

समाचार पत्रों से चयित अंश Newspapers Clippings

दैनिक सामयिक अभिज्ञता सेवा
A Daily Current Awareness Service

Vol. 44 No. 218 12-13 Nov 2019



रक्षा विज्ञान पुस्तकालय
Defence Science Library
रक्षा वैज्ञानिक सूचना एवं प्रलेखन केन्द्र
Defence Scientific Information & Documentation Centre
मैटकॉफ हाऊस, दिल्ली - 110 054
Metcalf House, Delhi - 110 054

With giant strides in self-reliance, DRDO set to galvanise the forces

*The interceptor, a Prithvi Defence Vehicle (PDV)
Mark-II, had a hit-to-kill capable kinetic kill vehicle*

By Anil Bhat

In August 2014, Prime Minister Narendra Modi sent out a strong message to Defence Research and Development Organisation (DRDO) by flaying it for what he referred to as harbouring the “chalta hai” (lackadaisical) attitude. He urged it to complete its projects before time to put India ahead in the world. With technology in defence sector changing fast, India is left behind because products that are “two steps ahead” come into the market “even before we conceptualise a system”, Mr Modi said.

Five years later in March 2019, the Prime Minister announced in a televised address to the nation that the anti-satellite (ASAT) missile test by Indian scientists had destroyed in a three-minute mission a decommissioned satellite nearly 300 km away. He commended India’s first test of such technology as a major breakthrough that establishes it as a space power and the fourth country to have used such an anti-satellite weapon after the United States, Russia and China. Termed as Mission Shakti (Power), the target of India’s first ASAT test by the DRDO on March 27 was a satellite in low earth orbit, which was hit with a kinetic kill vehicle.

India officially confirmed that the ASAT missile used in the test was a Ballistic Missile Defence interceptor and part of the Indian Ballistic Missile Defence Programme. The interceptor, a Prithvi Defence Vehicle (PDV) Mark-II, had a hit-to-kill capable kinetic kill vehicle. The 13 metres long three-stage missile was fitted with two solid-propellant rocket motor stages and the kill vehicle. DRDO chief G. Satheesh Reddy said that although some previously developed sub-technologies were used as a basis, the interceptor was a completely new missile capable of shooting down targets moving at a speed of 10 km per second at an altitude as high as 1,200 km. However, in order to minimise the threat of debris, the interception was performed against an object moving at 7.4 km per second at an altitude below 300 km. Dr Reddy said that the propulsive power of the interceptor missile can be increased to make it capable of targeting satellites at medium altitudes. The missile reportedly hit the satellite with an accuracy of less than 10 cm, which is comparable with the best reported performance of ASAT missiles. Some reports stated that the achieved accuracy was of a few centimetres. Dr Reddy also stated that the interceptor missile is capable of shooting down all the satellites present in Low Earth Orbit.

The 41st DRDO directors’ conference was held on October 15-16. Inaugurating the conference, defence minister Rajnath Singh said DRDO has made the defence forces of the country strong. He congratulated Dr Reddy and his staff for achieving a 100 days’ target and identifying milestones to commemorate 75 years of Independence as well as a roadmap for five years. He also urged the DRDO fraternity to imbibe the working ethos of former President A.P.J. Abdul Kalam and to aim for technologies that remain contemporary for the next 10-15 years.

Reiterating the “Make in India” motto, Mr Singh mentioned that the government is leaving no stone unturned in the areas of investment facilitation, skills enhancement, intellectual property protection and manufacturing infrastructure. Describing DRDO as the main centre for indigenous research and development, he expressed confidence in its likelihood of producing world-class weapon platforms and systems like combat vehicles, missiles, multi-barrel rocket launcher, unmanned aerial vehicle,

radar, electronic warfare systems, combat aircraft, propellants and explosives now and in the near future.

The inaugural function was attended by national security advisor Ajit Doval and the three services chiefs, General Bipin Rawat, Admiral Karambir Singh and Air Chief Marshal R.K.S. Bhadauria all of whom addressed the audience. On October 16, principal secretary to the Prime Minister, Dr P.K. Mishra, too participated.

Mr Doval appreciated DRDO for doing commendable work despite all challenges. He stated that the DRDO has a seminal role in making India technologically strong and that India should develop critical technologies indigenously.

General Rawat felt that DRDO has made major strides to ensure that needs of the services are met by providing various systems like artillery gun system, mines, anti-tank missile systems, and do on. He was confident that the future wars will be won with our indigenous systems.

Admiral Singh stated that the Indian Navy is efficiently using Varunastra, Maareech, Ushus, TAL and various other DRDO developed systems.

Air Chief Marshal Bhadauria appreciated DRDO's work in electronic warfare technologies, radars, composite materials for the light combat aircraft (LCA), airborne early warning and communications system, Astra and various other technologies. He also appreciated the capabilities of LCA Tejas and asked DRDO to develop the next generation aircraft AMCA, harnessing the technologies and experience of LCA.

Dr Reddy spoke about the successful development of many capability enhancing arms and equipment systems made by DRDO and added that for the first time, the theme for the 41st DRDO directors' conference is technology leadership for empowering India.

Two compendia, namely the DRDO-Industry Partnership: Synergy and Growth and DRDO Products with Potential for Export. DRDO Policy and Procedures for Transfer of Technology to support industry, were released and the new website of DRDO was launched. Dr Chitra Rajagopal, DG (Systems Analysis and Modelling) stated that DRDO is committed to equip our Armed Forces with internationally competitive systems so that they have a decisive edge in the battlefield.

Dr Mishra began his talk referring to a new initiative suggested by PM Modi that young scientists below the age of 35 years be given an opportunity to innovate and explore frontier areas and commended DRDO for setting up five young scientists' laboratories working in five niche technology areas like artificial intelligence, quantum technologies, cognitive technologies, asymmetric technologies and smart materials. Dr Mishra then suggested three R's, requirement, resources and relevance, as key factors in determining our country's quest for advancement in emerging technologies.

At the Vibrant Goa Global Expo and Summit 2019, held at Goa University, Taleigao, Goa, between October 17 and 19, DRDO signed 30 licensing agreements for transfer of technology with 16 Indian companies, including three start-ups. This is a major boost of ToT to the defence industry for end use of the Armed Forces.

Indian Armed Forces are procuring ready-to-eat meals, survival ration and emergency flying ration products from companies that have acquired ToT from DRDO. While these products with high nutrition value and higher shelf life cater to the requirements of the Armed Forces deployed in inhospitable terrain, these technologies are also useful for the larger interest of society.

The list of weapons and equipment produced/successfully tested by DRDO since 2016 at least is long and impressive and has proved that where there is political will, sound direction and support from the government, DRDO can make India's armed and security forces stronger and better equipped.

Missile programme a key success: DRDO Chief

What are DRDO's outstanding achievements?

DRDO in the last six decades has achieved major successes in terms of technologies, products, processes and systems. For us, each one of these achievements is important because it has established maturity of technologies within the country and helped us in achieving self-reliance over a period of time. I would consider the missile programme as one of our key success areas. Apart from that we have also developed various kinds of radars for different roles like surveillance, tracking etc. to provide inputs to weapon systems. A number of sonars have also been developed for Indian Navy. In addition, a lot of EW systems for land, air and sea have been developed for surveillance and counter-measures. LCA Mk1, MBT Arjun, Multi-Barrel Rocket System-PINAKA, Ballistic Missile Defence (BMD) Programme and the recently conducted Anti-Satellite Missile (ASAT) programme have been our other major achievements. For most of these systems, we are one among 5-7 countries in the world to have developed such capabilities independently.

Many of DRDO's achievements have proved to be good technology demonstrators, particularly in the field of missiles, but have they been produced in enough numbers?

We are following concurrent engineering to manufacture the missiles through our production partners. Therefore, all the missiles developed by DRDO have been realized with a significant contribution from the Indian Industries. It is important to note that the production order is governed by the procedures of the Defence Procurement Procedure (DPP) and quantities are produced in accordance with the requirements approved by the Government for defence products and systems. Our Industries have the capability to produce the numbers demanded by users based on DRDO technology.

What are the responses from Indian industry for Make in India? In the past, there have been many cases when defence PSUs have been nominated to produce a weapon system or some equipment. What is the present status?

The response from Indian Industries for "Make in India" has been phenomenal. We have been supporting the industries with our technologies in order to enable them to produce indigenous systems for the armed forces. We have been enabling Indian industries with R&D activities also. Defence PSUs have been traditionally nominated to produce weapon systems because required infrastructure for large scale integration was not available in private sectors till a few years ago. The integration requirements for weapon system are capital intensive; which was one of the deterrence for participation of private industries in these fields. However, with the 'Make in India' policy more and more private industries are willing to invest. I am optimistic about the weapon systems being produced by the private industries in the near future.

Which arms/equipment have been produced to counter terrorism and which of them have been/will be produced for Central Armed Police Forces and state police forces?

Many products developed by DRDO have found application in Counter Terrorism and Counter Insurgency operations. Some of the major products for counter terrorism and counter insurgency operations are insas rifles, weapon locating and tracking systems, remotely operated explosive and breaching devices, multi-mode hand grenade, less lethal plastic bullets, remotely operated vehicle, different types of jammers and low-cost surveillance systems. We are also fully prepared to develop new advanced systems or adopt/modify existing systems for different requirements projected by agencies involved in counter terrorism and counter insurgency activities.

What are DRDO's plans for the future?

DRDO has set a target for itself to achieve a complete self-reliance in terms of missiles, radars, sonars, torpedoes, armaments and EW systems. We intend to have no import for these systems in the next four to five years' time. We are working on the cutting-edge technologies which will be required for futuristic weapon systems. We will be offering our technologies to industries for an early realization of products and also to support R&D facilities in the industries. We shall use indigenous resources to develop major platforms and weapon systems. We are also looking at creating a pool of researchers, in the academia, by carrying out joint research in areas of mutual interest. Our focus will also be to support Start-ups through Technology Development Fund (TDF). Time and cost

management of all projects is another priority area for us. We have worked out our plans and roadmap for 2-3 years, 5 years and 10 years to achieve self-reliance for defence equipment.

