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# Abhyas: A drone or a destroyer?

*Abhyas can act as a decoy aircraft and a high speed subsonic missile*

*By Pradip R Sagar*

Minutes before 12 Mirage jets of Indian Air Force entered Pakistan airspace to bomb the Jaish-e-mohammad terror camp in Balakot in the early morning of February 26, two front-line Sukhoi 30 jets also moved menacingly towards Pakistan. Their aim was to divert attention of Pakistan's air defence mechanism, so that Mirage jets could complete their mission undetected.

The IAF mission was successful as the jets pounded the JeM hideouts deep inside the Pakistan territory. But was sending Sukhois on the attention-diverting mission the only option? Was it necessary to risk life of man and machine?

The IAF establishment believes that all such effort was part of its offensive strategic mission, and hence necessary. But now, the Defence Research Development Organisation (DRDO) has a solution, which could reduce the higher risks to 'the man and the machine.'



After eight years of development, scientists of the DRDO's Bangalore-based Aeronautical Development Establishment (ADE), on May 13, carried out successful flight trial of High-speed Expendable Aerial Target (HEAT), known as Abhyas.

For the uninitiated, Abhyas (HEAT) is a drone. It is designed to offer a realistic threat scenario for the practice of weapon systems. But it is much more than an aerial target. Besides for training purpose, it can be used for multiple things. It is country's first locally developed system.

If this system was available before the Balakote strikes, this drone could have been sent to fly near the border. So, these drone could have worked as decoy aircraft to test the defence mechanism of Pakistan. There would have been no need to risk Sukhois in such a mission, said officials.

After Balakot, the IAF has learnt many lessons to bolster its combat capability. The government's decision to fast-track arming of over 40 Sukhoi fighter jets with the BrahMos supersonic cruise missile and to tackle the shortage of Airborne Warning and Control System (AWACS) are an outcome of Balakot strike audit.

“The primary purpose is to sharpen the existing air-defence mechanism that is why it is named as Abhyas (means practice). These targets imitate fighter aircraft. These are peacetime operations to hone your skills,” explained a scientist privy to the development of Abhyas. The drone has the capability to cover the distance of 400 kilometers.

The flight test, which was conducted from the Interim Test Range, Chandipur in Odisha, was tracked by various radars and electro-optic systems. It can simulate a range of aircraft and missiles, as well as radar, infra-red and visual threats.

Official said Indian forces are spending a huge chunk of its budget to import aerial target drones to sharpen the air defence mechanism. A leading British firm exports such aerial targets to the three services and the DRDO as well. The DRDO officials claimed that one system of Abhyas, including the ground support, would cost around 40 lakh while the imported platform of aerial target costs close to Rs 1 crore.

Scientists pointed out that Abhyas can be used to do away with the post-launch recovery mode for Indian Navy, which is time-consuming and difficult in a scenario as the sea. It is used for defensive

training of surface-to-air missile crews against anti-ship missiles and for development testing and evaluation of air defense systems.

But, Abhyas is much more than an aerial target. While making presentations before the three services last week in South Block, the DRDO scientists have conveyed that they do not see it for a narrow perspective. “If intelligently used, Abhyas can cause huge damage to the enemy by its multiple applications. It is a very good aerial asset,” said P.S. Krishnan, former director, ADE, who has launched the Abhyas project.

“Abhyas has multiple applications. Its Radar Cross Section is increased 50 times to imitate a fighter jet. It also has a potential to be converted into a high speed subsonic missile. It can act as a decoy and also function as a jammer platform,” a scientist explained while adding that, “It is capable to carry warheads. But in its present form Abhyas is not meant for that. But in near future, it can be used depending upon your requirement.” The services can launch it with the help of a laptop anywhere.

With GPS, it has become more accurate and can even hit a window of a building. It is an armed missile once you put a warhead. With development of Abhyas, India has become the only nation to have such high-end multiple use drone technology in the sub-continent.

“In Balakot air-strike, the IAF had to risk its man and machine while trying to divert attention of Pakistan air- defence. But, with the induction of Abhyas into the services, such situations can be tackled with,” a DRDO official said.

It all started in 2012 when a group of six scientists wanted to convert the tow-body of a recoverable Lakshya-Pilotless Target Aircraft into an expendable self-propelled aerial target. The inspiration was that they had identified a mini gas turbine engine which fits inside the diameter of the tow-body. “The tow-body which is toed by a mother aircraft can be self-propelled,” said a scientist, involved in its development. He further explained that soon a launcher was made to launch Abhyas by intelligently adapting the 68mm rocket being manufactured by the Ordnance factories. And soon a wing was integrated and it was launched without the engine.

