides of her Bridge had two primary functions: Electronic Support Missions (ESM) to detect faint radar emissions from ships in the area and Electronic Counter Measures (ECM)

The 76mm main gun in action during pre-commissioning trials



employed for jamming the signals of enemy aircraft, incoming anti shipping and cruise missiles if they were detected.

Next to the ECM crew, a gunnery officer was checking the status of his 16 anti-ship Brahmos missiles, among the fastest and most lethal weapons in its class: a missile designed to fly at close to three times the speed of sound to penetrate the defences of enemy warships 300 kilometres away.

With its massive warhead, a single Brahmos missile could blast through the hull of an enemy ship, causing an explosion that could sink a relatively large frigate or destroyer in minutes.

But at this moment, the Commander of the ship and his First Officer, monitoring all of the ship's sensors and systems from their station in the middle of the Ops Centre, had a more immediate concern.

The Electronic Warfare suite 'Ellora', had picked up emissions from the same area where the *Kochi's* surface search radar had earlier detected a contact. And the information was getting worse. 'Ellora' had classified the threat. It was indeed a Chinese Type 052D destroyer, a ship of the same class as the *Kochi* and the pride of the Chinese Navy.

Seconds later, a loud buzzer sounded. "Incoming missile!" shouted 'SAMs,' the

Officer manning the Surface-to-Air Missile (SAM) console. Far above him, electronic beams from the Israeli-built MF-STAR (Multi-Function Surveillance, Track And Guidance Radar) had homed into a clear and present threat.

The Chinese destroyer had fired a long range YJ-18 'Eagle Strike' missile directly at the *Kochi*. "Second missile incoming!" shouted SAMs, as the radar began tracking a second and then a third Chinese subsonic missile headed straight in *Kochi's* direction.

But *INS Kochi* had an antidote: the Barak-8 Long Range Surface to Air Missile (LR-SAM) system jointly developed by Israel and India. The *Kochi* had 32 such missiles onboard, designed to deal with exactly this threat.

"Another missile inbound. That makes it four missiles inbound!": this was a worst-case scenario: a saturation attack. The fate of the 390 officers and seamen on the *Kochi* was now effectively in the hands of a highly automated weapon system.

Now at full-auto mode, the first Indian Barak 8 blasted off its vertical launcher ahead of the bridge of the destroyer. Accelerating quickly to four times the speed of sound, the missile shot straight up before arching in a parabola in the direction of the enemy missile it was assigned to intercept. The missile was not flying blind: critical



INS Kochi's RBU-6000 anti-submarine rocket launcher, LR-SAM and Brahmos vertical launch cells, and 76mm main gun visible from the bridge, while its sister ship is seen moored in the distance

data indicating the direction, speed and location of the incoming Chinese anti-ship missile was being fed to the Barak, enabling it to lock on to the first Chinese missile precisely.

In the final few seconds of its flight, the Barak, now being directed by data from its own radar, streaked down towards the Chinese missile. In moments, its warhead would detonate, activated by a proximity fuse triggered when the distance between the Barak and the incoming enemy missile was no more than a few feet. The first Chinese 'Eagle Strike' missile had been destroyed more than 70 kilometres away from the *Kochi*.

But with the Chinese destroyer launching its missiles in quick succession, the second, third and fourth 'Eagle Strike' missiles, some flying different trajectories than the first, continued to close in on the *Kochi* which kept firing as the incoming missiles approached, the automatic system assigning two missiles each to the final two missiles.

Inside the Ops Centre, the Commander of the *Kochi* focussed on a large LCD screen that dominated the Ops Centre. On it, critical data from the SAM officer's console was now being displayed. And as they tried their best to focus on their individual systems, different officers manning other systems would glance up at the big screen to get an idea of what was happening. They all knew that this was life or extinction. And they all knew there was nothing really left for them to do. Unless they chose

to deliberately intervene, the system was completely automated : Barak 8 surface-to air missiles would keep launching off the fore and aft deck of the *Kochi* until every last incoming missile was destroyed - or every last Barak missile had been fired.

And if the 'Eagle Strike' missiles weren't intercepted, *Kochi* would still keep fighting. Two of four Russian-designed AK-630 anti-missile guns on board the destroyer would collectively spew out 10,000 rounds per minute, creating a wall of lead between the Eagle Strike and the *Kochi*. The incoming missiles, it was hoped, would be obliterated as they tried to pierce this wall. And even as the missiles approached, there were other defensive systems on board the *Kochi*.

'Ellora', the Electronic Counter Measures system would try and jam the radars of the incoming 'Eagle Strike' while 'Kavach', an indigenous system would fire aluminium chaff in the area to confuse the sensors of the Eagle Strike and make the missile veer away harmlessly from the ship.

In the end, none of this was required. The Barak system was up for the challenge and every one of the subsonic Chinese anti-ship missiles were destroyed, the last one just 10 kilometres away from the *Kochi*, her explosion easily visible to the naked eye on this dark night.

This was now a Naval war. A frontline Indian asset had been attacked in international waters. The Indian fleet were bound to respond and that process had already begun. As *Kochi* defended herself, critical targeting data was being constantly

shared between *Kochi* and the *Shivalik*, the frigate accompanying her. They were linked through the Indian Navy's tactical network, a communications highway routed through the Navy's own satellite, the *Rukmini*.

For Indian warships deployed over large parts of the Navy's area of interest, the *Rukmini* gives a cohesive and heavily encrypted tactical picture : the location of other ships in their area, details of what their sensors are tracking, the ability to talk, transmit video and even access the internet. The two warships and also the unarmed fleet tanker accompanying them were sharing data of the battle through a secure tactical network operating through encrypted radio transmitters.

As she ward off the enemy missiles, the *Kochi* had provided *Shivalik* with the exact coordinates of the enemy Chinese warship, data which was fed into the *Shivalik*'s Brahmos missiles, two of which were ripple-fired even as *Kochi* fought off the enemy missiles heading her way.

Blasting off the vertical launch tubes on the deck of the *Shivalik*, the Brahmos missiles quickly accelerated to Mach 2.8 and headed towards the *Changsha* nearly 300 kilometres away. Ill-equipped to take on a weapon as fast and manoeuvrable as the Brahmos, the Chinese destroyer fired off her defensive guns, and her own chaff-dispensers. But by then, it was too late. She was obliterated.

Chilling ? Still, the scenario described above is not entirely unrealistic.

In 2011, INS *Airavat*, an Indian amphibious assault ship was challenged by the Chinese Navy at a distance of 45 nautical miles from the Vietnamese coast in the South China Sea by a caller identifying himself as Chinese Navy. The *Airavat* continued on course, ignoring the challenge which said, "You are entering Chinese waters."

India continues to have significant commercial interests in oil and gas in association with Vietnam, one of the countries involved in a heated maritime dispute with Beijing. And Vietnam, incidentally, has close Naval ties with India, which is known to have trained Vietnamese sailors.

And this is where a ship like the INS *Kochi* comes in. The second of a class of three advanced *Kolkata*-class destroyers, the 7,500 ton *Kochi* is a perfect example of how the government's mantra of 'Make in India' can be realised.



The Machinery Control Room (MCR) on board INS Kochi

The product of decades of experience in Naval ship design and manufacture, the INS *Kochi*, which was commissioned into the Indian Navy on 30 September 2015, incorporates the best Naval technology available anywhere in the world, technology customised and delivered to the state-run Mazgaon Docks Limited (MDL), Mumbai, which has integrated these systems onto an Indian-built hull.

Unlike most other warships of its class in the Indian Navy, the *Kochi* is large. There are no cramped gangways here, typical of other warships. There are abundant spaces and crew comfort, unlike in the past, is a real priority. 'Hot bunking' where sailors share the same bunks as colleagues when they are on another shift is a thing of the past. Instead, every sailor has a bunk and adequate locker space. The sailor's dining area is large and the galley is highly automated and includes, among other systems, an automated dosa maker !

The *Kochi* can speed along at more than 30 knots, close to 56 kilometres per hour, and be deployed in the open seas for several weeks if need be. Her Indian-built generators provide enough power to run a small town indefinitely. The generators are crucial in powering the air-conditioning systems on board. The *Kochi* needs 200 tons of cooling to ensure that her delicate electronics and weapon systems remain operational in our intensely hot and humid conditions.

While Machinery Control Rooms (MCR) of previous warships featured manual controls and analogue dials, the MCR on board the *Kochi* is completely automated. Officers here monitor fire fighting systems, propulsion and auxiliary systems, power generation, the ship's stabilisers, her air conditioners and four large Reverse Osmosis Plants that provide the ship and her crew with abundant fresh water.

The data provided by the MCR's systems are part of the Ship's Data Network (SDM), the backbone of what is an information highway on board the ship. Data from the SDM can be tapped across the ship on a need to know basis. A key part of the Ship Data Network System is the Combat Management System (CMS), which processes data from the sensors (radars, sonars and electronic warning systems) and the weapon systems. All of this is primarily routed to the Operations Centre of the warship, though in the event of damage to the Ops Centre during a battle, can be accessed from several stand-alone consoles spread across the ship.

Though she has been commissioned, INS *Kochi* and her sister ship INS *Kolkata* are yet to become fully battle-worthy. The long-range Barak 8 surface to air missile, one of her primary weapons, is presently being tested on board Israeli warships. It is understood that there are no major hurdles in the development of this new generation weapon, which will be installed on the INS *Kolkata*, the INS *Kochi* and their yet-to-be-commissioned sister ship, the INS *Chennai* within the next few months.

Captain Gurcharan Singh, the Commanding Officer of INS *Kochi*, has a glint in his eye when he tells us that he has been lucky enough to have been a part of the commissioning crew of three warships entering the Indian Navy, a rare feat for any sailor anywhere in the world.

At 46, he has the awesome responsibility of commanding 40 officers and 350 sailors on board the *Kochi*. According to the Captain, "Its a wonderful experience. For us as a commissioning crew, it's a great opportunity to take charge of a warship. We are very proud of the ship for two reasons. For one, the ship is a very potent and powerful platform and secondly, this ship is an outstanding example of our indigenous ship-building capability."

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Defence Minister Manohar Parrikar, seen with Admiral Robin Dhowan, CNS and Vice Admiral SPS Cheema, FOC-in-C Western Naval Command at the commissioning of INS Kochi

World Market for Conventional Submarines

Current State and Trends

The market for non-nuclear (that is diesel-electric, or conventional) submarines, like any other market, has numerous segments. The conditions in which submarines are required to operate are not uniform. The Australian Navy, for example, requires ocean-going boats, whereas the Singaporean Navy's interests are limited to coastal waters. The tasks which submarines are required to perform also differ widely. Some customers want boats capable of engaging an adversary's most advanced ships, submarines, and coastal targets, while others regard the use of submarines merely as an instrument for training their own anti-submarine forces. These different market requirements results in a great variety of boats on offer, from ocean-going to coastal models, with technology ranging from decades-old to

A Russian Kilo-class boat heading out to sea (photo: USC)



the most advanced and extremely bold. The products on offer are also shaped by the financial capacity of the buyer. There is plenty of demand for very complex and expensive submarines with extremely high performance characteristics, as well as relatively cheap and far less capable models. Obviously, there is a close link between the financial and military aspects of submarine programmes. Long-range and high-performance submarines are bought by the leading regional powers, or by countries that aspire to that position, and can afford such costs. Countries with limited military budgets, meanwhile, do not place such ambitious tasks before their Navies, and prefer to buy cheaper and less capable submarines.

Additionally, supply and demand on the market for submarines undergoes various changes over time. The end of the Cold War resulted in falling European demand for warships and submarines, forcing the main suppliers to look for alternative markets and whipping up international competition. As technology progresses, the price and performance characteristics of submarines change accordingly. Some suppliers leave the market, others emerge, while still others merge or break up. The priorities facing the buyers' navies change over time due to shifting geopolitical circumstances and changing economic fortunes. For example, the growing buying power of the Chinese armed forces has driven up demand for submarines in the entire South East Asian region. The importers' attitudes to buying submarines also undergo various changes, as some of them choose to develop their own indigenous capability in submarine building in order to reduce their reliance on imports. All these market processes take place almost simultaneously, making the market extremely complex and difficult to predict.

International Suppliers

There are currently about 35 submarines being built under export contracts. There are three main international suppliers: Germany's TKMS consortium, France's DCNS, and the Russian tandem of Rubin and Admiralty Shipyards. Buyers choose one of those three suppliers depending on various technological and economic considerations, as well as political preferences.

Submarines are also designed and built for their own national navies by Chinese shipyards, Spain's Navantia, Sweden's

Saab (the Kockums shipyard), and Japan's Mitsubishi and Kawasaki. Shipyards in Iran and North Korea also build small and midget submarines of indigenous design for their own navies.

Several companies have the capability to build non-nuclear submarines using foreign technology. These include Australia's ASC, South Korea's Hyundai Heavy Industries and Daewoo Shipbuilding & Marine Engineering, and Italy's Fincantieri. Finally, several shipyards have in the past assembled submarines from kits supplied by TKMS or DCNS.

There are also a growing number of independent suppliers. South Korean companies are developing the first indigenously designed submarine for the national Navy. The Dutch company Nevesbu is working to restore its former ability to design and build submarines. Britain's BMT design bureau also comes up with new submarine designs from time to time.

Changes in market segments

Analysis of the submarine models currently on offer yields the following observations, firstly that two distinct market segments have emerged since the 1960s:

- ✦ medium submarines of 500 to 1,100 tonnes, such as the German Type 205,

Type 207, and Type 540 boats, France's *Daphné*-class submarines, and Soviet Projects 613 and 633.

- ✦ larger boats of about 2,000 tonnes, such as Britain's *Oberon* type and Soviet Project 641.

Over the past 50 years, submarines in both segments have become larger. Looking at the history of Germany's Type 209 programme, submarines in the 'medium' segment had reached a total displacement of 1,100 tonnes (Type 209/1100) by the early 1970s, and approximately 1,500 tonnes (Type 209/1400) by the mid-1980s. France's *Agosta* boats, launched at about the same time, had similar dimensions. The medium segment is currently represented by Russia's *Amur 1650* boats, Germany's Type 214, and France's *Scorpene*, which range between displacements of 1,600 to 1,800 tonnes.

A similar trend can be observed in the ocean-going segment. *Oberon*-type submarines were replaced by the larger *Upholder* boats (which, incidentally, failed to enthuse potential buyers). Soviet Project 641 boats were succeeded by the larger Project 877EKM and Project 636 submarines. The *Collins* boats designed by Kockums for the Australian Navy were even



HMAS Rankin, a Collins-class submarine designed by Kockums (now Saab) and built in Australia for the Australian Navy (photo: USN/ Mass Communication Specialist Seaman James R Evans)

larger (3,000 tonnes). The latest models on offer in this segment include Germany's Type 216, France's *SMX-Ocean*, and Britain's *Vidar-36*, all of them weighing over 3,500 tonnes.

Several years ago, when the global financial crisis broke out, all the major suppliers started to offer smaller versions of their medium boats, ranging from 700 to 1,100 tonnes. These include Germany's Type 210mod, France's *Andrasta* (currently known as the *Scorpene 1000*), Russia's *Amur 950*, and Britain's *Vidar-7*. Even though these models have so far failed to attract any buyers, it is safe to say that they have created a new 'budget' segment of the submarine market.

Submarines that represent the ocean-going segment naturally have better performance characteristics and a much higher price. They have also become more capable, bigger, and more expensive over time. This has given rise to the emergence (or resurrection) of the 'budget segment' and the secondary market for used submarines decommissioned from their parent navies and sold to new buyers after repairs and/or upgrades.

Standard and customised projects

The export market for submarines can also be divided into standard and bespoke (customised) segments. All three of the leading international suppliers offer standard designs, such as Type 214, the *Scorpene*, or Russia's Project 636 and *Amur 1650* submarines. These boats are not built to any specific customer requirements; their specifications are tailored to suit an 'average' set of demands. Adapting a standard project to individual customer requirements usually comes to installing customer-specified weapons systems, and sometimes electronic systems. This approach represents a legacy of the period when foreign customers were offered submarines designed to meet the requirements of the exporter's parent navy. Obviously, when contractors design a standard model, one of their top priorities is to minimise their own costs and to maximise profit through the use of tried and tested solutions. Such an approach also has its own advantages for the customer as it reduces the price tag and minimises the risk of delays. These standard programmes – such as Germany's Type 209 – can have

a very long lifespan. For example, the first Type 209/1100 boat was delivered by the German supplier to the Greek Navy in 1971. The first Type 209/1400 boat was delivered to the Brazilian Navy in 1989. Three Type 209/1400 boats are now being built under an Indonesian contract. The Type 209 programme has therefore been going strong for over 40 years now. Russia's Project 877EKM/636 has proved almost as long-lived. The first boat in the series was delivered to the Soviet Navy in 1980. The first export delivery was made in 1986 to the Indian Navy, and more of these boats are now being built under a Vietnamese contract.

Buying 'bespoke' submarines, meanwhile, is something that only the most economically and technologically advanced countries can afford. Such boats meet the customer's individually tailored requirements, and they differ in very significant ways from the standard models. They are designed for a specific customer, and their series production ends once the initial contract has been fulfilled. Clearly, there are far fewer of these boats in operation compared with



The Indian Navy's first *Scorpene*-class boat, *INS Kalvari*, was launched earlier this year (photo: Indian Navy)

the standard designs. The cost of these programmes is a lot higher, as are the technical and financial risks. A mismatch between the customer's requirements and the capabilities of the boat's designer or builder can cause the entire programme to fail. Examples of customised submarine models include Germany's Type 210 boats (developed for the Norwegian Navy) and *Dolphin* boats (developed for the Israeli Navy), as well as Sweden's *Collins*-class submarines (developed for the Australian Navy). New submarines to be built for the Australian Navy (the SEA-1000 programme) and for the Indian Navy (Project 75I) can also be categorised as 'bespoke'.

Growing complexity and cost

The third aspect of the submarine market has to do with advances in technology. Submarines are becoming more complex and capable, which translates into higher costs. The growing complexity and capability is clearly in the interests of the suppliers, who want to secure a higher price for their product. Operating more complex and expensive submarines also requires increasingly costly infrastructure, training programmes, and other spending items. In other words, the growing complexity of the boats serves to expand the market for related services. From the supplier's point of view, this largely compensates for the fact that as submarines become more expensive, customers tend to place orders for smaller batches.

Improvements in submarines' specifications and characteristics are achieved by incorporating new equipment and upgrading the existing systems. For example, over the past 30 years non-nuclear export submarines have acquired water discharge torpedo launching systems, the capability to launch missiles (including surface-to-air versions), anti-torpedo systems, advanced sonars, air-independent propulsion systems, anechoic coating, and many other advanced features. Development of many of these technologies began in the final years of the Cold War under contracts with European navies and the Soviet Navy, but due to changes in the political and financial situation, by the time those technologies were finally ready, suppliers were forced to offer them to foreign customers.

Technological advances have also led to a stratification of the market. Not all the

customers require top-performance boats, and not all the naval budgets can shoulder the cost of the world's best submarines. As a result, there is much demand in the market for a combination of innovative, i.e. expensive, technologies with conservative and affordable solutions. Incidentally, the higher performance of 'bespoke' submarine models is achieved precisely through a greater use of innovative and advanced technologies compared to standard models. On the other hand, boats in the 'budget' segment that has emerged in recent years utilise a bare minimum of innovative solutions. For example, they lack such options as air-independent propulsion systems or complex sonars; their weapons systems use the swim-out principle, etc. The greatest variety of technology can be observed in the standard projects of the medium segment. At present, suppliers are building Type 214 boats with air-independent propulsion systems, the equally advanced *Scorpene* boats that lack such propulsion systems, and Type 209/1400 and Project 636 submarines, which represent 1980s technology. Other major differences include the lines of the boats, the composition of the sonar complex, the use of anechoic coating, the approach to equipment suspension, etc. In fact, it cannot be said that any specific submarine model is clearly superior to all the others. Obviously, the variety of the models on offer reflects the varying needs and buying power of different customers.

Increasing indigenisation

In yet another consequence of the growing price of non-nuclear submarines, most customers now make an effort to involve their own national industry in building – or at least outfitting – the submarines they buy for their navies. It has become quite common for submarines to be built or assembled at the customer's own shipyards, and to be fitted out with equipment supplied by domestic producers. Such programmes require the designer and the 'parent' shipyard to adapt their technologies. They must take into account the capability of the customer's shipyard where the submarine is to be built, and the capability of the importer country's industry in general. The 'parent' shipyard, for its part, must be prepared to supply material packages and components rather than finished submarines, and to establish a working relationship with the customer's shipyard.

Conclusions

Clearly, the submarine market is very complex, and it is impossible to describe all the recent trends in such a brief article. Nevertheless, the following conclusions can be made:

- ✦ There are a great many models of non-nuclear submarines on offer due to the varying requirements of different customers.
- ✦ None of the three leading suppliers has an 'ideal' solution that fits every possible market niche and customer requirement.
- ✦ There is healthy demand in this market for a great variety of technological solutions, and even though submarines are generally becoming more complex and capable, there is always demand for more advanced and expensive boats as well as for simpler and cheaper models.
- ✦ Suppliers compete mainly on price, and one of the ways of reducing it is to mass-produce standard models, which can then be adapted, to a greater or lesser degree, to suit the requirements of each individual customer.
- ✦ Russian submarine designers and builders offer standard models in every market segment. They also offer 'bespoke' designs, including boats that can be built at the customer's own shipyards and/or include many domestically produced components and materials.

*Article courtesy Igor Vilnit
CEO, Rubin Design Bureau*



Admiralty Shipyards

Submarine producers in Saint Petersburg



It starts with steel in Workshop No.6 – thick plates are cut and hammered into curved sections that are welded together to form spherical hull segments.

Indian media were granted access to the storied Admiralty Shipyards in Saint Petersburg, Russia, for the first time in July 2015. Vayu's Angad Singh was on hand to produce a photo essay of this famous facility.

There are tantalising glimpses of history everywhere in this 300-year old facility. The old bricks that make up the immense, airy workshop buildings all have tales to tell, and almost seem to whisper secrets in your ear as you thread your way past machinery old and new, watching yet another submarine take shape before your eyes.

The Admiralty Shipyards in Saint Petersburg are one of the enduring success stories of Russian shipbuilding, operating from the time of Peter the Great, through the Soviet era and into present times, they are also special as the site where most of India's submarine fleet has been built. 16 of the 23 submarines that have been operated by the Indian Navy since independence were launched into the icy waters of Saint Petersburg's Neva River from this very yard. Of the in-service *Kilo*-class, all but two were born from thick steel plates that arrived at the yard's Workshop No. 6.

Besides Indian boats, Admiralty has rolled out over 300 submarines in the past 100 or so years, including 41 nuclear submarines. Presently, however,



An incredibly powerful hydraulic hammer gives just the right curvature to dozens of steel plates so that they can be welded into watertight submarine pressure hulls

the yard is a centre for only conventional submarines and the odd surface craft, given understandable concerns over having a nuclear facility in the heart of Russia's second most populous city. Currently, the shipyard is working on a number of *Kilo*-class boats at various stages of completion, as well as further *Lada*-class submarines for the Russian Navy.



Admiralty Shipyards uses different types of cutting methods for different applications — from plasma cutters as seen above...