There was criticism reported in the media about the Arjun Main Battle Tank and the Tejas Light Combat Aircraft. Would you like to share what was the work done on both these systems to make them acceptable to the users.

MBT Arjun is one of the most potent fighting platforms in its class. The inputs of the users have been consolidated and roadmap has been evolved to offer MBT Mk-IA. It has gone through the tests also.

LCA MK-I has been accepted in Indian Air Force and FOC (final operational clearance) was given during Aero India Show 2019. HAL is geared up to produce these aircrafts as per scheduled requirements.

(The writer, a retired Army officer, is a defence and security analyst based in New Delhi)

<http://www.asianage.com/india/all-india/131119/with-giant-strides-in-self-reliance-drdo-set-to-galvanise-the-forces.html>



Tue, 12 Nov 2019

India's DRDO grants free patent access to local industry to boost indigenous production

By Rahul bedi

New Delhi: India's government-run Defence Research and Development Organisation (DRDO) has decided to grant local materiel manufacturers free access to technology for many of its patents in a bid to boost New Delhi's 'Make in India' initiative.

In an internal communication issued in September, but only recently made public, the DRDO said it will waive all licence fees and royalties for several patents.

Official sources told *Jane's* that the DRDO patents include technologies for missile development, aeronautics and naval systems, life sciences, combat engineering, armaments, and electronics and communication systems. The companies will include state- and privately-owned defence equipment manufacturers, start-ups, as well as micro, small, and medium-sized enterprises.

"The availability of DRDO-developed patents to Indian industry at zero cost provides an opportunity for enhancing its capabilities and climbing up the supply chain [for military equipment]," said the DRDO.

India's prevailing intellectual property (IP) landscape has been "characterised by a certain level of disconnect between the IP creators and potential users", it added, pointing out that the policy initiative to provide free patents would "synergise" the Indian defence industry.

According to the DRDO, local manufacturers will only be charged a "processing fee" of INR1,000 (USD13.97) for each of the patents, a list of which is set to be displayed on its website.

Eligible applicants will need to demonstrate their capacity to absorb the respective patent-protected technology, have an "adequate" manufacturing capability, and possess a "robust" quality control mechanism.

<https://janes.ihs.com/Janes/Display/1920681>

DRDO grants free patent access to boost indigenous production

By Vijay Mohan

Chandigarh: To boost indigenous production and give a fillip to the 'Make in India' policy, the Defence Research and Development Organisation (DRDO) has decided to grant the Indian industry free access to patents held for technologies developed by it.

A new policy formulated by the DRDO recently states that no licence fee or royalty will be applicable on the use of Indian patents held by the research agency. There are hundreds of such patents covering missile technology, aeronautics, naval systems, life sciences, armaments, combat engineering, electronics and communication material.

The previous DRDO policy called for managing intellectual property (IP) rights in an effective, efficient and ethical manner to derive full economic potential and consider opportunities for commercial exploitation of IP and wealth creation.

"Earlier, licence fee for patents and royalty could range anywhere from several lakh rupees to over a crore depending upon the type of technology involved, the cost of the project, baseline price and post-production quantum of sales to non-defence sector," a DRDO official said. Now, only a processing fee of Rs 1,000 would be charged.

Pointing out that the current IP landscape in the country was characterised by a certain level of disconnect between IP creators and potential users, the policy states that the availability of the DRDO patents to Indian industry at zero cost provides an opportunity for enhancing their capabilities and climbing up in supply chain.

Policy shift

- Indian public and private entities, including startups, will be granted free licence to DRDO patents
- Firms must have capacity to absorb technology, production capability, quality control mechanisms
- Will be required to submit annual commercial reports to DRDO

Licence fee

Earlier, licence fee for patents and royalty could range from several lakh rupees to over a crore depending upon the type of technology involved, the cost of the project, baseline price and post-production quantum of sales to non-defence sector. A DRDO official

<https://www.tribuneindia.com/news/nation/drdo-grants-free-patent-access-to-boost-indigenous-production/859684.html>

के-4 मिसाइल : समुद्र के भीतर से परमाणु वार की क्षमता

जनसत्ता संवाद

भारत ने हाल में अपनी के-4 परमाणु मिसाइल का परीक्षण किया। आठ नवंबर को आंध्र प्रदेश के तट से पनडुब्बी के जरिए प्रयोगिक तौर पर के-4 परमाणु मिसाइल दागी गई। रक्षा एवं अनुसंधान विकास संस्थान (डीआरडीओ) ने इसे तैयार किया है जिसकी मारक क्षमता 3500 किलोमीटर है। यह दो हजार किलोग्राम का आयुध (वॉरहेड) ले जा सकती है। इस मिसाइल के परीक्षण के बाद भारत पनडुब्बियों से मारक क्षमता बढ़ा चुका है।

इस मिसाइल प्रणाली को अरिहंत श्रेणी की परमाणु पनडुब्बियों के लिए विकसित किया जा रहा है। ये पनडुब्बियां भारत में विकसित की जा रही हैं, जो समुद्री इलाके में परमाणु सुरक्षा छतरी का काम करेंगी। आइएनएस अरिहंत पनडुब्बी को एक बार में चार के-4 मिसाइल से लैस किया जा सकता है। कुछ साल में सेना, वायुसेना और नौसेना को के-4 की सेवाएं हासिल होंगी। अंतरराष्ट्रीय दबाव से के-4 का परीक्षण गुप्त रूप से किया गया और डीआरडीओ ने आधिकारिक रूप से कोई टिप्पणी नहीं की।

डीआरडीओ ने आंध्र प्रदेश के विशाखापट्टनम तट पर समुद्र के भीतर बनाए गए 'अंडरवॉटर प्लेटफॉर्म' से के-4 परमाणु मिसाइल दागी। के-4 के अलावा भारत अन्य एक परमाणु मिसाइल प्रणाली बीओ-5 बना रहा है, जिसकी मारक क्षमता सात सौ किलोमीटर से ज्यादा है। कुछ हफ्ते में डीआरडीओ ने अग्नि-3 और ब्रह्मोस समेत कई और मिसाइलों के परीक्षण की योजना बना रखी है। के-4 मिसाइल प्रणाली पर काम तब शुरू हुआ, जब इसी तरह (के-4 की तरह) की क्षमताओं वाली अग्नि-3 मिसाइल को परमाणु चालित पनडुब्बी आइएनएस अरिहंत

में लगाने में तकनीकी समस्याएं खड़ी हो गईं। अरिहंत का व्यास 17 मीटर है, जिसमें अग्नि-3 फिट नहीं हो पाती। के-4 मिसाइल 12 मीटर लंबी है। इसका व्यास 1.3 मीटर का है। इसका वजन लगभग 17 टन है। ठोस ईंधन के रॉकेट से चलने वाला यह प्रक्षेपास्त्र लगभग दो टन भार का विस्फोटक ले जा सकता है। डीआरडीओ के अनुसार इस मिसाइल का लक्ष्य अचूक मारक क्षमता हासिल करना है।

के-4 के गैस प्रक्षेपक का 2010 में एक पंटून (छोटी पनडुब्बी) से सफलतापूर्वक परीक्षण किया गया। इसके बाद इसका परीक्षण 2014 में 30 मीटर की गहराई से हुआ था। परीक्षण सफल रहा था और मिसाइल हिंद महासागर में तीन हजार किलोमीटर तक पहुंची थी। इसके बाद सात मार्च 2016 को के-4 का एक बार फिर एक प्लेटफॉर्म (पंटून) से बंगाल की खाड़ी में परीक्षण किया गया। अप्रैल 2016 में फिर जानकारी आई कि इसका सफलतापूर्वक परीक्षण 31 मार्च 2016 को आइएनएस अरिहंत से विशाखापत्तनम के तट से 45 नॉटिकल मील की दूरी पर किया गया। परीक्षण में सभी मानकों पर खरी उतरी और शून्य त्रुटि के साथ लक्ष्य भेदने में सफल रही।

खास बात यह है कि के-4 मिसाइल और अरिहंत पनडुब्बी दोनों को देश में ही बनाया गया है। के-4 की रेंज 3,500 किलोमीटर है, साथ ही यह



बड़ा कदम

पूर्व नौसेना प्रमुख एडमिरल अरुण प्रकाश (सेवानिवृत्त) ने इसे एक बड़ा कदम करार दिया है, लेकिन उनके मुताबिक जल्द ही आइएनएस अरिहंत को 5000 किलोमीटर से ज्यादा रेंज की अंतर प्रायद्वीपीय मिसाइल (इंटर बैलेस्टिक मिसाइल) से लैस करने की जरूरत है, ताकि यह पनडुब्बी भारतीय समुद्र के किसी भी हिस्से में अपने लक्ष्य के लिए खतरा साबित हो सके।

दो हजार किलोग्राम गोला-बारूद साथ ले जाने में सक्षम है। के-4 मिसाइल का नाम पूर्व राष्ट्रपति एपीजे अब्दुल कलाम के नाम पर रखा गया है, जिसमें के-4 मिसाइल का कोड नेम है। इस परीक्षण के कामयाब होने के साथ ही भारत पानी के भीतर मिसाइल दागने की ताकत रखने वाला पांचवां देश बन गया है। इससे पहले यह तकनीक अमेरिका, रूस, फ्रांस और चीन के ही पास थी।

Operational air-independent propulsion for Kalvari submarines: A critical technology for underwater stealth

The Made in India AIP system is therefore already planned to be retrofit onboard first submarine which enters a major refit. The indigenous AIP system is still at a developmental stage whilst pending four Submarines under the project are scheduled for commissioning in the next two years

By Huma Siddiqui

New Delhi: The recent announcement by Defence Research and Development Organisation (DRDO) about the Land-Based testing of the indigenous Air-independent Propulsion (AIP) is going to take time before it gets operationally ready to be fitted on the submarines of the Indian Navy.