The project was, however, not without problems. “Being a miniaturised bird, it is required not only a mini engine but also a micro navigation system. After all initial hiccups and extensive simulations, Abhyas was successfully flown on May 13, last month,” he proudly added.

A low-cost target is a requirement of the armed forces. The project was sanctioned with an initial funding of Rs 15 crore. But the project picked up pace after the three services floated a global tender for procurement of 225 HEAT drone for its operational requirement in 2015.

“Abhyas was designed to be launched from a zero-length launcher by two 68mm rockets. It could fly upto an altitude of 5 kms and at a speed of 180 met/sec. It had an endurance of 45 minutes,” said the scientist. However, little did the scientists know that that development was much beyond science and technology. It was not a national strategic project like Agni. Hence, to influence the top hierarchy to accord priority was a tough mission for the ADE scientists.

“Being a small bird, the accurate measurement of its centre of gravity and the booster thrust line was very important. The navigational sensors were MEMS (micro-electro-mechanical systems) based and posed its own limitations although it offered advantages of space and weight,” another scientist explained.

Official said that the fuselage for the Abhyas consists of five sections, namely the nose cone, equipment bay, fuel tank bay, air intake bay and tail cone. And the material for the nose and tail cones are made up of composite material (glass fiber-reinforced polymer), whereas the material of the equipment bay, air intake bay and fuel tank are made up of an aluminium steel alloy.

After its successful launch, the DRDO will now select a private firm as developer and production partner.

<https://www.theweek.in/news/sci-tech/2019/09/02/abhyas-drone-that-acts-as-decoy-aircraft-subsonic-missile.html>

Tue, 03 Sep 2019

## Joint Naval annual quality conclave (JNAQC) to be held in Visakhapatnam on September 05, 2019

Visakhapatnam: The Joint Naval Annual Quality Conclave (JNAQC) under the theme ‘Transformation of QA Paradigm: Opportunities and Challenges’ will be hosted by the Naval Quality Assurance Establishments under the aegis of Director General Quality Assurance (DGQA), Ministry of Defence in Visakhapatnam on September 05, 2019. Vice Admiral Atul Kumar Jain, Flag Officer Commanding-in-Chief of Eastern Naval Command will be the Chief Guest for the annual event.

A group of eminent leaders and apex level leadership of large organisations will be delivering keynote addresses during the JNAQC. The guest speakers include Dr Tessy Thomas, DS & DG (Aero Systems), DRDO, Rear Admiral Kalidoss Srinivas, Project Director Ship Building Centre, Rear Admiral SK Nair, Assistant Chief of Materiel (Information Technology & Systems), Rear Admiral S Chaubey (Retd), CMD ECIL, Rear Admiral Surendra Ahuja, (Retd), MD Boeing India, Rear Admiral Shekhar Mital, (Retd), MD & CEO CEMS India Ltd, Cmde Siddharth Mishra (Retd), CMD BDL and Shri R Muralidharan, Chief Technology Officer Tata Power SED. In addition, a large number of senior officers from Indian Navy, Indian Army, DRDO, MoD including academia will be participating in the event.

The second session will focus on ‘Quality Challenges of Emerging Technologies’ in which Rear Admiral SK Nair, NM, ACOM (IT&S) will provide insights on Management of Emerging Technologies in Indian Navy.

It is envisaged that the Conclave will provide a vibrant environment for stimulating discussions on all aspects pertaining to Transformation of QA Paradigm and will benefit all stakeholders by enabling cross-fertilisation of ideas and best practices from diverse fields.

<https://indiaeducationdiary.in/joint-naval-annual-quality-conclave-jnaqc-held-visakhapatnam-september-05-2019/>



Tue, 03 Sep 2019

## Aiming for a military power working in unison

*The concepts of integrating services’ headquarters with the MoD and designating a chief of defence staff along with its associated joint staff cannot be considered mutually exclusive.*

*Indeed, together they constitute national military power. By focusing merely on the CDS, we do no justice to the PM’s vision of military power working in unison*

*By Air Marshal Brijesh Jayal (retd)*

Observing that the scope and nature of warfare were changing, in view of which the military power will have to work in unison, and to address changes that experts have long been advocating, Prime Minister Narendra Modi recently announced his government’s decision to create the post of Chief of Defence Staff (CDS).

