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'We'll become self-reliant in radars, sonars in 5 yrs'

The successes with anti-satellite test and Tejas LCA has uplifted Defence Research and Development Organisation's (DRDO) confidence, with futuristic military technologies like hypersonic missiles, next-generation tanks and over the horizon radar

By Kalyan Roy

New Delhi: In an interview to DH's Kalyan Ray, DRDO chairman G Satheesh Reddy shares the details of futuristic technologies on which DRDO is working and the areas in which India will become self-reliant in the next five years. Excerpts:

Q: Existing DRDO programmes are mostly those that were conceptualised in the 1970s and 1980s. What are the technologies that DRDO would like to muster 25-30 years from now?

A: Our veterans have laid a very strong foundation stone for us to progress and think about the route for self sustenance in technologies for the defence forces through research and development in DRDO. It's our endeavor to traverse the path and realize a number of weapons systems, to meet the present and futuristic requirements of our users. The new systems include Advanced Medium Combat Airera – the twin-engine medium weight fighter airera with 5th generation technologies, unmanned combat aerial, next-generation battle tanks, air-borne warning and control systems and high endurance UAV. Among the missiles, the aim is to develop naval anti-ship missiles and long-range hypersonic cruise missiles. Among the sensors and electronic warfare systems, R&D on very long-range radar, over-the-horizon radar, quantum radar and sensors suite for submarines are being undertaken. In the propulsion and engine field, high thrust aero engine, Wheeled vehicle engine with 1500 horse power and 600 hp are being developed. In the next 4-8 years, we should have prototypes and initial trials on at least some of these projects. As far as the new technology initiatives are concerned, we need to focus on swarm drone, artificial intelligence, cognitive, morphing, stealth, cyber defence, quantum communication, computing and advanced smart materials.

Q: Can you share details of new technologies like hypersonic missile and next-generation main battle tanks?

A: Hypersonic vehicles will have a speed of 6-20 Mach (1 Mach is the speed of sound). It will be a cruise missile and the process of developing hightemperature, high-strength material has started for the hypersonic vehicle. The next generation MBT will be lightweight and have sensors to sense the the enemy ahead. They will also be having better defensive mechanisms.

Q: You recently had a successful anti-satellite test under Mission Shakti — What is the future of this programme? Do you plan more such tests?

A: The ASAT has been a capability demonstrator of India's technological advancement to neutralise enemy satellites. Such tests will not be repeated and would not be carried out in higher altitude. We have always said no to weaponisation of space but that will not stop us from gaining technological capabilities to defend our national interest. DRDO would continue to work on development of advanced technologies for Air and Missile Defence systems. Any further work would be undertaken only on the directions of the government.

Q: Is DRDO looking at a bigger space programme?

A: We plan several activities as space becomes the fourth dimension of warfare, but I would rather not talk about them. India needs to work on a number of sensors and related systems for the space and a lot of defence-related activities for space needs to be carried out.

Q: Can you provide an update on the missile development programme?

A: We received further orders on Aakash and concluded the user trials for Nag anti-tank missile, which will be inducted soon. The Helina trials will be completed this year whereas the trials for the MPATGM will be finished next year. The trials are also going on for Stand-o anti-tank missile. Other future missile programs include Akash NG, MRSAM for Army, VL-Astra, AAM-Astra MK-II, ASM-Rudra-M and naval anti-ship missile.

Q: Can you elaborate on the progress made on LCA (Air Force) and LCA (Navy)?

A: Final Operational Clearance (FOC) for LCA (Air Force) was accorded in February 2019 and the production center HAL has commenced the Series Production. The Defence Ministry has finalised the orders for 83 LCA Mark-1 aircra to the IAF. The production of LCA Mk-1A by the HAL is to be completed in the next 4-5 years. HAL has also commenced production activities for Tejas Trainers. Two prototypes have been built and are undergoing flight tests. On LCANavy Mark-1, the development activities are to be completed by 2020 subsequent to which we will undertake flying trials. Development of LCA Mark-2 is going on simultaneously.

Q: Compared to the situation two decades ago, how much import reduction has been made possible by DRDO?

A: The production value of systems and equipment developed by DRDO and inducted or approved for induction by the services stands over Rs 2.73 lakh crore, which leads to huge foreign exchanges savings. The indigenous content in DRDO products have gone up to 40-45%. In the next five years, we expect that there will be no imports the areas of radars, sonar, torpedoes, armaments and EW systems.

Q: But the armed forces still complain about DRDO's repeated failure to meet the deadlines?

A: We concentrate on quality in a big way. For critical systems produced by our lead agencies, we engage third party quality assurance agencies. Though DRDO is not directly involved in the mass production of systems developed by it for armed forces but still, DRDO involves the external quality assurance agencies such as DGQA, DGAQA and user service representatives right from the inception stage of its Mission Mode Projects. A comprehensive in house quality and reliability policy ensures adherence to strict QR norms at every stage of development process. However, quality issues during production as flagged time to time, arise at Production Agencies, which are also being addressed by instituting mechanisms to hand hold the during the Product life cycle. We are also developing a sustained quality culture amongst Defence MSMEs with the involvement of professional bodies such as Quality Council of India. The time lag earlier happened due to lack of ecosystems in the academic institutions as well as in the industry. The systems have changed a lot now. The industries have also matured as they deliver built-to-specifications systems. There are now procedures and mechanisms within the organisation to improve efficiency so that the products can be delivered on time. However, in research and development, unforeseen problems can always come up as some amount of uncertainties are involved

Q. Getting quality manpower is an issue for most of the scientific institutions. How serious is the problem in DRDO, particularly because of the attrition factor, and how do you deal with it?

A: The department faced the attrition issue prior to implementation of 6th and 7th CPC recommendations. However, with increased pay and perks and technical challenges, the trend of attrition has been arrested to a greater extent.

<https://www.deccanherald.com/national/we-ll-become-self-reliant-in-radars-sonars-in-5-yrs-760227.html>

IAF decision to buy 83 LCA Tejas will boost aeronautical sector in the country: DRDO Chief

DRDO Chief G Satheesh Reddy, on Monday, said that the Indian Air Force's decision to buy 83 Light Combat Aircraft (LCA) Tejas will boost the capabilities of indigenous aeronautical sector

New Delhi: The move by the Indian Air Force (IAF) to place orders for 83 Light Combat Aircraft (LCA) Tejas will help boost the scientific community in the country's aeronautical sector and the industry, Defence Research and Development Organisation (DRDO) chief G Satheesh Reddy said on Monday.

The IAF is expected to place orders worth around Rs 45,000 crore with the Hindustan Aeronautics Limited (HAL) to acquire 83 Tejas fighters.

"It is a great boost to the aeronautical sector of the country. The LCA has been developed by DRDO. It is a complete indigenous technology. The LCA went through operational clearance and then it got final clearance in February this year," Reddy told ANI.

"Now getting at one go orders for 83 LCAs from the IAF is a boost to the scientific community in the aeronautical sector and also to industry. This gives confidence to aeronautical engineers, scientists to develop aircraft which the IAF requires," he said.

The IAF had issued a tender for 83 LCAs about two years ago and the project was stuck over the pricing issue as the government and the Air Force felt that the price offered by the HAL was slightly higher.

Reddy said that the LCA Mark 2, which is being developed now, will also be inducted into the IAF.

"The LCA Mark 2 is about four-and-a-half generation aircraft which is close to the fifth generation. The aircraft has been completely redesigned with many features incorporated. Capabilities have also been built-in based on the knowledge acquired from the Mark 1. The Mark 2 will be a good fighter aircraft for the IAF," he noted.