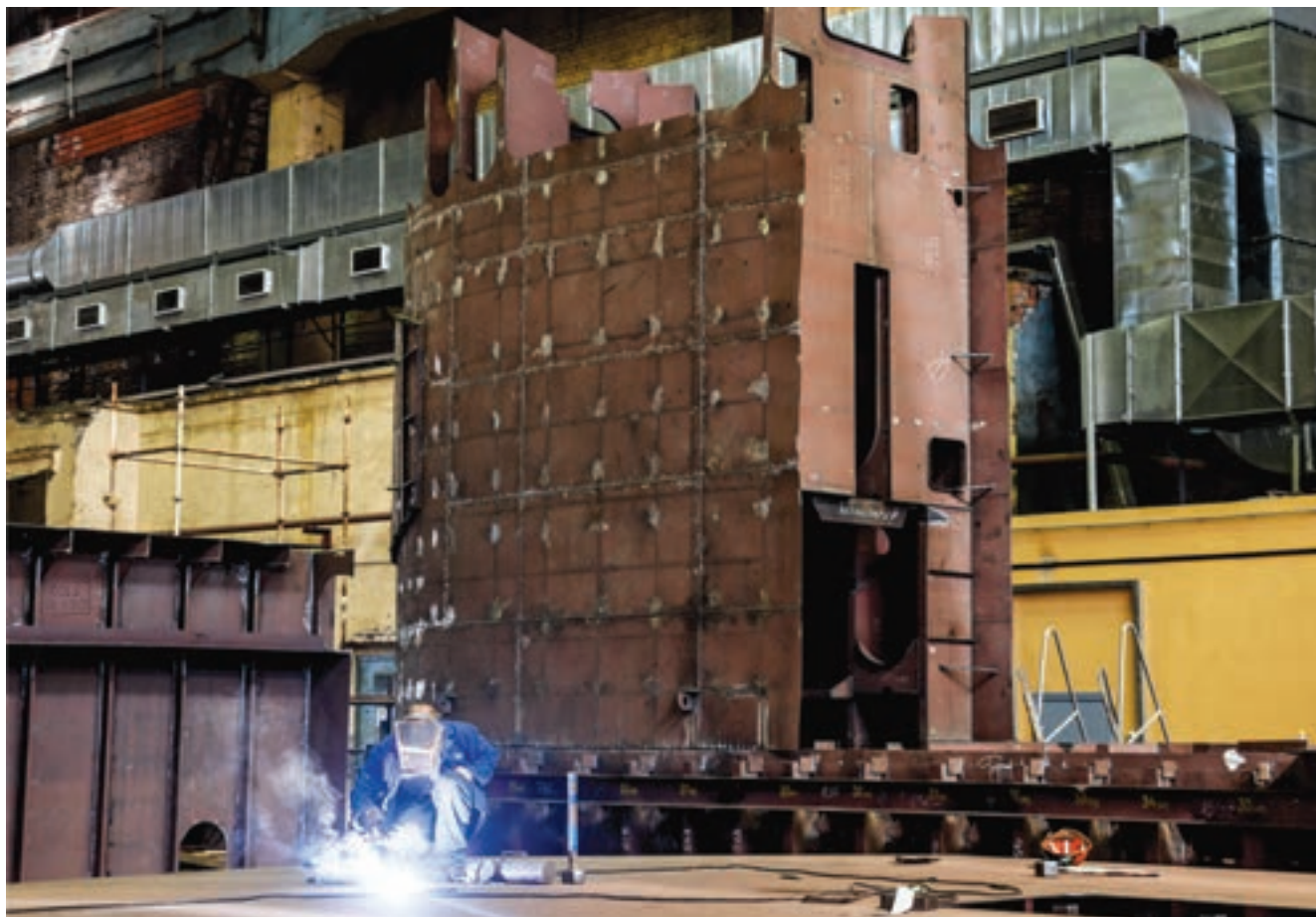
... to computer-controlled waterjet cutting machines pictured here



Even with all the machinery in the world, sometimes there is simply no substitute for human power!



Workshop No.9 is one of the locations where larger submarine and surface vessel sections are built and tested before being sent on for final assembly



All but two of the Indian Navy's Project 877EKM (Kilo- or Sindhughosh-class) submarines passed through Workshop No.9 at Admiralty Shipyards



The final product, a completed Kilo-class boat, viewed from across the Neva

The FREMM multi-mission frigate 'Auvergne'

DCNS sails ahead!

DCNS has floated the French Navy's FREMM multi-mission frigate *Auvergne* in Lorient. This achievement took place on 2 September and marked an important step in the construction of the "most modern front-line ship of the 21st century". The FREMM *Auvergne* is the sixth frigate in the programme and fourth of the series ordered by OCCAr on behalf of the DGA (the French defence procurement agency) for the French Navy. With three FREMMs currently under construction in DCNS' Lorient site, DCNS is accelerating the production speed in order to deliver six FREMMs to the French Navy before mid-2019. Two additional frigates equipped with strengthened anti-aircraft capacities will be delivered before 2022. Two further units have also been sold to international clients; The Royal Moroccan Navy and the Egyptian Navy.

"The floating of the FREMM *Auvergne*, after the delivery of the FREMM *Tahya Misr* to the Egyptian Navy and the delivery of the FREMM *Provence* in June, demonstrate DCNS's ability to successfully achieve a serial production", explains Anne Bianchi,

On 13 October in Riyadh (Saudi Arabia), the President of the King Abdulaziz City for Science and Technology (KACST), Dr Turki bin Saud Mohamed Al Saud, in the presence of Prince Muhammad bin Salman and of the French Prime Minister, Manuel Valls, signed a cooperation agreement with the Chairman and CEO of DCNS, Hervé Guillou. The goal of this agreement is "to foster the development of a Research and Development centre dedicated to the naval and maritime domain."





Mistral-class projection and command ships (BPC)

FREMM Programme Director at DCNS. The company commenced construction of the FREMM *Auvergne* in August 2012, and this new-generation frigate will be operated by an optimised crew of 108 (half that required for the frigates of the previous generation). Four surface ships currently being produced at DCNS Lorient

On 10 October, DCNS signed a contract with the Ministry of Defence of the Arab Republic of Egypt for the supply of two MISTRAL-class projection and command ships (BPCs). After delivery of a FREMM frigate and the construction of four GOWIND 2500 corvettes, currently on-going, this agreement strengthens the strategic relations with the Egyptian Navy, initiated by the Group in 2014. By 2020, the Egyptian Navy will deploy a fleet of at least seven combat ships designed and built by DCNS.

Hervé Guillou, Chairman and CEO of DCNS announced that: "After the contracts for the supply of four GOWIND corvettes and a FREMM frigate, we are proud that the Egyptian Navy continues to place its trust in us today by signing a contract for the delivery of two MISTRAL-class BPCs. With 7 combat ships already ordered to date and a latest-generation frigate already in operation in the Egyptian Navy, DCNS is thus participating in the modernization of the defence infrastructure of this strategic French ally."

The two projection and command ships (BPCs) ordered by the Egyptian Navy from DCNS will join their home port in the summer of 2016, after the training of future crews. This training will

be given mainly over the first half of 2016 in Saint-Nazaire. With regard to associated BPC support ships, DCNS will supply in particular four new-generation landing crafts (CTM NG), designed by the Group as an integrated system to an amphibious force organised around *Mistral* ships, and two fast landing crafts (EDAR), designed and built by CNIM.

Considering that the first of the four future GOWIND corvettes for the Egyptian Navy is already being built, that the other three will be assembled in Egypt in Alexandria and that the FREMM *Tahya Misr* frigate was already delivered to the Egyptian Navy on 23 June 2015, the signature of this new contract further strengthens the strategic

partnership developed between DCNS and the Egyptian Navy. By 2020, the Group will have supplied at least seven ships to Egypt contributing to the modernisation of its defence mechanisms.

With a length of 199 metres, a displacement of 23,000 tonnes and a speed in excess of 18 knots, the *Mistral*-class BPC is defined by its large carrying capacity. The *Mistral*-class BPC is designed for force-projection, peacekeeping and humanitarian-support operations, and is equipped with a particularly modular command and control centre, featuring efficient communication systems that can be adapted to all shipboard headquarter configurations. It also has an onboard hospital, and can carry out large-scale humanitarian missions.



The Mistral-class ships (BPC) are designed for force-projection, and are equipped with a modular command and control centre.

Rolls Royce :

long term commitment to the Indian Navy



Rolls-Royce has a deep relationship in India stretching back more than 80 years and is contributing significantly towards the modernisation of the armed forces. We are proud to have powered the first aircraft of both the Indian Air Force and Indian Navy and are committed to continuing this relationship long into the future. Today, we are deeply embedded in India as an investor, a high skills employer and as a supplier of power systems for use in the air, on land and at sea.

Rolls-Royce has worked alongside the Indian Navy since the induction of its first aircraft in 1953 and today we power a number of the Indian Navy's fleet, including the Sea Harrier, the Sea King and the Hawk.

INAS 300, the Indian Navy's carrier strike squadron have been continually supported by Rolls-Royce since its formation in 1960, a legacy that continues today with Rolls-Royce personnel embedded with the Squadron in Goa. With induction of the Sea Harrier in the early 1980s, Rolls-Royce helped to train the initial cadre of Indian Navy personnel, both alongside the Royal Navy and at our Bristol factory before moving with the Squadron to India. In the 1990s, Rolls-Royce supported the establishment of the Indian Navy's overhaul facility in Kochi. This is part of our long term commitment to Indian self-reliance.

In the short term, our priority is to support today's fleets, in particular the Sea Harrier as it plays a vital role in India's maritime security. In the medium term we will continue to support the operation of the Sea King, a critical military asset, which has years of operation remaining. We will also help the Indian Navy maximise its use of the Rolls-Royce powered Hawk Advanced Jet Trainer, which is an expanding fleet, crucial to the Navy's combat aircraft capability. Looking to the longer term, there are a number of Rolls-Royce powered aircraft that we believe could be of interest to the Indian Navy. The most obvious of these is the US-2i amphibious aircraft which shares largely common engines with the Indian Air Force's C-130J fleet.

Rolls-Royce is playing a leading role in the government's 'Make in India' initiative. We have been undertaking license production in India for nearly 60 years with increasing levels of capability transfer throughout this time. In recent years we have moved beyond the license production model, undertaking world class manufacturing for our global civil customers through our IAMPL joint venture. The IAMPL facility is now at full production employing over 130 people for a wide range of engine programmes including the Trent XWB. In addition,

around 1000 engineers, through our partnership with QuEST & TCS, work at Rolls-Royce managed engineering centres in Bengaluru. For our new facility in Bangalore, we plan to employ around 500 people by 2017. The engineering facility will produce components and develop technology in support of our Aerospace business.

India is one of the most important strategic markets for Rolls-Royce and we continue to build on our long-standing partnership with the country. We will continue to support India's infrastructure and modernisation needs and will remain committed towards delivering 'better power for a changing world'.



Steven Gillard, Vice President, Customer Business - Defence, Rolls-Royce

An Amazing Spectrum

Airbus Military in Spain

Vayu's UK Editor, Richard Gardner reports from Seville, Spain, as Airbus Defence and Space presents its annual Trade Media Briefing (TMB'15)

They say "The rain in Spain falls mainly on the plain" and even as delegates arrived from around the world to attend the annual *Airbus Defence and Space (Airbus DS) Trade Media Briefing* at Seville, this reputation was easy to understand as the skies were storm-filled and it was extremely wet at the Headquarters of what was formerly known as Airbus Military. But whereas previous annual briefings had also reflected stormy prospects for the company's latest product, the A400M Atlas transport, this time the atmosphere was noticeably more upbeat.

The 2015 briefing was due to take place earlier in the year, but had to be cancelled at the last moment owing to a fatal accident in May involving an A400M making its first flight after completion. The report into the cause is due to be released before the end of 2015, but the problem was soon identified and rectified and now every effort is being made to get the programme back on schedule, with deliveries steadily building up, as visitors were able to see for themselves



Airbus flightline at Seville

in October. There have also been significant management changes within the group and this is part of the major reassurance

campaign that has been launched to pacify customers waiting for delayed deliveries and expecting improved quality control.



Airbus A330 MRTT refuels an F/A-18 Hornet

Military aircraft chief salesman, Antonio Rodriguez Barberan, provided an initial overview of the military product line, which was wider in scope than many may realise. It extends beyond the main Seville products, the A400M and C295 and CN235 transports, to Eurofighter, the A330 MRTT, UAV developments and extensive military upgrade and sustainment support services. According to Antonio, the company's aim was to be present in most military market segments and to be number one or two in each segment. A tall order maybe, but Airbus was already well on its way to achieving this in terms of supplying military transports and air tankers. The company's worldwide presence included 1,800 aircraft sold to 70 countries, with 145 operators and over 5 million flight hours accumulated. He added that an ever growing global footprint was making the products more supportable, and India was identified as one of the countries for future developments.

Achievements in the past year: The A400M is now operational with five air forces (France, UK, Germany, Turkey and Malaysia) and presentations have been made to nine more potential customers, with what are described as "serious negotiations underway". The first aircraft for Spain are also in final assembly. Its light and medium aircraft have achieved 28 new orders in 2014, including for four new customers. So far in 2015, 15 more orders have been added. Airbus expects to maintain its market share in this category of 75% long



Airbus C295 of the Ghana Air Force plus a RAF A400M

term. In addition to the primary transport role of the C295 and CN235, these types are being continuously developed to cover other tasks including search and rescue, maritime surveillance, marine pollution Control, Anti-submarine and surface warfare and aerial photography. New roles being developed include ISTAR/EW, Signals Intelligence, fire-fighting, Airborne Early Warning and the gunship fire-support role. Another growing niche market for these aircraft is government and State VIP transport. The combined C295 and CN235 market penetration is around 60%. The biggest regional market is Asia Pacific with 140 sales, Africa and the Middle East have ordered 130 aircraft, Europe 105, and the Americas have ordered 100 aircraft.

Selection of the A330 MRTT has continued the pattern of attracting new customers to what is the undoubted market leader in the large tanker/transport market. Recent orders include two for Qatar, and three for a joint NATO MRTT group comprising the Netherlands, Norway, Poland and Luxembourg. France is to buy twelve, and South Korea has ordered four.

India has announced its selection of the type. To date there are now 26 A330 MRTTs in service. Eurofighter continues to offer upgraded Typhoons with AESA radar and other improvements. The latest customer to select the fighter is Kuwait, which is expected to buy 28. Work continues on a proposal for a new joint European MALE UAV definition



Airbus CN235 of the Philippine Air Force

phase. Other upgrade programmes include improved Tornados for Saudi Arabia and P-3s for the German Navy.

An updated review of the C295 and CN235 programmes was given by Fernando Ciria, Head of Marketing for Light and Medium Transport and ISR programmes. He started by highlighting the fact that the C295 was the best-selling military aircraft in its category. Over 160 aircraft had been sold to 23 operators in 22 countries. Eleven of these were repeat orders. The new C295W features enhanced engine

performance and has winglets. These improvements give an 8% increase in range (out to 2,300 nm with a 4 ton load). The winglets provide an aerodynamic gain that translates into a 5.5% fuel advantage on a typical mission. The engine mode upgrade also allows a larger payload from hot and high airfields – 7.85 tons at 500 nm from an altitude of 6,000ft. The first flight of the C295W development aircraft took place on 11 April 2014 and has now been certified. The first delivery took place in April 2014 to the Mexican Navy.

Efforts to further expand applications for this versatile platform have included modifications to allow a fire-fighting role and a version for Special Forces as a transport or a fire-support gunship. The capacious cabin of the C295 allows room for extensive mission systems and displays so that the aircraft can act as a Signals Intelligence or Ground Surveillance platform, with specialist sensors and multiple target tracking radar, including communications intercept and jamming equipment. Modifications to give the C295 more weapons capability in the Maritime Patrol (MPA) and anti-submarine (ASW) roles is being undertaken so that air-launched homing torpedoes and air-to surface missiles can be carried. The larger C295 and CN235 can both be given a cost-effective MPA or SAR role as they feature high levels of manoeuvrability at low level above the sea surface, combined with an endurance of up to 11 hours.

The US Coast Guard uses a large fleet of CN235s for law enforcement, border patrols, and para-rescue operations. Special large size bubble windows give excellent visual coverage for crew members, while electro-optical video cameras, including infra-red, allow all-weather and night operations. During the author's visit, a well-equipped Omani C295 MPA/ASW aircraft was present on the flight line



The Airbus plant at Seville, Spain

undertaking various ground tests. The latest generation FITS mission system is incorporated. Palletised ISR mission systems can be provided to that the aircraft can be used for transport duties when not required for ISR or MPA duties. If required to provide electronic surveillance and order of battle generation, with onboard ELINT/COMINT analysis or electronic countermeasures this can also be supplied in a very compact package that also has the advantage of being able to operate from short runways almost anywhere, not restricted to international airports. Israel's ELTA has supplied a 4th Generation AESA radar which has been trialled atop a C295 in an aerodynamic rotating dome for the detection of multiple small and fast targets, giving 360 degree coverage.

For Ground Surveillance tasks, the C295 can carry high resolution SAR/GMTI radar arrays and an EO/IR target designation turret, ESM, ELINT and COMINT. It would seem that Airbus is keen to exploit every possible combination of ISR and EW mission roles that can be carried aboard its C295 and CN235 aircraft. At the briefing it also suggested that close air support for Special Forces was an ideal role for the C295, which could deploy parachutists and supplies and also carry underwing weapons and stores. In collaboration with ATK the gunship role was another capability as previously mentioned. But its future planning is already looking beyond the C295 platform. The company showed an image of an A330 fitted with a top-mounted rotating radome which might become a replacement for the current generation of Boeing E-3Ds, in widespread use around the world, but many of which are over 40 years old. Such an A330 AEW&C platform would offer even more on-board volume for electronic equipment, environmental control, electrical generation and distribution systems, crew rest areas and additional operational ISR/EW tasking potential, with extremely long range and/or endurance on station, and high transit speed. However, the future vision for Airbus DS didn't end there. The company briefing also included images of a military configured A320 platform (which could presumably also be sized as an A319 or A321, depending on customer need) which could have a ground surveillance, EW or maritime patrol role, and could become a European rival to Boeing's P-8A Poseidon.



Airbus Seville final assembly: A400M tails

Antonio Caramazana is Head of the MRTT programme and gave a more detailed update on progress during the previous twelve months. He said that the A330 tanker transport had been very active on military operations. This included The RAF's *Operation Shader* in the Middle East in support of Tornado operations against ISIL targets, and also helping refuel other coalition aircraft. Twelve aircraft were in service. The aircraft was also in service with the Royal Australian Air Force (5 aircraft) with a detachment based in the Middle East. Royal Saudi Air Force MRTTs were involved in tanking support operations for combat air strikes against targets in the Yemen. The RSAF now has six in service. The UAE has three and some of these have also been used in operations over Syria, Iraq and Yemen. Most of these operations have involved air-to-air refuelling missions, but the aircraft have also been used, particularly by the RAF for overseas deployments carrying up to 200 troops, and for supporting combat aircraft deployments carrying equipment and ground personnel.

During the year the refuelling boom functionality has been released allowing full use of the Airbus developed control-by-wire boom to refuel USAF combat aircraft, such as the F-15 and F-16, as well as larger types such as other MMRTs and Boeing Wedgetails. The MRTT has also been cleared to refuel combat fighters using the FRU drogue and probe method

including the Typhoon, Tornado, Mirage, Rafale, F-18 Hornet and Super Hornet and AV-8B Harrier. Night refuelling can now be undertaken on all these types and clearance trails were successfully undertaken at Edwards AFB and Patuxent River in the USA for additional US types including the EA-6B, A-10 and B-1B. This included the first MRTT wet boom refuelling of the F-35A by RAAF MRTTs. In the UK, expansion of the FRU refuelling functionality included clearance of refuelling trials with two different types of C-130J, the E-3D Sentry, and A400Ms. Worldwide medical evacuation flights have been flown and the RAF has carried over 500,000 passengers aboard its MRTT Voyagers so far. Some 56,400 flight hours have been flown by the type in service. A series of enhancements is now being applied to new MRTT deliveries. The initial customers will be Singapore, France and Korea for delivery from 2018. This performance improvement package has been triggered by new increased weight capability resulting from the standard upgrade of the basic A330 which has structural and aerodynamic improvements. Inside the aircraft, there will also be new computer displays associated with an avionics upgrade. Adjustments to the military systems fitted in the MRTT include improvements to the industrialisation process with more standardisation of electrical and mechanical solutions. It is clear that the MRTT has now



At Airbus Seville integration stage

settled down to being a very capable and mature military air asset, and the clear leader in its field, offering more usable cabin space and fuel off-load capacity, endurance and a more modern airframe than its nearest rival.

It then delved to Joey Borkenstein, Senior Advisor Air Combat Operations, to provide an update on the Eurofighter programme. A steady programme of upgrades continues to roll forward, though this has proceeded at a slower pace than originally intended as a result of various spending cuts and delays across the defence budgets of the main European partner nations. Keeping the momentum going on these upgrade packages has not been an easy task as some customers have been slower to respond as they have not been so actively engaged in combat operations as others, who have long recognised the need to adopt progressively better avionics, radar and weapons systems. However, the first four upgrade packages are identified and are being implemented over the next five years, with others following out to at least 2030, ensuring the Typhoon has a long operational future ahead of it. One of the most immediate upgrades is the clearance of new missiles. The first of these will be the Storm Shadow/Taurus, which is a very long-range stand-off weapon for use against well defended key targets. The Storm Shadow is battle proven aboard Tornado and combines low observability with high precision. It is to be delivered for service on Typhoon by 2017. The MBDA

Meteor is intended as an air dominance long range air-to-air missile with a two way data-link and has an unprecedented No Escape Zone. This is also due to be cleared over the next year. The next enhancements cover the carriage of the latest Paveway IV precision bombs. Available in 500lbs and 1000lbs versions, the weapon has laser guidance, GPS/INS guidance and Typhoon can be configured to carry up to six while retaining its full air defence role. The third new missile, being pushed as a priority by the UK is the clearance for Brimstone II attack missiles. These have been developed from the standard Brimstone, which has a proven combat record over Afghanistan and Iraq, and features a dual mode high accuracy seeker with a very good performance against small moving targets. It has all-weather day or night capability and is very compact so up to twelve can be carried on four triple launch mountings, without compromising AAR missile capability. The most anxiously awaited upgrade remains the adoption for Typhoon of the Captor-E AESA radar from Selex. This features the biggest “field of regard” for any AESA of its type, thanks to its mounting on a moveable rather than a fixed plate. This wide angle capability allows even more multiple targets to be identified, tracked and addressed, with multiple uses, from air-to-air interception to sea search and surface strike. It has a high resistance to jamming and can operate with various active and passive detection

options. Other developments include an upgraded defensive aids suite with a more powerful jamming capability and passive geolocation.

During the last year Eurofighter Typhoon operations have continued at a high pace with some operators, notably the UK and Saudi Arabia, where they have been in daily combat in the Middle East. Increasing surveillance “probe” missions by Russian long-range reconnaissance aircraft have resulted in round-the-clock intercept scramble missions to escort the interlopers away from national and NATO air regions from Norway to Turkey. Continuous deployments of NATO Typhoon squadrons to the independent Baltic States have provided additional reassurance of NATO support at a time when these former Soviet Union states have felt threatened by the situation in the Ukraine and Crimea.

But it was the flight test programme for the A400M Atlas which was to form a major part of the update briefing at Seville. Since the last Trade Media Briefing the A400M flying totals have risen to 7,903 hours on 2,901 flights. Particular achievements during 2015 have included many important way points including: the first flight refuelling receiver trials from an A330 MRTT, and fuel delivery to two F-18 fighters, two-ton load extraction using parachutes, DASS (Defensive Aids Sub-System) and RWR self-defence tests, paratroop deployment trials and off-runway surface tests. Associated with low-level flights was certification of an enhanced vision system with night vision goggles. Certification of low level free-flight down to 150ft was achieved in late 2014, with height down to 500ft using NVGs. Infrared sensors and flare systems were also tested under many different conditions and included full flare jettison. The A400M has a very extensive DASS system, which includes radar warning receivers and other systems, some of which are customer specific. During the period of the media visit several RAF A400Ms had returned to Spain for fitting and integration of the UK’s DASS system.

Various dynamic air drop tests have taken place with live jumps carried out. These tests confirmed that there are issues involved in using the two rear side doors for troop air drops. The turbulence from the powerful engines causes cross-over problems which can bring departing paratroops into contact

with each other after exit, so measures are in hand to find and evaluate a solution. A test aircraft is being fitted with a spoiler which 'it is hoped' may solve the problem, but tests will continue into 2016 using full-size representative dummy troopers. Free-fall jumps from the cargo ramp door have been certified for departures of up to 29 jumpers at a time. Sticks of 12 jumpers can be despatched from the rear ramp. Further tests in early 2016 include despatch of two x 58 paratroops in one stick and high altitude paratroop drops. Heavy cargo drops of loads of up to 4 tons have been certified for gravity and parachute extraction. Total loads of 12 tons have been despatched using three platforms carrying 4 ton loads each. The art and science of air delivery is a complex one, especially involving such an automated fly-by-wire aircraft and the tests have included despatching different size loads from different positions on the cabin floor and rear cargo door. The capability will be expanded so that 25 ton loads can be despatched in safety. Every aspect of the

despatch trials has been carefully recorded and the final standard of clearance will allow the aircraft to fully undertake the tactical transport as well as strategic transport roles. Further tests in September and October 2015 have included landings and take-offs from grass runways and soil surfaces. The third stage in these tactical op tests involves further operations from sand surfaces. The landing gear of the A400M incorporates the first certification of technology based on micro-strain measurement to indicate to the pilots that the gear has functioned correctly and wheels are on the ground or in flight. The traditional system based on proximity sensors has been changed by a calibrated pin (strain measurement) design. Due to the aircraft's landing gear configuration this new system has significantly improved the landing run performances on low friction surfaces.

During 2016 additional capability will include Polar area navigation, automatic aerial delivery of parachutists via static line and refuelling other aircraft from wing-mounted HDUs. The intended capability

for aerial refuelling of helicopters by the A400M has been dropped for the present. Tests have led to the conclusion that this problem is not easily solved without an unacceptably extensive modification of the HDU design, which performs very well for all fixed-wing AAR requirements, meeting the majority of operational needs.

The briefing contained much more information on various technical projects that reflect a very active continuous improvement policy. The company is keen to simplify the manoeuvres involved in trying to get the maximum feasible automation in reaching important improvements in operational and safety aspects of aerial refuelling. These improvements are aimed to save time, costs and reduce risks. Currently undergoing feasibility studies the follow up step would be to move to a proof of concept in a flight test environment to validate the techniques.