Before a Defence Quality Assurance (QA) approved 'productionised' version is available for operational exploitation onboard Kalvari-class submarine, the Ministry of Defence/Indian Navy have options open to procure AIP system from an international supplier. "While the preference will be given to the indigenously made AIP, keeping the submarine performance issues in mind in the face of the hostile situation in the waters, options are always open to buy urgently from vendors who meet all parameters," said a top source.

Six Kalvari class (Scorpene) diesel-electric attack submarines (SSKs) under Project 75 are being built by Mazagon Dock Limited (MDL) with the support and technology transfer (ToT) from French company Naval Group (former DCNS). As has been reported earlier, two out of six submarines have been commissioned.

What is the function of AIP?

"An Air-independent Propulsion (AIP) system onboard a submarine allows conventionally powered submarine to operate without access to the outside air. A Kalvari Class submarine when fitted with an AIP system onboard shall be able to run its electric propulsion motor and electrical network while bypassing the conventional batteries. This shall allow it to remain submerged for a longer duration by reducing the need to surface often to take in the air for running diesel engines for charging conventional batteries" explains Milind Kulshreshtha, a C4I expert.

Though the Kalvari class submarines are powered by conventional diesel-electric propulsion systems, as per the original plans, the last two submarines were to be equipped with an indigenously developed AIP technology. This state of the art Fuel-cell based AIP design was taken up by the DRDO for indigenous development since such technology from abroad was extremely expensive. The fuel cell-based AIP uses hydrogen and oxygen to generate electricity has almost no moving parts (making them quieter) and produces minimal waste.

The indigenous AIP system is still at a developmental stage whilst pending four Submarines under the project are scheduled for commissioning in the next two years. The Made in India AIP system is therefore already planned to be retrofit onboard first submarine which enters a major refit.

Tests & Trials of Indigenous AIP System

It has to undergo a well-defined stringent Testing & Trial stage prior to being qualified even for installation onboard (an operational ship or submarine). According to Kulshreshtha, "A system like AIP shall initially be undergoing multiple Land Based Test Site (LBTS) trials to prove its efficacy ashore. This ashore system version shall be re-designed for fitment onboard a Kalvari class submarine and subsequently installed for experimental trials. The risk here with an R&D version system fitted on

an operational vessel is that it may keep going for sea trials as part of multiple iterative improvement cycles, leading to a very undesirable operational situation.”

Indian Navy shall be always eager to enhance the submarine’s operational capabilities (especially in hostile waters) for an active role like intelligence gathering etc. but stuck with an experimental system. Further, it is all too well known that getting an operational vessel tied down ashore for experimental work (as a priority over and above its Operational commitments) is not easy.

Once the R&D version fitted onboard achieves all the desired parameters as per laid down Naval requirements (like noise signatures, efficiency etc.), a ‘production’ version design of indigenous AIP will evolve.

“Then the design shall be handed over to a manufacturing partner (like a Defence PSU) under a ToT for further supply to the Indian Navy. The local Industrial agency shall setup an AIP production division and the first of the system manufactured shall undergo a rigorous Director General Quality Assurance (DGQA) Test Schedule. This procedure includes specialised tests like Type Testing and Environmental Tests. A Type Test procedure establishes the suitability of the manufactured system for Defence application,” the expert adds.

Environmental Checks for Indigenous AIP

As per DGQA procedure, the first AIP system shall undergo Environmental checks like Vibration Test, High Temperature, Damp test, Drip Proof and Tropical test as laid down in the Joint Services Standard (JSS) 55555. While being verified against the laid down Environmental specs, the system usually gets ‘Yellow Banded’ i.e. earmarked as ‘not fit’ for use onboard and kept in the workshop as a reference set.

Installation & Commissioning of AIP

Installation on board a submarine is an involved activity and follows some tough guidelines. The supplier has to provide System Specialists to assist in supervising the work and inspection of work throughout onboard fitment including Connectorisation, Setting to Work, Harbour and Sea Trials. T

Explaining the process, Kulshreshtha adds, “Board of officers from Naval Headquarters, submarine, and Dockyard with assistance from OEM, Shipyard or other suitable agencies shall be constituted for the promulgation of Feasibility of fitment document. This will be further approved by the HQtrs so as to ensure a smooth retro fitment of AIP system. Final acceptance of the system shall be the responsibility of a designated Naval Trial & Testing team for handing over of a completely proven system to the Submarine staff for exploitation and maintenance onboard.”

<https://www.financialexpress.com/defence/operational-air-independent-propulsion-for-kalvari-submarines-a-critical-technology-for-underwater-stealth/1761445/lite/>

DRDO team visits CUJ for setting of Kalam centre for Science & Technology

Jammu: To select the site for Kalam Centre for Science & Technology (KCST) and to recommend the submitted research projects for execution, a DRDO team visited the Central University of Jammu.

The team of ten members was led by Dr Sudhir Kamath, OS & DG, DRDO. The other members of the DRDO team were Dr Shiv Kumar, Dr K K Pathak, Dr Renu Tyagi, Dr GSBS Rawat, Dr Padmavathi, Dr Rajesh Pillai, SAG, Dr Saibal Pal, Amit Sharma, Advisor Cyber and Mohd Ikram.

The DRDO team interacted with the Science faculty and especially with all the Project Investigators (PIs, who presented their research proposal. After thorough discussions and deliberations, DRDO officials recommended three research proposals for execution under vertical 1(Computational System Security). Out of the eight submitted research projects under vertical 2 (Sensors), only four research proposals have been recommended for execution by DRDO experts.

Earlier, DRDO and CUJ had entered into a Memorandum of Understanding (MoU) for establishment of Kalam Centre of Science and Technology (KCST) at its campus on Sept 26, 2019 at New Delhi in the presence of Defence Minister, Rajnath Singh. The sanctioned amount of this centre is Rs 59.94 crores. The site for centre was finalized by the visiting team during this visit. It is expected that the Bhoomi Puja and foundation laying ceremony will be graced by the Defence Minister very soon.

In the end of meeting, Dr K K Pathak briefed the gathering about the future road map of the KCST. The proposed drawings of KCST were also presented by engineering wing of the University. The meeting was also attended by Heads of various Departments, including Prof Devanand, Dean School of Basic and Applied Sciences; Prof B S Bhau, Dean Research Studies, CUJ; Mohd Iqbal (Finance Officer) and Er Vishal Bargoitra (Exen). The vote of thanks was delivered by Dr Ravi Kumar, Registrar of the University.



<https://www.dailyexcelsior.com/drdo-team-visits-cuj-for-setting-of-kalam-centre-for-science-technology/>

Development of Ladakh and DRDO

By Dr. sudarshan Kumar

Ladakh, “the land of high passes” decorates the northern most region of erstwhile Jammu and Kashmir State and India. It carries great historical and geo strategic significance since ancient times. The passes of Ladakh region interconnect some of the economically and politically significant zones of world like South Asia, China, Central Asia and Middle East since time immemorial. This, in the past formed the basis of a constant endeavour of Rulers/ Kings to have Ladakh region as a part of their kingdom thus leading to successive invasions at different times. Consequently, in the year 1834, the Sikh general Zorwar singh under Raja Gulab Singh invaded and conquered it. Later, the execution of treaty between British East India company and Raja Gulab Singh on 16th march 1846 laid the foundation of Dogra rule in the state of Jammu & Kashmir and Ladakh became a part subsequently. The successive Dogra rulers ruled the state for nearly hundred and one years and ladakh remained a princely state till Maharaja Hari Singh signed the instrument of accession on 26th October 1947. During this period, Dogra rulers extended the boundaries beyond Banihal and conquered Gilgit, Baltistan and other northern areas. Thus the state of Jammu and Kashmir became one of the largest state of undivided India and had an area of around 2,22,236 sq km. But post independence era witnessed a wavering and tumultuous course. 72913 sq km area (Gilgit, Baltistan and northern areas especially Hunza and Nagar) was illegally occupied by Pakistan and nearly 33510 sq km area (Aksai Chin) was annexed by China. Furthermore, 3180 sq km area(Shaksgam tract) has been acceded to China by Pakistan. The region of Ladakh owing to its geostrategic location has massive security constraints and immense critical unavoidable security purview. The possession of Ladakh region by virtue of its strategic location can not be ignored as it is a boost to the country’s defence preparedness. Ladakh provides a physical approach to the frozen battle field connecting to the rest of the country. To the west of Siachen Glacier, across the Saltoro ridge lies Pakistan occupied Gilgit and Baltistan, east of it lies China occupied Akasi Chin. The possession of Siachen Glacier by Indian forces has made it impervious to China and Pakistan from linking to Kashgar-Xigate road thus benefiting India. This further endorses the urgency to develop this important land and the recent bifurcation is the first step in this direction. Ladakh shares it’s border with Tibet to the east, Lahul and Spiti district of Himachal Pradesh in south, Jammu and Kashmir and Baltistan to the west and south west corner, Xingjing Karakoram pass in the north. Ladakh is the coldest desert with the highest elevation at Salro Kangri (7742M) and the lowest elevation (Indus river) of 2250M, a total population of around 274289. The height of the terrain and it’s undulating areas thus characterizes harsh climatic conditions encompassing low humidity (20-40 %), low atmospheric pressure (493 mm Hg), high wind velocity, very low annual precipitation and sub zero temperatures of up to -40oC during winter months. The harshness of conditions can be adequately acknowledged by the plight of a man sitting in the sun with his feet in shade, who can have sun stroke and frost bite at the same time. These harsh conditions are further ameliorated by the sparse and scanty vegetation leading to very low moisture in the atmosphere. Rains are rare. Also snow fall may occur in the months of July and August due to high mountains all around. It also experiences heavy snow fall during winter. Thus the area remains cut off from the outside world for nearly six months. More over 90% of the population is constituted by the tribes scattered throughout the region . Therefore the biggest challenge for the authorities is how to improve the socio economic conditions of the masses living in this harsh environment. The creation of Union Territory of Ladakh by Modi 2.0 government for speedy development of this highly strategic region is a first step in this direction. Hence the cost effective sustainable technology will be the key

for carrying out sustainable development in the field of agriculture, water management, connectivity, waste management, health care, education and employment generation. DRDO had developed number of technologies, which can foster the development of this newly created Union Territory of Ladakh in the above mentioned fields. Firstly, in the field of agriculture especially for growth of vegetables, and animal fodders, Agro Animal technologies developed by Defence Institute of High Altitude Research (DIHAR)Laboratory of DRDO have found wide acceptance among the local farmers of Ladakh region who are able to grow 48 different types of vegetables through out the year. Annually these farmers are producing around 4500 MT vegetables and 1192 MT of animal fodders and 25% milk. This has also helped in employment generation in the region, besides upliftment of their socio-economic conditions. The farmers are earning around 70-80 million rupees every year. The model of production by farmers and supply through co-operative society is very well functional in UT Ladakh. This model can be replicated in high mountain regions in other parts of the country as well. Besides DIHAR has also established Dairy Herds for distribution of high yielding progeny, developed Packages for practice for rearing of poultry in high altitude, Survival garden for medicinal plants and Solar Poly House Dryer for high altitude areas.