Reddy said the "Akash" air defence missile is among the systems which have been acquired by the Indian Army and the Air Force.

"A number of industries have been supplying various systems and components to this programme. The defence public sector undertakings (DPSUs) have been the lead integrator of the Akash system. A large number of orders which we received from the Indian armed forces have been already produced and handed over. Industries have flourished due to this. Indian industries are now established to manufacture large numbers of missile systems in the country," he said.

Reddy stressed the present order of Rs 5,000 crore for Akash will give a boost to the industry and the production lines will be utilised.

The DRDO has also received orders worth close to about Rs 25,000 crore from the Indian armed forces, he said, adding, "We are expecting more orders."

Reddy noted that many countries have shown interest in purchasing equipment like the LCA.

"The country is gaining momentum towards exporting many of the defence systems. The world is observing that India is developing state-of-the-art defence systems...In a few years, we should be able to export a lot of defence equipment," he said.

The DRDO chief described as a "great success" the artillery gun developed by India.

"The long-range gun has been designed and developed by the DRDO along with private industries. So, India now stands tall in having developed that gun. A number of trials have been conducted and

trials are still on...In the coming years, the system will get inducted giving a boost to the Army," he added.

On Pakistan's "successful" test of 290-km range surface-to-surface ballistic missile Ghaznavi, Reddy said the neighbouring country may have conducted a routine test.

"Probably, Pakistan did a routine test. I am not very sure about it. I don't think it is very significant... Indian missile capabilities are very strong. A number of missiles have been developed indigenously. Prithivi and Agni series are being developed. We are self-reliant in areas of missile systems," he added.

<https://www.timesnownews.com/india/article/iaf-decision-to-buy-83-lca-tejas-will-boost-aeronautical-sector-in-the-country-drdo-chief/485463>



Tue, 10 Sep 2019

IAF to get Made in India fighter jets Tejas in service soon

The new order will come with homemade advanced avionics and radars

By Huma Siddiqui

To meet its depleting fighter squadron numbers, the Indian Air Force (IAF) is expected to place an order for additional 83 Light Combat Aircraft (LCA)-Mk1A aircraft. This will be in addition to the earlier 40 aircraft order placed with the state-owned Hindustan Aeronautics Limited (HAL). This brings the total order to 123 LCA 'Tejas' indigenous fighters.

According to top officials the approval for the additional 83 was given in 2016 by the Defence Acquisition Council (DAC) and the request for proposal was issued by the IAF in 2017 and the proposal for which was submitted in March 2018 to IAF. The LCA-Mk1A is different than the earlier order of 40 aircraft. The new order will come with homemade advanced avionics and radars.

So far no contract for the additional 83 indigenous fighter planes has been inked due to the price quoted by HAL which was more than the price of the SU-30MKI.

However, according to officials, the pricing will be discussed with the costing committee and a contract will be signed soon. The total cost for the new order of 83 indigenous aircraft is expected to touch Rs 45, 000 crore and this is expected to give a boost to the Make in India initiative as well as create jobs in both the public and private sectors.

So far, HAL has two contracts with the Ministry of Defence (MoD) for the supply of 20 aircraft for the Indian Air Force (IAF) in Initial Operation Clearance (IOC) configuration and another 20 aircraft in Final Operation Clearance (FOC) configuration.

Highly placed sources have confirmed that "Each contract delivery comprises of 16 fighters and four trainer aircraft. The state-owned company has completed production of all 16 fighters in IOC configuration with a significant improvement in Light Combat Aircraft 'Tejas' production rate during the last two years."

Sources added that the company is undertaking the production of 16 'Tejas' which is in FOC configuration. The clearance for the production of these was given in January this year. And for the remaining eight trainers (four in IOC and four in FOC) a provisional standard of preparation for production has recently been received and the work has just begun."

Outsourcing:

To enhance the production rate, HAL has also outsourced major assembly modules to private partners like DTL, Bengaluru (Front fuselage), Alphonso, Bengaluru (Rear Fuselage), VEM Technologies, Hyderabad (Center Fuselage) and L&T, Coimbatore (Wings). Additionally, a parallel production line is also established at Aircraft Division, Bangalore to support the increased rate of production.

Export potential:

As has been reported earlier, the company has received a Request for Information (RFI) for the supply of LCA-Tejas earlier this year from the Royal Malaysian Air Force (RMAF) and submitted the proposal to RMAF, Malaysia. Two Tejas aircraft had participated in LIMA 2019 for evaluation by RMAF. Further evaluation is being done at the prospective customer end with inputs from HAL as when called for.

<https://www.financialexpress.com/defence/iaf-to-get-made-in-india-fighter-jets-tejas-in-service-soon/1700987/>

THE ECONOMIC TIMES
WWW.ECONOMICTIMES.COM

Wed, 11 Sep 2019

India to spend a whopping USD 130 billion to modernise forces

Govt plans to procure a range of critical weapons, fighter jets, missiles, submarines and warships in 5-7 years

New Delhi: India has finalised a road map to spend USD 130 billion in the next five to seven years to modernise the armed forces and bolster their combat capabilities over rivals in the region, according to an official document and military sources.

The plan includes procurement of a range of weapons, missiles, air defence systems, fighter jets, submarines and warships, drones, surveillance equipment and developing infrastructure for extensive use of artificial intelligence, official sources said.

While India's spending has remained relatively constant in the last 10-15 years compared to its GDP, China's has significantly ramped up defence budget during the period.

"The government will spend USD 130 billion for fleet modernisation in the next 5-7 years across all armed forces," the official document stated.

Multiple military sources said the government's aim is to invest in capabilities so that the armed forces can effectively deal with any possible threat from either China or Pakistan.

Last month, Prime Minister Narendra Modi announced clearing a long-pending proposal to establish the post of chief of defence staff (CDS) for boosting coordination among the Army, the Indian Air Force and the Navy.

The sources said the CDS will play a key role in implementing the modernisation drive in the three forces.

The sources said establishing India as a military power in the outer space will be another key aspect of the plan.

The government's immediate priority is to fast-track pending proposals including procuring 2,600 infantry combat vehicles, 1,700 future ready combat vehicles for the Indian Army and paving way for supplying 110 multirole fighter aircraft to the Indian Air Force, they said.

"Infantry modernisation is a key focus area," said a source.

The armed forces have been pushing for adequate allocation of funds so that they are well prepared to deal with the possibility of a "two-front" war on both northern and western borders.

Sources said government is aware of China significantly ramping up its air and naval powers, adding the aim is to equip both the the Indian Air Force and the Indian Navy with capabilities on par with its adversaries.

To bolster its operational capability, the Navy has already finalised a plan to have 200 ships, 500 aircraft and 24 attack submarines in the next 3-4 years. At present, the Navy has around 132 ships, 220 aircraft and 15 submarines.

The sources said the government is also determined to significantly enhance IAF's overall combat capabilities and a detailed plan is being finalised.

The government is also working on a mega defence project to make the airspace over almost all its major cities, including Delhi and Mumbai, virtually impregnable, the sources said.

It is also inducting the first batch of its intercontinental ballistic missile system -- Agni V -- which is expected to significantly bolster the country's air defence system.

The missile, with a strike range of 5,000 km, is capable of carrying a nuclear warhead. Very few countries, including the US, China, Russia, France and North Korea, have intercontinental ballistic missiles.

In its missile armoury, India currently has Agni-1 with a 700 km range, Agni-2 with a 2,000-km range, Agni-3 and Agni-4 with 2,500 km to more than 3,500-km range.

The sources said the government's focus will be to develop the domestic defence industry and key policy initiatives are expected to be rolled out for it in the next couple of months.