But, this is another story!

Article and photos: Richard Gardner



Head-on view of the Airbus A400M



Surya Kirans in their new *avtaar*

As reported earlier this year (see Vayu III/2015), the Indian Air Force's Surya Kirans aerobatic display team has been re-established with new BAE Hawk Mk.132 aircraft. The team made their public debut on Air Force Day 2015 with a four-aircraft display at Hindan AFS, where Vayu's Angad Singh spent time with them and reports on their current and future plans.

Hindan AFS, October 2015 : The drone of a Pilatus PC-7 trainer fades away at the Air Force Day 'Parade Square' at Hindan Air Force Station as the type's solo display concludes. Turboprop trainers, helicopters, special operations aircraft, strategic airlifters and frontline fighters have already had their turn in the sky over Hindan, yet it is only now that necks crane and eyes frantically scan the murky haze that unfortunately blankets the national capital region each year around October. Every one of the thousands gathered here are looking eagerly for a flash of sunlight to illuminate the bright red-and-white painted wing of an approaching Hawk jet trainer.

Then suddenly, there they are : four sleek Hawks emerge from the smog in a diamond-shaped formation and the crowd erupts as they begin their display with a pass from left to right at show centre.

The *Surya Kirans* are back !

Established in 1996 as part of No.52 Squadron ('The Sharks') based at Bidar AFS in Karnataka, the *Surya Kiran* ('Sunbeam' in Sanskrit) team served for 15 years as representatives of the IAF at home and abroad, and were a vital publicity and outreach asset for the Air Force. Such was (and remains) the strength of the *Surya Kiran* "brand" that the IAF has elected not to rename the team (there were options aplenty including resurrection of the

Thunderbolts and the evocative *Tiranga* but the consensus was to retain *Surya Kiran*.

Only the livery has changed, and even there the visual link to the past paint scheme is retained, although the dayglo orange has given way to a richer, darker colour that is closer to red. The scheme itself more closely evokes the meaning of *Surya Kiran*, with alternating red and white rays emanating from a 'sun' painted on the vertical fin. Additional red and white longitudinal stripes near the wingtips and ends of the stabilators add a touch of 'visual weight' to extremities of the aircraft.

The team was formally re-established on 16 February 2015, with No. 52 Squadron resuming operations at Bidar.



Six select pilots commenced conversion training on Hawk AJTs toward the end of March. This initial nucleus of the team consisted of three former *Surya Kiran* pilots, including the CO, Wg Cdr Ajit Kulkarni, who had no prior experience with the Hawk, and three Hawk Qualified

Flying Instructors (QFIs) with no prior experience in formation aerobatics. The two groups combined expertise in different areas to ensure a smooth start for the team, and were soon joined by a fourth ex-SKAT pilot to make a total of seven pilots in the team.

Formation aerobatics training – practising for actual display flying – began for the team around July, after all the pilots had achieved the requisite level of experience with the Hawk. At this point, the objective of being able to perform their maiden display at the Air Force Day Parade began to look



increasingly achievable, and despite the monsoon weather that limited training time in the air, the pilots took every opportunity to perfect their four-ship routine. By 8 October 2015, four pilots were fully qualified to fly the formation display, allowing the team's public debut to proceed as planned.

From here on, the team has planned a measured work-up to a full nine-aircraft display, regaining their status as one of a small handful of aerobatic teams in the world flying with such a large number of aircraft in formation.

At present, the team operates six BAE Hawk Mk.132 aircraft (two for training and reserve) that, unlike the SKAT Kiran Mk.IIs of old, are not functionally modified and therefore remain available for use as regular advanced jet trainers. Of course, they no longer sport the typical IAF grey of their Bidar-based brethren, with the new livery being executed in its entirety - from concept to completion - in a mere 28 days, overseen by Wg Cdr RN Sinha, the team's Senior Engineering Officer (SEO). Hindustan Aeronautics Limited (HAL) subcontracted the painting of the *Surya Kiran* aircraft to Bangalore-based firm Matcon, who imported special polyurethane paint from the UK to complete the task to specification.

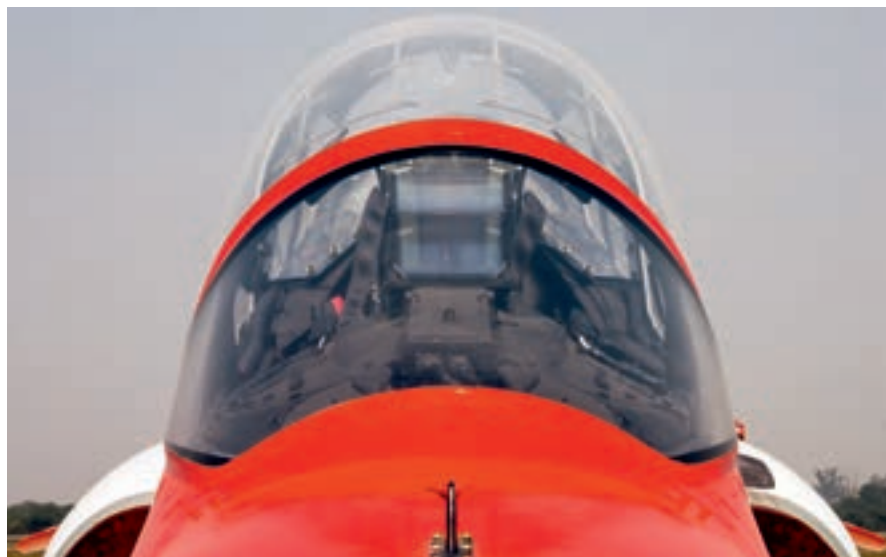
With aircraft and initial aircrew in place, their short-term goals are simple: display as often and in as many different places as possible. The most basic part of training - transition to the Hawk AJT - is complete for all members of the team. This involved 48 conversion sorties and roughly as many hours of flying for each pilot. The team constantly called on the expertise of their Bidar-based compatriot Hawk units ('HOTS') to maintain high levels of safety throughout the conversion programme. All new manoeuvres and routines were initially supervised by the AOC of Bidar AFS as well as the Chief Instructor at the base. Senior ex-SKAT personnel were also attached to audit for safety, which was and remains paramount in the team's efforts.

Now, Wg Cdr Kulkarni reckons that eight to ten displays in a range of unfamiliar locations will be adequate to get the team accustomed to the rigors of formation flying in varied conditions and make them more adaptable so that they can be comfortable flying their displays anywhere in the country - and indeed the world. After Hindan, the team was slated to



display over Mysore in October itself, and is then hoping for opportunities to perform at as many scheduled Air Force events as possible, including such proceedings as passing out parades, awarding of President's Standards and Unit Citations and a planned firepower demonstration in March next year.

When all seven pilots are fully qualified for the four-ship display and the team is at ease with their aerobatics, training for a six-aircraft display, including a 'synchro pair,' will commence. Initially, Wg Cdr Kulkarni estimates that it will take 4 to 6 weeks of dedicated training to transition to what is called a six-ship 'composite'



display, which means all six aircraft will display in formation together, much as they did on Air Force Day this year. Only then will the team create and begin training for a more dramatic routine involving a 'synchro pair,' which would see two of the six aircraft detach from the main formation and perform a different range of manoeuvres together in between passes by the main formation. These include splits, level and rolling crosses, hesitation rolls, and the 'heart loop' made famous by the previous *Surya Kiran* team. If all goes as planned, the six-aircraft display including the synchro pair will be performed in time for Air Force Day 2016.

The final step, from six aircraft to nine, is "the most difficult" according to Wg Cdr Kulkarni. It will take at least another full year to make this transition, and the transition itself will also be entirely contingent upon delivery of a batch of smoke-capable Hawks. While the present Hawk aircraft in use by the team cannot generate smoke trails like the Kiran Mk.IIs used to, the contract for an additional 20 Hawks specially configured for display flying with the ability to generate white and coloured smoke, so as to allow the *Surya Kiran*s to provide the same visual spectacle they did in the past, is imminent. These definitive SKAT aircraft will likely also see some changes to the livery as inputs from various sources in the intervening years are taken into account.



VAYU on-the-spot reports

Vayu's UK Editor Richard Gardner reports from the largest defence and security show of the year



This September London hosted the biggest ever Defence and Security Equipment Exhibition at the ExCeL Centre in London. Over 1,600 exhibitors took part and there were national pavilions from 42 nations and 8 visiting warships, with an external exhibition site for military aircraft and helicopters. But it was in the very large exhibition halls that could be seen examples of the latest vehicles, missiles, UAVs and the many seminar theatres where a continuous programme of briefings and discussions took place throughout the week, covering all aspects of defence and security, from the changing international threats and progress on new programmes, to cyber defences for commercial and military organisations. There were many senior representatives of armed forces



An operational RAF Typhoon FGR4 on static display fitted with cruise missiles, LGBs, Brimstone PGMs and Meteor BVRAAMS

and security agencies from all over the world while keynote speakers from the UK's Armed Forces gave presentations on current UK defence policy and capabilities, outlining how future programmes were developing. Most major international defence companies were present and it was clear that the competitive defence export sector was entering a new era where a new generation of products would soon be entering service, aimed at offering improved capabilities, but with affordability a recognised factor. The show was decidedly international and within its exhibition site were areas devoted to Air, Naval and Land Forces, and also Special Forces, Unmanned

2 missiles from MBDA. There was also a separate Brimstone display stand in the hall where the performance of the new Mk 2 dual-mode version of the missile was being promoted. These can be carried on triple launchers used in conjunction with any standard NATO pylon. The weapon system has highly accurate precision-guidance with enhanced tracking capability against multiple small, fast moving targets, which can be armoured vehicles, pick-up trucks or Fast Inshore Attack Craft. They are small and light and can be carried on medium size UAVs or almost any attack aircraft. MBDA also had a display of its new Brimstone 2 derived missile optimised for use as a

multirole precision weapon for the British Army's next generation attack helicopter, which has not been chosen but is expected to be latest version of the AH-64 Apache. The new missile would be for combating fast and agile land and maritime threats.

Thales had a very large exhibition stand at the show and this was divided into different areas covering land, sea and air applications, including displays for airborne command and control, surveillance and anti-submarine aircraft platforms, radars, lightweight missile systems as also its Watchkeeper UAV, which is being developed further for export customers. The company announced the Watchkeeper-X as an export version of the system supplied to and in service with the British Army. This new version offers different options for particular customer needs and has a rough airstrip capability and is rapidly deployable by air or surface transport. As well as having two sensor turrets, the UAV can also be fitted with the Thales I-Master radar for high-resolution surveillance and moving target identification and tracking. Weapons can be carried and other uses include electronic and communications intelligence gathering.

The new AMASCOS mission system is a fully integrated mission system for maritime and ground surveillance, and can be carried aboard a wide variety of jet and turboprop platform aircraft. Demand for maritime surveillance and patrol aircraft is growing with the need for tighter control



MBDA's proposed Future Attack Helicopter Weapon based on the company's Brimstone missile

Air Vehicles and a zone featuring medical services and disaster relief. This article will focus mainly on air, missiles, UAVs and related systems for air and naval operators.

News broke as the show was opening that Kuwait had ordered 28 Typhoon multi-role fighters as an Italian-Kuwaiti government-to-government agreement. The full details have not yet been announced, as the contract is not yet signed, but sources indicate that the aircraft will be new build and to the latest Tranche 3 standards, which will almost certainly include the new Captor-E AESA radar and the associated avionics, mission system and weapons upgrades. The missile choice is presently unknown, but no doubt the final contract will include crew training and an extensive support package. At DSEI there was a Typhoon FGR4 on static display, which included Meteor, ASRAAM and Brimstone



Thales Watchkeeper model at the show, fitted with FFLMM glide bombs

of desert and frontier regions. The new Thales offering can deal with multiple mission requirements and is configured with the latest generation of sensor suites and innovative, user-friendly interfaces. The system is built around a tactical command system and with its modular architecture can be configured to optimise the crew task. A particularly outstanding feature is the touch-screen format of the displays, which is fully interactive and allows a very efficient operator work load thanks to high levels of automation, including data fusion, target identification and integration with onboard library data for classification of targets. There is a high level of hardware redundancy for enhanced reliability with a massive database to support the sensors, such as infra-red, electro-optical and radar. Operators can select displays to match the mission but the layout of the touch-screen controls is moveable overlaid on the same main screen and becomes familiar and easy to use in a very short time.

to engage surface targets, such as small boats or coastal targets. The sensors include daylight video and thermal imaging with a stabilised guidance unit and the system has a 24-hour day or night capability. The launcher can be in the form of a man-portable tripod for rapid deployment or mounted on a lightweight vehicle or boat deck. Malaysia is the first confirmed export customer, and has also ordered the Starstreak missiles for the system.

Attracting much interest was Rheinmetall Defence which displayed two examples of advanced High Energy Lasers (HELs) for use against low- and slow-flying UAVs. This was shown on an Oerlikon Skyshield turret and also on a naval gun mounting in place of the usual 27mm cannon. The company has developed a range of HEL systems from a 5kW unit on an APC to 10kW, 20kW and up to 50kW models offering an impressive surface-based air defence capability, with pin-point accuracy and instant reaction.

Another major exhibitor at DSEI was Finmeccanica, which includes Selex ES, AgustaWestland, and Alenia. Selex announced a new scalable disabling system for use against UAVs, known as the Falcon Shield. The company recognises that individual or swarms of small UAVs represent a growing threat to defence and civil targets and Falcon Shield is a non-kinetic countermeasure which is rapidly deployable and uses electro-optical and electronic surveillance sensors and radar to provide threat detection, identification and tracking. It works in day or night conditions and can discriminate from false signals even in urban environments to defeat potential threats using radio frequency intervention. The threat vehicle can be disrupted or control captured and the integrated security framework can include kinetic solutions if required by the customer. Another anti-drone disrupter was announced by a consortium of UK specialist companies comprising Blighter Surveillance Systems, Chess Dynamics and Enterprise Control Systems. Claimed to be the first Anti-UAV Defence System (AUDS) to go to market, this blocks command and control signals to the UAV and (in trials) was able to detect and disrupt rotary wing and fixed wing small UAVs within 15 seconds.

AgustaWestland have responded to UK MOD requests for capability demonstration flights for a Rotary Wing Unmanned Aerial System (RWUAS). This is aimed at forthcoming Royal Navy studies into what it may need to deploy to provide a future maritime unmanned air system. The use of small Scan Eagle UAVs from Royal Navy ships has confirmed the extra flexibility these give in providing short-range surveillance and tracking information. The UK trials, now completed, involved 27 hours of



Interactive Thales AMASCOS consoles at the show

Thales also displayed its new, advanced Lightweight Multiple Launcher - Next Generation (LML-NG), - which combines in one small launcher the capability to fire surface-to-surface or surface-to-air missiles. This incorporates a new head and sensor assembly for firing two types of laser-beam riding missiles, the Starstreak or the Lightweight Multi-role Missile (LMM). Starstreak is a high-velocity anti-aircraft weapon for use against any air target from a UAV or helicopter to a fast jet, and can be fired from any angle. The LMM is designed



The FFLMM is a free-fall glide bomb variant of the Thales LMM missile



The Rheinmetall High Energy Laser turret attracted considered interest

simulated unmanned demonstration flying and 22 automatic simulated deck landings using the SW-4 RUAS Solo technology demonstrator. The trials included launch and recovery, mission management and mission system integration with the ship Combat Management System. The

second set of tests involved simulated deck landings and the third phase involved the use of mission sensors to identify various targets of interest. The Solo demonstrator aircraft was flown as an Unmanned Air System under automated control from a ground station, but with a safety pilot

onboard. The Royal Navy is reportedly considering results of the demonstration to assess see how such a system could provide persistent maritime capability from a rotary-wing platform operating from the deck of a frigate-size warship. The demonstration programme also looked at using rotary-wing UAVs for mine hunting, hydrographic survey and airborne surveillance. AgustaWestland also gave an update on progress of the new AW159 Wildcat military helicopter in service with the British Army and Royal Navy.

Existing rotary wing UAVs include the Schiebel Camcopter S-100, which has recently been tested by Tunisia. The test flights took place over different terrain and coastal areas, with use of an L-3 Wescam multi-sensor turret. It can fly by day or night and is robust, enabling flight to continue in bad weather.

Raytheon was active at DSEI with its full range of missile and weapon products on display. The new SeaRAM is a close-in rapid reaction surface-to-air missile launch system combining Raytheon's Rolling Airframe Missile (RAM) in a new 11 round launcher, which replaces the 20mm chain gun in a Phalanx turret. The existing architecture of the Phalanx system is retained, complete



Lockheed Martin SC-130J model showing search radar and electro-optical turret, ASHMs, MAD boom, and weapons bays housed in enlarged sponsons

with multiple search and track sensors and SeaRAM can replace a standard Phalanx mounting with minor modifications, opening up optional close-in air defence solutions for major warships, including the US Navy's destroyers. Raytheon also briefed journalists on the latest Paveway 4 and Small Diameter Bomb II precision weapon developments and live fire tests.

The subject of Multi-Mission Maritime Aircraft was a major theme at the show even as the UK considers replacement of its retired Nimrod aircraft. A 'split solution' was one idea supported by many

transport, as well as being chosen by the US Coastguard with a search radar and open systems architecture, it could become a very flexible air asset.

Lockheed Martin revealed its latest proposals for a long-range multi-role air platform based on the SC-130J. This would feature a roll-on 5-console mission cabin module with extra soundproofing and insulation and a mission system based on that supplied to the Royal Navy on its latest AgustaWestland Merlin Mk. 2 ASW helicopters. It would also have a new AESA radar capable of detecting small targets

in high sea states and on land, including moving targets, with a comprehensive suite of self-defence and electro-optical surveillance sensors. Lockheed Martin claimed that it would be a low-risk programme, using well-proven airframes and engines and the mission system and sensors were also well proven, and would be fully integrated. Elongated side sponsons would contain weapons bays for torpedoes and missiles that would be dropped at low level, and underwing fuel tanks give the aircraft a maximum unrefuelled endurance of 14 hours. Typically this might translate into a six and a half long mission on station at a distance of 1,000 miles. The aircraft would have provision for in-flight refuelling in addition to the built-in long range.

India was well represented at DSEI 2015 with a large stand exhibiting models of current aircraft and missiles and visual displays highlighting national research and development activities as well as production capabilities. There are a growing number of joint programmes with global partners, including Embraer, which has been closely involved with the new EMB-145 ISTAR radar surveillance and electronic warfare platform which was represented in model form. The 'Make in India' theme was prominent and this message was clearly underlined at DSEI 2015 by the presence of the *Talwar*-class guided missile frigate INS *Trikand*, which was tied up alongside the show halls, and was one of the largest warships in attendance. [see following article].



Model of India's DRDO-Embraer AEW&C aircraft at the show

Text and photos: Richard Gardner

with one platform performing specialised oceanic maritime air cover and another, smaller platform taking over more localised surveillance. Airbus is promoting a solution based on a comprehensive ASW mission system aboard a C-295 twin turboprop aircraft, with provision for search radar and anti-submarine weapons. Finmeccanica's Alenia offered a C-27J multi-role MPA platform that could carry out a wide range of missions from maritime surveillance and search and rescue as well as anti-submarine and anti-surface warfare, Special Forces air support and logistical supply. The company highlighted its export successes (78 aircraft ordered by 12 air forces) and suggested that as the aircraft had a proven operational track-record in acting as an Electronic Warfare platform and battlefield support



Indian Navy frigate INS Trikand was the largest warship in attendance at DSEI, arriving after completion of the Indo-UK Exercise Konkan 2015



Indian Capabilities on display

UK Naval Chief: “intensely proud to welcome the Indian Navy back to London”



Indian defence and security capabilities were once again on display at Defence & Security Equipment International (DSEI). A total of 12 companies attended and the importance which India attaches to DSEI was highlighted by the planned presence of an Indian Navy frigate which was part of a squadron visiting Europe.

As Admiral Sir George Zambellas, First Sea Lord and Chief of the Naval Staff, said: "The Royal Navy is intensely proud to welcome the Indian Navy back to London on their first visit in recent times to our great global capital. The UK and India are both great maritime trading nations, with fast growing economies. We are both investing in our navies as highly



MKU introduces new 6th Gen armouring technology

MKU's new 6th Generation (V6) armouring technology, reduces the weight of Armour solutions for helicopter platforms by 40 per cent, thereby improving the performance and endurance capacity of armoured helicopters. This technology has been developed after extensive research, development and trials by MKU's team of engineers based in Germany. The use of Polyshield V6 technology helps save the 'effective payload' capacity of the helicopter without compromising on its protection. As an example, the use of Polyshield V6 technology enables the pilot of a Sikorsky CH-53 helicopter (with 50 sqm of armouring) to carry three extra soldiers, or 325 kg of ammunition or provisions, or an additional 415 litres of fuel in the aircraft, for increased flight radius. A reduction in the gross weight creates favourable conditions for take-off, further assisting in its rate of climb, aided by its engine power and the atmospheric conditions.



MKU stand at the Exhibition

practical contributions to hard and soft defence power, as well as reflecting our strategic ambition, but also because we both know that you cannot have prosperity without proper security. So, as historic maritime friends, there is a huge amount we can learn from one another, whilst we seek to contribute to the stable, peaceful and rules-based world order. The visiting warship has already participated in exercises with the Royal Navy, together with visits to Portsmouth and Plymouth. Their presence at DSEI now presents an ideal opportunity to demonstrate their technology and capability to a global audience".

The Admiral further stated that "India, under the Modi government, has been looking to create an extensive defence manufacturing capability. India has made significant advances in terms of technology and capability in recent years; DSEI offering a valuable platform for Indian companies to tap into export markets and build relationships in the defence sector, supporting the aim of Modi's 'Make In India' strategy, which is targeted to transform India into a manufacturing leader", The Confederation of Indian Industry (CII), the main driver behind the initiative, also had a significant presence at DSEI. CII is a non-government, non-profit, industry-led and industry-managed organisation that works to create and sustain an environment conducive to the



Indian Navy Talwar-class frigate
INS Trikand sails to DSEI

development of India, partnering industry, Government, and civil society, through advisory and consultative processes.

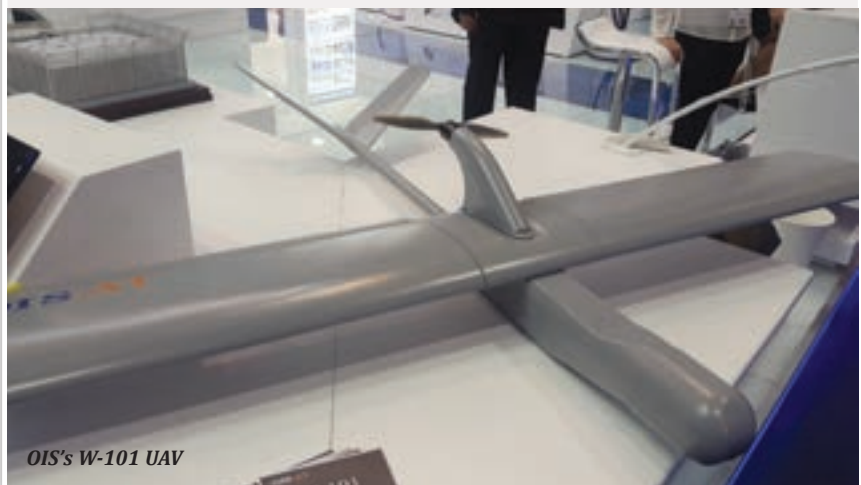
Traditionally an importer of defence hardware, India certainly has the capability to design and develop complex military products. The country is seeking world markets for its capabilities, which include missiles, radar, avionics equipment and naval systems. Exhibitors at DSEI 2015 included AGLAYA, Applied Systems, Bharat Dynamics (BDL), Bharat Electronics (BEL), Brahmos Aerospace, Mishra Dhatu Nigam (MIDHANI), Garden Reach Shipbuilders & Engineers (GRSE), Mazagon Dock Limited (MDL), Hindustan Aeronautics (HAL), MKU Offset India Solutions (OIS) and Zen Technologies.



OIS-AT's Dual-Use Radar Systems at DSEI 2015

At DSEI 2015, OIS-AT was looking “to accelerate global sales of its latest solutions and innovative products - its comprehensive range of 3D radar systems which have already attracted an ‘unprecedented level of buyer interest’.” Recognising that the international defence and security sectors’ needs are in continuous evolution as new threats to national security have to be countered, OIS-AT’s four dual-use radar systems leverage advanced technology developments that are under patent filings. Explaining the rationale for developing the dual use radar systems, Sanjay Bhandari, Founder Chairman & Managing Director of the OIS Group of companies said “It is almost impossible to understate the value and importance of radars in terms of being a real game changer in commercial technological applications as well as creating military advantage. As India’s leading private sector radar house our experience in radar systems design, manufacture, and, most importantly, integration and use of the technology in the real-world environment to meet each customer’s specific business operational requirement is unmatched.”