Secondly, there is scarcity of water in this cold arid region. Hence judicious use of water in irrigation, drinking and daily use is an inescapable necessity. Hence, standardized low cost Drip Irrigation System(DIHAR)and Back Pack type high altitude Water Purifier(DLJ) with capacity around 12-18 l/hr have been developed to cater the needs of people in high altitude areas.

Thirdly, the connectivity to this remote area is the back bone for sustainable all round development. Although Border Road Organization and State Government departments are primarily responsible for improving the connectivity of remote areas of this highly sensitive region yet for emergency purpose High Yield Polymer Concrete Composite (developed by Defence Laboratory Jodhpur (DLJ),a DRDO laboratory has a lot of potential application.

Fourthly, the most important aspect is the establishment of ultra infrastructure in medical diagnostics in Ladakh region. Also inter connecting the various health cares units with tele medicine system for providing health care to the door step will bring revolution in health care sector . The authorities at the helm of affairs in the new UT must examine this aspect. This type of technology is available in the country and can be customized as per requirement. Besides, Central Government Health Scheme (CGHS) must be extended to both serving and retired employee of Union Territory of Ladakh and Jammu and Kashmir by opening number of CGHS wellness centers in the Union Territories.

Fifthly, niche technologies viz Alcohol Gel for food warming , Biodigester technology for resolving the problem of un-decomposed human waste , Hybrid Generators for en cashing Solar Power and numerous other technologies are available in the country for use in high altitude areas. Lastly we need to mention about abundant potential for tourism development in this region which needs to be explored. Various measures for its promotion should be undertaken which will further aid in the region's all round development.

The author is of the opinion that Modi 2.0 Government's decision of complete integration of Jammu and Kashmir with Union of India and bifurcation in two Union Territories viz Ladakh and Jammu & Kashmir is mainly to expedite all round development in these two union territories and also to ensure the fruits of innovative technologies are harnessed in each region by each section of society. Hover ever the implementation of program and adaptation of technologies will depend on the mind set of initiator and acceptor.Also bottom up consortium approach for initiation of new projects in the region will yield faster and meaning full results as compared to that of top down approach. (The author is former Director General DRDO & Special Secretary MOD GoI)

<https://www.dailyexcelsior.com/development-of-ladakh-and-drdo/>

IIT Mandi Invites applications for national workshop on aerospace

The workshop will help participants to understand and implement state-of-the-art concepts of design, manufacturing and conditioning monitoring pertaining to advanced composite for aerospace application

IIT Mandi is calling for applications for the National Workshop on 'Advanced Composites for Aerospace: Design, Manufacturing and Condition Monitoring Perspective'.

The workshop will be held from 11th to 15th February 2020. Interested participants can apply through the workshop website on or before 30th November 2019.

Designed especially for engineers and researchers, the objective of this workshop is to introduce state-of-the-art concepts of design, manufacturing and conditioning monitoring pertaining to advanced composite for aerospace application.

The Institute is expecting to host eminent scientists from Aeronautics Research & Development Board (the aerospace research wing of DRDO) who will provide the exposure to cutting edge research perspectives on composites in the aerospace industry.

The subject experts delivering lectures in this workshop include:

- S.C. Jain, Professor, School of Engineering, IIT Mandi
- Dr. Himanshu Pathak, Assistant Professor, School of Engineering, IIT Mandi
- Dr. Subhamoy Sen, Assistant Professor, School of Engineering, IIT Mandi
- Dr. Sunny Zafar, Assistant Professor, School of Engineering, IIT Mandi
- Dr. Rajeev Kumar, Associate Professor, School of Engineering, IIT Mandi
- Dr. Viswanath Balakrishnan, Associate Professor, School of Engineering, IIT Mandi
- Dr. Vishal Singh Chauhan, Associate Professor, School of Engineering, IIT Mandi
- Dr. Makarand Joshi, AR&DB, DRDO
- Dr. S.K. Pandey, AR&DB, DRDO

Speaking about the importance of this workshop, Dr. Subhamoy Sen, Workshop Coordinator and Assistant Professor, School of Engineering, IIT Mandi, said, "To materialize the aspiration of making India a global manufacturing hub, the in-house development of state-of-the-art design and manufacturing concepts for all spheres of industry is being encouraged. The civil, defence and commercial aerospace industries are also pushing their limits to compete with the world leaders in this domain."

"Over the last decade, composite materials have found large scale applications in aerospace industries. With the advent of cheap sensor technologies and powerful computational facilities, condition monitoring has come up as another avenue to ensure safety and serviceability of composite materials in use in the aircrafts," he added.

The one week workshop has been designed to introduce theoretical and practical aspects of composite material research to engineers and researchers to make them equipped to solve problems. This workshop will be particularly beneficial for engineering students, engineers and scientists working in various institutions.

The workshop is open to faculty members, students from Engineering Institutes, Colleges, Polytechnics and Practicing Engineers and Researchers from Industries and R&D Institutions.

The workshop will also provide a thorough idea of Micro-Macro mechanics-based analysis of composite using ANSYS and DIGIMAT software; hands-on experience of Condition Monitoring of composites and Manufacturing techniques for a wide range of composite materials.

At the end of this workshop, the participants will be in a position to identify and select appropriate manufacturing technique for the composite materials, implement design and conditioning monitoring criterion to ensure efficient mechanical performance.

The primary objective of this workshop includes:

- Introduction to Composite Materials: Basics and Fundamentals
- Manufacturing techniques for Polymer Matrix Composites, Metal Matrix Composites and Ceramic Matrix Composites
- Mechanics of Composite Materials
- Introduction to Finite Element Method for the design analysis of Composite materials
- Micro-macro mechanics-based analysis using ANSYS and DIGIMAT software
- Condition monitoring of composites and application of machine learning
- Hands-on experience with composite condition monitoring
- Exposure to cutting edge research on composites in aerospace industries (will be presented by Scientists from Aeronautics Research & Development Board, DRDO)

Intimation of selection will be communicated to the participants by 5th January 2020.

<http://bweduction.businessworld.in/article/IIT-Mandi-Invites-Applications-For-National-Workshop-On-Aerospace/11-11-2019-178767/>

Navy's woman officer to be posted abroad as defence attache

By Rajat Pandit

New Delhi: The Navy has now also selected its first woman officer for the post of a defence attaché abroad, which comes a month after the IAF posted Wing Commander Anjali Singh as the deputy air attaché at the Indian embassy in Moscow.

Sources said Lt-Commander (equivalent to an Army Major) Karabi Gogoi, a naval engineer currently posted at the Karwar base in coastal Karnataka, has been selected for the post of the assistant naval attaché also at the Indian embassy in Russia. “Lt-Commander Gogoi will finish her Russian language course this month. She is likely to take over the new post in Moscow in December after requisite approvals,” said a source.



The appointments of Wing Commander Singh and Lt-Commander Gogoi are the first time that woman officers have been selected for defence diplomacy in the male-dominated environs of the armed forces. If the former as an aeronautical engineer specializes in handling fighter jets, the latter has experience in warship construction and maintenance.

Lt-Commander Gogoi, who grew up in Guwahati, was commissioned into the Navy in 2010. Her husband, Lt-Commander Pranjal Handique, is also a gunnery officer in the Navy. “She was selected over other candidates for the diplomatic assignment after an interview conducted by a board of senior naval officers,” said the source.

India has well over 100 defence attachés or advisors (DAs) posted in different countries across the globe, with some countries like the US, UK and Russia having representatives from all the three Services, the Army, Navy and IAF.

DAs act as the main interface with the host country’s military authorities, while also assisting in security and protocol tasks as well as keeping track of the military technology available in the country. Russia, of course, is a long-standing strategic partner of India, having been the primary source for acquisition of weapon systems since the 1960s.

<https://timesofindia.indiatimes.com/india/navys-woman-officer-to-be-posted-abroad-as-defence-attache/articleshow/72027986.cms>

Centre may create single agency for cyber defence

The new policy – National Cyber Security Policy 2020 - will emphasize cyber security awareness and hygiene. It is likely to suggest a cybersecurity course for schools and colleges curriculum

By Sudhi Ranjan Sen

New Delhi: India may soon have a single authority or agency responsible for the entire spectrum of defensive cyber operations in the country, a senior official in a security agency said on condition of anonymity.

The move comes even as India faces renewed threat of cyber attacks and cyber terrorism. For instance, the breach in a part of a network of India's largest civil nuclear facility, the Kudankulam Nuclear Power Plant (KNPP) in Tamil Nadu, in September. The attack did not compromise critical systems, but gained access to the plant's administrative network.

According to the official cited in the first instance, the government's plan is to rearrange and reorganize over a dozen agencies engaged in the protecting India's cyber infrastructure.

Currently, these agencies have their individual control and reporting systems. The idea is to restructure these to ensure better coordination and functioning, the official added.