<https://economictimes.indiatimes.com/news/defence/india-to-spend-a-whopping-usd-130-billion-for-military-modernisation-in-next-5-7-years/articleshow/71053542.cms>

THE ECONOMIC TIMES

Wed, 11 Sep 2019

Rajnath Singh to receive Rafale on October 8

"October 8 is auspicious for two reasons. It is both Dussehra and Air Force day on that day," government sources told ANI

New Delhi: Defence Minister Rajnath Singh will travel to France on October 8 to receive the first Indian Rafale combat aircraft manufactured by French firm Dassault Aviation that will come to India only next year.

"October 8 is auspicious for two reasons. It is both Dussehra and Air Force day on that day," government sources told ANI.

The Defence Minister will travel along with Defence Secretary Ajay Kumar and other senior officials to receive the aircraft from France on October 8, they said.

As per earlier plans, Balakot operations in-charge and current Air Force Chief Air Chief Marshal BS Dhanoa was to travel to receive the plane on September 19-20 from France.

Now, an Air Force team will visit France around the same time and sign documents with the French after which the Indian pilots will start training on the advanced Indian Rafale planes.

"Once they start training, they may also fly the aircraft once the Defence Minister and his team reach the location near Bordeaux," the sources said.

Though the planes would officially be inducted on October 8 into the IAF, they would start arriving in India only in May 2020 after refitment to Indian specifications and training of pilots and personnel.

They said top military brass as well as senior officials of the Dassault Aviation, the makers of Rafale, will also be present at the handing over ceremony.

The Indian planes have been equipped with a lot of India-specific enhancements, which have been fitted at a cost of around one billion euros.

Though small batches of Indian pilots have already trained on the French Air Force planes, the Indian Air Force would train 24 pilots in three different batches till May 2020 for flying the Indian Rafale fighter jets.

The Indian Air Force will deploy one squadron each of the Rafale combat aircraft at its airbases in Ambala in Haryana and Hashimara in West Bengal.

In September of 2016, India signed a deal with the French government and Dassault Aviation to acquire 36 Rafale fighter jets for over 7.8 billion euros to arrest the fall of combat squadrons and meet urgent requirements on the eastern and western fronts.

<https://economictimes.indiatimes.com/news/defence/rajnath-singh-to-receive-rafale-on-october-8/articleshow/71063552.cms>

THE ECONOMIC TIMES

Tue, 10 Sep 2019

IAF's 17 Squadron to be resurrected Tuesday; to be first Rafale unit

*The 'Golden Arrows' 17 Squadron was commanded by Air
Chief Marshal Dhanoa during the Kargil war in 1999*

New Delhi: The Indian Air Force on Tuesday is expected to resurrect its 'Golden Arrows' 17 Squadron which will be the first unit to fly the multi-role Rafale fighter jets.

IAF Chief B S Dhanoa will resurrect the 17 squadron at an event on Tuesday at the Ambala Air Force Station as it prepares to receive the Rafale jets, official sources said.

The 'Golden Arrows' 17 Squadron was commanded by Air Chief Marshal Dhanoa during the Kargil war in 1999.

The squadron, which operated from Bhatinda air base, was disbanded in 2016 after the IAF started gradual phasing out of Russian-origin Mig 21 jets.

The squadron was formed in 1951, and initially it flew de Havilland Vampire F Mk 52 fighters.

India is expected to receive the first Rafale jet by end of this month.

The IAF has already completed preparations, including readying required infrastructure and training of pilots, to welcome the fighter aircraft.

The sources said the first squadron of the aircraft will be deployed at the 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.

India had inked 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.

A number of IAF teams have already visited France to help Dassault Aviation, the manufacturer of Rafale, incorporate India-specific enhancements on-board the fighter aircraft.

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.

The Congress raised several questions about the deal, including on rates of the aircraft, and alleged corruption but the government has rejected the charges.

The IAF spent around Rs 400 crore to develop required infrastructure like shelters, hangers and maintenance facilities at the two bases.

In July 2017, Air Chief Marshal B S Dhanoa, during his visit to France, flew a Rafale jet at the Saint-Dizier airbase to gain first-hand experience of the aircraft.

According to the deal, the delivery of the jets was to be completed in 67 months from the date the contract was inked.

<https://economictimes.indiatimes.com/news/defence/iafs-17-squadron-to-be-resurrected-tuesday-to-be-first-rafale-unit/articleshow/71053058.cms>

THE ECONOMIC TIMES

Tue, 10 Sep 2019

Multi-aligned on Apaches and S-400s

One should be sceptical of coincidences in life. This holds even truer in geopolitics. In the morning of the very day Prime Minister Narendra Modi left for Vladivostok, Russia, in the evening, the Indian Air Force (IAF) inducted eight US Apache AH-64E helicopters into its armoury. As far as the timing of the two events goes, it underlines how far India has come from the old days of 'zero-sum' defence procurement.

Russia remains India's biggest defence shop, accounting for 58% of the latter's defence imports in 2014-18. But despite mutterings now coming from the 'other corner' — the \$5 billion S-400 Triumf air defence system India sealed with Russia last October led to fingerwags about 'serious implications' from Washington — it is well understood by Russia, the US, and indeed the market out there, that the business of India's defence will play a much larger role in New Delhi's relationships with these countries than such procurement had in the past. But, above all, what the AH-64E provides is value for IAF: it can disarm opticalinfrared guided missiles used in low-flying, under-the-radar situations; it can stay 'on glide' for a longer duration than any other attack helicopter if its engine is disengaged; and it has the capability to guide its Hellfire variant missile via radar, infrared and optical means. In other words, the AH-64E is a helluva machine.

Unlike past shopping sprees that became mired in controversies, the Apache deal, inked in 2015, has been transparent and without hitch. Both military men and CAs should be happy. Along with the 'strategic balance' that India is finally displaying — openly, boldly — the induction of the Apaches, with 15 more to join the hangars next year, marks this boy's growing up while buying the right 'defence toys'.

<https://economictimes.indiatimes.com/blogs/et-editorials/multi-aligned-on-apaches-and-s-400s/>

Indian Navy to commission 2nd scorpene class submarine INS Khanderi; to start work on special stealth frigates

According to top sources in the Indian Navy, the ceremony will be held in the presence of the defense Minister Rajnath Singh, chief of the Indian Navy Admiral Karambir Singh and other top naval officers

By Huma Siddiqui

Later this month Indian Navy will commission the second Scorpene class submarine –INS Khanderi in service. The submarine has successfully completed all trials and will be joining the Western Naval Command located in Mumbai. There will be another major event – the launching of stealth frigate under Project 17A at the Mazagon Dock Limited (MDL). These are multi-role frigates and the first-of-its-kind warships being built in India and will be equipped with stealth features.

According to top sources in the Indian Navy, the ceremony will be held in the presence of the defense Minister Rajnath Singh, chief of the Indian Navy Admiral Karambir Singh and other top naval officers.

The first Scorpene-class submarine was inducted in service in the presence of Prime Minister Narendra Modi in December 2017.

India and France had inked a \$ 3 billion contract in 2005 for the licensed production of six Scorpene-class submarines at MDL, under Project 75. The contract was between Naval Group, formerly known as DCNS of France and MDL, Mumbai.

This Kalvari-class Scorpene submarine will come with state of the art stealth technology and also has the ability to launch an attack on the enemy by using precision-guided weapon. “The attack which can destroy the enemy can be launched with torpedoes, tube-launched anti-ship missiles, from underwater or from the surface. And since it has stealth feature it will not be vulnerable to the enemy and will remain unmatched by other submarines,” explained an officer.