DSEI’s focus on important newer areas, such as Unmanned Systems Zone, was a significant platform for OIS-AT, which has designed, developed and manufactured another industry’s first: the 3D Multi-function, Multi-mode UAV Detection and Tracking and Air Surveillance Radar System. This radar system can be automatically tuned for detecting UAVs or high speed fighter aircraft and helicopters with a click. Unlike most air surveillance radars today, it includes a unique Sense-N-Avoid feature to identify UAVs that may be on a collision course, allowing the controller to take remedial action. Another Radar that is part of OIS-AT’s portfolio, is the 3D Bird Detection, Tracking and Monitoring and Deterrence Radar System targeted for aviation safety for both military and civilian airports.



OIS's W-101 UAV

Assorted Highlights



Biggest ever display of waterborne demonstrations at DSEI 2015

Defence and Security Equipment International (DSEI) featured its largest ever display of small boats and equipment for military and security use. The programme had two dynamic demonstrations daily, displaying the remarkable capability of at least 10 specialised boats and UAVs, together with associated equipment. Boats undertaking demonstrations included Atlas Elektronik's Aramis, an unmanned surface vessel for mine detection; Delta Power's Phantom rib; Safehaven's Barracuda high speed stealth interceptor; Norsafe's Magnum project boat and Zodiac's SRA SeaRib, a semi rigid boat from Survitec which deployed vessel stopping gear; Supacat showcased an eight metre rib with a new OXE 200hp diesel engine and BAE Systems showed a Pacific 24 Rib from the Royal Navy Type 23 Frigate. Equipment from Chemring, Drumgrange, Pontoon and Dock and Versadock also featured as part of the demonstration.

This year's DSEI had 43 Commando Royal Marines who provided a demonstration of their boarding capability on two ORCs (Offshore Raiding Craft), assisted by the SeaOwl Group's VN Partisan acting as a target. The Partisan, which is a commercially owned naval training vessel, also provides a flight deck for the launch of UAVs - Datron World Communications' Sky Ranger remote unmanned surveillance helicopter were launched from the Partisan's deck to showcase this capability. The inclusion of Partisan marked the first time DSEI had featured a commercial vessel in its waterborne demonstrations. Other demonstrations included a presentation of the Atlas SEA FOX remote mine hunting equipment.

Saab's latest Carl-Gustaf M4 and AT4 debut

Saab presented, for the first time at DSEI, the next-generation Carl-Gustaf M4

system were also exhibited for the first time at DSEI. These enhanced variants deliver extended range (ER) performance and improved high explosive (HE) effects.

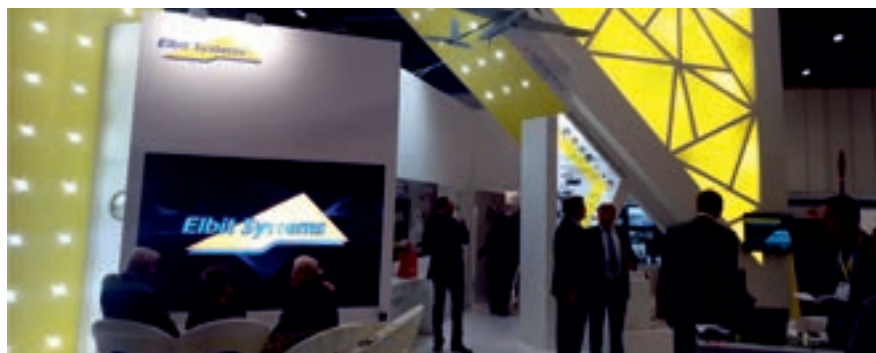


alongside new capabilities for the AT4. The Carl-Gustaf M4 is the next evolutionary step in the development of Saab's multi-role, portable weapon systems and can be deployed in any combat environment to effectively dictate the outcome of each engagement. Important new capabilities developed by Saab for its AT4 weapon

"With an AT4, any soldier can now defeat more targets with greater flexibility and in many more scenarios."

Elbit Systems showcases GRX-8000

Elbit Systems showcased its Tadiran GRX-8000, the latest generation of its High



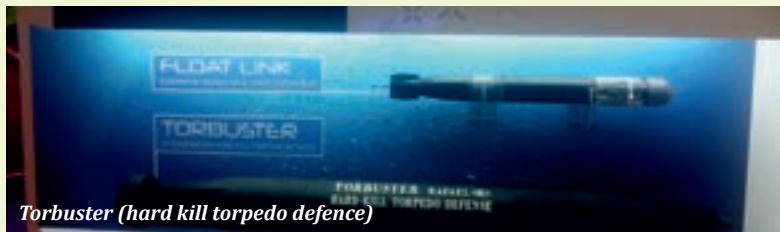
A range of innovations from Rafael



The Sea SpotterIRST system



The RecceLite XR



Torbuster (hard kill torpedo defence)



Spike NLOS



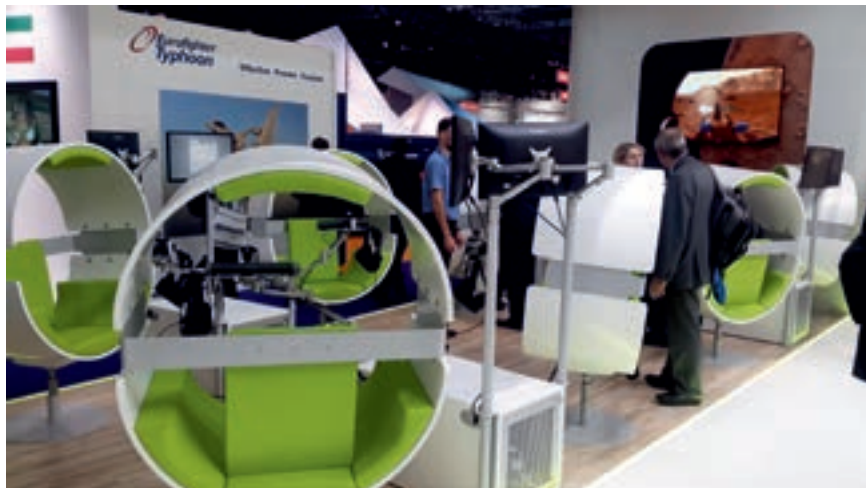
Elbit's GRX-8000

Capacity (HC) Frequently Hopping (FH) line-of-sight broadband radio systems. The GRX8000 is a Software Defined Radio System (SDR), designed to meet the growing need for reliable data capacity in the modern battlefield. It significantly extends the range and throughput of military wireless networks while maintaining unique immunity and anti-jamming capabilities for operation under very harsh environments.

The system supports the latest IP services and interfaces along with legacy communication protocols for backward compatibility. With its extremely high system gain the GRX-8000 supports very long distances in Point-To-Point and Point-To-Multipoint network topologies. The system supports a wide variety of services ranging from traditional telephony to broadband multimedia and very latest C4 ISR data.

'Virtual reality' from Airbus Defence and Space

Airbus Defence and Space displayed its cutting-edge products, technologies and services using virtual reality in a first at a major show. In an innovative step, its entire stand was designed around bespoke virtual reality cockpits; with visitors transported into a virtual world wearing Oculus Rift headsets. Airbus Defence and Space has taken the ground-breaking move to create a more compelling customer experience at one of the world's key defence events, which will also allow it to convey the breadth of its current portfolio across defence, space, military and civil aircraft in a unique way. Visitors were invited to experience three scenarios: disaster relief, a virtual air show and even a trip to Mars. The disaster relief scenario featured the Airbus A400M military transporter bringing aid to a small town



that has been devastated by an earthquake. It demonstrated how effectively the full portfolio could be utilised in aid situations. The user leaves the A400M and moves into a waiting vehicle which drives them through part of the disaster, en-route to a NATO Deployable Communication and Information Systems (DCIS) tent. It also demonstrated how the Airbus Defence and Space DCIS mobile communications system could help frontline troops from across the world organise and co-ordinate complex missions in theatre where communications had been compromised.

The virtual air show presented a virtual line-up of Airbus platforms from Tanan UAV to Zephyr, C295 MPA,

A400M, A330 MRTT Voyager and A380. The virtual trip to Mars featured a demonstration of the ExoMars rover vehicle showing it manoeuvring across the Red Planet conducting experiments. The move to 'virtual reality' is designed to present the entire Airbus Defence and Space portfolio in a way that enables visitors to experience the full range of capabilities.

Sagem: delivering high performance and innovation

Sagem (Safran) showcased its expanded offering of systems and equipment for land and naval forces. These systems span a wide range of demanding operational requirements, including intelligence,

protection, engagement, precision strikes and asymmetric combat.

Sagem's stand was organised in several main areas: infantry and dismounted combat, navigation, optronic systems for land and naval platforms, surveillance drones, fire support and missile seekers.

Front-line targeting and intelligence: To carry out this critical function, Sagem offers the JIM LR (Long Range) multifunction infrared binoculars, as the core of a tactical intelligence and targeting system operating as part of a network.

Modernisation of infantry and special forces: The company offers an infantry soldier modernisation system that integrates operating feedback and the latest technologies, while also calling on the company's expertise as supplier of the FELIN modernisation system for the French army.

Patroller long-endurance drone: Developed in France by Sagem, the Patroller is a surveillance drone system based on the EASA-certified S15 Stemme-Ecarys airframe. The Patroller offers endurance exceeding 20 hours with a payload of over 250 kg. The Patroller's modular architecture is such that it can carry out both military and homeland security missions.

Multi-mission optronic systems: Sagem's range of optronic systems covers intelligence, engagement and protection requirements for land and naval forces (including both submarines and surface vessels).



Mockup of the Patroller at the Safran stand

Inertial navigation for ships and land vehicles: Sagem's Navigation unit presented its Sigma 40 laser gyro systems for surface ships and submarines, the Sigma 30 inertial unit for artillery systems, BlueNaute™ attitude and heading units for maritime navigation, and the Sigma 20 tactical land navigator.

MBDA highlights the Sea Ceptor

MBDA highlighted the progress of Sea Ceptor, the next-generation, ship-based, all-weather, air defence weapon system ordered by the UK MoD. Utilising the Common Anti-air Modular Missile (CAMM), Sea Ceptor provides complete protection against all known and projected air targets. The weapon system is now in full-scale development for the as the principal air defence capability for the Royal Navy's Type 23 and Type 26 frigates.



Mati Hindrekus and Loïc Piedevache of MBDA at their stand

Sea Ceptor is designed to protect both the host ship and high value units in the local area. Capable of multiple channels of fire, the system will also counter saturation attacks with a range of 25 km. The missile can operate from the DCNS Sylver and Lockheed Martin Mk41 launchers using a quad-pack configuration to maximise pacing density and for optimum installation on smaller ships. The soft vertical launch



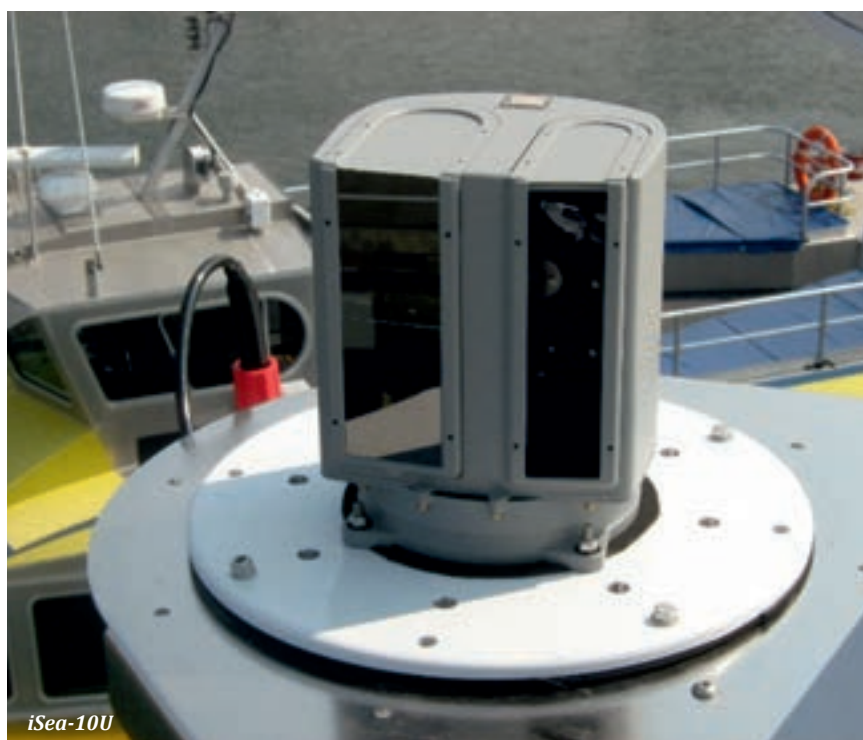
The Sea Venom on display

technology reduces system weight and provides flexible installation. The weapon's Command and Control system is designed to be integrated into new or existing naval combat systems. A dedicated tracking radar is not required as Sea Ceptor is able to use data provided by the ship's surveillance radar.

Controp and the iSea Family

Controp Precision Technologies Ltd. presented the comprehensive iSea Family of maritime payloads at DSEI 2015. Their new line of seven short, medium and long-range maritime payloads (iSea-10U, 20U, 20, 30, 30HD, 40HD and 50HD) was uniquely developed and ruggedised for the challenging

and often harsh maritime environment and they provide solutions for most types and sizes of maritime platforms. Features include a continuous IR zoom lens, gyro-stabilised gimbals and multi sensor options, which provide 'outstanding capabilities'. The iSea systems can be installed on RIBs, Patrol Boats, OPVs, Corvettes, Frigates as well as special vessels like hovercraft and USVs, and can be integrated with the vessels' systems. "Ideal for manned or unmanned maritime security and defence platforms," the iSea systems are successfully operated and deployed by Special Forces, Law Enforcement, Coast Guard, Search and Rescue (SAR), Anti-Piracy units and others.



iSea-10U

Atlas Elektronik at DSEI 2015



The Atlas Elektronik Group showcased its range of products and technologies with the main focus on innovative products and technologies in the fields of submarine systems, surface combatant systems, unmanned vehicles, torpedo technology, and systems for coastal and harbour protection.

In a sonar concept study, the company was asked to define, specify, design and develop a new array configuration for the then latest boats of the German Navy (U212A, 2nd Batch). Aspects of a fundamental nature, such as the influence of the flow-induced noise on a flank array of expanded area, called the Expanded Flank Array, were theoretically clarified by simulation and also empirically through trials and measurements. Trials with the test body 'Flame' showed that the array to be developed should be fitted with a sonar dome for enhanced performance. This is one of the unique features of the EFAS array in comparison to competing systems, which do not have a sonar dome.

The subsequent development work was carried out in close collaboration with ThyssenKrupp Marine Systems. Through the comprehensive use of numerical simulation methods, Atlas broke new ground in order to obtain optimum solution for the partly conflicting requirements regarding the acoustics, the flow properties and strength, especially in view of the very high shock requirements.

The development yielded a solution that was able to demonstrate considerable gains in performance for the EFAS at sea with the U-35 of the German Navy. The range of this new type of flank array can extend up to 100 kilometres for surface targets, such as merchant ships, and typically is a factor of two or three times more than the values achieved with the precursor array.

The effectiveness of tactical data links is one of the strategic success factors in networked and joint operations. The prime challenge is to give all participating units full information to meet both the tactical situation and the requirements in near real-time for a common operational picture. The innovative Atlas Data Link System ADLiS offers a degree of interoperability that is 'unprecedented' in the market: coverage of all NATO Link channels (11, 16 and 22), provision of the new Link A for non-NATO units, as well as the unique ability to allow data exchange between all channels. ADLiS means boundless tactical communication in near real-time.

By integrating products across the Atlas Group, a highly effective mine warfare mission system has been developed. With its large and flexible payload bay, the ARCIMS unmanned surface vehicle (USV) is augmented by the advanced Atlas SeaCat autonomous underwater vehicle (AUV) to allow autonomous mine-hunting missions. ARCIMS' AUV launch and recovery system allows the AUV to be launched over the stern for concealed mine-hunting operations. For

example, in an over-the-horizon or covert mine-hunting mission, the USV launches the AUV, which then carries out its mine warfare mission by surveying the seabed using on-board sonar. By surfacing temporarily during the mission, the AUV transmits sonar data back to the Command Centre via the USV acting as a relay station. The USV can recover the AUV automatically through a nose-mounted capture device, thus efficiently retrieving the vehicle for the next mission.

With a maximum range having repeatedly been demonstrated to extend beyond 80 nautical miles, the SeaHake mod4 Extended Range (ER) sets a 'new benchmark' for heavyweight torpedo operations that unlocks new tactical and operational capabilities. While retaining all tactical capabilities of the original SeaHake mod4, the new ER version fully exploits the combat battery and propulsion system to achieve the world's longest range for heavyweight torpedoes, outperforming its competitors by a factor of two to three. To permit communication between the torpedo and firing unit, a new high-precision navigation and communication section provides a satellite communication and navigation capability throughout the operational cycle.

This unique performance provides significant new operational and tactical capabilities, such as launching the torpedo from land for coastal defence, surface ship launching from long range, and torpedo operations using third-party targeting (TPT) into extreme littoral environments.

For land-launching, an innovative mobile launching system for the SeaHake mod4 ER forms the basis of a robust and effective anti-access/area denial (A2-AD) coastal defence system. The large-area coverage of the system, utilising the torpedo range of more than 80 nautical miles, combines with the low-cost readiness and operation to offer unparalleled efficiency in coastal A2-AD against surface and subsurface targets. High-value installations and sea lines of communication (SLOC) chokepoints can be covered 24/365 with instantly ready and mobile effectors.

The new Atlas protection system ASCA considers the specific requirements of the diverse application environments through its extremely scalable and modular architecture. Thanks to the versatile configuration possibilities with underwater and surface sensors, an optimum situation picture can be generated for any local and regional need. Starting with the protection of port terminals or refineries and expandable up to the full surveillance of entire coastal regions and the wide-ranging exclusive economic zones (EEZs) extending out to 200 nautical miles, ASCA is able to cover all the necessary tactical, operational and strategic missions. Depending on the needs of the customer, all products of Atlas Elektronik can be integrated into the flexible system architecture together with third-party units.

Courtesy : Atlas Elektronik

Eight more F-16 Blk. 52 for Pakistan?

Although no official announcements have been made, it has been widely reported that preceding Pakistan PM Nawaz Sharif's visit to Washington DC in October 2015, the US administration was considering the sale of eight additional F-16 Block 52 fighters to Pakistan. The move is reportedly "aimed at improved the bilateral ties between the nations, which have become strained



owing to Pakistan's continued support of regional terrorist groups and differences over Pakistan's posture on nuclear weapons." Should the sale of additional F-16s go through, the PAF would have a substantial inventory of F-16s, both the earlier model with upgrades and a squadron of F-16 Block 52s. Disagreements could still cause a review in the process, which has been done in the past. In March this year, the House Committee on Foreign Affairs froze \$150 million in foreign military financing and held back delivery of used US Navy ships, stating that they were "not essential" for fighting militants in Pakistan.

Kuwait orders 28 Eurofighter Typhoons

As reported earlier (*see Vayu VI/2015*), Kuwait has confirmed its intention to purchase 28 Eurofighter Typhoons with an MoU signed in Rome on 11 September to purchase 22 single-seat and six twin-seat such aircraft through a government-to-government deal with Italy. Italian Eurofighter partner Alenia Aermacchi had been leading the efforts to sell the Typhoon to Kuwait, the aircraft to be produced on the Italian production line at Cameri. The aircraft will be to Tranche 3 standard and the first export variants with the new airborne electronically scanned array (AESA) radar. Deliveries are expected to begin in 2019.



Artist's depiction of a Kuwaiti Typhoon

First USAF F-35As at Hill AFB



Operational conversion training has commenced at the USAF's Hill Air Force Base, Utah, with the newly delivered Lockheed Martin F-35A Lightning IIs of the 388th Fighter Wing's 34th Fighter Squadron 'Rude Rams'. The first two operational F-35As to be stationed at Hill had arrived there on 2 September and shortly commenced their weapons employment, range familiarisation and mission system proficiency.

French fighters in action

Renewed airstrikes were launched by French Air Force Rafales and Mirage 2000s against IS targets including arms depots in and around the city of Raqqa in Syria, after the string of terrorist attacks around Paris in mid-November 2015. The French Defence Ministry said that immediately there were ten sorties against 'Division 17' and 'Avant-garde Camp' of the IS around Raqqa, the radical group's self-proclaimed capital.



The first airstrikes in Syria had been launched by Rafales of the French Air Force on 27 September as part of 'Operation Chammal' which involved attacks on an IS training camp located in the Euphrates Valley, south of Deir-ez-Zor. Five Rafales, an Atlantique 2 and an C-135FR were involved in the mission, the aircraft reportedly based at Al Dhafra in Abu Dhabi. According to reports, the Rafales used their Reco NG pods on their earlier missions which included intelligence, surveillance and reconnaissance (ISR) over areas controlled by IS and Syria.

Indonesia's Su-35 purchase

Indonesian Defence Minister Ryamizard Ryacudu has confirmed that the Sukhoi Su-35 has been selected to replace the *Tentara Nasional Indonesia-Angkatan Udara*, Indonesian Air Force's, F-5E/F



Tiger fleet, eventually expected to involve a total of around 16 aircraft (see *Vayu VI/2015*). The buy would be staggered and the aircraft bought in smaller batches to spread the cost, the initial tranche probably involving eight aircraft. TNI-AU pilots are already familiar with Sukhoi fighters with Indonesia currently flying two Su-27SKs, three Su-27SKMs, two Su-30MKs and nine Su-30MK2s.

China orders 24 Su-35s



Russia and China have contracted for 24 Sukhoi Su-35 fighters, at an estimated \$2bn. "China has officially become the first foreign contractor of the Su-35 aircraft. The contract has no precedents in the history of military aircraft deliveries," Director General of Rostec, Sergey Chemezov stated. The Su-35s will be built at the 'Gagarin' Komsomolsk-

na-Amur facility in Russia's Far East, which is part of Sukhoi Company, Russia's largest aircraft manufacturer.

Additional Su-30 contracts

According to Sergey Chemezov, head of Russian state defence holding company Rostec, additional orders for 22 Su-30 multi-role fighters have been received. The first is an agreement with Algeria for delivery of 14 Sukhoi Su-30MKAs, while the second is with the Russian Navy and covers 8 Su-30SMs. Both orders are expected to be fulfilled by 2017.



Russian Air Force Su-30SM in flight
(photo: Alex Beltyukov)

The Su-30MKA and Su-30SM are derivatives of the Su-30MKI developed for India, which operates some 200 of the type. Algeria already has 44 of the aircraft while the Russian Navy operates eight in the maritime strike role from Crimea. Deputy Defence Minister for Procurements Yury Borisov also recently said that a larger 75-aircraft Su-30SM contract is planned for the Russian Air Force.

Eurofighter Typhoon 'enhancements'



MBDA's Marte ER on the Typhoon

In November 2015, capability enhancement work on the Eurofighter Typhoon included flight testing for the P2E Programme, the Phase 2 Enhancement Capability Update which introduces a broad range of capability enhancements to the aircraft. Along with the Storm Shadow and Meteor missiles, there are enhancements to the radar, DASS (defensive aids sub-system) and other avionics which will enhance the aircraft's lethality and survivability across all roles. The effects deliverable by both weapons are enhanced by the high-kinetic characteristics and highly integrated sensors of the Eurofighter Typhoon. This improves the weapons' range and gives the pilot the situational awareness to employ them most effectively.

J-10C with WS-10 engines

According to sources in China, the Chengdu J-10C has been flown powered by the indigenous WS-10 ('Taihang') engine, making its maiden flight on 22 September. Still unmarked, the re-engined J-10C had first been observed just days earlier when it appeared alongside the latest Chengdu J-20 fighter prototype, '2016', which made its 20-minute maiden flight on 19 September. There has been considerable speculation around the J-10C's new engine: some observers identify this as the WS-10G that reportedly generates around 137.3Kn (30,865lb) of thrust, while others assume that the aircraft retains the WS-10B as used in J-10B '1035'. Although the 'Taihang' was tested in this prototype, production B-10Bs have retained the Russian-origin AL-31FN.



The J-10C first appeared in December 2013, as the first of an upgraded multi-role variant of the fighter. The new version is expected to include an active electronically-scanned array (AESA) radar and greater use of composite materials.

PAF Saab 2000 Erieye

The Pakistan Air Force Saab 2000 Erieye AEW&C which was extensively damaged during a terrorist attack on PAF's Base Kamra-Minhas has been repaired and returned to service. The aircraft was officially declared operational with its No.3 (AEW&C) Squadron on 10 September at Minhas, after being repaired by the co-located Pakistan Aeronautical Complex (PAC).