The Ministry of Electronics and Information Technology, the Ministry of Home Affairs, the Ministry of Defence, the National Security Council Secretariat (NSC), and the National Technical Research Organization (NTRO), and several other departments and agencies have their own cyber units that look at various aspect of cyber security.

Then there are specialised units including the Computer Emergency Response Team, India (CERT.IN), National Critical Information Infrastructure, and the National Cyber Coordinator Centre.

More are being added by the day. For instance, MHA recently launched CyCord (Cyber Cooperation Centre) under the Intelligence Bureau (IB). CyCord is a platform of several agencies and government departments. It plays a defensive role in the cyber world, and focused on hacking and online investigations. The ministry already had the National Cybercrime Threat Analytics Unit (TAU), the Platform for Joint Cybercrime Investigation Team, the National Cybercrime Forensic Laboratory and the Cybercrime Ecosystem Management Unit.

National Cyber Security Coordinator, Lieutenant General Rajesh Panth has now been given the job of working out a structure that brings together the capabilities of all these units and agencies. "The primary task of the National Cyber Security Policy 2020 will be to bring in cohesion," the official cited in the first instance said. He added that "there have been several rounds of discussions at the National Security Council Secretariat (NSCS) on the issue and a broad framework has already been worked out."

The last National Cyber Security Policy was released in 2013. The new policy – National Cyber Security Policy 2020 - will emphasize cyber security awareness and hygiene. It is likely to suggest a cyber security course for schools and colleges curriculum.

The reorganisation will need the assent of the Union Cabinet before being implemented.

"The reorganization must also deal with the fact that the Information Technology Act is under the Ministry of Electronics and Information Technology (MEITY). In the current parliamentary system, the ministry responsible for implementing the law generally gets to regulate and execute it," a second senior official associated with Indian cyber security efforts said, asking not to be identified.

"We are studying models across the world before we arrive at a structure," a third senior official directly involved in the process of coming up with the plan said on condition of anonymity.

“Globally, the trend is to have overarching agencies for better and command and control. It is time we also have a similar structure. India’s capabilities in the cyber world have expanded and there are a large number of agencies, but sharing real-time information is always not enough. Cyber defence capabilities is a critical strategic requirement. I think this a very positive move,” said Aruna Sudarajan, a former telecom secretary.

Across the world, the command control of defence cyber operations has been put under a well defined single command and control. For instance, the Government Communications Headquarters (GCHQ) of the United Kingdom is responsible for all things related to protecting cyberinfrastructure. Similarly, the Cyber Security Agency of Singapore reports to the Prime Minister and is responsible for the complete spectrum of defensive cyber operations. The National Security Agency of the US has the complete command and control.

<https://www.hindustantimes.com/india-news/centre-may-create-single-agency-for-cyber-defence/story-pD3QUcNvU2a9THFCF01SMO.html>

THE ECONOMIC TIMES

Tue, 12 Nov 2019

India to fund 250 defence startups over next 5 years

The defence ministry will be earmarking at least Rs 500 crore for its Innovations for Defence Excellence (iDEX) initiative. Expressing his support for the initiative, defence minister Rajnath Singh said at a function on Monday that India could emerge...

By Manu Pubby

India will fund at least 250 defence startups over the next five years as it seeks new technologies to give a cutting edge to the armed forces. The plan is to achieve at least 50 ‘tangible innovations’ by the startups that can be inducted over the coming years.

The defence ministry will be earmarking at least Rs 500 crore for its Innovations for Defence Excellence (iDEX) initiative and will try to bring together innovators with public and private sector industry and the armed forces to find new technology solutions.

Expressing his support for the initiative, defence minister Rajnath Singh said at a function on Monday that India could emerge as a \$10 trillion economy over the next 10-15 years if innovation talent is harnessed.

“Looking at the talent India possesses, I am pretty confident that we can become \$10 trillion economy in the next 10-15 years,” the minister said at the government’s ‘Def Connect’ seminar, emphasising that the need of the hour is to strengthen research and development in defence manufacturing.

Singh said India needs to change course from being a net importer to a net innovator and exporter of defence technologies in the near future.

<https://economictimes.indiatimes.com/news/defence/india-to-fund-250-defence-startups-over-next-5-years/articleshow/72016505.cms>

Indian Army's M777 regiment to get 3 made-in-India guns

Of the 18 howitzers with which the army is raising its first regiment, 15 are being supplied by BAE Systems and three by its Indian partner Mahindra Defence, said the second official, also on condition of anonymity

By Rahul Singh

New Delhi: The Indian Army's first regiment of ultra-light howitzers is expected to consist of 15 ready-built M777s supplied by the US, and three locally built guns that will represent the country's Make in India push for military hardware, two officials familiar with the move said.

The howitzers will be delivered to the army by the year-end, enabling the force to raise the first of its planned seven M777 regiments early next year, said one of the officials cited above who asked not to be named.

India ordered 145 howitzers from the US for \$750 million in November 2016. As part of the deal, M777 manufacturer BAE Systems will supply 25 ready-built howitzers and the remaining 120 guns are being built locally in collaboration with Mahindra Defence Systems Limited under the Modi government's Make in India initiative.

Of the 18 howitzers with which the army is raising its first regiment, 15 are being supplied by BAE Systems and three by its Indian partner Mahindra Defence, said the second official, also on condition of anonymity.

A spokesperson for Mahindra Defence declined to comment.

"The parallel induction of imported howitzers and the locally assembled ones serves the army's interests. The rate of production will be higher and delivery faster under such an arrangement. Also, if there are any issues with the howitzers, the army can quickly reach out to the original equipment manufacturer and the Indian partner," said Lieutenant General Subrata Saha (retd), who was the army's deputy chief when the M777 deal was inked three years ago. The army is likely to get all the 145 howitzers by the end of 2021.

Saha also said that the M777s were an important part of the army's field artillery rationalisation plan (FARP) as the guns were designed for flexible deployment in mountainous terrain.

The 155 mm/39-caliber howitzers can be sling-loaded to Boeing CH-47F (I) Chinook helicopters and swiftly deployed to high-altitude areas to provide accurate artillery fire support. India ordered 15 Chinook helicopters from the US for \$1.18 billion in September 2015. Six of them have already been delivered.

The army is preparing to deploy its new M777s in eastern Arunachal Pradesh and the howitzers could prove to be a game-changer in the sector due to their tactical mobility, as reported by HT on October 7.

The howitzers have a range of 24-30 km.

The ~50,000-crore FARP lays down the road map for inducting new 155mm weaponry, including tracked self-propelled guns, truck-mounted gun systems, towed artillery pieces and wheeled self-propelled guns. The plan seeks to equip 169 artillery regiments with a mix of nearly 3,000 guns over the next eight to 10 years.

The M777s were the first artillery guns to be ordered after the Bofors scandal unfolded in the late 1980s. These howitzers have superior tactical mobility as they are made from titanium and aluminum

alloys and weigh only 4,218 kg, which is half the weight of conventional artillery guns deployed in the northern and eastern sectors.

Apart from the M777s, some of the other Make in India projects include local production of AK-203 assault rifles and K9 VAJRA-T artillery guns.

<https://www.hindustantimes.com/india-news/m777-regiment-to-get-3-made-in-india-guns/story-xhNr4drnZCckqN3qErlfyK.html>

Business Standard

Wed, 13 Nov 2019

Tata, Adani, Bharat Forge, Mahindra in race for Rs 25k-cr Navy chopper deal

*The Navy will now take the case to the Defence Acquisition Council
with the shortlisted names of both Indian and foreign manufacturers*

Four Indian firms including Tata, Adani, Mahindra Defence Systems and Bharat Forge have been shortlisted by the Indian Navy as strategic partners for the project involving a deal worth Rs 25,000 crore for indigenous manufacturing of 111 Naval Utility Choppers.

Under the first project of the strategic partnership policy of the Narendra Modi government to develop indigenous industry's defence manufacturing capacity, 111 light helicopters have to be built indigenously through joint ventures between Indian and foreign firms.

"The four Indian firms will now need to partner with foreign original equipment manufacturers including European Airbus Helicopters which has offered two choppers, American Sikorsky-Lockheed Martin and Russian Rosoboronexport," sources in the Navy told ANI.

The Navy will now take the case to the Defence Acquisition Council with the shortlisted names of both Indian and foreign manufacturers for the ambitious project to get the approval from the government for its shortlist and take the process forward.

Sources said a total of eight Indian companies had shown interest in becoming strategic partners including a public sector undertaking but only four have been shortlisted by the force which will use the new choppers to replace its fleet of Cheetah/Chetak helicopters.

The Strategic Partnership model was first envisaged under the leadership of late Manohar Parrikar during his stint as defence minister and gained shape later under Nirmala Sitharaman.

The strategic partnership model envisages tie-up between Indian and foreign firms leading to the acquisition of niche technologies and setting up of modern production facilities in India.

Under the plan, the first 16 helicopters have to be delivered from the OEM's overseas production facility and the remaining 95 helicopters are to be manufactured in India by the selected strategic partner firm.

https://www.business-standard.com/article/news-ani/four-indian-firms-including-tata-adani-in-final-race-for-rs-25k-crore-chopper-deal-for-navy-119111200787_1.html

India concludes price negotiations to acquire 62 C-295 transport aircraft

The Defence Ministry has concluded cost negotiations with TATA and Airbus for the purchase of Airbus C-295 transport aircraft as part of the long-delayed Avro replacement programme of the Indian Air Force (IAF).

“Cost negotiations for the C-295 deal have been completed. It is now being processed to put it up for clearance from the Cabinet Committee on Security (CCS). It is expected to be signed in the next few months,” a senior Defence official said.

Initially, after the completion of cost negotiations, it was felt that a waiver from the Defence Acquisition Council (DAC) would be needed on some technical issues. But Defence sources said the issue “has now been resolved.”

The IAF has 56 Avro transport aircraft which are in urgent need of replacement. A further six aircraft for a maritime mission role for the Indian Coast Guard have been added taking the total number required to 62, estimated to cost upwards of \$3 billion.