This class of submarine is not only the best in the world but it is designed in such a way that it can operate in all kinds of theatres of operation which includes the tropics too. It is also fitted with state-of-the-art communications which will help in interoperability with other components of the navy.

It also has the capability of undertaking different kinds of missions like anti-surface warfare, anti-submarine warfare. And can be sent on a mission of intelligence gathering, mine laying, and area surveillance.

Sources in the Navy have also confirmed that the third Scorpene submarine INS Karanj has now reached the advanced stages of trial and on completion is expected to join the Indian Navy later this year or early next year.

In May this year, the fourth submarine, currently under construction at MDL and named `Vela` had touched water once all the outfittings were done. And the balance two – Vagir and Vagsheer submarines are still in various stages of construction at the MDL.

The strength of the submarines in the Indian Navy has slipped to just 15 from the 21 conventional submarines. Under the 30-year plan for the Project 75 six Scorpene submarines have to be procured, followed by additional six which to be built here in India.

Project 17A

The design for the frigates under Project 17A was completed in 2013. Both MDL and Kolkata based Indian Defense PSU Garden Reach Shipbuilders and Engineers (GRSE) will be building these frigates.

To ensure that the private sector companies play an important role in the building of the frigates, almost 2100 MSMEs are also part of Project 17A. MDL will be making four stealth frigates while GRSE will be building three frigates. And it is estimated that the ship will be delivered in 2023.

Expert View

Sharing his views on the delay of the commissioning of INS Khanderi, Commodore Anil Jai Singh (retired) said, “The commissioning of INS Khanderi is much delayed because of the Indian Navy very rightly insisted on all defects being settled before accepting the submarine. The delay in the delivery of Project 75 submarines which are running 5-7 years behind schedule is not only about the cost and time overruns but more significantly the compromise it has led to in our undersea warfare combat capability and the vulnerability this has exposed us to. Khanderi will hopefully, alleviate that to some extent.”

Explaining about Project 17A, Singh said that “The Project 17A is an advanced stealth frigate of which seven are to be built – four in MDL Mumbai and three in GRSE Kolkata. These frigates are integral to our blue water power projection aspirations.”

Since there is limited docking facilities in Mumbai, the dry docking facility which has been added will help in not only in easing the existing constraints but also enable a faster turnaround of ships for operational deployments, he added.

<https://www.financialexpress.com/defence/indian-navy-to-commission-2nd-scorpene-class-submarine-ins-khanderi-to-start-work-on-special-stealth-frigates/1701859/>

THE ECONOMIC TIMES

Tue, 10 Sep 2019

Integrated Battle Groups on Pakistan, China borders soon

IBGs to be set up on basis of tasks, threats & terrain within the next two years

By Shaurya Karanbir Gurung

New Delhi: As part of one of the biggest war-fighting transformations taken up by the Indian Army, future Integrated Battle Groups will be set up on the basis of its tasks, threats and terrain where it will be located, top officials said, adding that these formations will come up along the frontiers with Pakistan and China.

The first Integrated Battle Group (IBG) will come up under the army's Yol-based 9 Corps under the Western Command in the next two years, officials added. They said it will take about four to five years for the complete 'IBGisation' of the army. Work is also being done on setting up IBGs in the eastern frontier. An IBG will be tested in a war game in Arunachal Pradesh by this year-end. Having tested IBGs in the plains under the Western Command, the army wants to see how well they will function in the mountains.

“When we look at IBGs, we have to first look at the terrain, threat, tasks and resources available. If I know that my threat across the border is mechanised, then my IBG has to be equipped accordingly. If I know that when I cross the border during battle and will encounter ditches, then I will need breathing apparatus for my equipment. In another sector, if the threat is from armoured formations such as tanks,

so I will need armour. We will also have to look at whether the IBG will need artillery and where can it be deployed,” an official said.

“Therefore, we are also looking at logistics support for IBGs. It can depend on logistic establishments along the border and be equipped according to its requirements,” the official added.

“An IBG in 9 Corps will be setup. This will take one to two years to happen. Here, it is easier to adjust resources, because of the way they are deployed. But, we don’t want to disturb the units and their cycle of rotation,” said another official. An IBG on the western front will have different equipment, training and tactics compared to the ones to be setup along the eastern front.

On the eastern front, the 17 Mountain Strike Corps which has been tasked to fight along the India-China border will be converted into an IBG.

“The entire process for IBGisation will take four to five years. It will depend on the tasks allotted to them. We are also shedding manpower such as some IBGs may need engineers and others may not,” the official explained. Currently, army formations have been set up on the thinking of ‘one size fits all’ and there is a need to instead have ‘leaner and meaner’ forces, officials said.

The concept of IBG was finalised last year under an army study to restructure the forces to meet future challenges. An IBG, which will be a little smaller than a division, will integrate the existing elements of infantry, tank regiments, artillery, engineers and signals. It will comprise six battalions of these elements and will be directly under a Corps.

<https://economictimes.indiatimes.com/news/defence/integrated-battle-groups-on-pakistan-china-borders-soon/articleshow/71057789.cms>

For Greater Punch

WHAT IS INTEGRATED BATTLE GROUP?
Between a brigade and division, it is a formation comprising existing elements of infantry, tank regiments, artillery, UAVs, engineers and signals

Will have about six battalions of infantry, armoured and artillery, and placed directly under a Corps

Each IBG will be differentiated on the basis of threat, terrain and tasks

HOW IS IT DIFFERENT FROM EXISTING FORMATIONS?
IBGs ensure better integration and self-sufficiency as compared to the existing formations, allowing it to strike harder and quicker across the border

A brigade during hostilities has to wait to be augmented by different types of units, which increases the time to mobilise

WHERE HAS IT BEEN TESTED?
Two configurations of IBG were tested – for offensive roles (involving cross-border operations) and the other for defensive postures (to withstand an enemy onslaught)

Business Standard

Wed, 11 Sep 2019

Indian defence SME beats out global giants to deliver command system to Malaysian warships

By Ajai Shukla

New Delhi: On Monday, the Royal Malaysian Navy (RMN) cleared a combat management system (CMS) that a small, but cutting-edge, Indian electronics company has developed for two of its frontline warships – the British-origin RMN frigates, KD Leiku and KD Jebat.

A warship’s CMS is the brain of its combat capability. The CMS continuously interacts with all the ship’s sensors and weapons – including radar, sonar, missiles, rockets and torpedoes – and assesses the

threats that they detect. Then, the CMS suggests weapons to neutralise the threat; and it fires and controls those weapons.

In addition, the sophisticated CMS software collaborates with friendly warships' command systems over a real time datalink. This develops a "common operating picture" for fleet operations.

Validating the truism that high-technology is mostly developed by micro, small and medium enterprises (SMEs), C2C DB Systems is the only Indian firm that has developed a complete CMS, including tactical datalink capability and warfighting modules (which navies guard zealously).

For example, the Indian Navy's warfighting modules are developed secretly by an in-house department called the Weapon and Electronics Engineering Establishment (WESEE). The CMS' supporting modules are developed by companies like Bharat Electronics Ltd and Tata Power (Strategic Engineering Division).

C2C DB Systems is based in Bengaluru and has a total strength of 50, including senior management, hardware and software engineers and mechanical design engineers. Its annual turnover is around Rs 25 crore.

Yet, this small firm partnered with a Malaysian firm, Marine Crest Technologies, to wrest the tightly contested RMN contract from global competitors such as Thales of France, Saab of Sweden and UK-headquartered BAE Systems.