Initial inspection by PAC Kamra had indicated the aircraft should be repairable but was later assessed as "beyond repair". An even later re-assessment determined it could be repaired after all, Pakistani personnel completing the work for \$15 million over a period of ten months.



Storm Shadow missile trials

An Eurofighter Typhoon Instrumented Production Aircraft (IPA) has successfully completed a release of the MBDA Storm Shadow, conventionally armed, stealthy, long-range stand-off precision missile. This continues the series of trials that Eurofighter Partner Company, Alenia Aermacchi, is leading to demonstrate full integration of the Storm Shadow missile with Typhoon's weapon system. With support from Eurofighter Partner Company BAE Systems, missile designer and producer MBDA, and specialist trials support from QinetiQ, the trials were conducted in November 2015 at Aberporth MoD firing range, in the UK.



F-35C in sea trials

The US Navy's Lockheed Martin F-35C Lightning II has carried out a second at-sea period aboard the nuclear-powered aircraft carrier USS *Dwight D. Eisenhower* (CVN 69). Two test aircraft, CF-03 and CF-05, conducted day and night carrier qualifications over a period of eight days as part of the second phase of at-sea development testing (DT-II). Trialing the suitability and integration of the F-35C in an at-sea environment, DT-II included simulated maintenance operations and general maintenance plus fit tests for the aircraft and



support equipment. The evaluation involved high-risk flights to test the jet's ability to take off at a reduced airspeed, at weights from 55,000-60,000lb (24,948-27,216kg) while carrying full fuel loads, an inert 2,000lb (907kg) GBU-31 Joint Direct Attack Munition and two AIM-120 AMRAAM missiles in the internal weapons bays.

'Project Habibi'

The Iranian Aircraft Industries (IACI) are restoring the Islamic Republic of Iran Air Force's (IRIAF) fleet of 24 Dassault Mirage F1s to fully mission-capable status and have added new weapons under 'Project Habibi'. Further, seven years after the project, IACI re-delivered a fourth Mirage F1EQ to the 102nd Tactical Fighter Squadron at TFB, in August 2015. Five years back, two new roles were defined for the Mirage F1 fleet, being air-defence of south-eastern Iran and for anti-ship strike.

Yak-130s for Bangladesh

Delivery of the first Yakovlev Yak-130 jet trainer/light attack aircraft for Bangladesh has taken place, transported onboard an Antonov An-124-100 heavy transport aircraft. The Bangladesh Air Force is buying 16 Yak-130s, which are being built at the Irkutsk



File photo of the Yak-130

Aviation Plant. Financing for the deal, which is estimated to be worth around \$800 million, is understood to be provided as part of a \$1 billion credit agreement between Bangladesh and Russia that was signed in January 2013.

Turkey transfers 34 T-37s to PAF

In an agreement signed on 28 October 2015, the government of Turkey will transfer 34 T-37 jet trainers and their spare parts to Pakistan "free of cost" in a landmark deal signed between the two countries in Ankara. The agreement was reached during the meeting of Pakistan-Turkey High Level Military Dialogue Group (HLMDG) which concluded in Ankara.

The PAF has in the past employed T-37s for pilot training but phased them out some decades back and replaced them with the K-8 Karakoram jet trainer. Now, receipt of these obsolete jets can only be explained by their eventual employment perhaps in the counter-insurgency role in mountainous terrain.

New Chinese Armed Drone revealed

On 21 November 2015, China displayed its latest and biggest military unmanned aircraft at an industry expo in Shenzhen, Guangdong province, in an attempt to attract more buyers for its combat drones. The CH-5 combat/reconnaissance drone, developed by China Academy of Aerospace Aerodynamics under China Aerospace Science and Technology Corp, made its first flight in August, becoming the heaviest military drone in China.

Considering that China's defence sector normally never publicly display advanced weapons designed for the People's Liberation



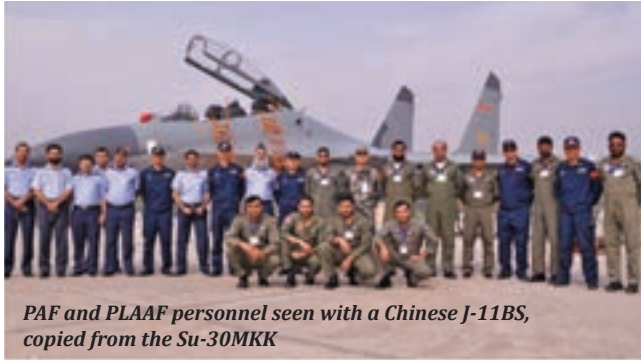
Army (PLA), the public debut of CH-5 at the China (Shenzhen) International Unmanned Vehicle Systems Trade Fair indicates that this is a marketing strategy. "We have sold the CH-3 to several foreign nations and now we plan to launch the export version of the CH-5 to the international market. It can perform air-to-ground strike, reconnaissance and transport operations," stated Shi Wen, chief designer of the CH series at China Academy of Aerospace Aerodynamics.

CH-5 is produced from composite materials and has a wingspan of 20 metres. With a size twice as big as its previously developed counterparts, the drone can be airborne for upto 40 hours and operate at an altitude of up to 10 km. Compared with other military drones that usually have a maximum take-off weight of less than 1,500 kg, the CH-5 is much more powerful-it is able to fly with a weight of 3,000 kg and carry 900 kg of equipment and weapons.

Pakistan's Scan Eagle

It is understood that Insitu has been contracted to provide its Scan Eagle to Pakistan under the foreign military sales programme. The company was awarded a \$15.18 million US Naval Air Systems Command contract for hardware and technical data with contract completion completed in August 2016.

'Shaheen-4': Air Exercises between the PLAAF and PAF



PAF and PLAAF personnel seen with a Chinese J-11BS, copied from the Su-30MKK

Fourth in the series of Air Exercises between the Air Forces of Pakistan and China, 'Shaheen-4' took place in the first half of September 2015, but this time in an unusual area : Central Tibet. The first such air exercise took place in north-western Pakistan, around Peshawar and Kamra, the second in China's western Xinjing-Uygur region, around Hotan, the third in Pakistan's Punjab province, around Shorkot in May 2014.

Although the PLA Air Force spokesman did not specify the exact location, it is leant that Shaheen-4, was held at several PLAAF air bases in Central Tibet, some north of Nepal and south-west of Lhasa, including Yinchuan air base.

While the PAF deployed elements of six fighter squadrons comprising JF-17s, Mirage III/5s and Shenyang F-7PGs apart from a KJ-200, the PLAAF had J-10As, J-11Bs, Su-27UBKs, F-7s and its own KJ-200 AEW&C aircraft taking part from tactical transport aircraft and helicopters. During the exercise, the two arms were formed as 'Red Force' and 'Blue Force' and as Wang Xu, Professor

of Pakistan Studies at Peking University said, "We can learn a lot from Pakistan's training philosophy and system and in preparing to fight terrorism in north-western China, such drills could boost China's capacity to tackle tough situation".

The PAF's Air Vice Marshal Mujahid Anwar Khan and PLAAF's Lt Gen Zheng Qun Liang, represented their respective countries.

Such Air Exercises and other flying operations in Tibet have obviously been followed closely by Indian authorities and the IAF CAS made particular reference to this during his pre-Air Force Day Conference at New Delhi. "In the Tibet Autonomous Region, flying operations (of Chinese People's Liberation Army Air Force) have increased exponentially and the capability (has been) increasing throughout the year... We also have our assets, our infrastructure and are deploying our forces (along the border). Therefore, there is no need to worry," Air Chief Marshal Arup Raha stated.



PAF officers with PLAAF personnel and J-11BS two seat multirole fighter



PAF personnel with Mirage 5F

Additional CH-47s ordered by Turkey

Boeing has received an order for additional CH-47F Chinook heavy-lift helicopters from Turkey. The number involved was not revealed in the US Department of Defence announcement, but approval to buy five CH-47s for the *Türk Kara Kuvvetleri* (TKK or



Turkish Land Forces) was announced on 7 January 2015. Turkey's requirements for a heavy-lift helicopter go back some six years but insufficient funding for the full procurement led to a letter of offer and acceptance eventually being signed on 9 July 2010, for just six CH-47Fs. As part of a \$3.4 billion US Army multi-year CH-47F production contract awarded to Boeing on 17 June 2013, a portion of the funding was allocated to support FMS helicopters for Turkey.

14 CH-47Fs for Netherlands

The Netherlands are to procure 14 new Boeing CH-47F Chinook transport helicopters to replace the 11 older-model CH-47Ds currently in service. These will join six previously purchased CH-47F(NL) variants, which will be modernised, bringing the RNLAf Chinook fleet to 20, with deliveries to begin in 2019.

Thailand orders KAI T-50s

The Royal Thai Air Force is to buy four T-50TH Golden Eagle jet trainers from Korea Aerospace Industries (KAI), with the contract signed on 17 September in Seoul, the deal worth around \$110 million. The aircraft will replace elderly Aero L-39 Albatros jet trainers currently in Royal Thai Air Force (RTAF) service. Although the limited Thai defence budget has only been able to finance an initial four T-50s, KAI said that it expected follow-on orders from the RTAF "when funding allowed."

Last C-17 built at Long Beach

The 279th and last C-17 Globemaster III built at Long Beach, California, departed on 14 November 2015, flying to San Antonio before being delivered to Qatar. One last C-17 built



prior to No. 279 will be flying out later in November 2015 as The Boeing Company officially shuts down its final assembly plant. (The IAF currently operates ten C-17s but has had a requirement for three more).

SAR S-76Ds for China

Sikorsky have delivered the final two of an order for eight S-76Ds to the China Ministry of Transport (MOT). MOT's helicopter fleet, which is the basis of China's airborne search and rescue (SAR) maritime operations, now totals 16 S-76s, eight of which



are S-76Ds, operated by the China Rescue and Salvage Bureau. In December 2012, the China MOT purchased four S-76D SAR helicopters and then in July 2013 contracted for another four of the same model.

Russian FSS order Ka-226Ts

Russia's Federal Security Service (FSS), has ordered six Kamov Ka-226T light twin helicopters to complement the Ka-27PSs for maritime patrol tasks. The new helicopters will operate off the deck of the newly-procured Project 22460 ships assigned to the FSS's border patrol arm. The budget for the Ka-226 procurement



amounts to 2.3 billion roubles (US\$35million). The Ka-226T, powered by Turbomeca Arrius 2G1 engines de-rated to 580shp have significantly enhanced hot-and-high capability as well as one engine inoperative margins to boost operational safety. The FSS sub-version is designated Ka-226.57 and will feature upgrades to meet the FSS's requirements for operations from the decks of border patrol ships.

Rafale adds SATCOM

The Dassault Rafale omni-role fighter has demonstrated a new satellite communications (SATCOM) capability with two of its aircraft equipped with the new system, at Mont-de-Marsan air base. The single-seat Rafale C and a two-seat Rafale B assigned to *Escadron de Chasse et d'Expérimentation* (ECE) 5/330 'Côte d'Argent' flew a test mission accompanied by a C-135FR tanker, a three-and-a-half hour flight to Lajes air base in the Azores, during which a number of messages, both operational and experimental were exchanged by 'chat'. (Ed: The Indian Navy's Dornier 228s are also equipped with SATCOM.)



First F-16V with advanced AESA radar

The first F-16V fitted with Northrop Grumman's advanced APG-83 Active Electronically Scanned Array (AESA) Scalable Agile Beam Radar (SABR) flew on 16 October 2015 at Fort Worth. The F-16V 'Viper' advanced avionics configuration also includes a new cockpit Centre Pedestal Display, a modernised mission



computer, a high-capacity Ethernet data bus, and several other missions systems enhancements that collectively add significant combat capabilities "to address the dynamic threat environments emerging in the coming decades."

Network-Enabled Harpoon in flight test

The US Navy completed a free-flight test of the new network-enabled Harpoon missile system on 18 November at the Sea Range at Point Mugu, California. The upgraded missile, known as Block II+, will have the ability to receive in-flight updates that improve the targeting and engagement of moving maritime targets.

The free-flight missile event was the first end-to-end functionality test of an inert Harpoon Block II+ from pre-flight to target impact. The test proved that the missile could receive target location updates from an F/A-18 while in-flight through its network-enabled datalink. It then successfully acquired a moving ship target using its active radar seeker and guided itself autonomously to impact the target. This test, the culmination of 152 lab-test sessions, 15 aircraft ground tests and 16 flight tests, will be followed by another more demanding developmental test in fiscal year 2016. The AGM-84N Harpoon Block II+ will also have a new GPS guidance kit that will enhance the weapon's navigation. Harpoon is an all-weather, over-the-horizon weapon designed to execute both land-strike and anti-ship missions against a range of targets.



ASRAAM for the RAF

MBDA has received a contract worth over £300M from the British MoD to equip the RAF with the ASRAAM infra-red guided air-to-air missile. The missiles will be produced at MBDA's new Bolton manufacturing and assembly site that will be commissioned in mid-2016. The engineering activities are being carried out at MBDA sites in Stevenage and Bristol. ASRAAM is the *Advanced Short Range Air-to-Air Missile* in service with the RAF on the Tornado and Typhoon, the Royal Australian Air Force on the F/A-18 Hornet and on order for the Indian Air Force's Jaguars.

C-27Js for "undisclosed" African AF

Finmeccanica-Alenia Aermacchi has received orders for two C-27J tactical airlifters from an "undisclosed" African Air Force, the two aircraft to be delivered in 2017. The C-27J is already operational in several countries including Lithuania, Italy and the United States as also in the Sub-Sahara with Chad. The C-27J has also been



ordered by the Air Forces of Italy, Greece, Bulgaria, Lithuania, Romania, Morocco, US, Mexico, Australia, Chad, Peru and Slovak Republic, with a total of 82 aircraft delivered to date.

Elbit Intelligence Integrated Systems

Elbit Systems will supply intelligence integrated systems, for homeland security applications to an "undisclosed country" in South American region. Under the contract, to be supplied within less than a year, Elbit Systems will provide the customer with



Hermes 900 UAS systems and an intelligence gathering system. Elad Aharonson, General Manager of Elbit Systems ISTAR Division stated "Since establishing the ISTAR Division, we have witnessed a growing demand for solutions combining a range of ISTAR in-house technologies, and we are pleased to be able to supply our customers with our cutting-edge systems, creating a power multiplier".

Boeing KC-46A Pegasus flies

A KC-46A Pegasus tanker (EMD-2) made its first flight 25 September from Paine Field in Everett, Washington. The EMD-2 completed its flight as a KC-46A tanker, which will now begin flight testing in support of the next programme milestone. The



US Air Force contracted with Boeing in February 2011 to acquire 179 KC-46A refueling tankers to begin recapitalising the aging tanker fleet, this flight being a step toward fulfilling a requirement for 18 KC-46A aircraft plus necessary support equipment by August 2017.

Upgraded C-130s for Israeli Air Force



The first improved C-130 ('Karnaf', Hebrew for Rhino) heavy transport aircraft has flown from Nevatim Airbase in southern Israel after a long process in which new and advanced systems were installed on it and its main wing was replaced, as part of an overall renewal project for the C-130 division. It is expected that within a few years, the concerned squadron will only operate the improved C-130s which are to be in service till 2040.

Thales Spy 'Ranger' mini-drone

Thales have unveiled the Spy 'Ranger', the latest-generation surveillance and reconnaissance mini-drone specifically for armed forces, security forces and essential operators. Spy 'Ranger' has been designed by a team consisting of Thales and French aerospace SME, Aviation Design. Its development follows four technological pillars: a robust and innovative electric powered airframe, the most advanced gimbal in the world to optimise observed frontline and range, the highest tactical datalink standard, and a combat-proven command and control software so as to maintain combat effectiveness under most adverse conditions.



warhead has included IM threat tests (to demonstrate insensitivity) and underwater trials (to demonstrate performance).

Chinese submarines for Pakistan

At an event in Islamabad on 6 October, Pakistan's Minister for Defence Production, Rana Tanveer Hussain, stated that four of the eight conventional submarines to be acquired from China would be built at the state-owned Karachi Shipyard and Engineering Works (KSEW). The remaining four will be built in China, with both sets of submarines to be constructed simultaneously.



Although Hussain did not reveal what type has been selected, it is widely believed that China is offering the Type 039A (*Yuan*-class) AIP-equipped diesel-electric submarines, or an export derivative thereof.

Upgrade of Royal Navy's Spearfish torpedo

TDW GmbH has been awarded a contract from BAE Systems for qualification and delivery of the insensitive munition (IM) blast warhead to be used in upgrade of the Royal Navy's heavyweight Spearfish torpedo. Blast warheads are used to combat both surface and underwater targets effectively. Ships in particular can be combated most effectively using a blast warhead, which generates a shock wave. Through the initial assessment and development phases, TDW have played a leading role in the design and testing of the new Spearfish warhead. To date the testing performed on the

Sagem optronic masts for Swedish Navy

Sagem (Safran) has been selected by Swedish shipyard Saab Kockums to supply the optronic masts for four submarines to be deployed by the Swedish Navy. The contract provides for Sagem Series 30 optronic surveillance masts to outfit two future A26 class submarines and two *Gotland*-class submarines, already in service, along with initial logistic services and options for additional systems. Saab Kockums' selection of Sagem's optronic mast was based on its high-performance optronic sensors, easy integration in the ship's combat system, and a human-machine interface that allows for optimised operation of its high-definition imaging functions.



Raytheon SeaRAM missile fired from LCS

The US Navy has successfully fired a tactical missile from a SeaRAM launcher on an 'Independence' littoral combat ship, off the coast of California. USS *Coronado* (LCS 4) fired a Rolling Airframe Missile from a SeaRAM anti-ship defence system, both produced by Raytheon, during which test, the SeaRAM detected, tracked and engaged an inbound threat target, and fired a RAM Block 1A that successfully intercepted the target.



Ka-32A11BC helicopters for China

Russian Helicopters (part of State Corporation Rostec) has signed a contract with China's Jiangsu Baoli for delivery of 4 Ka-32A11BC fire-fighting helicopters in 2016-2017. "These helicopters are being successfully operated in China. This contract confirms our interest in developing mutually beneficial cooperation, and we plan to continue to grow it through additional deliveries and new projects," stated Russian Helicopters CEO Alexander Mikheev.



Russian Helicopters test Mi-171A2 prototype

Russian Helicopters, has started flight testing of a second prototype of the medium multirole Mi-171A2 at Mil Moscow Helicopter Plant. The new Mi-171A2 prototype includes all the unique features typical of this type of helicopter, making it



competitive with its global peers. Pre-flight and certification testing are also currently underway.

The Mi-171A2 represents latest development of the medium multirole Mi-8/Mi17 series, with improved technical features as well as a higher level of safety, comfort and automation. The power plant comprises a full FADEC VK-2500PS-03 engine and an auxiliary power plant by Safir, which enables the engine to be started at altitudes of up to 6,000m. The main rotor systems of the entire Mi-8/17 series have been completely overhauled.

LM completes acquisition of Sikorsky

Lockheed Martin has formally acquired Sikorsky Aircraft, the leading military and commercial rotary-wing aircraft producer and aligned under the Lockheed Martin Mission Systems and Training (MST) business segment, Sikorsky Aircraft is now known as *Sikorsky, a Lockheed Martin company*. "We are proud to welcome the Sikorsky team to Lockheed Martin," stated Marillyn Hewson, Lockheed Martin chairman, president and CEO. "Lockheed Martin and Sikorsky share a legacy of innovation and performance that has shaped the history of aviation for more than a century. Together, we are even better positioned to provide the best value for our customers, employees and shareholders."



Maiden flight of MRJ

Mitsubishi Aircraft Corporation and Mitsubishi Heavy Industries, Ltd. (MHI) conducted maiden flight of its first MRJ (Mitsubishi Regional Jet), the next-generation regional jet on 11 November 2015. The MRJ took off from Nagoya Airport and confirmed its basic characteristics and functionality in ascent, descent and turning in airspace off the Pacific coast during its 1.5-hour maiden flight. Hiromichi Morimoto, President, Mitsubishi Aircraft Corporation stated, "We will make our utmost efforts towards type certificate acquisition, committing all our resources to develop and produce the finest regional jet aircraft, to enter commercial service in 2017."



Fatigue Strength testing of Sukhoi Superjet 100

At the Central Aerohydrodynamic Institute named after NE Zhukovsky (TsAGI), fatigue strength testing of Sukhoi Superjet 100 long range version was initiated to confirm the designed service life of the aircraft of 70 000 flight hours and 54 000 cycles. In 2014, this SSJ100, certified model RRJ-95LR-100, with production number 95075, was delivered dis-assembled by the An-124 'Ruslan' freighter to Zhukovsky, near Moscow. Fuselage, wings and tail were



'Escorted' by a Su-35, the Sukhoi Superjet 100 in flight

put together and special purpose load complex, measuring sensors and structure health monitoring systems were adjusted to the assembled SSJ100 airframe. The confirmed designed service life of the aircraft is presently 9000 flight hours and 6000 cycles. In 2013, the Aviation Register of the Interstate Aviation Committee (IAC AR) certified the long range Sukhoi Superjet 100 and confirmed its compliance with IAC AR regulations while works are undergoing to achieve the European Aviation Safety Agency (EASA) certificate for this model of Sukhoi Superjet 100 - RRJ-95LR-100. The SSJ100 long range is powered by SaM146 engines with increased by 5% takeoff thrust performance.

Chinese C-919 airliner rolled out

On 2 November 2015, the new Chinese 158-seater C919 airliner was rolled out at a hangar at Shanghai's Pudong International Airport. As Jin Zhuanglong, chairman of Commercial Aircraft Corp of China COMAC stated at the launch ceremony, "The rollout of the first C919 aircraft marks a significant milestone in the development of China's first indigenous airliner", which would be approximately the same category as the Airbus A320 and Boeing 737. The C919, which has a reported range of up to 5,555



kilometres, will make its first test flight in 2016, but this could well be delayed by another year. COMAC has orders for 517 of its C919s almost all of them from domestic companies while, among foreign airlines, Thailand's City Airways is the first customer.

H130 for Bhutan

Airbus Helicopters has delivered the first H130 helicopter of the Ecureuil family, to the Kingdom of Bhutan. This is the first of two helicopters acquired by the Royal Bhutan Helicopter Services Limited (RBHSL) for para-public and commercial tasks. The second H130 is expected to be delivered in June 2016



RBHSL's H130s have been equipped with a tracking system, cargo sling, bambi bucket and stretcher to perform a wide range of parapublic missions, such as emergency medical services (EMS), fire fighting and disaster management. At the same time, the quick-role change capabilities allow the interior to be converted for VIP transport or for panoramic helitour flights.

Bombardier CS100 flight test programme

Bombardier Commercial Aircraft's CS100 aircraft flight test programme is close to completion with only a few tests remaining and Bombardier is on track to have the aircraft certified this year with Transport Canada. Function and reliability (F&R) testing on the C Series aircraft commenced with a four-leg flight by the CS100 F&R test aircraft. The first F&R flight, which started and ended in Mirabel, Québec, included stops in Moncton, New Brunswick; Halifax, Nova Scotia and St-John's, Newfoundland and Labrador.



Rolls-Royce Trent XWB-97's test flight

The Rolls-Royce Trent XWB-97, the most powerful version of the Trent XWB engine which will power the longer range A350-1000 aircraft, has been test flown in an Airbus A380 flying testbed aircraft, which flew with one of its four Trent 900 engines replaced by a Trent XWB-97, at Toulouse, France. This marked the first flight of the world's largest 3D printed aero engine structure, the engine's front bearing housing has aerofoils made by the Additive Layer Manufacturing technique. Rolls-Royce is developing the technology, which has potential to improve manufacturing and product functionality in terms of design optimisation, cost and speed.



ATR 72-600s for Air New Zealand

Air New Zealand and ATR will purchase 15 additional ATR 72-600s for some US\$ 375 million. The airline, which ordered seven ATR 72-600s in 2011, had already exercised all of its five options as well as converted two purchase rights into firm orders. With the arrival of all aircraft, Air New Zealand will operate, by 2020, a total of 29 ATR 72-600s, the third largest fleet of ATR aircraft worldwide. Air New Zealand's ATR '600' fleet will progressively replace the ATR '500s', while strengthening the airline's network and services across the country.



GE9X-powered Boeing 777X fleet for the Emirates

Emirates has signed a \$16 billion (USD) OnPoint solution Agreement with GE Aviation for the maintenance, repair and overhaul (MRO) of the GE9X engines that will power the airline's fleet of 150 Boeing 777X aircraft over a period of 12 years. At the



2013 Dubai Air Show, Emirates had placed a record \$76 billion (USD) order for 150 Boeing 777X twin-engine aircraft, powered by GE's new GE9X engine. The single largest order by value in the history of US commercial aviation, included 300 units of GE9X engines, themselves worth US\$16 billion.

Emirates also signed a 12-year OnPoint solution contract with GE Aviation worth \$36 million (USD), covering the maintenance and inventory support for various avionics, electrical power and mechanical systems on all Emirates Boeing 777 aircraft in currently service and the 44 more 777-300ERs on order.