Funds Crunch

While sources expressed optimism that the deal would be signed in this financial year, it is contingent on the availability of funds. The IAF has a situation where committed liabilities for this year are more than the capital allocation in the budget and few big ticket deals are on the agenda. For instance, the IAF recently concluded a deal for five additional Akash Surface-to-Air systems and a deal for 83 Light Combat Aircraft (LCA)-MK1A is expected to be concluded this fiscal.

As part of the deal, 16 aircraft will be built by Airbus at its manufacturing facility and delivered in fly away condition and the remaining will be built locally by the TATA-Airbus joint venture under transfer of technology.

The sole bid by Airbus and TATA with the C-295 aircraft for the Avro replacement programme was approved by the DAC in May 2015, but the contractual negotiations have been repeatedly delayed. The Request For Proposal (RFP) was issued to global firms in May 2013.

This deal has become even more critical as a separate project to jointly co-develop and produce a Medium Transport Aircraft (MTA) of 20 tons with Russia to replace the An-32s in service was scrapped after initial design discussions.

While the An-32s are being upgraded and are not due for immediate replacement as they have residual air frame left, the IAF has no future MTA lined up. In the absence of a new MTA development project, there is discussion on making the C-295 the replacement for the An-32 fleet in future.

Building The Aircraft

The MTA program envisages the direct import of 16 C295s and the local assembly/licence-building of the remaining 46 aircraft at a facility set up by the JV near Bangalore. In keeping with the 2013 MTA tender, 24 of these will be imported in kit form for local assembly and include a 30% indigenous content. The level of indigenous content is then expected to double to 60% in the remaining 22 platforms. Delivery of the first locally assembled C295 is expected to begin within 60 months of the contract being signed, industry sources said.

Senior IAF officers said that while the IAF's C295 version will fulfil its requirement for a tactical airlifter, the ICG variant is expected to operate as a multi-mission maritime aircraft.

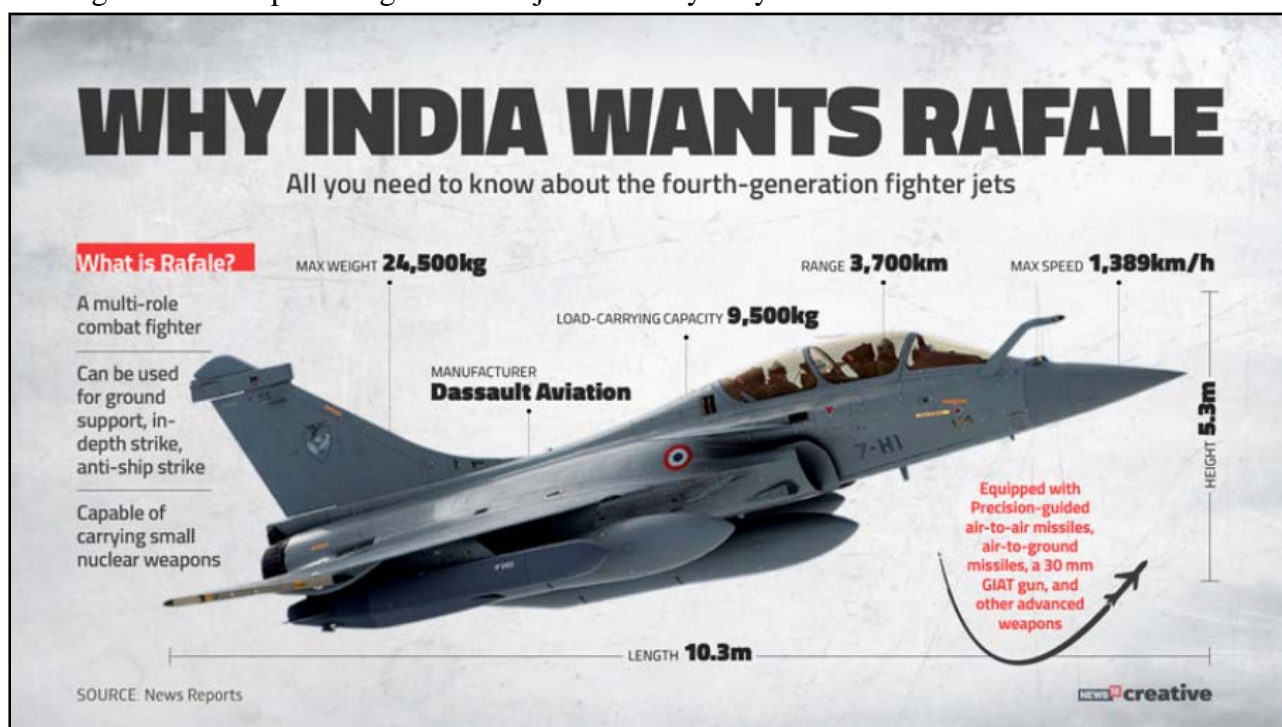
<http://www.indiandefensenews.in/2019/11/india-concludes-price-negotiations-to.html>

With the induction of Dassault Rafale, IAF's firepower has increased exponentially: Here's how

India chose Dassault Rafale over Lockheed Martin's F-16 used by Pakistan Air Force, Boeing's F/A-18, Eurofighter Typhoon, Russia's MiG-35 and Sweden's Saab Gripen

By Arjit Garg

Defence Minister Rajnath Singh received the first of 36 Rafale fighter jets and flew a sortie in the MMRCA fighter jet from a French airbase in Paris to gain first-hand experience of the aircraft. Rafale is handed over to Singh on the foundation day of the Indian Air Force. The first Rafale bears a tail number 'RB 01', where 'RB' stands for Air Chief Marshal R.K.S. Bhadauria, who played an important role in negotiations for procuring 36 Rafale jets in the flyaway condition.



India had signed an inter-governmental agreement with France in September 2016 for procurement of 36 Rafale fighter jets at a cost of around Rs 58,000 crore. The aircraft is capable of carrying a range of potent weapons and missiles and the first squadron of the aircraft will be deployed at Ambala air force station, considered one of the most strategically located bases of the IAF. The Indo-Pak border is around 220 km from there. The second squadron of Rafale will be stationed at Hasimara base in West Bengal. Here's a look at the history and specifications of the Dassault Rafale to understand what makes this Fighter Jet so special for the Indian Air Force.

Importance of Rafale

After the Indian Air Force struck a Jaish-e-Mohammed camp in Balakot in February this year, Prime Minister Modi said, "Rafale fighters could have delivered even better results". His reference was apparently to the stealth of Rafale, an air-dominance aircraft manufactured by French aircraft manufacturer Dassault Aviation. Since India was waiting for deliveries of Rafale when the attacks

happened, the Indian Air Force deployed a dozen Mirage-2000 aircraft, made by the same company to hit the targets.

Rafale is a Medium Multi-Role Combat Aircraft (MMRCA) that is said to boost India's air dominance exponentially, currently safeguarded by fighter jets like Russia made Sukhoi Su-30MKI and MiG 29, along with French Mirage-2000 and indigenously built HAL Tejas.

Origin of Rafale

Rafale is a French word meaning "gust of wind" and is a French-origin Delta winged, twin-engine multirole fighter aircraft manufactured and designed by Dassault Aviation. The initial requirement of Rafale came into light in the mid-1970s, when both the French Air Force and Navy expressed a requirement for a new generation of fighters. In early '80s Dassault was formally announced to build aircraft for the French government and the testing started in 1991. The production of the first aircraft series started in late 1992 but was suspended in 1995 due to political and economic uncertainty.

The production was restarted in 1997 after an initial order of 48 aircraft was placed by the Ministry of Defence followed by further order of 59 Rafale in 2004 and 60 aircrafts in 2009. The French Air Force first operational Rafale squadron, EC 1/7 "Provence", was stationed at Saint-Dizier airbase in 2006. Along with the French Military including Air Force and Navy, countries like Egypt and Qatar are the current operators of the Rafale MMRCA, while India will join the list this year itself.

Combat Proven

The Dassault Rafale has been combat-proven and has actively taken part in many wars in the last 13 years. From 2006 to 2011, French Air Force and Navy Rafale fighters were engaged in countless combat missions in Afghanistan where they demonstrated a high proficiency. In 2011, French Air Force and French Navy Rafale fighters were engaged in coalition operations over Libya. They were the first fighters to operate over Benghazi and Tripoli and carried out the whole spectrum of missions. French Air Force Rafales have taken a leading role in Mali, helping destroy enemy infrastructure and support friendly troops in contact. More recently, Rafales were engaged in support of peace-keeping operations in the Central African Republic, and as part of a wide international coalition in Iraq.

India and Rafale Deal

Though the idea to induct additional fighter jets in the IAF has been since 2001, the actual process began in 2007. The current IAF fleet largely consists of heavy and light-weight combat aircraft. So the defence ministry considered bringing in intermediate medium-weight fighter jets. The Defence Acquisition Council, headed by then Defence Minister AK Antony, approved the 'Request For Proposal' to buy 126 aircraft in August 2007. This kick-started the bidding process. The plan included acquiring 126 aircraft, 18 of them in fly-away condition and the rest to be made in India at the Hindustan Aeronautics facility under transfer of technology.

Dassault's Rafale was not India's only choice as several international aviation manufacturers expressed interest upon knowing the Indian government's mammoth plan to revamp its air force fleet by introducing MMRCAs. Six renowned aircraft manufacturers competed to bag the contract of 126 fighter jets, which was touted to be the largest-ever defence procurement deal of India. The initial bidders were Lockheed Martin's F-16s, Boeing's F/A-18s, Eurofighter Typhoon, Russia's MiG-35, Sweden's Saab's Gripen and Dassault's Rafale.

All aircraft were tested by the IAF and after careful analysis on the bids, two of them — Eurofighter and Rafale — were shortlisted. Dassault bagged the contract to provide 126 fighter jets as it was the lowest bidder and the aircraft was said to be easy to maintain. After Rafale won the contract, the Indian side and Dassault started negotiations in 2012. Though the initial plan was to buy 126 jets, India scaled it down to 36, that too in ready condition. The first squadrons of the Rafale are set to join the IAF fleet by 2019.