RMN placed the order for the two CMSs and tactical datalink systems in April 2018, stipulating a delivery period of just nine months for the first system. Typically, developing a similar system in India takes about two years.

With C2C DB demonstrating the complete functionality of the CMS and datalink during "factory acceptance trials" in January 2019, and the system shipped to Malaysia the next month, C2C DB Systems became the only Indian entity to have developed a complete CMS, along with a tactical datalink. It is also the only Indian entity to have exported such a system.

The complete system was installed on board the first RMN frigate in March, after being fully integrated with the warship's weapons and sensors. "Harbour acceptance trials" of the tactical datalink were unconditionally cleared on Monday, while CMS trials are under way. Next will come "sea acceptance trials" at the end of this month.

C2C DB Systems is tightly integrated into India's warship production eco-system. It has worked with WESEE to develop the complete front-end software for the CMS of India's first indigenous aircraft carrier, INS Vikrant. It has also done classified work for the nuclear missile submarine, INS Arihant.

**INDIA
TODAY**

Tue, 10 Sep 2019

Who will be India's first Chief of Defence Staff?

NSA Ajit Doval's report will clear the air on CDS

By Sandeep Unnithan

New Delhi: Prime Minister Narendra Modi's August 15 Independence Day announcement of a Chief of Defence Staff (CDS) has set the cat among the pigeons.

The defence ministry is mystified as to how and why the PM shot down its recommendation for a permanent Chairman Chiefs of Staff Committee.

In 2018, the armed forces and the bureaucracy had agreed upon creating a new post of permanent CoSC (the senior-most service chief presently serves as the Committee Chairman). This recommendation was forwarded to the PMO for approval.

The CDS, first recommended by the task force appointed by a Group of Ministers in 2001, is a hot potato within South Block. The smaller services, the Air Force and the Navy, fear being swallowed by the larger Indian Army. The bureaucracy fears being upstaged by a super chief.

A senior Army official feels this could merely be a case of the PM choosing a better-sounding designation-"after all Chief of Defence Staff has a better ring to it than Permanent Chairman Chiefs of Staff Committee" he says. We will of course know only when the committee headed by National Security Adviser Ajit Doval submits its report to the government next month. The Doval committee is to frame the terms of reference for the post and define his powers - whether he will have power over budgets and command troops on the ground.

Given inter-service seniority issues, one of the present chiefs is likely to be made the first CDS. Army Chief General Bipin Rawat who becomes Chairman CoSC on September 30, when Air Chief Marshal BS Dhanoa retires, is seen as a frontrunner for the post.

General Rawat has privately ruled himself out of the race citing his age - he retires on December 30 this year after a three-year stint as Army Chief. But there's a catch - General Rawat turns 62, the upper limit for a general's tenure, only on March 16. Here again, how the committee frames the age and tenure for the post of the CDS could prove crucial. If the CDS is given an upper age limit of 64 years, then General Rawat automatically becomes eligible for the post. (*The writer is Executive Editor, India Today.*)

<https://www.indiatoday.in/news-analysis/story/who-will-be-india-s-first-chief-of-defence-staff-1597140-2019-09-09>

The Tribune

Tue, 10 Sep 2019

Govt plans to raise CRPF, BSF battalions in state

New Delhi: To take up special recruitment drive for Jammu & Kashmir (J&K) youth in paramilitary forces, as promised at the time of doing away with special provisions under the Article 370 and reorganisation of the state into two Union Territories (UTs), the government is considering raising one separate battalion each of the CRPF and BSF.

Sources in the Ministry of Home Affairs (MHA) said, the move was a "goodwill gesture" on the part of the Centre, which had promised better employment opportunities for the terror-hit state.

"The MHA is readying to take up a dedicated recruitment drive for J&K youth in paramilitary forces and for the purpose plans are afoot to raise one separate battalion each of the CRPF and BSF," a senior official said, adding that one battalion in the two paramilitary forces comprised of around 1,000 personnel.

The official said the move was "purely aimed at creating job opportunities" for the youth of J&K. "Currently, a roadmap is being worked out to ensure smooth recruitment process is rolled out," he added.

Sources said apart from the MHA, several other ministries, including Skill Development and Entrepreneurship, Minority Affairs, Tribal Affairs, Agriculture and Farmers' Welfare, Rural Development, Panchayati Raj and Food Processing, had joined hands for the implementation of 85 Central schemes in the two UTs.

The sources said special emphasis was also being given to accelerate the implementation of people-centric schemes like PM-Kisan, Pradhan Mantri Jan Dhan Yojana and Stand-Up India.

<https://www.tribuneindia.com/news/govt-plans-to-raise-crfp-bsf-battalions-in-state/830208.html>



Wed, 11 Sep 2019

India voices concern over wrongful acts using ICTs: India

Voicing concern over the malicious use of new Information and Communications Technologies (ICTs), India has said that nations should not knowingly allow their territory to be used for committing "internationally wrongful" acts like cyber terrorism through it.

Joint Secretary (EG & IT) (Cyber Diplomacy) in the Ministry of External Affairs Upender Singh Rawat said on Monday that the issue of cyber warfare, cyber doctrines and their impact on international security should be taken up at all relevant international fora.

"It is of concern that cases of malicious use of new ICTs to the detriment of states are increasing and there is a need to express strong condemnation and rejection of these violations," Rawat said at the Open-ended Working Group (OEWG) on developments in the field of Information and Telecommunications in the context of international security.

He said keeping in mind the existing and potential threats in the use of ICTs to international peace and security, it is important that nations not knowingly allow their territory to be used for committing internationally wrongful acts using ICTs including cross border cybercrime and cyber terrorism.

"The impact of cybercrime and cyber terrorism on national, regional and international peace and security need to be considered as international cooperation on them will facilitate building trust and confidence among member States, thereby contributing to international peace and security," he said.

Further, collaborative efforts to deal with cybercrime and cyber terrorism should be seriously taken up and real time cooperation between Government agencies should be developed to tackle this menace.

Rawat added that the applicability of international law to the ICT domain and cybersecurity-related laws, policies and practices at national, regional and international levels should be developed through open, inclusive, transparent and non-discriminatory approaches that involve all stakeholders.

"Stakeholders should promote education, digital literacy and technical and legal training as a means to improving cybersecurity as well as bridging the emerging digital divide," he said.

He noted that with the evolving threat landscape and emergence of new ICTs, there is a need for additional norms including those to avoid tampering of supply chain, condemn offensive cyber operations by malicious actors and take down ICT infrastructure being used for botnets.

Emphasising that capacity building is an important aspect of OEWG discussion, he said improving capacities and strengthening national cyber security capability is equally in the interest of UN member States, including countries which have advanced capabilities given the interconnected nature of the domain.

Confidence Building Measures include developing mechanisms for practical cooperation between cyber agencies, promoting bilateral cyber dialogues, cyber capacity building, exchange of information on cyber threats, cyber policy, structure and law enforcement, cooperation on cybercrime and cyber terrorism and mechanisms for protection on information infrastructure.

He stressed that India believes that as a responsible group of experts, it is "our duty for future of our digital society" to develop a consensus on definitions of cyber sovereignty, jurisdiction in ICT domain, data sovereignty, cyber weapon, cyber conflict, cybercrime and cyber terrorism, cyber deterrence, cyberattacks.

India hopes that OEWG will contribute to the cyber norms development process with a view to promoting common understanding among UN member States on the existing and potential cyber threats; practical cooperative measures to address them and how international law applies to ICT domain, he said.