PurePower for Philippine A320neos

Philippine Airlines (PAL) has signed a Memorandum of Understanding with Pratt & Whitney to power its order of 15 firm plus 15 purchase right A321neo aircraft, with deliveries to begin in 2017. "We pride ourselves on the fact that we embrace innovative technology within our aircraft fleet," said Jaime Bautista,



president and chief operating officer, Philippine Airlines. "The A321neo aircraft with PurePower engines helps us keep our fleet young and modern. With these aircraft, we will be able to reduce our fuel burn and subsequent operating cost, which is great news for our business."

Pegasus Signs \$500 m. agreement with CFM

One of Turkey's leading low-cost carriers, Pegasus Airlines, has signed an eight-year 'Time & Materials Support' agreement with CFM International to cover a total of 90 shop visits for the CFM56-7B engines powering its fleet of Boeing 737-800 aircraft. The agreement, which also includes the purchase for four spare engines, is valued at \$500 million. The Istanbul-based low cost airline has been a CFM customer since it launched its charter flights in 1990.



MBDA and BAE Systems agreement on APKWS

BAE Systems has an agreement with MBDA to support marketing efforts for the Advanced Precision Kill Weapon System (APKWS) laser-guided rocket in Europe. The APKWS system is a mid-body guidance section fitted between the motor and the warhead, transforming a standard unguided 70 mm (2.75 in) munition into a precision laser-guided rocket to provide a low-cost surgical strike capability. This highly innovative approach requires no modifications to the rocket, launch platform, or fire control/launcher system and allows militaries to leverage existing infrastructure and munitions investment.

Merger of Nexter Systems and KMW

Nexter Systems and Krauss-Maffei Wegmann, two of Europe's leading manufacturers of military land defence systems have agreed to merge into one joint holding company. The alliance of the two groups under the umbrella of a joint holding company creates a Franco-German defence technology group with a current annual turnover nearing 2 billion euro, an order book of around 9 billion euro and more than 6,000 employees. "The alliance of KMW and Nexter creates a group with the momentum and innovative force

required to succeed and prosper in international competition." In addition, it offers its European and NATO customers the opportunity of increased standardisation and interoperability for their defence equipment, with a dependable industrial base.

BAE's Archer System for Sweden

BAE Systems has delivered the first production series Archer artillery system to the Swedish Defence Materiel Administration (FMV) during a ceremony at the company's Karlskoga facility. "The Archer system is one of the world's most advanced artillery systems with high mobility and precision", providing fire support that is powerful and flexible, and features high levels of autonomous operation under protection. It is based on proven subsystems and has an extensive ammunition portfolio.



RADA's tactical radars for Israel

RADA Electronic Industries Ltd, have been selected by the Israeli Ministry of Defense (IMoD) to supply its tactical radars for the protection of communities adjacent to Israel's southern border against short range threats, including fires and aerial threats. The company is also expanding its Multi-Mission Hemispheric Radar (MHR) family, introducing 3 new variants in various sizes and ranges for air & surface surveillance.



Thales new generation lightweight multiple launcher

The Thales Lightweight Multiple Launcher New Generation (LML NG) system has been displayed for use on a tripod or vehicle mount, and supporting swift deployment of STARStreak and/or the Lightweight Multirole Missile (LMM) systems. The system provides two ready to fire missiles, allowing it to handle saturation air attacks or provide a complimentary surface to surface capability. The man-portable system is designed to suit



a wide range of missions from lightweight rapid reaction roles to air droppable operations. The STARStreak missile, with an extremely fast time of flight can be deployed to tackle a variety of threats from head on or fast crossing aerial targets, to targets such as Unmanned Aerial Vehicles (UAVs) and helicopters. When used with the LMM, a capability is provided to enable the defeat of surface targets such as Light Armoured Vehicles (LAVs), trucks and fixed installations and aerial targets such as UAVs. Both systems utilise Thales unique laser beam riding guidance system.

IAI's 'Terra' dual band radar system

Israel Aerospace Industries (IAI) has unveiled the 'Terra' dual-band radar system for optimisation of early-warning, detection and accurate tracking of very long range targets such as ballistic missiles, satellites and air-breathing targets. The Terra, developed and produced by ELTA Systems Ltd., IAI's Subsidiary and Group, comprises the Ultra UHF band radar (ELM-2090U), and the new ELM-2090S Spectra S-band very-long-range search and track radar. Terra's enhanced performance is achieved through automatic handover and redundancy between the ULTRA and SPECTRA radars, combined

with improved target load sharing, Electronic Counter-Counter Measures (ECCM) and severe-weather resilience.



Pakistan helps China export HJ-8 missile

Owing to Pakistan's "assistance", the China North Industries Corporation (Norinco) has exported its HJ-8 anti-tank missiles to 20 different countries around the world. Pakistan currently produces the HJ-8 under license from China, which has helped it build an independent production line to manufacture the anti-tank missile. In the late 1980s, the Pakistan Army, which had already been equipped with the American-built BGM-71 TOW anti-tank missile, also ordered the Chinese-made HJ-8. Owing to Pakistan's strong diplomatic ties with various South Asian and South American



nations, nearly 10,000 HJ-8 missiles have since exported to around 20 countries, which include Bangladesh, Bolivia, Egypt, Ecuador, Kenya, Malaysia, Morocco, Peru, Sri Lanka, the Sudan, Syria, the United Arab Emirates, Uruguay, Venezuela and Zimbabwe.

Saab BOL self-protection pods for Australia

Saab has received an order from Australia for a number of additional BOL countermeasure dispensers to be used on F/A-18A/B Hornet aircraft. Deliveries will take place during 2016. BOL is a high-capacity countermeasure dispenser for chaff and flares, which provides pilots with a sustained defensive capability to successfully accomplish their missions. Australia acquired BOL in 2008 for the F/A-18A/B Hornets of the Royal Australian Air Force (RAAF). This new order for an undisclosed number of BOL systems "will increase the RAAF's operational capability."



Saab Barracuda mobile camouflage systems

The demand for advanced signature management during operations in urban environments is constantly growing. Now Saab is presenting a new configuration of the Barracuda MCS system to meet these needs. With this improved camouflage solution adapted for urban warfare Saab has taken the first steps into the future of camouflage solutions. The new urban warfare configuration builds on Saab's Barracuda MCS technology which is a tailor-made, multi-purpose covering with optimised colours, designs and properties for all environments. It enhances survivability, sustainability and logistics of vehicles and equipment, while all the time providing a 'stealth' or masking capability in the visual, near-infrared, thermal infrared and broadband radar wavelengths.



Saab Giraffe radar's enhanced anti-UAS skills

Saab has demonstrated and proven an improved capability for its Giraffe AMB radar to detect low, slow and small targets. This 'Enhanced Low, Slow and Small' (ELSS) function allows the Giraffe AMB to undertake dedicated counter-Unmanned



Air Systems (UAS) operations, while conducting its full suite of regular air surveillance functions. The new ELSS function was demonstrated in April during a UK-government sponsored trial to test and evaluate radar performance against demanding air targets in a complex environment. Known as 'Bristow 15' and conducted over the ranges at West Freugh, in Scotland, the trial is thought to be the only one of its kind held outside the USA.

AT4CS RS systems for Saab

Saab has received an order from the US Army for the shoulder-launched AT4CS RS (reduced sensitivity) anti-armour weapon system. Deliveries will take place during 2016. The AT4CS RS is a disposable, preloaded weapon with a specially developed, unique shaped-charge warhead that delivers outstanding behind-armour-effects inside the target. Thanks to this new warhead the AT4CS RS also has improved insensitive munition (IM) characteristics. In 2014,



new versions of the weapon were introduced to the market. These new variants are part of the AT4CS family and build upon Saab's modular 84-mm product range including the Carl-Gustaf multi-purpose reloadable weapon system and the AT4 family of disposable weapons. The new AT4 variants – the AT4CS ER (extended range) and AT4CS HE (high explosive) provide multi-purpose, direct fire support with confined space capabilities.

UK orders Giraffe

Saab has received orders from the UK Ministry of Defence for additional Giraffe AMB radar systems plus upgrades of the existing systems and associated equipment valued at is approximately SEK 610 million. Deliveries will start late 2015 and continue until 2018. The Giraffe AMB radar provides a full 360° update of the air situation out to 120 km every second. It can operate in challenging environments such as mountains, complex coastal regions and wind



farm areas. The upgrade will take the UK's existing systems to the same production-build standard as the new Giraffe AMB, enhancing the primary radar's performance and capacity.

RBS 70 missiles for Latvia

Saab has received an order for RBS 70 missiles from the Ministry of Defence of the Republic of Latvia. Deliveries will take place during the period 2015-2016. Latvia has been an RBS 70 system customer since 2004. This order for missiles is part of Latvia's long-term plan to further increase its air defence capabilities. The contract includes the delivery of missiles, training and associated equipment plus an option for additional orders.



RBS15 successfully test-fired by Croatian Navy

The Croatian Navy has conducted its second firing this year of an RBS15 anti-ship missile, at the beginning of October. Earlier this year, in May, Croatia conducted an RBS15 test firing from one of its land-based launchers. The October firing was conducted by a vessel of the Croatian Navy, the firing was part of the wider *Exercise Joint Force 15*, which was held in the Eugen Kvaternik military



training area, Slunj, and on the naval ranges at Dugi otok. The missile was fired from the *Kralj*-class missile boat *Dmitar Zvonimir*.

The RBS15 in its latest version, the RBS15 Mk3, can be integrated on ships, land batteries and mobile launchers. It is also in service as an air-launched weapon that is integrated on the Gripen fighter and compatible with other NATO aircraft.

Airbus DS support for C295W water bomber

Airbus Defence and Space and The Coulson Group of Canada have signed a Memorandum of Understanding covering the industrialisation, supply and support of the new water bomber version of the Airbus C295W transport aircraft. Under the terms of the agreement The Coulson Group of Alberni BC, Canada through its operating company Coulson Airplane Ltd, will develop and manufacture a version of its Retardant Dropping System (RDS) which is already in operation with the world's most demanding



firefighting agencies. The system installed in the C295W will consist of two roll-on-roll-off internal tanks, which after the fire season can be easily removed. The highly versatile C295W will then be available for its conventional role as a ramp-equipped, multi-role transport able to carry cargo, troops, paratroops or stretchers. The RDS for the C295W comprises two internal tanks of 3,500 litres each able to transport water or retardant and able to be refilled in under seven minutes. When dropping, the flow-rate can be adjusted via the cockpit control panel according to the desired coverage, aircraft speed and height over terrain. A prototype C295W water bomber has been flying since 2013.



The World of Airbus

Ultra-Long Range A350-900 variant launched

Singapore Airlines (SIA) has selected Airbus' newly launched Ultra-Long Range version of the A350-900 for non-stop flights to the USA. Under an amendment to the carrier's existing order for 63 A350-900s, seven of the aircraft will now be delivered with an Ultra-Long Range capability for flights of up to 19 hours. In addition, the carrier has placed an additional order for four A350-900s, taking its total firm orders for the A350 XWB Family to 67.



Optimised for non-stop flights to the US, the aircraft, designated A350-900ULR (Ultra-Long Range), will include a modified fuel system to increase the fuel carrying capacity, an increase in Maximum Take-Off Weight, plus aerodynamic improvements, enabling service to the US West Coast, as well as to New York. Involving a distance of some 8,700 nautical miles, the New York service will be the world's longest commercial passenger route, with an expected flight time of up to 19 hours. Moreover, the 'unique flexibility' offered by the A350 XWB allows operators to reconfigure their A350-900ULR to the standard long-haul A350-900 specification should they require it.

A320 production increased to 60 a month by mid-2019

To match ongoing high demand for its A320 Family, Airbus will to further increase production rate of the Family to 60 aircraft a month in mid-2019. To enable the ramp-up Airbus will extend its capacity in Hamburg with the creation of an additional production line. In parallel Airbus will integrate cabin furnishing activities for A320 aircraft produced in Toulouse into the Final Assembly Line in Toulouse, thereby harmonising the production



process across all A320 Family Final Assembly Lines worldwide. The A320neo Family incorporates latest technologies including new generation engines and Sharklet wing tip devices, which together deliver more than 15 percent in fuel savings from day one and 20 percent by 2020 with further cabin innovations.

CAS orders 30 A330 Family and 100 A320 Family aircraft

China Aviation Supplies Holding Company (CAS) has signed a General Terms Agreement (GTA) with Airbus for the acquisition of 30 A330 Family aircraft and 100 A320 Family aircraft. The 30 A330s are a firm up of the commitment signed in



June 2015. The GTA was signed in Beijing by Li Hai, President and CEO of CAS, and Fabrice Brégier, President and CEO of Airbus, in the presence of Chinese Premier Li Keqiang and visiting German Chancellor Angela Merkel. The first agreements on setting

up an A330 C&DC in Tianjin, China were signed by Airbus and Chinese partners in March 2014 and witnessed by French President Francois Hollande and visiting Chinese President Xi Jinping. This was followed in October 2014, when Airbus, the Tianjin Free Trade Zone (TJFTZ) and the Aviation Industry Corporation of China (AVIC) signed a Letter of Intent (LoI) in Berlin, Germany, and a framework agreement that was signed in July 2015 in Toulouse.

R-R Trent 700s for new Beluga XL transporter

Rolls-Royce has been selected by Airbus to provide Trent 700 engines and long-term TotalCare engine service support, worth \$700m for five new Beluga XL air transporter aircraft. The aircraft will replace the current Airbus Beluga fleet, which is powered by



engines GE CF6. The Beluga XL, based on the A330 design, was launched in November 2014 to address the A350 XWB ramp up and the transport capacity requirements for other programmes. Compared to the current Beluga, the Beluga XL will provide Airbus with an additional 30 per cent air transport capacity.

China Eastern Airlines receives 50th A330

China Eastern Airlines has taken delivery of its 50th A330 aircraft at a ceremony in Toulouse, France. Powered by Rolls Royce Trent 700 engines, the A330-200 features a two class cabin layout seating 30 passengers in business class and 203 in economy. "With a fleet of that has grown to 50 A330s over nine years, China Eastern is demonstrating its continued confidence in the superior performance and comfort of the A330," said Fabrice Brégier, Airbus President and CEO, "We are confident that with one of the world's largest A330 fleets, China Eastern will strengthen its position as one of Asia's



leading international carriers and continue to offer its passengers the best flying experience." China Eastern began operating the A330 in 2006 and today its fleet has grown to be one of the world's largest. China Eastern also operates a fleet of around 230 single aisle A320 Family aircraft, taking its Airbus fleet to some 280 planes in total. China Eastern is one of Mainland China's three major airlines.

Finnair is first European A350 XWB operator

Finnair has taken delivery in Toulouse of the first of 19 A350 XWBs on order, thus becoming the first European operator and the third worldwide of the all-new airliner. The aircraft is configured in a three-class layout, with 297 seats, comprising 46 business class, 43 economy comfort and 208 economy.



Assembly of first A350-1000

Airbus began fuselage assembly of the largest member of the A350 family at its Hamburg and Saint-Nazaire plants. Germany-based subcontractor Premium Aerotec handed over the first complete front fuselage section for the first A350-1000, now delivered by air to Hamburg where it will be equipped before being flown to Saint-Nazaire on board one of Airbus's Beluga fleet of aircraft. The front fuselage section is largely manufactured from carbon fibre composite material (CFRP). Airbus will incorporate the section into the first -1000 test machine (MSN59). This fuselage section will be completed by a CFRP door frame, which Premium Aerotec said will bring significant weight and cost savings compared to a traditional aluminum section.

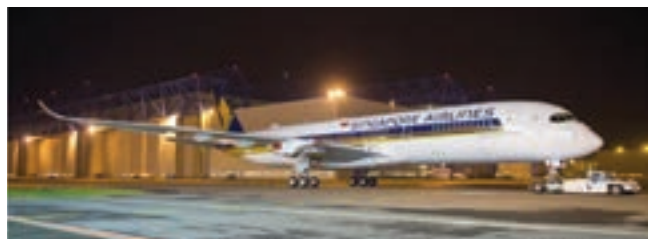
Honeywell technology for A320 and A330s

Honeywell Aerospace's latest navigational technology will be available as an option on Airbus A320 and A330 aircraft from early 2018. The new Integrated Multi-Mode Receiver will offer Airbus customers access to the latest precision navigation capabilities, a cost-effective solution that increases airport traffic capacity while decreasing weather-related delays, noise and operating costs through more efficient routing and improved navigation performance. Honeywell's Integrated Multi-Mode

Receiver (IMMR) navigation receiver will enable airline operators to take advantage of the latest in satellite-based navigation such as Honeywell's SmartPath Ground-Based Augmentation System (GBAS), which allows more accurate approach and landing access than today's land-based systems. The new navigation receiver will also offer expanded capabilities for landing in very-low-visibility weather conditions.

Singapore Airlines' 1st A350 XWB

The first A350-900 for Singapore Airlines has been revealed in the airline's livery following completion of painting in Toulouse. The aircraft is now set to move to the next stages of production, including the installation of engines and cabin furnishing, before



starting ground and flight tests. The aircraft is scheduled for delivery to Singapore Airlines in the first quarter of 2016. Singapore Airlines has ordered a total of 67 A350s and will operate the aircraft on long haul routes to Europe as well as on ultra-long range non-stop services to US and selected regional routes.

Recaro receives Airbus Innovation Award

Recaro Aircraft Seating of Germany received the *Airbus Innovation Award* for proactive innovation supporting Airbus in the field of Systems and Equipment, Cabin and Propulsion. "Our collaboration and this new award are an important milestone in the



Heino Ostermeier, Airbus' Senior Vice President of Cabin Procurement, congratulates Dr. Mark Hiller, CEO and Shareholder of Recaro Aircraft Seating, Sunitha Vegerla, General Manager of Recaro Aircraft Seating Americas, Inc., and Jochen Weidner, Director Programme Management at Recaro Aircraft Seating, on the Airbus Innovation Award 2015 (from right).

long-term partnership of our two companies. In our customers' view we made an impressive track record in the aircraft seating industry with innovation leadership, high annual growth rates, an outstanding operational performance and a strong global brand", explained Dr. Mark Hiller, Chief Executive Officer and Shareholder of Recaro Aircraft Seating.

A400M completes grass runway certification tests



Airbus Defence and Space has successfully completed certification testing of the A400M new generation airlifter on a grass runway. The tests using the development aircraft MSN2 took place over a three week period at the airfield of Écurey-sur-Cooles in France in September and examined the aircraft's behaviour on grass and natural soil runways. The A400M demonstrated 'excellent performance' both in taxiing manoeuvres, such as U-turns, and during take-off and landing on the 1,500m strip. These tests followed earlier successful results on the gravel surface at Ablitas in Spain and will be followed by tests on sand surfaces next year.

RAAF A330 MRTT refuels F-35 fighter

An Airbus A330 Multi Role Tanker Transport (A330 MRTT) of the Royal Australian Air Force has successfully refuelled a F-35A Joint Strike Fighter of the US Air Force. During a four-hour sortie from Edwards AFB, California, the tanker, known in RAAF service as the KC-30A, conducted 59 contacts including five "wet contacts" during which 19,600kg (43,200lb) of fuel were passed. All the refuelling was performed using the A330 MRTT's Airbus Airborne Refuelling Boom System (ARBS).



The Yak-130:



Combat trainer with a punch !

Russian aircraft manufacturer Irkut has commenced deliveries of Yak-130 combat jet trainers to the Bangladesh Air Force, the first batch of six aircraft delivered to Dhaka aboard an Antonov An-124 transport. The 16-aircraft contract with Bangladesh was signed in 2013, with a \$1 billion credit line provided by Moscow for acquisition of military hardware.

Bangladesh is the third foreign customer for the Yak-130, the first being Algeria, which received its first batch of trainers in 2011. Algerian media reports state that the Algerian Air Force is using Yak-130s both as trainers and as light attack aircraft in warfare against terrorists, essentially as jet-powered counterinsurgency (COIN) platforms. The Yak-130's armament allow ground targets to be engaged with both guided and unguided weapons and for engaging airborne targets, the aircraft is armed with Vypel R-73E infrared-homing close combat missiles. The Yak-130's maximum payload is three tonnes, giving it significant striking power in low intensity conflicts.

The Republic of Belarus, the second export customer for the Yak-130, received four aircraft in April 2015 (see *Vayu VI/2015*). At the MAKS 2015 air show

in August, Belarus signed a contract with Irkut for a second batch of four Yak-130s, Major General Oleg Dvigalev, Commander of the Air Force and Air Defence of Belarus, stating that there were plans to acquire eight additional Yak-130s,

and that Belarus may replace its Su-25 ground attack aircraft with Yakovlev strike aircraft, presumably the strike-modified variant of the Yak-130 that was displayed during MAKS 2015 (see *Vayu VI/2015 and below*).



Aperture of the laser rangefinder on the nose of a modified Yak-130 at MAKS 2015

Alongside export deliveries, Irkut continues to hand over Yak-130s to the Russian Air-Space Forces (RASf) with the RASf training centre in Armavir made operational with Yak-130s, the Russian MoD having ordered a total of 80 such aircraft.

There is also interest in the Yak-130 from a number of Asian and Latin American nations, likely because its subsonic performance characteristics are quite similar to those of various 4 and 4+ generation fighters already in operation with many of these countries. For example, the Yak-130 is stable and steady at angles of attack up to 35°, like many in-service fighter aircraft. The aircraft features twin-engine configuration to maximise safety and survivability, while an active safety system prevents possible in-flight errors by trainees. For instance, an automatic spin recovery system activates during emergencies, ensuring safety of the aircraft as well as aircrew. In any event, the Yak-130 is fitted with a 'zero-zero' ejection seat.

The aircraft is also rugged and 'maintenance friendly', allowing it to deploy autonomously to airfields that are often in

poor condition. Protective inlet covers, much like those of the MiG-29, close during take-off and landing, preventing foreign objects from being sucked into the engines and causing damage. An on-board oxygen generating system obviates the need for a crucial support item during deployment of the aircraft to far-flung locales.

Irkut is now making the Yak-130 even more attractive to foreign buyers by expanding its combat capabilities. At MAKS 2015, an experimental Yak-130 was displayed in the static park, equipped with a range of modifications aimed at making it a formidable strike platform, incorporating a laser rangefinder in the nose. The system is intended for visual identification of ground and surface targets and measurement of slant distance to them. The type also featured a new self-defence system mounted as a pod on the wing. The Yak-130 is to be fitted with a wide range of guided and unguided air-to-ground munitions and short-range air-to-air weapons, both for aircrew training as well as strike missions. The aircraft's open architecture avionics suite allows usage of various ones of Russian or foreign origin.

"Yak-130 (tail number 01) was upgraded by Yakovlev design bureau (part of Irkut Corporation) in accordance with the requirements of foreign customers; the upgrade is focused on increasing the jet's combat effectiveness (Yak-130 may be used as a light attack aircraft)," read an Irkut statement. The laser rangefinder allows Yak-130s to operate better in mountainous regions or any area with varied terrain and improves accuracy in target location and usage of weapons, according to Irkut.

The 'Talisman-NT' self-defence system seen mounted on the Yak-130 at MAKS this year drew significant attention. It is designed to substantially increase the aircraft's survivability in combat missions. The system was developed by designers from Belarus and is being proposed for integration with all versions of the aircraft, including those for export. Further developments planned for the Yak-130 include provisions for in-flight refueling and addition of a fire-control radar.



Yak-130 at MAKS 2015, with its laser rangefinder and 'Talisman-NT' EW pod on the outermost pylon



Turkish Coast Guard Aviation

Adnan Menderes International Airport at Izmir is the main hub for aviation operations of the Turkish Coast Guard (TCG), known as *Sahil Güvenlik Komutanlığı* (SGK) in Turkish. Opened in 2001, the airport is used for training and maintenance, being one of four Mission Coordination Centres of the Coast Guard, the other three being Ankara, Antalya and Samsun.

The TCG is a part of the Turkish Armed Forces and responsible for controlling the maritime jurisdiction areas and coastline of Turkey, as well as countering illegal actions in these domains. The TCG is also the main Search and Rescue Coordination Authority in the Turkish Search and Rescue (SAR) Zone. During peacetime, the TCG and its 5,500 personnel are under command of the Turkish Interior Ministry, however, during emergency and wartime, the Turkish Navy exercises control over the Coast Guard.

The TCG is organised into four area commands: Black Sea, the Sea of Marmara and Adjacent Straits, the Aegean Sea, and the Mediterranean Sea.

Until 1956, General Command of the Customs Guard was responsible for duties concerning security of the maritime borders of Turkey. Under Law No. 6815 the duties of prevention and pursuit of smuggling, protection and security of the borders, coasts and territorial waters were delegated to the General Command of the Turkish Gendarmerie under the Ministry of Internal Affairs. The Gendarmerie Regional Sea Commands were founded in Samsun, İzmir and Mersin. In addition, the Maritime Branch was formed within the General Command of the Gendarmerie headquarters. Between 1957 and 1971 the Aegean Sea Region Command, Black Sea Region Command and lastly the Mediterranean Sea Region Command were formed.