Specifications

The Rafale is a modern fighter jet known for its agility, speed, weapon holding capacity and attack capability. The Dassault Rafale has a delta wing design and is capable of g-forces as high as 11g (in case of emergency). The Rafale is available in both single and dual seating cabin (India ordered 28 single and 8 dual seater Rafale). The Rafale is 15.27 metre long and a wingspan of 10.80 metre. The empty weight of Rafale ranges from 9900 kg to 10600 kg depending on the variant and maximum take-off weight of 24500 kg.

The Rafale is powered by two SNECMA M88 engines, each capable of providing up to 50 kilonewtons (11,000 pounds-force) of dry thrust and 75 kN (17,000 pounds-force) with afterburners. The engines push the Rafale to attain a high speed of 1.8 Mach (1912 kmph) and a range of more than 3700 km with 3 drop tanks.

Dassault has also loaded the Rafale with a Martin-Baker Mark 16F "zero-zero" ejection seat, capable of operation at zero speed and zero altitude. In terms of weapons, the Rafale can be equipped with air-to-air missiles, air-to-ground missiles, and air-to-surface missiles along with Nuclear weapons. For avionics, the Rafale is also equipped with AESA radar, SPECTRA Electronic Warfare System andIRST System.

The Rafale jets will come with various India-specific modifications, including Israeli helmet-mounted displays, radar warning receivers, low band jammers, 10-hour flight data recording, infra red search and tracking systems among others. With Input from PTI

<https://www.news18.com/news/auto/with-the-induction-of-dassault-rafale-iaf-firepower-has-increased-exponentially-heres-how-2381681.html>

Kudankulam plant safe, India tells Russia after reports of cyber attack

A part of a network at the Kudankulam in Tamil Nadu, India's largest civil nuclear facility, was breached earlier this year during a hacking attack believed to have originated on foreign soil

New Delhi: Indian authorities have informed their Russian counterparts that the Kudankulam nuclear power plant was secure following reports of a recent cyber attack and that measures had been put in place to prevent a repeat of such incidents, a top Russian diplomat said on Tuesday.

A part of a network at the Kudankulam in Tamil Nadu, India's largest civil nuclear facility, was breached earlier this year during a hacking attack believed to have originated on foreign soil. The attack did not compromise critical systems linked to the functioning of the plant but compromised the facility's administrative network.

"NPCIL (Nuclear Power Corporation of India Limited) has assured us that the plant is safe. Measures have been taken to prevent a repeat of such events...There is nothing to worry about," Roman Babushkin, the deputy chief of the Russian mission in New Delhi, told reporters.

"We are working with Indian agencies to stop any further attacks and the agencies of the two countries are interacting regularly," he said, adding cyber security and information security was one of the key areas of cooperation between India and Russia.

Russia's state-run firm Atomstroyexport is playing a key role in the construction of the 6,000-MW Kudankulam project, which will have six VVER-1000 nuclear reactors supplied by Moscow. Two of the reactors are currently operational, two more are being constructed and preliminary work and planning has started for the remaining two.

Babushkin said Russia was closely involved in creating the multiple layers of security for "physical and software safety" of the nuclear power plant and in training Indian personnel to operate and secure the facility.

Russia, he said, is in talks with India to build up to 20 civil nuclear reactors. "We are waiting for the government of India to identify a new site for building another plant with six reactors," he said.

"Serial production has several benefits in terms of long-term planning and pricing. Russia is the only country making nuclear plants in India, which is looking for alternative sources of energy. Civil nuclear power is one of the basic pillars of cooperation between the two countries," Babushkin said.

<https://www.hindustantimes.com/india-news/kudankulam-plant-safe-india-tells-russia-after-reports-of-cyber-attack/story-HoI99WnaLC8K2mRPUVe6PJ.html>

Tue, 12 Nov 2019

India-US exercise Tiger Triumph takes off from India's eastern seaboard

First-ever India US joint Tri services Humanitarian Assistance and Disaster Relief (HADR) Exercise code-named 'TIGER TRIUMPH' scheduled on the Eastern seaboard will start from Nov 13-21, aimed to develop interoperability for conducting HADR operations. The announcement for this tri-lateral drill was made by the US President Donald Trump at the 'Howdy, Modi' even in Texas recently. Indian Armed forces have such tri-service exercise with Russia.

The Tri-service drill has been organised under the aegis of the headquarters of the Integrated Defence Staff. "From the Indian Navy ships including INS Jalashwa, Airavat and Sandhayak has been despatched. Also, Indian Navy's P8i long-range maritime reconnaissance is participating in the drill," said the official spokesperson of the Indian Navy.

The Indian army is sending around 400 troops, including Army's signal, medical and communication arms from 19 Madras and 7 Guards, and Indian Air Force (IAF) MI-17 helicopters and Rapid Action Medical Team (RAMT) are going to participate in the exercise. And US Navy Ship Germantown with troops from the US Third Marine Division is coming.

During the three day Harbour Phase at Visakhapatnam from Nov 13-16, the opening ceremony along with a Joint Flag Parade and Media Interaction will be held onboard INS Jalashwa on Nov 14. Also, according to officials, personnel from both navies would also participate in training visits, subject matter expert exchanges, sports events and social interactions.

For the Sea Phase, ships with troops embarked, would undertake Maritime, Amphibious and HADR operations. On reaching the HADR area at Kakinada, the landing of Relief Forces would be moved to the drill location.

While the Indian Army and the US Marines will be setting up a joint command and control centre, the IAF RAMT and the US Navy Medical Team would establish a Medical Facility Camp which will be providing medical aid to victims, who would have been previously evacuated by road and air to the Camp.

The tri-service drill will culminate with a closing ceremony onboard US Naval Ship Germantown on Nov 21.

<http://www.defencenews.in/article/India-US---Exercise-Tiger-Triumph-takes-off-from-Indias-Eastern-Seaboard-757936>

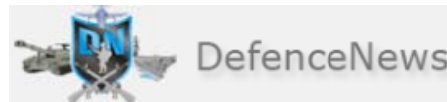
War games begin in Pokhran tomorrow

Jaisalmer: War game exercise Sudharshan Shakti by Indian Army's Southern Command will be organised at Jaisalmer-Barmer desert from November 13 to 18. Indian Air Force will also take part in this exercise.

Over 40,000 army jawans will participate in this exercise to develop combat skills and deep strike capacity. General officer commanding of 21st Core, Lieutenant Yogendra Dimri, on November 15 will review the exercise. The culmination of this exercise will be at Pokhran Field Firing Range, Jaisalmer between November 29 and December 4. It will be attended by defence minister Rajnath Singh, army chief and other senior officers of the Indian Army and IAF.

Defence spokesperson Lt Col Sambit Ghosh said, "A massive military exercise of Indian Army is currently underway in Barmer. The exercise aims to validate battle readiness and operational effectiveness of Sudarshan Chakra Corps in an integrated air-land battle scenario. The exercise will showcase tanks and other armoured vehicles duly supported by overwhelming land and air-based fire power conducting fully integrated operational manoeuvres.

<https://timesofindia.indiatimes.com/city/jaipur/war-games-begin-in-pokhran-tomorrow/articleshow/72014439.cms>



Tue, 12 Nov 2019

India's air defence upgrades are eroding Pakistan's offensive capability

Through its deployment of land-attack cruise missiles (LACM) and various ballistic missiles, Pakistan stated that it is maintaining "minimum credible deterrence." However, while that might be accurate in terms of its nuclear deployment capability, Pakistan's conventional deterrence is at risk of eroding.

By 'conventional deterrence,' we refer to Pakistan's ability to leverage its conventional capabilities – such as airstrikes, deploy armoured columns, or launch conventional warheads at long-range – to dissuade its adversary India from instigating a potential conflict through a pre-emptive strike.

The main causes for this erosion of capability stem from multiple factors, but the most pressing problem, at least in the near-term, is India's significant investment in ground-based air defence systems. This would include the flagship, the S-400, and an assortment of other potent solutions, such as the Barak 8.

The Impact of India's Air Defence Efforts ::

In response to its airstrike on Balakot, the Pakistan Air Force (PAF) undertook a retaliatory air campaign – designated "Swift Retort" – centered on its core assets, namely the F-16, JF-17, Mirage III/5, Falcon DA-20 electronic warfare (EW) jammer, and Erieye airborne early warning and control (AEW&C) system.

Whatever the intent of Swift Retort, it was without a doubt a template of an offensive counter-air (OCA) package. Moreover, with some element of surprise to India (such as the disproportionate size

of the OCA force), the PAF had demonstrated a credible offensive capability should India trigger a conflict.

However, the PAF's ability to exercise that capability is eroding in the face of India's growing investment in ground-based air defence systems (adding to its significant spending on new multi-role fighters).

The most significant of these new air defence assets is the S-400. In 2018, India signed the \$5.5 billion USD contract with Russia for the long-range surface-to-air missile (SAM) system. While the S-400 is best known for the 40N6 missile, which offers a range of up to 400 km, it is in fact a multi-layered solution comprising of various SAMs, including the 250 km 48NG, 120 km 9M96E2 and 40 km 9M96E.

Though Washington is opposing the sale, it appears that India is on-track to start receiving the S-400 after 2020, according to the Russian Federal Service for Military-Technical-Cooperation.[1]

In addition to linking the S-400 into an integrated air defence ground environment (ADGE), which will see it draw on gap filler radars (to plugin blind spots of the S-400's long-range, high-altitude radar), India will also deploy the Barak 8-based MRSAM platform at-scale through the 2020s. The baseline Barak 8 offers a range of up to 70 km.[2] Israel Aerospace Industries (IAI) is also developing a long-range variant of the Barak-8, i.e., the Barak 8ER, which could potentially have a range of up to 150 km.

<http://www.defencenews.in/article/Indias-air-defence-upgrades-are-eroding-Pakistans-offensive-capability-757931>



Wed, 13 Nov 2019

China builds villages, extended cantonments, military infrastructure near LAC

The army of China is building villages, an extension of cantonments, close to the Line of Actual Control (LAC). The aim of these integrated model villages is to ensure military and civilian population co-existence at the frontier.