<https://www.dailypioneer.com/2019/business/india-voices-concern-over-wrongful-acts-using-icts--india.html>



Tue, 10 Sep 2019

Pakistan Air Force to buy 36 retired Mirage V jets from Egypt as IAF gets ready to deploy Rafale

Mirage-V is a jet which is not even a match for the Indian Air Force (IAF) Mirage-2000, the combat aircraft used to bomb terror camps in Balakot in February 2019. Moreover, India will soon have the French Dassault Rafale, one of the most advanced and versatile multirole combat aircraft in the world, in its arsenal

By Priyarag Verma

Pakistan is negotiating with Egypt to buy 36 Dassault Mirage-V fighter, an aircraft which even the French company has stopped producing. The Mirage-V jets have been retired by Egypt but the Pakistan Air Force wants them to be upgraded for its fleet.

Mirage-V is a jet which is not even a match for the Indian Air Force (IAF) Mirage-2000, the combat aircraft used to bomb terror camps in Balakot in February 2019. Moreover, India will soon have the French Dassault Rafale, one of the most advanced and versatile multirole combat aircraft in the world, in its arsenal.

The 36 Rafales will add more lethality to the IAF which will base one squadron at Ambala in Haryana while the second will be operating from West Bengal's Hashimara. IAF Rafales will be equipped with beyond visual range (BVR) air-to-air Meteor, short and medium-range air-to-air MICA and precision-guided air-to-ground SCALP missiles.

Pakistan already operates 92 Mirage-V and another 87 Mirage-III jets along with F-16 Fighting Falcons, one of which was shot down by an IAF MiG-21 Bison piloted by Wing Commander Abhinandan Varthaman on February 27, 2019. The country also has Chengdu J-7 and JF-17 Thunder combat jets. Pakistan Air Force wants the Mirage-V upgraded with better radars and electronic warfare suites before taking their delivery. The country has been upgrading the Mirage III and V in its arsenal under Project ROSE (Retrofit Of Strike Element). The jets which Pakistan is looking at already have a helmet-mounted display, mission pods along with the ability to carry out airstrikes in the night.

While the negotiations have been going on for the last few years, Pakistan now wants the jets immediately as tensions with India rise. The February 26, 2019, airstrikes carried out by IAF Mirage-2000 jets before daybreak on the Jaish-e-Mohammad terror camp in Pakistan's Balakot had caught the country's air force napping which failed to even track the Indian jets.

The Mirage-V is currently in service with only the Pakistan and Egyptian air forces.

<https://zeenews.india.com/world/pakistan-air-force-to-buy-36-retired-mirage-v-jets-from-egypt-as-iaf-gets-ready-to-deploy-rafale-2233202.html>

China must join Russia, US to limit nuclear-tipped missiles race

By Sandeep Dikshit

New Delhi: As the world seeks to pull back from an unbridled nuclear-tipped missiles race, it is imperative to rope in China, the new superpower on the blocks, to enable a three-way agreement on a ceiling along with the US and Russia.

China's involvement in a new treaty to limit deadly ultra-long range missiles tipped with multiple nuclear warheads will check the domino effect on India and Pakistan that are experimenting with similar longer range ballistic missiles with implications for the stability of the subcontinent.

The New START (Strategic Arms Reduction Treaty) is the sole nuclear arms control agreement between the US and Russia. Like the old START, it has enforced an upper limit of 1,550 strategic offensively deployed nuclear weapons on no more than 700 deployed launchers. This is backed by rigorous joint verification.

The original START was a Cold War relic when China had not come of age. In tune with its growing economic and military strength, China is beginning to match the US and Russia not just in the range of its nuclear missiles but also more powerful delivery systems on land, air and sea.

China is on way to becoming a modern strategic nuclear force with the imminent induction of Dong Feng 41 that will have a range of 10,000 kms thus posing a threat to every nook and corner of the US, India and, in an uncertain world, even its current ally Russia as well. The South Koreans have already alerted India about the Chinese plan to modernise its strategic nuclear forces command and control system to match that of the US and Russia. The Dong Feng – 41 will be mated with the already-developed dissociable warheads that can be mounted easily on the intercontinental ballistic missiles.

There is the growing fear that China will soon match the Big Two in other equally lethal means of delivering nuclear weapons. From air, it will soon be capable of inducting a heavily redesigned bomber (Hong-6) capable of carrying air-launched cruise missiles. This will catapult China in the same league as the Americans and the Russians.

To put the Chinese development of Hong-6 and the importance of heavy lift strategic bombers in perspective, India has none nor is Russia and the US likely to provide it with any. China is not stopping at Hong-6 but engaged in evolving a much more lethal Hong 20 which may debut at the same time as the Russian Tupolov Pak DA and the American B-21 Raider. While China will not suffer from any limitation on the numbers because it is not under any treaty, the Russians and the Americans will have to keep the numbers low to adhere to the New START's upper ceiling of a total of 750 launchers whether by sea, land or air.

In the sea too, despite derision from western think-tanks, China has started secretly patrolling the Yellow Sea, East China Sea and South China Sea with Julang 2 submarine launched ballistic missile fitted on its four operational nuclear-powered submarines. More worryingly, it is poised to deploy the next generation Type 096 SSBN fitted with the more advanced Julang-3 missiles with an effective range of 15,000 km and fitted with up to 10 warheads.

From being just an economic powerhouse and possessing a top drawer conventional military, China has or already become capable of matching both Russia and America in deadly multiple-warhead laden long range delivery systems.

The world can hardly afford to overlook the emergence of a third country capable of raining down nuclear hell in any corner of the world. While Russia and the US are equally capable of doing the same, they have been bound by a treaty that limits the numbers.

US President Donald Trump has already abrogated the Intermediate Range Nuclear Forces Treaty (INF) with Russia on grounds that Moscow secretly violated it by developing 9M729 missile. But the actual elephant in the room was China. Almost 95 per cent of Chinese ballistic missiles are in the range of 500 to 5,500 km and unlike Russia and the US, there was no treaty that put a limit on the numbers.

As a result, China has been free to deploy any number of these missiles to face Japan, South Korea, Taiwan and India. While India has responded by upping the numbers, the US has been unable to do so in Japan, Taiwan and South Korea which are under Washington's nuclear umbrella and prohibited from going down the nuclear path. US Donald Trump has already hinted that it was not a solitary missile developed by Russia but China that had led to the scrapping of the INF Treaty.

Since intermediate missiles do not pose a threat to the American mainland but to countries in China's vicinity that have different political systems and world views, the US has not bothered to initiate the move for a new three-way INF Treaty involving both Russia and China. This has also compelled India and Pakistan to compete against each other in developing more accurate and lethal intermediate range missiles.

The New START between Russia and the US will expire in two years. Preliminary talks may have already begun. But the matter of long range missiles and delivery systems coupled with China's latent capability to double the number of warheads from the existing 300 to 600 in next to no time, makes it imperative that countries talking of limiting arms race in space must take similar steps on earth as well.

No bar on dragon

- The New Strategic Arms Reduction Treaty is a nuclear arms control agreement between the US and Russia
- The two countries have to keep the number of nuclear arms low to adhere to upper ceiling of 750 launchers under new treaty
- But there is no such limitation on China because it is not bound by such treaty

<https://www.tribuneindia.com/news/china-must-join-russia-us-to-limit-nuclear-tipped-missiles-race/830322.html>

The Indian **EXPRESS**

Tue, 10 Sep 2019

Chandrayaan-2: Vikram Lander in single piece, in a tilted position, says ISRO official

"We are making all-out efforts to see whether communication can be re-established with the lander," the official said. "An ISRO team is on the job at ISRO Telemetry, Tracking and Command Network (ISTRAC) here"

Bengaluru: Not losing hope, the Indian Space Research Organisation continued to make all-out efforts to establish link with Chandrayaan-2's 'Vikram' lander, now lying on the lunar surface after a hard-landing. Vikram, with rover 'Pragyan' housed inside it, hit the lunar surface after communication with the ground-stations was lost during its final descent, just 2.1 km above the lunar surface, in the early hours of Saturday.