As a consequence of changes in the international security environment during the 1960s, and because of the geo-strategic location of Turkey, the length of its coasts, and pre-requisites of being a maritime nation, it became clear that Turkey needed a new and more professional Coast Guard

Command. Efforts on the establishment of the Coast Guard Command gained pace in 1967 owing to the absence of necessary law enforcement forces that could impose various bans and laws by Ministries having duties over territorial waters. Within this framework, the Coast Guard Command Law was adopted on 9 July 1982, and the Turkish Coast Guard Command established. The Turkish Coast Guard Command started to operate independently from 1 September 1982.

In 1993, the main sub-commands of Coast Guard Command were designated as regional commands: *Marmara and Straits Region Command, Black Sea Region Command, Mediterranean Region Command* and the *Aegean Sea Region Command*.

The Maritime Search and Rescue Coordination Centre is located in Ankara and is responsible for coordination of operations and tasking the various regional commands,” explains Commander Murat Oglakci, responsible for operations with the Agusta AB-412EP/SAR helicopters located at Izmir-Adnan Menderes International



AB-412EP/SAR helicopter parked at Izmir

airport on the Aegean Coastline. "The Coast Guard control areas range from Hopa to Igneada, Marmara Denizi and the area from Enez to Cevlik. This is basically the whole part of the Turkish Search and Rescue region," observes Cdr Oglakci.

History of the Turkish Coast Guard Air Command goes back to November 1992 when the Command was established at Topel Naval Air Station, 100 km east of Istanbul. Shortly after that, the first aircraft, three Augusta AB-206s and one Moulin

MX-7-were added to the inventory. The latter was the first fixed wing aircraft for the Turkish Coast Guard but was withdrawn from use in July 1996. In 1999 an Augusta A109 was added to the inventory and saw service till 2005 and is now 'preserved' at the Izmir Coast Guard Air station. The AB-206s were phased out of service in December 1998.

In December 1999 a major relocation and modernisation process was initiated for the aviation component of the Turkish

Coast Guard. New facilities were established at the international airport of Izmir Adnan Menderes in 2001, and the relocation process included the procurement of new Augusta AB-412EPs, of which fourteen are currently in use. As of 2013 three new CASA CN-235 maritime patrol aircraft have been delivered as part of the 'MELTEM II' programme. A replacement programme (Multi-mission Helicopter Project) has also commenced to identify a new helicopter type for Coast Guard Air missions. A decision on this is pending, with no fixed timelines.

Currently, backbone of the SGK Air Command remains the AB-412EP of which fourteen are in operation and positioned across Coast Guard stations Izmir, Antalya, Samsun and Istanbul. Furthermore there are heliports available on demand at Mersin and Amasra. "It is expected within 2-3 years a dedicated location will be built for the Coast Guard in the Istanbul area," according to Cdr Oglakci.

The first two contracts (MARTI 1 and 2) for initial batch of the AB-412EP were signed during March 1998 and in the same year an additional contract was signed with Turkish companies Aselsan and Netas for domestic production of the ASELFLIR 200, IFF, monitor, radio equipment and video and digital cameras.



Pair of TCG CN-235 MSAs equipped with search radar, EO/FLIR and SLAR at Izmir

The other contracts (MARTI 3 and 4) were signed on December 2004. "A new Multi-mission Helicopter Project has been started to procure helicopters which have longer endurance and capacity than the AB-412EP helicopters; we need a heavier type of helicopter to conduct our missions more effectively," says Cdr Oglakci.

"The AB-412EPs (locally designated AB-412SAR) are equipped with a number of modifications to allow over sea operations. A glass cockpit with four displays, auto hovering function, more powerful engines, Full Authority Digital Engine Control (FADEC) system, night vision capabilities, cameras in both the hoist and cabin which allows crew and pilots to oversee the rescue operations have been installed. Furthermore a so-called ADELTA (Automatically Deployable Emergency Locator Transmitter) has been installed recently to identify the potential crash area of an AB-412," states Lt (Electronic Engineer) Baris Dünder at Izmir Coast Guard station.

The first two AB-412EPs were delivered in June 2002. AB-412EP TCSG-502 was used for initial pilot training, with three Turkish Coast Guard instructors receiving their training in Vergiate, Italy by late 2002. Presently new Coast Guard pilots receive their initial pilot training at the Army Aviation training school located at Army Air Base Güvercinlik near Ankara. "We have been following the same training path as the Army students," says one of the new junior Coast Guard pilots, Hakan Kuru. "We train for 51 weeks with 100 hours of flying on the AB-206 and about 80 hours on the UH-1H."

The effective range for rescue operations for the AB-412EP is about 90 nautical miles, which includes 15-20 minutes on scene. In case of emergency the response time is 30-90 minutes for both day and night operations across Turkey. The Coast Guard Command Centre in Ankara is responsible for dispatching assets to perform search and rescue operations. Currently the Turkish Coast Guard is heavily involved in the rescue and tracking of illegal immigrants who are trying to get out of Turkey, with the Aegean and Mediterranean Seas being the routes most often used by immigrants. Other tasks performed by the Coast Guard are SAR, anti-terrorist operations, pollution control, border control and homeland security.

Fixed Wing Operations

Besides helicopter operations, the Turkish Coast Guard has started to operate the



A view of the operator consoles in the TCG CN-235 MSA

fixed wing CASA (now Airbus Defence and Space) CN-235 MSA (Maritime Surveillance Aircraft) from 2013. The procurement and development of the MSA dates back to 1998, when the initial contracts were signed. The first two aircraft were delivered in 2001, while the third was delivered in January 2003 as part of 'MELTEM I.' The Turkish Navy (*Türk Deniz Kuvvetleri*) ordered six CN-235s as part of the same order. 'MELTEM' is till date the most ambitious maritime surveillance and patrol programme conducted in Europe over the last decade. For 'MELTEM II,' which started in September 2002, Thales has modified the three CN-235 MSAs for Exclusive Economic Zone surveillance missions by the Turkish Coast Guard and six CN-235s for anti-surface and Anti-Submarine Warfare (ASW) configuration for the Turkish Navy. Aselsan, as a subcontractor, was awarded a contract to develop a Tactical Command System (TCS), Tactical Command and Control Information System (TCCIS), Ground Control Station (including an education system), System Integration Test Bench and Mission Systems. The MSA version is now equipped with video and digital cameras, radar, Aselfir 200, Ocean Master 400 radar, Side Looking Airborne Radar (SLAR) and the integration of the AMASCOS (Airborne Maritime Situation and Control System) developed by Thales.

To support SAR tasks, smoke markers (Mk.25 Mod 2) and Aerolite 6 life rafts have been installed. "The CN-235 MSA is able to deploy life rafts for about 100 persons in one drop," according to a CN-235 pilot. The crew of the MSA consists of two pilots, two observers, two operators and

one flight technician. The radar has a range of 200 nmi and is able to track 200 contacts simultaneously. The Aselfir 200 has an effective range of about 20 nmi. The SLAR is capable of detecting sea pollution up to 20 nmi when operating at 15,000 feet. The newly installed UV-IR scanner can also detect sea pollution through infrared and ultraviolet radiation.

TCG pilots fly about 15 missions to adapt to the MSA version of the CN-235, according to a former Turkish Navy pilot. "We had representatives from Thales for two years at Izmir, who were former French Navy pilots, to instruct on MSA. We are very satisfied with the new aircraft, and are now able to detect many more pollution incidents." On average, pilots fly around 175 hours a year, mainly focusing on training. "The amount of flying hours increases each year due to the demand," according to a TCG CN-235 crewmember. "Currently we are focusing on training our Sensos (Sensor Operators). As we had to start from almost scratch with the new MSA aircraft we are also developing documentation and building our unit. We have 75 per cent of our pilots operational, with focus on operators now. We are highly interested to cooperate with other countries as we feel there is much to learn for us, however we are still in training modus."

The first Coast Guard CN-235 MSA was test flown in December 2012 followed by a formal acceptance ceremony held at Turkish Aerospace Industries (TAI) facilities on 28 January 2013. The CN-235 gives a wider reach, and allows for new missions to support the Turkish Coast Guard.

**Carlo Kuit & Paul Kievit/
Bronco Aviation**

Air War History

Flying the 'Hump'



A lone C-46 Commando over flying the Hump

On 8th April, 1942, Lt. Col. William D. Old of the US Army Air Force flew a loaded Douglas DC-3 from Dinjan in the upper reaches of Assam to Kunming in China. Thus began one of history's greatest large-scale airlifts, over the forested jungle tracts of lower Assam and the formidable heights of the Eastern Himalaya, the 'Hump'.

In the months following Pearl Harbour, the Imperial Japanese Army had invaded and subdued much of South East Asia, including Thailand, the Philippines and Singapore. Realising that the capture of Burma was imperative to defeat Chiang Kai-shek and the Chinese resistance as well as make inroads into British India, the Japanese crossed the Thai border in January 1942, aiming to sever the road link between India and Kunming, thereby stopping vital supplies from reaching the Chinese Generalissimo. With the Burma Road cut off, General Stilwell's troops began laying a new road from Ledo in Assam, but it was clear that if they intended to keep Chiang Kai-shek's forces in the war, the Americans would have to look to an air route.

Franklin Roosevelt had his own reasons to order the flying of supplies over the treacherous Hump into China. He believed that more than a million Japanese troops were tied down in China, so it was essential that Chiang Kai-shek remained in the fight. He also envisioned a democratic China rising in the power vacuum that the defeat of Japan would bring in the Eastern sector. Following the fall of Lashio, the southern terminus of the Burma Road, the

US President categorically told General Henry 'Hap' Arnold, commander of the Army Air Forces, that the "route to China be kept open, no matter how difficult". Hap Arnold in turn instructed the Tenth Air Force to commence operations to implement an 'air bridge' to China.

Indian Airfields

In order to fly over the 'Hump', the US Tenth Air Force was based out of several airfields in North-Eastern India: Chabua, Mohanbari, Sookerating, Jorhat and Dinjan saw round the clock operations, with C-47 Skytrains and Chinese National Air Corporation (CNAC) DC-3s transporting tonnes of supplies on a daily basis to the beleaguered Chinese. The aircraft carried crucial aviation fuel to keep the Flying Tigers (1st American Volunteer Group)

and the 500 aircraft strong Chinese Air Force aloft, as well as troops, ammunition, materials, heavy machinery and medical supplies. Overall, the Tenth Air Force and the CNAC flew almost 1000 tons of material in the first two months of flying over the hump, much lower than what the Chinese demanded. Having been reorganised from the Tenth Air Force into the Air Transport Command (ATC) under General Alexander, the ATC stepped up the scale of its operations, flying through treacherous weather and in the face of marauding Japanese fighters. Tonnage steadily increased in the following months, but so did the accidents caused by rough weather and inexperienced pilots.

In addition to the ATC and the CNAC, General Arnold also deployed B-29 Superfortresses of the Twentieth Air Force in



India as part of Operation *Matterhorn*, the strategic bombing of Japan. The 40th Bombardment Group was based in Chakulia, the 444th at Chara and Dudhkundi, the 462nd at Piardoba and the 468th at Kalaikunda. Flying from their bases in India, the 20th Air Force would land at advanced air fields in Szechaun province, before hitting Japanese targets in occupied China or on the Japanese mainland. Similarly, bombing runs from the Indian peninsula were made on Rangoon, Bangkok, Saigon as well as targets as far as Singapore and Sumatra. On 5th June, 1944, the 404th Bombardment Group hit the Makasan rail yards in Bangkok, the 2261 mile round trip mission being the longest yet attempted in the war.

The Aluminium Trail

Traversing the Hump was precarious business, the success of each mission subject to the capricious weather. Flying over peaks that soared over 15,000 feet with alarming regularity, the ATC and CNAC pilots had to face some of the worst flying weather in the world. The monsoon months were the most disconcerting, with low visibility, gale force winds, thunderstorms prevalent throughout the route and torrential showers making takeoffs and landing highly risky. But the stormy weather meant that the pilots did not have to deal with raiding Japanese Zeros. In winter, the clear skies masked the perils of the invisible jet stream which hindered flights, while the cold would lead to instances of icing with terrible regularity. Japanese advances into northern Burma and the fall of Myitkyina meant that the aircraft had to fly a route that stretched further north, over the 'high hump', the north eastern spur of the Himalayas where none of the passes dipped below 3000 metres. This was far more treacherous territory to fly through, with vile weather conditions.

Although attacks by Japanese fighters decreased substantially, aircraft were still lost with frightening constancy. The challenges posed by foul weather were compounded by a dearth of reliable weather charts, navigational aids and lack of reliable airfields on both sides of the border. In addition, the C-47s, C-87s and C-109s were unsuited for high altitude operations and unable to clear the high peaks of the hump, forcing the pilots to weave through perilous mountain passes. The accident rate of the C-109, a tanker version of the C-87 that inevitably caught fire and exploded in mishaps, earned it the sobriquet of 'C-One-oh-Boom'. The introduction of the C-46, which could fly higher and faster than any of the other aircraft being used, meant that tonnage improved and accidents reduced, even if they still occurred with alarming frequency. With the cessation of hostilities in late 1945, the glittering remains of wrecked aircraft dotted the route over the hump, and became known as the



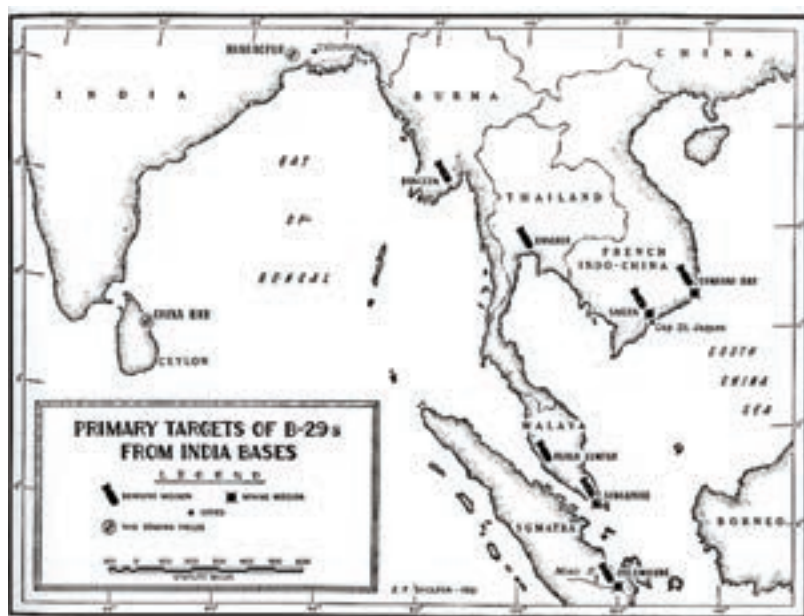
Jagged peaks of the Hump as seen from a C-46

'Aluminium Trail', a gruesome and silent witness to the countless lives lost in keeping Chiang Kai-shek's army in the war.

In flying countless sorties over the hump, what the pilots of the ATC and CNAC achieved was no mean feat. The remains of aircraft and pilots among the Aluminium trail are testament to that. By the war's end, the ATC had transported from India a momentous 650,000 tons of men and materiel, with the CNAC chipping in 75,000 tons, albeit at terrible human cost. The ATC lost over 1400 aircraft in their three years flying the hump in the China-Burma-India theatre, with 3861 personnel laying down their lives. The CNAC lost 37 aircraft, with 81 fatalities. The casualties suffered by the ATC in the China-Burma-India theatre were the highest among all non-combat units, and in several cases higher than combatant units. Although the airlift could not bring about the defeat of the Imperial Japanese Army in China as was its objective, the lessons the Americans learnt from the years of airlifting men and materiel were invaluable later in the decade, as they provided a lifeline to thousands as Stalin's forces cut off all road and rail links to Berlin.

Legend goes that all pilots downed over the Hump ended up in Hogy Taw, a little Burmese village which was the pilots' version of Shangri-la, a sort of paradise. The US Joint Prisoner of War/Missing in Action Accounting Command (JPAC) has been combing the forests of Arunachal Pradesh since 2008 for remains of men and aircraft along the Aluminium Trail. Over 400 air crew are still unaccounted for. One can never be certain, but perhaps many of them ended up at Hogy Taw. It's what their fellow hump pilots would like to believe!

Vijay Matheswaran



(Pictures courtesy Life Magazine)

Along the Aluminium Trail

A poignant journey in an American ATV, searching for the remains of a downed American aircraft from World War II

It had rained that day in the summer of 1942. The forest was lush green and teeming with wildlife. A young warrior named Kimusai, from the village of Salomi in Nagaland's Kiphire district, was out on a hunt. He was newly married, and wanted to treat his wife to a feast of wild boar. It was twilight, and he already had a few kills to his name, all small animals. The moon would be out soon, he thought, and so he paused at the top of a hill, planning out a path that would take him down to the forest below.

Except for the sound of the jungle, it was quiet. But, all of a sudden, Kimusai heard a deafening wailing sound. He looked up and saw a giant bird flying very low, with a massive fire on its wings. As he watched in horror, it narrowly missed hitting a hillock. But, a moment later, came crashing down right below where Kimusai was standing. There was an ear-splitting sound, and a thousand fires erupted around the crash site. Kimusai was a brave warrior, but he had never heard such a loud noise nor had he seen such a big fire. He dropped his kill and ran all the way to his village.

The elders at Salomi saw the burning bird and heard the explosion too. Those were the early days of Christianity in Nagaland, and many still strongly held on to animistic beliefs. The burning bird was seen as a message that the Gods were angry. Prayers were held, *mithuns* (cattle) were sacrificed, and nobody was allowed to go to the jungle to hunt. But Kimusai and a couple of hunters decided to investigate the giant bird from the sky, and made their way to the site.

They had never seen an aircraft before, but knew that it was not a bird from the heavens. The fire in the forest had died down but there was an overpowering stench of burnt flesh.

Among the debris, they found human remains – three dead bodies in different degrees of dismemberment. Two of the mutilated bodies were near the aircraft, while they found a third corpse stuck to the branches of a tall tree.

They buried the three airmen some distance away from the aircraft, collected a few things from the site, including a gun, and didn't return there for many years.

North East India was the only World War II theatre in India, and the battles of Kohima and Imphal have been declared as two of the greatest battles in WWII, battles that changed the course of the War. The remains of these grim battles are scattered across the region. Some tanks, guns, unmarked graves, Samurai swords of Japanese officers, weapons, unexploded bombs and aircraft remains have been found, but the jungles and high mountains still hold many secrets. It took a lot of coaxing, but the jungle of Nagaland eventually revealed one of its secrets to me.

About 12 years ago, while on a solo motorcycle trip in the area I got stuck in the rain and sought shelter in a roadside shack – the likes of which one finds all over Nagaland. There were three old men in the shack, and they had a fire going to make some tea which we all drank from bamboo mugs. When the rain stopped, we heard a far away drone of an aircraft in the overcast sky, and one of them casually remarked that he hoped that this aircraft also does not end up like the one in the jungle.



An aircraft in the jungle? I immediately bombarded him with questions... the old man just pointed to the blue mountains in the distance and said it lay behind the third mountain range. A very vague indication indeed and so it's taken me a decade to find it.

The remains of the WWII-era aircraft lay scattered over a large area under the jurisdiction of a new village named Tsurevong, in the Kiphire district. To get to Tsurevong from Guwahati, I had charted out a route through the remote areas of Nagaland and of course, a large part of it

was off-road. Now the only reason I was able to attempt this route to begin with was because my steed for this expedition was a Polaris RZR SW 800 all terrain vehicle (ATV). Not only is this perhaps one of the only vehicles on the planet able to traverse this kind of terrain, but there's also poetry to the fact that we're using an American off-roader to search for the remains of a downed American aircraft.

Rain plagued me as I drove out from Guwahati, and it didn't let up until I passed the Kaziranga National Park where a friend, Thejakielie, joined me. The RZR SW 800 has a roof and a windshield, but against the heavy rain it provided about as much protection as standing under a papaya tree! We bought plastic sheets to save ourselves from the rain (not that it helped much), and also to protect our bags and cameras. The RZR has a luggage rack at the back, which we filled to the brim with a spare wheel, tent, oil, coolant, some electrical equipment, rucksacks and four cans of petrol. Since we would be covering ground at night, we also fitted a couple of aftermarket headlamps on the roof.

We crossed into Nagaland a little after sundown through the Sonari border. The



topography changed immediately after we crossed the bamboo barricade – and so did the condition of the roads. It was only 45 kilometres to the town of Mon, but it took us the better part of four hours to cover the distance. The road disintegrated and totally disappeared at some stretches. The RZR obviously didn't mind the bad roads, but it was difficult to drive fast through slush in the heavy rain. The last thing we wanted was to slide off the mountain at night.

Our lights cut a lonely furrow through the rain and the black mountains, but close to midnight we drove into the Helsa Resort. Built atop a hill, the resort has lovely bamboo cottages built in the traditional Konyak manner.

Mon is the headquarters of the Konyak Nagas. Among all the Naga warriors, the Konyaks were the most feared, mainly for their reputation as fierce head-hunters!

After breakfast, we drove 42 kilometres to reach Lungwa village. This village seems caught in a time warp. It shares an international boundary with Myanmar, and the border passes right through the middle of the huge thatched house of the Chief (referred to as the *Angh*). And so we had tea in Myanmar, and returned for a smoke in India!

The *Angh* is not a rich man in monetary terms, but he wields enormous influence. The *Angh* of Lungwa controls about 50 villages inside Myanmar. The Konyak warriors practiced headhunting till quite recently in fact. When a warrior would bring back the head of his enemy during a battle, he was decorated with tattoos on his face and body. The more heads he collected, the more intricate the tattoos became, and the more his esteem in society rose.



Head-hunting is a thing of the past of course, and all the tattooed warriors are on the wrong side of 50 – in a few years' time, there will be none left.

The Konyaks are master craftsmen – they make beautiful artefacts out of wood, bamboo, copper and bone. They have amazing handmade muzzle loading guns and manufacture their own gunpowder. According to some books, they had been making guns even before the British landed in India.

After topping up the fuel tank and the jerry cans early the next morning, we started out for Mokokchung. Thirty kilometres out of Mon, we reached the small town of



Wakching, where the road dropped down and disappeared. It was rainy and sunny at the same time, and after a couple of hours of total off-roading, we came across a small hut where the lady of the house offered us some tea and biscuits. It was in the middle of nowhere, and I wondered how on earth they sustain themselves.

We crossed an ancient looking iron bridge over the roaring and muddy Dhiku river, and rested under a huge jackfruit tree for lunch. Riding a Polaris ATV sure makes one hungry!

The short wheelbase of the RZR SW 800 makes sliding through corners a breeze. And we hardly slowed down at all while negotiating big pools of water, safe in the knowledge that it wasn't going to stall. After more than five hours of slipping, sliding, jumping and getting drenched in muddy waters, we suddenly emerged out of a thick canopy of very tall grass and hit a brilliant highway at the village of Merangkong, in the Mokokchung district. All this while, we hadn't seen any other vehicles at all, and had to guess which path to take at intersections because there was no one to ask for directions. Mokokchung has the loveliest roads in all of Nagaland, but the Polaris isn't exactly meant to be driven on tarmac.

The next day we had another couple of hours on good roads before we took a nondescript left turn from the village of Longkhum. At some point after the bulldozer cut through the hills, they laid stones on the track and then seemingly forgot all about it. It was good news for us though, as we got a stretch of more than 50 kilometres of off-road tracks with no traffic whatsoever.

After a brief stop at Wokha, we carried on to Kohima. To have called ourselves dirty would have been an understatement, and Thejakielie was rightly apprehensive about whether or not his family would let us walk in through the door of his house – which was en route. Thankfully, they did!

Rokovor, a photographer, joined us at Kohima. We passed a number of small villages and towns, most of which had magical oriental names: Mima, Cakhabama, Pfutsero, Chizami, Losami, Jessami, Meluri, Akhegwo, Longmatra, and Pungro.

As we approached Pungro, I watched the beautiful Zinki river flow gently and disappear across around the bend as it made its way into the Chindwin river in Myanmar.

The next morning, we had another 45 kilometres to cover off road before we were to hit the village of Tsurevong. Along

the muddy road, we drove past Pungro village, New Vong, the Lekhimro Hydel Electric project, Moya village, and finally to Tsurevong – the village beyond the blue mountains!

The RZR's 4x4 option came into play when we were forced to take a detour through a mountainside that had been charred for felling. The RZR tackled the steep ascent and descent with aplomb. We had to drive through deep tracks made by logging trucks that were filled with water. It was no problem, though, as the 12-inches of suspension travel did the trick. The drive-shafts and the suspension arms took regular impact on the logs and rocks, but they withstood the punishment without complaint.