Huge buildings with residential complexes, having sports and recreational facilities like basketball and volleyball courts, have come up in the last couple of years, sources said.

Officials said that the idea is to have dual-usage for these complexes.

However, there seems to be no takers and most of these establishments are still vacant.

"Both the army and civilians can use it. The development also strengthens the claim over land in case of an escalation. They are extensions of military cantonments," an official said.

The places also have observation towers. These places are under a close watch of the Chinese People's Liberation Army.

Due to differences in perception of the Line of Actual Control, that acts the as the border, there are often face-offs between Indian and Chinese troops while patrolling their areas.

There are over two dozen of these integrated villages across the LAC, while most are in the eastern sector opposite Arunachal Pradesh and Sikkim.

There are also plans to have hotels near the integrated villages.

These villages, meant to accommodate the tribal and nomadic population on the Chinese side, are well connected by newly made four-lane roads.

"This is a relatively new concept but it's still not clear what is the idea behind it as these are close to the LAC and under a visual range," said an Army source.

While there is no plan to settle people close to the LAC on the Indian side, India has been opening some of these places for tourists.

While the overall infrastructure push has been a high priority for the Chinese on their side, India had ignored development of forward areas for long.

The areas close to the LAC have been scantily populated on both sides but there has been an attempt by China to inhabit these places.

Over the past few year, roads and overall infrastructure development has been a major priority for the Indian government and some mega road projects have been completed while some are are underway.

<http://www.defencenews.in/article/China-builds-villages,-extended-cantonments,-military-infrastructure-near-LAC-757940>



Tue, 12 Nov 2019

World war III questions: Would nuclear weapons be used in a China-India war?

A hypothetical war between India and China would be one of the largest and most destructive conflicts in Asia. A war between the two powers would rock the Indo-Pacific region, cause thousands of casualties on both sides and take a significant toll on the global economy. Geography and demographics would play a unique role, limiting the war's scope and ultimately the conditions of victory.

India and China border one another in two locations, northern India/western China and eastern India/southern China, with territorial disputes in both areas. China attacked both theaters in October 1962, starting a monthlong war that resulted in minor Chinese gains on the ground.

Both countries' "No First Use" policies regarding nuclear weapons make the outbreak of nuclear war very unlikely. Both countries have such large populations, each over 1.3 billion, that they are essentially unconquerable. Like all modern wars, a war between India and China would be fought over land, sea, and air; geography would limit the scope of the land conflict, while it would be the air conflict, fought with both aircraft and missiles, that would do the most damage to both countries. The trump card, however, may be India's unique position to dominate a sea conflict, with dire consequences for the Chinese economy.

A war between the two countries would, unlike the 1962 war, involve major air action on both sides. Both countries maintain large tactical air forces capable of flying missions over the area. People's Liberation Army Air Force units in the Lanzhou Military Region would fly against Punjab, Himchal Pradesh and Uttarakhand and from the expansive Chengdu Military region against India's Arunachal Pradesh. The Lanzhou district is home to J-11 and J-11B fighters, two regiments of H-6 strategic bombers, and grab bag of J-7 and J-8 fighters. A lack of forward bases in Xinjiang means the Lanzhou Military Region could probably only support a limited air campaign against northern India. The Chengdu Military Region is home to advanced J-11A and J-10 fighters but there are relatively few military airfields in Tibet anywhere near India.

Still, China does not necessarily need tactical aircraft to do great damage to India. China could supplement its aerial firepower with ballistic missiles from the People's Liberation Army Rocket

Forces. The PLARF overseas both nuclear, conventional and dual-use ballistic missiles, and could conceivably move up to two thousand short- and medium-range DF-11, DF-15 and DF-21 ballistic missiles into positions adjacent to India. These missiles could be used to blitz Indian strategic targets on the ground, at the cost of making them unavailable for contingencies in the South and East China Seas.

Meanwhile, India's air forces are in a better position to contest the skies than their Chinese counterparts. While the war would take place on China's sparsely manned frontier, New Delhi is only 213 miles from the Tibetan frontier. India's air fleet of 230 Su-30Mk1 Flankers, sixty-nine MiG-29s and even its Mirage 2000s are competitive with or even better than most of China's aircraft in theater, at least until the J-20 fighter becomes operational. India likely has enough aircraft to deal with a two-front war, facing off with Pakistan's Air Force at the same time. India is also fielding the Akash medium-range air defense missile system to protect air bases and other high-value targets.

While India could be reasonably confident of having an air force that deters war, at least in the near term, it has no way of stopping a Chinese ballistic-missile offensive. Chinese missile units, firing from Xinjiang and Tibet, could hit targets across the northern half of India with impunity. India has no ballistic-missile defenses and does not have the combined air- and space-based assets necessary to hunt down and destroy the missile launchers. India's own ballistic missiles are dedicated to the nuclear mission and would be unavailable for conventional war.

The war on the ground between the Indian and Chinese armies might at first glance seem like the most decisive phase of the war, but it's actually quite the opposite. Both the western and eastern theaters are in rugged locations with little transportation infrastructure, making it difficult to send a mechanized army through. Massed attacks could be easily stopped with artillery as attacking forces are funneled through well-known valleys and mountain passes. Despite the enormous size of both armies (1.2 million for the Indian Army and 2.2 for the Chinese Army) fighting on the ground would likely be a stalemate with little lost or gained.

The war at sea would be the decisive front in a conflict between the two countries. Sitting astride the Indian Ocean, India lies on China's jugular vein. The Indian Navy, with its force of submarines, aircraft carrier INS Vikramaditya and surface ships could easily curtail the the flow of trade between China and Europe, the Middle East, and Africa. It would take the Chinese Navy weeks to assemble and sail a fleet capable of contesting the blockade. Even then, the blockade would be hard to break up, conducted over the thousands of square miles of the Indian Ocean.

Meanwhile, shipping to and from China would be forced to divert through the western Pacific Ocean, where such diversions would be vulnerable to Australian, Japanese, or American naval action. 87 percent of the country's petroleum needs are imported from abroad, particularly the Middle East and Africa. China's strategic petroleum reserves, once completed sometime in the 2020s, could stave off a nationwide fuel shortage for up to seventy-seven days—but after that Beijing would have to seek an end to the war however possible.

The second-order effects of the war at sea would be India's greatest weapon. War jitters, the shock to the global economy, and punitive economic action by India's allies—including Japan and the United States—could see demands for exports fall, with the potential to throw millions of Chinese laborers out of work. Domestic unrest fueled by economic troubles could become a major problem for the Chinese Communist Party and its hold on the nation. China has no similar lever over India, except in the form of a rain of ballistic missiles with high-explosive warheads on New Delhi and other major cities. A war between India and China would be nasty, brutal and short, with far-reaching consequences for the global economy. The balance of power and geographic constraints means a war would almost certainly fail to prove decisive. Both sides have almost certainly concluded this, which is why there hasn't been a war for more than fifty years. We can only hope it stays that way.

<http://www.defencenews.in/article/World-War-III-Questions-Would-Nuclear-Weapons-Be-Used-in-a-China-India-War-757929>

The voyage home: Japan's Hayabusa-2 probe to head for Earth

By Kyoko Hasegawa

Japan's Hayabusa-2 probe will leave its orbit around a distant asteroid and head for Earth on Wednesday after an unprecedented mission, carrying samples that could shed light on the origins of the Solar System.

The long voyage home would begin at 10:05 am (0105 GMT), with the probe expected to drop off its precious samples some time late 2020, the Japan Aerospace Exploration Agency (JAXA) said.

"We expect Hayabusa-2 will provide new scientific knowledge to us," project manager Yuichi Tsuda told reporters.

The probe will bring back to Earth "carbon and organic matter" that will provide data as to "how the matter is scattered around the Solar System, why it exists on the asteroid and how it is related to Earth," added Tsuda.

The mission took the fridge-sized probe some 300 million kilometres (186 million miles) from Earth, where it explored the asteroid Ryugu, whose name means "Dragon Palace" in Japanese—a reference to a castle at the bottom of the ocean in an ancient fable.

In April, Hayabusa-2 fired an "impactor" into the asteroid to stir up materials that had not previously been exposed to the atmosphere.

It then made a "perfect" touchdown on the surface of the asteroid to collect the samples that scientists hope will provide clues into what the Solar System was like at its birth some 4.6 billion years ago.

"I'm feeling half-sad, half-determined to do our best to get the probe home," said Tsuda.

"Ryugu has been at the heart of our everyday life for the past year and a half," he added.

'New destination'

Hayabusa-2 will receive its orders to head for home on Wednesday, break free of the asteroid's gravity on November 18 and fire its main engines early next month en route to Earth, JAXA said.

Tsuda said the six-year mission, which had a price tag of around 30 billion yen (\$278 million), had exceeded expectations but admitted his team had to overcome a host of technical problems.

It took the probe three-and-a-half years to get to the asteroid but the return journey should be significantly shorter because Earth and Ryugu will be much closer due to their current positions.

Hayabusa-2 is expected to drop the samples off in the South Australian desert, but JAXA is negotiating with the Australian government about how to arrange it, Tsuda said.

The probe is the successor to JAXA's first asteroid explorer "Hayabusa", which means falcon in Japanese. The earlier probe returned with dust samples from a smaller, potato-shaped asteroid in 2010 despite various setbacks during its epic seven-year odyssey, and was hailed as a scientific triumph.

The first generation probe re-entered Earth's atmosphere and burned out.

Under the current plan, Hayabusa-2 will boldly continue its journey in space after dropping off its capsule to Earth, and might "carry out another asteroid exploration," JAXA spokesman Keiichi Murakami earlier told AFP.

"The team has just started to study what can be done (after dropping off the capsule)," but there is no concrete plans about a new destination, Tsuda said.

<https://phys.org/news/2019-11-voyage-home-japan-hayabusa-probe.html>