“It had a hard-landing very close to the planned (touch-down) site as per the images sent by the on-board camera of the orbiter. The lander is there as a single piece, not broken into pieces. It’s in a tilted position,” an ISRO official associated with the mission claimed on Monday.

“We are making all-out efforts to see whether communication can be re-established with the lander,” the official said. “An ISRO team is on the job at ISRO Telemetry, Tracking and Command Network (ISTRAC) here.”

Chandrayaan-2 comprises an orbiter, lander (Vikram) and rover (Pragyan).

The mission life of the lander and rover is one Lunar day, which is equal to 14 earth days.

ISRO Chairman K Sivan had said on Saturday that the space agency would try to restore link with the lander for 14 days, and reiterated the resolve on Sunday after the orbiter’s camera spotted it on the Lunar surface.

An ISRO official said: “Unless and until everything is intact (lander), it’s very difficult (to re-establish contact). Chances are less. Only if it had soft-landing, and if all systems functioned, then only communication can be restored. Things are bleak as of now.”

“I will rate it (restoring link) as good,” another senior official of the space agency said, raising hope that lander springing to life again is not ruled out.

“But there are limitations. We have experience of recovering spacecraft (which had lost contact) in geostationary orbit. But here (in the case of Vikram), that kind of operational flexibility is not there. Already it’s lying on the surface of the Moon, and we cannot reorient it. Vital thing is antennas will have to pointed towards the ground station or the orbiter. Such operation is extremely difficult. At the same time, chances are good and we will have to keep our fingers crossed,” the official said.

The official said the lander generating power is not an issue, as it has “solar panels all around it” and it also has “internal batteries” which “are not used much.”

Vikram carried three payloads Radio Anatomy of Moon Hypersensitive Ionosphere and Atmosphere (RAMBHA), Chandra’s Surface Thermo-physical Experiment (ChaSTE) and Instrument for Lunar Seismic Activity (ILSA).

<https://indianexpress.com/article/technology/science/hopeful-of-restoring-link-with-chandrayaan-2s-vikram-lander-isro-officials-5979463/>

The Indian **EXPRESS**

Wed, 11 Sep 2019

Frozen screens tell story: Chandrayaan-2’s Vikram lander fell silent 335 m from Moon

It is likely that touchdown occurred at a much higher velocity than the “stringent touchdown requirement of 5 m/s in vertical and horizontal velocity” or less, as specified by ISRO in the planning phase

By Johnson T A

Bengaluru: Data frozen on giant screens at the Mission Operations Complex at ISRO’s Telemetry Tracking and Command Centre early on Saturday are the basis on which the space agency has begun its analysis of the Vikram lander’s failure to soft-land on the Moon.

The data suggest a failure in the “Fine braking phase” in the final part of Vikram’s journey (an altitude of 5 km to 400 m), which kicked in when the lander was 5 km from the surface of the Moon.

In its statement, ISRO said that “normal performance (of Vikram) was observed up to an altitude of 2.1 km”, and “subsequently, communication from Lander to the ground stations was lost”.

The frozen screens at mission control have shown that communication was lost when the lander was barely 335 metres (0.335 km) from the surface of the Moon. The screens show that the green dot representing the lander started to deviate from the time its altitude was just above 2 km, and continued to deviate before stopping at a point that was clearly below 1 km altitude, and somewhere near or below 500 m.

At that time, the module was still moving with a vertical velocity of 59 metres per sec (or 212 km/hr) and a horizontal velocity of 48.1 m/sec (or 173 km/hr). The lander was at that point around 1.09 km from its designated landing spot on the Moon.

As per plan, Vikram should have lost most of its velocity by the time it was 400 m from the surface of the Moon, and should have been hovering above the intended landing site — set to make a soft vertical descent at “walking pace”.

“Data received at mission control showed that the landing was going as intended until the 2 km altitude. The communication link was lost when the lander was a few metres from touchdown,” a former head of an ISRO centre, who was at mission control on September 7, said.

It is likely that touchdown occurred at a much higher velocity than the “stringent touchdown requirement of 5 m/s in vertical and horizontal velocity” or less, as specified by ISRO in the planning phase. “In the final touchdown phase, the velocity should have been only 1 or 2 metres per second, something like a walking pace,” the former senior ISRO scientist said.

Early analysis suggests that Vikram began to experience a “high pitch rate” (spinning rate) after it attempted — around an altitude of 7 km — to manoeuvre into position to pick up images of the lunar surface in order to select a place to land, the scientist said.

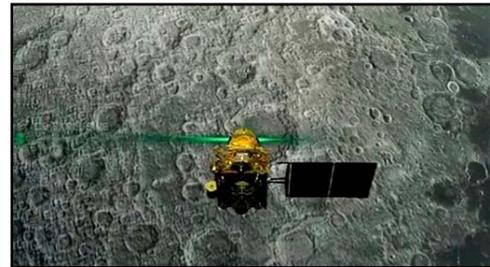
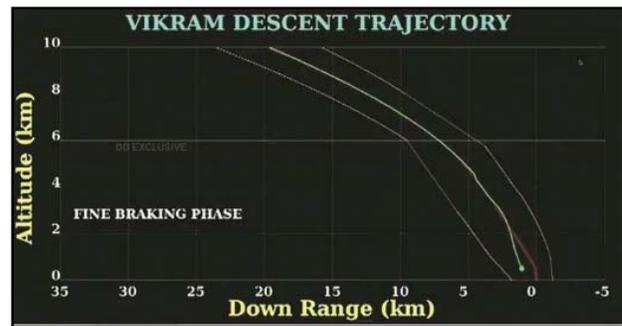
Snatches of conversation that occurred in mission control among the mission director and the centres monitoring the parameters of the lander through the landing process, also indicated that a glitch occurred in the final “fine braking phase” of the descent.

“Please confirm the parameters,” mission director Ritu Karidhal radioed several minutes after the screens froze up indicating loss of communication with the lander. “Braking ended at around two km,” was the message radioed back to mission control.

The 15-minute process of reducing the velocity of the lander from 1680 m/sec (6048 km/hr) to zero m/sec was in the 13th minute when the screens at mission control froze. Until that point, the Navigation Guidance and Control System — working in auto mode on the basis of final data fed into its systems (including data fed around four hours before the descent, at a distance of 30 km from the Moon’s surface) — had performed precisely to plan.

A “rough braking phase” had reduced the velocity of the lander from 1680 m/sec to 146 m/sec, when it was 7.42 km from the Moon’s surface — resulting in screens at mission control showing the mission was going as per “pre flight indications”.

From 7.42 km to 5 km, the lander coasted in the “attitude and absolute navigation control phase”, reducing velocity almost to the intended 96 m/sec (346 km/hr). Around 9.52 minutes into the landing operation, Vikram’s imager is understood to have been switched on.



When ISRO Chairman K Sivan approached Prime Minister Narendra Modi to convey the status of the mission after the loss of the communication link, he said “the telemetry link has been lost to the ground”. P Kunhikrishnan, the director of the U R Rao Space Centre, told officials that “they are getting data only from Madrid (ground station), no other telemetry links”.

The braking thrust for reducing the speed of the lander from 1680 m/sec to the range of zero m/sec was being provided by four 800 N liquid fuel engines (each having eight thrusters) on board, using new “throttleable technology” developed at ISRO.