Tsurevong, with just 38 households, has no electricity, no proper roads and no schools for the village children. They all go to school in Pungro. It's in these far-flung villages of Nagaland that one gets to see village life in all its unvarnished rustic glory.

On an earlier visit, old man Kimusai and I sat on a large rock in the midst of some teak and alder trees that overlooked the valley. He had a faraway look on his eyes as he narrated the story. His memory was sharp and his story telling ability brilliant. He spoke as if it had happened

yesterday. By the time he finished, the sun was setting and the sky had turned a flaming red. He stood up with a deep sigh and made his way home.

"The place was haunted by the spirit of the men who died there," Kimusai said. He didn't specify further, and I didn't probe more.

It was probably a C-47 transport aircraft that had taken off from Chabua in Assam. American pilots flew these supply sorties across the high snow covered jagged peaks of the Himalayas to ferry much-needed material to the armies of Chiang Kai-shek, who were fighting the Imperial Japanese army in Kunming in south western China.

These missions were fraught with danger. The aircraft were up against natural elements like snow and 200 mph winds, as well as Japanese fighters such as the A6M Zero. This infamous route was nicknamed 'The Hump' and 'Skyway To Hell' by the brave airmen who flew these perilous sorties. More than 700 aircraft went down in this region during WWII. Many fell in the deep jungles of Arunachal Pradesh, Nagaland, Manipur and Myanmar (the 'Aluminium Trial').

Like so many others, this aircraft never made it back to base after dropping its cargo in Kunming, China. The evergreen jungle soon overgrew the wreckage, and it was only in 1967 when the villagers started clearing the forest for cultivation that the remains of the downed aircraft were revealed.

The villagers knew the worth of aluminium of course, and so they piled logs on top of the fuselage and set it on fire. Some made utensils out of the melted aluminium, while others made fantastic machetes and knives out of the steel.

The site is a few kilometres below the village, which is where we left the Polaris. Since some of the forest had been burnt recently for *jhum* cultivation, it made the trek to the crash site a bit easier.

The grass at the site was tall and thick, and the trees massive. I could hear a stream, but couldn't see it initially because of the thick undergrowth. The village pastor, Retringia, slashed a path with his razor sharp machete and we followed close behind. It was deadly quiet, and except for the occasional call of the lone eagle that circled the sky, ours were the only sounds.

We first found the still shiny landing gear, a few twisted wheels, parts of the gearbox and engine – including a crankshaft,



a fan of some sort, and some other heavy parts that were scattered over a large area. We walked downstream, slashing away at the thick foliage and found a number of large engine parts.

A whole lot of parts are buried underground, and they keep popping up during cultivation every year. A couple of years ago, a villager dug up a radio set and a rusty but still-loaded revolver!

It was an overwhelming sense of discovery, as this was something that I've waited to uncover for a very long time. And the fact that the headman told me that I was the first person from 'mainland' India to visit the site made it even more satisfying. It had been quite a journey, and I couldn't have done it without my trusty steed – the Polaris RZR.

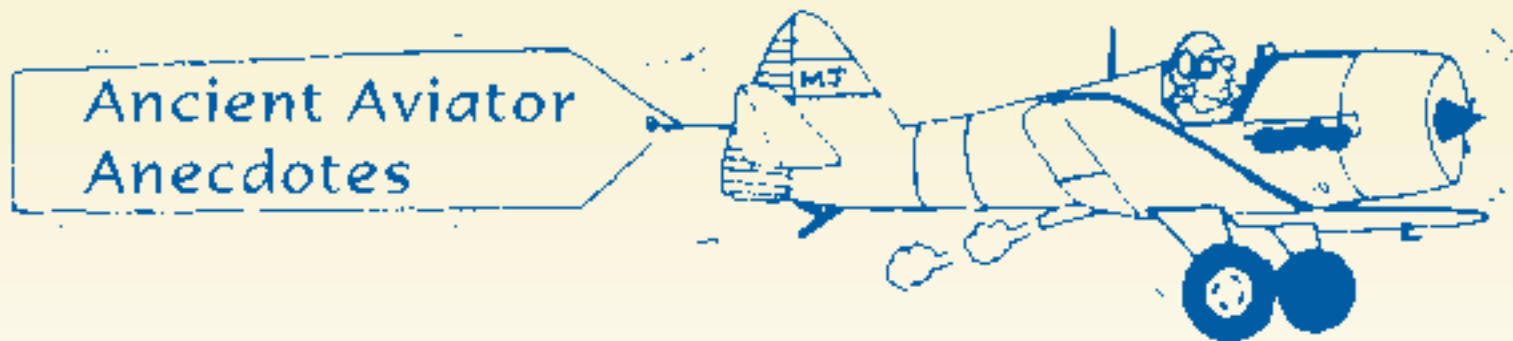
As I sat on a fallen tree and looked down towards the valley, I couldn't help but imagine the plight of the aircrew as they came down in flames. Even if they had survived the crash, it would have been near impossible for the wounded airmen to survive in this dense jungle crawling with wildlife.

These remains lie in a far and obscure place, but it's well worth the effort – especially with the RZR as your companion. It's a true reminder, though, of the kind of hell that the soldiers and airmen went through during this long and bitter war.

After more than 70 years, nobody knew where the three graves were laid but I said a silent prayer for the men who died so far away from their homeland.

Text: Shahwar Hussain Photos: Rokovor Vibienuo and Shahwar Hussain

Air Vice Marshal Cecil Parker's



“Last of the Hunters”

The very nature of aviation requires its practitioners to remain constantly on the right side of the learning curve! Consequently, aviators (even long retired ones like this writer) can never ignore news of an air crash anywhere in the world. On 22 August 2015, while in London on a visit, I caught the tail end of a TV news broadcast which described a plane crash during an air display to mark the 75th anniversary of the Battle of Britain. What drew my immediate attention was that the aircraft was a Hawker Hunter. This type is now near sixty years old and was part of our own air force for some forty years.

I had special personal interest having flown the Hunter for ten consecutive years (1962-72) in peace and war. I was naturally interested in the cause factors for the crash of one of the safest, reliable and most delightful aircraft ever designed and built. The UK Air Accident Investigation Board, in its interim report, stated that ‘the aircraft was too low in a looping manoeuvre’ and crashed killing eleven bystanders and injuring more on the A-27 motorway in one of Britain’s worst air show disasters. Amazingly the pilot was pulled out alive from the blazing wreckage in critical condition.

The 51-year-old pilot had flown Harriers in the RAF, had over 14,000 flying hours with British Airways and had 40 hours of experience on the Hunter. He held a valid display authorisation issued by the UK CAA to “display the Hunter to a minimum of 500 feet agl during standard

category aerobatic manoeuvres.” From the many amateur and professional pre-impact video footage repeatedly aired, I could immediately identify the unmistakable silhouette of the Hunter (Trainer) in a near vertical attitude above the tree line. The pilot has an excellent professional reputation but apparently misjudged his height and got into an aerodynamic stall too low.

While in the UK I was in personal touch with some of the ex-IAF officers settled there. They included an ex-squadron commander, ex-station commander cdr, old flying instructor, fellow fighter pilot and a coursemate, three of whom themselves too were experienced Hunter pilots. Our conversation was therefore dominated by news of the Shoreham Air Show disaster and we recalled our own many ‘errors of judgement’ and lessons learnt therefrom including one in which this writer was lucky to survive sixty years ago in another aircraft type.

Over the years, 1957-97 our air force had seven Hunter-equipped units and I had the privilege of raising and commanding the IAF’s first Hunter Operational Training Unit (1966-69) and commanded No.20 Sqn (1969-72). Though this aircraft type was phased out before the millennium, the last vintage IAF Hunter was scheduled to participate in the Air Force Day Flypast to mark its 69th anniversary on 8 October 2001. Unfortunately, owing to bad weather, that flypast (to which I had been invited) had to be cancelled. I was however destined

to view on TV the dying shots of probably the last vintage RAF Hunter and be reminded once again that very rarely do aircraft cause accidents;—people do. The good news is that, on the day of our return, the pilot had recovered and been discharged from hospital.

A Doctor In The Air

In the air force, medical officers, though on the posted strength of squadrons, function directly under the Senior Medical Officer (SMO) of the air base where their squadron is located. As doctors they report professionally to the SMO and as officers, to the CO of their units. This dual reporting can be a trifle confusing to new doctors recruited directly from civilian medical colleges. Unlike their counterparts from the Armed Forces Medical College (AFMC), their introduction to the armed forces is a brief orientation course at the Army Medical Corp (AMC) Centre before donning uniform. In view of their relatively long training period, all medical officers are somewhat older at entry and are also granted a higher rank.

In 1970, a new medical officer from civvy street reported on posting to the squadron I was in - command of. I welcomed him, explained his role and hoped he would find time to interact with squadron personnel to guide and help them whether they required medical help or not. He seemed receptive but was still a bit uncomfortable in his new Flt Lt’s uniform. He told me he was married

but would be staying in the mess as his wife was to deliver a son soon. (I attributed his confident prediction of gender to his profession).

I received reports of our Doc's unhappiness with the 'unhygienic' conditions of our squadron tea club and flight crew room. I had a rather high spirited bunch of young officers at that time and our new medical officer seemed to resent being referred to as 'Doc' by them. Being a teetotaler he cautioned them against visiting the bar and threatened to have them 'grounded' if he felt they were imbibing unwisely. These veiled warnings resulted in some mischief when Doc's scooter was 'misplaced' and he received a telegram informing him of the birth of a son. Doc came around happily distributing sweets but three days later was in a disappointed mode when he received actual news of the birth of a daughter. I had to make special efforts to help him adjust to squadron life!

One afternoon I was required to carry out a routine air test on our Hunter trainer aircraft. There is a little known old IAF regulation that authorises medical officers to be given an air experience sortie on aircraft at their base. I spoke to my Flt Cdr and asked him to ascertain from our Doc if he was free and would like to fly. When I reached the aircraft I saw him fully kitted out in borrowed flying kit, briefed and ready for the very first flight in his life. He coped well, seemed to enjoy the experience and post-flight appeared a bit less judgmental and more friendly all round (I was informed the next morning our Doc conducted his sick parade wearing flying overalls)!

During the 1971 Indo Pak War, Doc, though with his leg in plaster owing to a scooter accident, stayed continuously with our pilots and technicians on the tarmac and blast pens in Pathankot helping in any way he could, a very valuable asset to the squadron indeed. A few months later when my own posting orders were received, he came to request my help in getting him a pair of flying overalls which strictly speaking he was not entitled to! I had an extra pair on which I had the squadron crest and a Hunter shoulder patch attached and gifted them to him.

Over the years Doc kept in touch and I learned that he had become a specialist and reached air rank. Years after we had both left the IAF we met in the NCR where

Doc was now a consultant in a corporate hospital. With great pride he told me that he had fathered three daughters, two of whom were in the medical profession. He enquired about each of the officers in our sqn by name. His prosperity was quite evident in his girth hence I fully understood his one regret; he could no longer fit into his flying overalls!

On Parade

The first words of command we aspiring flight cadets heard on reporting to the Air Force Academy (AFA) 64 years ago, were 'Fall In'. The joker in our boisterous young group of new arrivals, called back, 'Fall in to what yaar?' Our laughter died down when a tall uniformed person (we were yet to recognise ranks) identified the voice, came over and said in a slow measured tone, 'Fall into line Mr Whateveryournameis'. We 'fell in' and soon learned that air force pilot training also required a great deal of learning and discipline in the classroom, drill square and the Mess. We were soon drilling smartly on the parade ground, learned to take pride in our movements and turnout and put up a fine Passing Out Parade (POP) 18 months later.

In the IAF, Monday was observed as a Maintenance Day when there was no flying but the activities commenced with a compulsory station parade. We young squadron officers were detailed as 'supernumeries' in the rear rank. Not being a very exciting activity we sought to attend 'Sick Parade' on Monday mornings. The medicos marshaled all their resources and sent us back to the parade ground with advice to return after the parade if the sudden 'aches & pains' had not subsided by then! (No wonder I never saw an air force medical officer on parade!). As we grew in service and rank we graduated to being a Flight Commander, Squadron Commander and eventually the Parade Commander after which one only reviewed parades.

In March 1965 I was Flight Commander in a squadron based in Palam. We were told that His Highness (HH) Prince Philip, Duke of Edinburgh was arriving and that a Guard of Honour (GoH) was to be presented. Another squadron leader and I were detailed as 'Escort Officers' to HH while a wing commander was nominated as the GoH Commander. Hindi words of command had been introduced; our

wing commander (from the deep south) was fluent in Malayalam and English but a trifle hesitant in Hindi. He however soon memorised the words of command diligently and put up an impressive display at our two rehearsals. On the actual day, we escorted HH to the saluting dais to which the GoH Commander marched smartly and said in a loud parade-ground voice, '*Sammana garada aap ke nirikshen ke liye hazir hai shriman*'. HH leaned forward and said clearly, "Commander could you please repeat that in English?" For a fraction of a second time froze while the linguistic memory circuits of the three of us within earshot were working overtime! After a brief pause the Commander replied that the GoH was ready for inspection. The rest of the ceremony went off very well and, after HH having thanked us and departed, we heard the wing commander exclaim with feeling, "we must be the only armed forces in the world required to speak and think in two different languages simultaneously!"

In the late 1970s, as AOC Adampur I was somewhat surprised to receive a signal detailing me to attend the coming Republic Day Parade in New Delhi. Till then my only participation had been in several Flypasts from 'tail-end-charlie' on Vampires to leading the Hunter block. It turned out that a decision had been taken to include war decorated gallantry awardees in the parade. Accordingly six senior recipients of the Maha Vir Chakra (three from the army, two from the air force and one from the navy) were required to 'sit-to-attention' in two open jeeps in ceremonial uniform. We rather enjoyed the experience especially after passing India Gate when we hijacked the jeeps to the nearest Mess for much needed liquid refreshment.

As Commandant of the AFA in the 1980s my entire schedule stretched from one Graduation Parade (GP) to the next. Over the years GPs had added both style and substance by way of flypasts, aerobatics, para drops, band music, rifle drills and live commentaries all of which make for a spectacular event our air force can be proud of. Certainly quite a development from my simple POP in 1952 on conclusion of which, we heard a familiar voice call out 'Fall in Sirs' and our genial Drill Instructor (Sgt Krishnamurthy) came with a smile to congratulate us while still on parade.

25 Years Back

First Indian AEW Demonstrator

The first Airborne Early Warning Technology Demonstrator (AEWTD) aircraft of the Aerospace Surveillance Warning and Control System (ASWAC) Project has been test-flown in Bangalore. With its distinctive saucer-shaped rotodome, the specially modified HAL/Bae 748 demonstrator was first flown on 5 November by pilots of the Aircraft and Systems Testing Establishment (ASTE) Bangalore, piloted by Air Vice Marshal AS Lamba, Commandant of the ASTE, and Group Captain Ravish Malhotra, Chief Test Pilot at ASTE.

The organisation was initially headed by Air Marshal CV Gole and later by Dr K Ramchand. The initial project for configuring two HAL/Bae 748s were funded at some Rs 200 crores (\$85m) 1985 prices.

AI order 5 Boeing 747-400s

Air India has decided to exercise its options for the purchase of five additional Boeing 747-400 aircraft. The airline is also considering other aircraft-types to augment its fleet of medium-capacity long-range aircraft. For its long-range operations. Air India now has only a fleet of Boeing 747s which are too big for use on some routes. Hence, the look at medium-capacity aircraft.

Three aircraft are being considered for the purpose are the Airbus A340, McDonnell Douglas MD-11 and the Boeing 777.

IA order 12 more A320s

The Government is going ahead with the purchase of 12 more Airbus A320 aircraft. The Minister for Civil Aviation said that India could not afford to "miss the slot" of getting the A.320s in view of the growth in the air traffic in the country and the huge backlog of orders with aircraft companies. The 12 A.320s, costing an estimated Rs 800 crore, were scheduled to be delivered in batches of six each in 1990-81 and 1991-92. Discussions between officials of India Airlines and Airbus Industrie would be held to firm the exact delivery schedule.

INAS 339 commissioned

Vice-Admiral S Jain, FOC-in-C Western Naval Command, commissioned the new anti-submarine/anti-surface vessel helicopter squadron INAS 339 dedicated to the defence of offshore installations, on 23 November, at Bombay. The squadron comprises six recently-acquired Westland Sea King Mk. 42B helicopters, equipped with sophisticated ASW/ASV sensors and weapons including modern torpedoes and BAe Sea Eagle anti-ship missiles. The squadron is the third in line after INAS 330 and 336, also equipped with the Westland Sea King.

From Vayu Aerospace Review Issue VI/I 1990

Nag test-fired

India's third-generation anti-tank missile, the Nag ("Cobra") was successfully test-fired at the Interim Test Range (ITR) at Chandipore on 29 November. The Nag has fire-and-forget and top attack capabilities as the "important mission requirements with a view to overcome the disadvantages of present systems. The reaction time of the missile from 'seeker' lock-on is under two seconds. Nag has been designed to defeat futuristic armour including reactive armour of ranges upto four kilometers. The missile system can be deployed on tracked and wheeled vehicles and helicopters.

MiG-29 vs. F-16

In simulated air combat and what may be described as a most significant lesson for air defence planners of the Indian Air Force, the MiG-29 has proved "superior" to the F-16 in a simulated one-versus-one dogfight. Conducted by the Luftwaffe's aircraft & systems testing centre at Manching, north of Munich in Bavaria, a former East German MiG-29B was matched against a F-16 and the Soviet-built fighter reportedly scored a kill against its US built adversary at a range of 60 km. Although the mark of the F-16 has not been revealed, it is assumed to have been a USAF F-16C which does not, yet, have a beyond-visual range (BVR) capability. Future variants of the F-16C will have an APG-66 radar matched to the AIM-20 Advanced Medium Range Air-to-Air Missile (AMRAAM). Luftwaffe analysts, meanwhile, were said to be "surprised" at the effectiveness of the MiG-29's radar and BVR missile combination.

PAF gets 32 Mirages

The first batch of 32 Mirage IIIO fighters purchased from Australia by the Pakistan Air Force, arrived at Karachi port in late November. The Australian High Commissioner in Pakistan said that the rest of the Mirages would be shipped to Pakistan "soon".

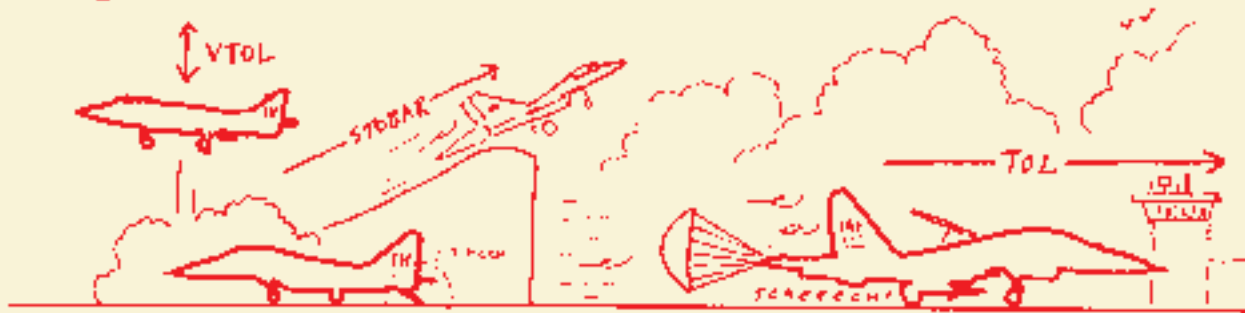
Flash Point in the Gulf

Chairman of the US Joint Chiefs of Staff, General Colin Powell has stated that apart from concentrated and sustained aerial strikes to dislodge Iraqi forces from Kuwait, the USA would "force the Iraqis to consider the consequences of a combined and overwhelming air-land-sea campaign against a powerful coalition force". In an action which was aimed clearly to demonstrate its attitude, two missiles were launched by Iraq from a site west of Basra in the westernly direction and these impacted at a target 300km away (in Iraq), indicating that they were either 'Al Abbas' or 'Al Hussein' derivatives of the Soviet 'Scud B' missile. It is believed that there are some 500-1000 similar missiles in Iraqi inventory, with either conventional HE or chemical warheads.

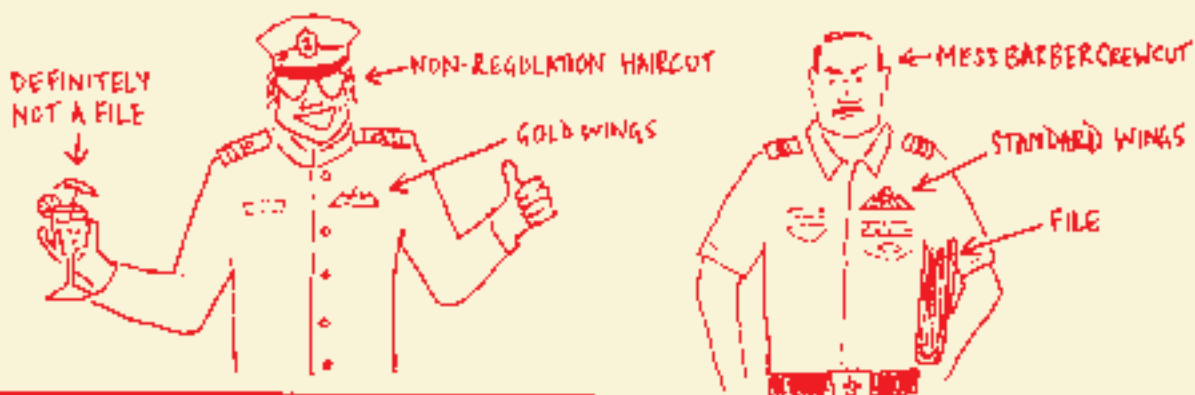
Out of my mind !

3 KEY DIFFERENCES BETWEEN NAVAL AVIATION & THE AIR FORCE

① TAILHOOKS, SKI-JUMPS & VTOL vs. TAIL CHUTES & TOL...



② FANCY UNIFORMS (AND WHITE SHOES...) VS. NOT-SO-FANCY UNIFORMS.....



③ BEACHES VS. BASES.....



Tale Spin

Agyat Udan Vastu

This is the season in India for unidentified flying objects (UFO) “a mysterious object seen in the sky for which it is claimed no orthodox scientific explanation can be found, often supposed to be a vehicle carrying extraterrestrials”. And since there have been a rash of UFO sightings across the country since the past issue of *Vayu*, these can be titled in the vernacular.



In early October 2015, there were ‘star-like’ objects over Puducherry, then a ‘Fireball’ over Bhor in Maharashtra, a ‘Sphere’ over Kanpur, a ‘Disc’ over Lucknow the same day, which changed to a ‘Sphere’ over Chandigarh in mid-November and then as this Issue goes to press, a ‘Triangle’ over Pune. But wait ! The image above has the ‘UFO’ adorned with the tri-colour. So, what and where was this ?

Momos of Tibet

Ever since Tibetan refugees crossed the McMahon Line to flee Chinese repression in the late 1950s, they have lived happily in India, bringing their unique culture and ways with them. Perhaps the most visible of these are their momos, now one of the most sought after snack in India. The fact that the Government has just appointed a former head of the Aviation Research Centre (ARC) as an adviser in the Ministry of Home Affairs (MHA) to handle Tibetan affairs, is delicious affirmation of this relationship !



‘Heli dug dug !’

The recent State elections in Bihar created great expectations in various constituencies which were contested with no holds barred. The results are now well known but easily the most enduring memory is that of the helicopters ! Most crowds gathering to listen to *netas* were more interested in the rotorcraft that brought them than the inevitable speeches and in fact, a former Chief Minister was visibly upset about low turnouts. So the new *modus operandi* was for his helicopter to deliberately circle villages before landing. Apart

from Makhdumpur, similar scenes were witnessed in Jamui and Bhagalpur where there was virtual frenzy as the helicopters hovered.

The real constituency ?

Fighters by Credit Card

Sweden could well become the world’s first cashless society, thanks to the country’s embrace of information technology as well as the crackdown on organised crime and terror. With digital giro systems, early electronic payment services and other advances in online financial services, Swedish banks have been early adopters of advanced IT systems.

With Sweden offering its Gripen multirole fighters to India, could this be a revolutionary relationship between two IT countries as per the manner that next generation fighters are paid for ?!



Breach of Form

In a finding described as “inescapable”, the Bombay High Court held that the nearly 150-year-old Breach Candy Club in south Mumbai with a veritable who’s who of Mumbai as its members can be governed only by Europeans, still. The HC held that the present managing committee with Indians appointed at the helm “prima facie appears to be illegal” and disbanded it ! And this too 68 years after India’s independence.

Hark back to 1942 when a rapidly descending de Havilland Dragon Rapide of the IAFVR Coastal Defence Flight almost jettisoned a 250 lb bomb on the Royal Bombay Yacht Club which then had strict rules barring Indians from its premises.

This is hardly a *Tale Spin* and deserves the full McCoy in a future Issue !



Afterburner



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