The lander was being guided to the surface of the Moon by an Inertial Navigation System onboard, in which Vikram was taking decisions by itself, without intervention from ground stations, on the basis of data obtained from cameras, sensors, and altimeters on board.

<https://indianexpress.com/article/india/chandrayaan-2-isro-vikram-fell-silent-335-m-from-the-moon-5984442/>

The Indian **EXPRESS**

Wed, 11 Sep 2019

Explained: How ISRO is trying to reconnect with Chandrayaan-2’s Vikram lander, within a deadline

Chandrayaan-2: The probability of establishing contact is not going down with time. But there is a deadline nonetheless. The ISRO has to succeed in the next two weeks (by September 21)

By Amitabh Sinha

Pune: It is over three days since the Vikram lander of Chandrayaan-2 mission lost its communication link with the ground station. The Indian Space Research Organisation (ISRO) has said its efforts to restore the link have not been successful so far. In the meanwhile, Vikram has been located on the Moon’s surface through the orbiter module, which has also taken a thermal image of the lander. The condition of Vikram — whether it has been destroyed, or is still intact — is not yet known.

Is there still hope to restore contact with Chandrayaan-2’s Vikram Lander?

In this case, the time elapsed since contact was lost has no bearing on the chances of re-establishing contact with the lander. The probability of establishing contact is not going down with time. But there is a deadline nonetheless. The ISRO has to succeed in the next two weeks (by September 21).

Why this deadline?

Because the Moon will enter into a lunar night after that. Remember, even the lander and rover were supposed to be functional only for 14 days from the day of their touchdown. Lunar days and nights are equivalent to 14 Earth days. The nights on the Moon can be very cold, especially in the south polar region where Vikram is lying. Temperatures could drop to as low as -200°C. The instruments aboard the lander are not designed to withstand that kind of temperature. The electronics would not work and would get permanently damaged. So, if no connection is established in the next two weeks, ISRO will have to all but give up hope after that.

How is ISRO trying to establish contact with Vikram Lander?

Communication with remote objects is possible through electromagnetic waves. For purposes of space communication, frequencies in the S-band (microwave) and L-band (radio waves) of the electromagnetic spectrum are usually used. As of now, it is not known why the communication link was lost. Since it happened when the lander was in flight, power failure in its communication unit can be a probable reason. But after that, the lander has hit the Moon’s surface at a speed far greater than needed for a safe landing. It could have suffered partial or complete damage.

Communication with the instruments can be made only if those instruments are in working condition. Vikram was designed to communicate with both the ground station and with the orbiter. An attempt is being made from both to restore contact. Signals of specific frequencies, which the instruments on the lander are tuned to receive, are being sent in the hope that one instrument or the other would be able to receive them and respond.

What factors can help or hinder this?

A key issue is the position of the antenna on the lander. It was supposed to be erect and free of any obstructions, so that it could scan a wide area to receive signals. A torchlight, if held up for example, spreads in a conical fashion and after a certain distance, the cone would spread almost 180°. A vertical antenna can also scan for signals from a similarly vast conical area. However, if the antenna is buried, pointing towards the ground, or is otherwise obstructed, its ability to receive signals would be diminished considerably. The conical area in which it can scan would also be reduced.

The orbiter has the best chance to establish contact. Making many revolutions of the Moon every day, it will be trying to send signals to Vikram every time it crosses over it.

It is not rare to lose contact with a space object, and then re-establish connection. But it is far more easier if the space object is in orbit, or otherwise in good working condition.

<https://indianexpress.com/article/explained/chandrayaan-2-how-isro-is-trying-to-reconnect-with-vikram-within-a-deadline-5984629/>

hindustantimes

Tue, 10 Sep 2019

One step closer to a future in space

As nations look for alternatives to earth, we must praise Isro's efforts in expanding India's horizons

By Shashi shekhar

First, many congratulations are due to the scientists of Indian Space Research Organisation (Isro). Their first attempt resulted in the lander reaching the moon's surface, but have lost contact with it. Despite this, they have proved that the organisation, which once had to carry its equipment to its headquarters in Thumba, Kerala, on a bullock cart, has now evolved into a huge establishment. The journey of science draws inspiration and energy, not from successes but from failures. After all, Thomas Alva Edison faced failure many times in his efforts to light a bulb.

The greatest test of any country and its countrymen comes when young dreams die. The way the audio and visual media created a sensation around the Chandrayaan-2 landing sent hopes skyrocketing. And the entire country graciously accepted the news that communications with the lander, Vikram, had snapped. The manner in which Prime Minister Narendra Modi appreciated and encouraged the scientists must be lauded. The people who heard his words on the morning when scientists faced this setback will remember them for a long time.

For people of my generation who grew up listening to the rhyme 'Chanda mama door ke, puye pakayen gur ke...', such a scientific narrative means the end of poetic romanticism. I was just nine when Neil Armstrong took the first steps on the surface of the moon. The world was different then. There was no social media, and television in India was limited to just Delhi. Even at that time, I saw my elders glued to the radio. People were so curious and excited, wondering if the first person stepping on the moon is reaching a place more beautiful than even heaven. For millennia, we have equated the moon with beauty and we wondered if the actual moon would prove this true.

But the reality was different; the moon's surface was filled with deep craters proving that all the literary imaginings about the moon were mere fantasy.

Science follows thought, and thoughts always require the support of imagination. Apollo 11 forced poets of the world to think in an entirely different manner. During those days, some people recalled the American general Homer Boushey's comment that one "who controls the Moon, controls the Earth". But it takes time to understand such comments.

Today, the moon seems to be emerging as a protector of humanity. There is evidence of water there. Needless to say, the crisis of drinking water is deepening on the earth due to the burden of a rising population, and hence, we feel the need for alternative planets. Besides the moon, Mars is also the focus of attention of scientists because there appears to be enough water to sustain life there as well.

Here it would be appropriate to mention one of our own scientists. Syed Zahoor Qasim, who belonged to Allahabad (now, Prayagraj). He led India's first expedition to Antarctica. As a young reporter, I had covered his felicitation ceremony held in Prayag Sangeet Samiti. In his speech, he said that in the coming days, Antarctica will provide us with water as well as an alternative place to inhabit. At that time, we, who have been born in the vicinity of rivers like Ganga and Yamuna, could not even imagine the current water crisis. But Qasim's statement made us understand that if science doesn't have a far-sighted approach, humanity will be beset with one crisis after another.

India's expedition to the moon should also be seen in the same perspective. When US President Donald Trump says that China and India should be considered developed countries, then despite economic contradictions, we should have a far-sighted approach. The European Space Agency is talking about settling an international village on the moon by 2030. The Russian space agency, Roscosmos, also announced that it will start building a colony on the moon by 2025 which will be completed by 2040. In such a situation, the world's largest democracy cannot take a back-seat.

Soon, Indians are going to leave China behind as far as population is concerned. Therefore, we will have to focus on alternatives to the earth. Here, I would like to draw your attention to a historical tragedy. Had the Mughal emperors focused on forming a navy instead of spending on a lavish and luxurious life, we wouldn't have become slave to European colonialists. The kings and queens of Europe were doing it. Queen Mary gifted the world's most powerful navy to England, later Czarina Catherine recognised the power of the sea. She used to say that we (Russia) needed a window to the world. The window was the ocean. And, for this, she even divided Poland. Columbus, who discovered America, was funded by Queen Isabella of Spain.

The future belongs to space. Therefore, Isro should be congratulated because it is making plans keeping in mind future necessities and requirements.

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