A recall of recent history will, perhaps, indicate why I believe that the PM’s call for ‘military power working in unison’, whilst laudable, is unlikely to be achieved merely by the addition of the

CDS post. The Kargil Review Committee (KRC) had highlighted various shortcomings in the security system, recommending a complete review. In pursuance, a GoM (Group of Ministers) formed four task forces, of which the one on Management of Defence was led by Arun Singh, former Union Minister of State for Defence and a keen student of military affairs. Recommendations of these task forces were reviewed by the GoM, whose report was released in 2001.

The core weaknesses in our higher defence management system are in two areas. One, linkage between the Ministry of Defence (MoD) and the services' headquarters and the other, of jointmanship and integration amongst the services. These are central to where in governance the nation wishes to place its armed forces and what authority it is willing to endow upon them, apart from the traditional gun-fodder role for which there are no competitors any way.

In respect of the former, the KRC had noted: "India is perhaps the only major democracy where the armed forces' headquarters are outside the apex governmental structure. The chiefs of staff have assumed the role of operational commanders of their respective forces rather than chiefs of staff to the Prime Minister and Defence Minister."

Both the KRC and the Arun Singh task force had, hence, recommended the integration of services' HQ with the MoD. The GoM, however, did not favour this approach where both civil and uniformed personnel could work side by side, contributing to jointness in policy formulation. Instead, it suggested a cosmetic change of nomenclature of service headquarters from 'attached offices' to 'integrated headquarters'.

Further, by emphasising that there will be no dilution in the role of the defence secretary as the principal defence adviser to the defence minister on all policy matters, the GoM ensured that genuine integration within the MoD remained a mirage. Ironically, the KRC's caution that "political, bureaucratic, military and intelligence establishments appear to have developed a vested interest in the status quo" had prevailed.

No justification had then been put forth to indicate why physically integrating the services' HQ with the MoD was not considered viable, a model that works perfectly well in Western democracies. One can only guess that the political executive preferred to deal with the uniformed fraternity through a bureaucratic cushion and the civil bureaucracy feared dilution in its authority by working alongside the uniformed. A sad commentary on our governance mindset in an age of 'revolution in military affairs' where, as the PM observed, "both the scope and nature of warfare were changing."

On jointmanship and integration within the services, the CDS, as proposed by the GoM, was to be the principal military adviser to the defence minister, provide single-point military advice to the government and exercise administrative control, as distinct from operational military control, over the strategic forces.

Further, he was expected to promote efficiency in planning, budget and equipment prioritisation and so on without in any way being accountable for the impact of his decisions on the operational potential of the services. This dichotomy stemmed from the fact that operations would have continued to remain the responsibility of the respective service. With one more layer of bureaucracy being added, albeit in uniform, not all were enthusiastic.

There is a recent view that since an integrated HQ now already exists, all that is needed is a CDS to head this. This shows a superficial understanding of jointmanship in the complex arena of individual service ethos, training and war-fighting.

In the US, where also lack of jointmanship was acutely felt, the concept of joint chief of staff had to be mandated through the Goldwater-Nicholas Act in 1986. Mindful of single-service ethos challenges, the Act also formalised the concept of professional military education (PME) and mandated the strengthening of focus on joint matters in courses of instruction offered by PME schools and the maintenance of rigorous standards for the education of joint specialty officers. It is pertinent

that for an officer to be posted in the JCS in the US, he/she must have undergone some of these PME courses.

The concepts of integrating services' headquarters with the MoD and designating a chief of defence staff along with its associated joint staff cannot be considered mutually exclusive. Indeed, together they constitute national military power. In a model generally followed by other democracies and in keeping with the principle of designating authority with associated accountability, the chiefs, as part of the MoD, are expected to concentrate on managing their service with regard to budgeting, future planning, recruitment, training, operational readiness, while shedding the actual operations to the CDS who can then focus on joint fighting and operational prioritisation. By shying away from the concept of integrating the services' headquarters with the MoD and focusing merely on the CDS, we do no justice to the PM's vision of military power working in unison. It is this mindset that has cost the nation a model of higher defence management that best suits our national security needs.

Now that the PM has flagged a vision for military power working in unison, he may consider the setting up of a Blue Ribbon Panel to look at the entire issue of civil-military relations and arrive at an organisational and higher defence management model that can best achieve this vision, in keeping with the national ethos and genius. This can form the basis of a blueprint for a potential National Defence Act for the nation and Parliament to debate and adopt.

*(Air Marshal Brijesh Jayal (ret'd) Former Air Officer Commanding-in-Chief, South Western Air Command)*

<https://www.tribuneindia.com/news/comment/aiming-for-a-military-power-working-in-unison/826810.html>

## Business Standard

Tue, 03 Sep 2019

# IAF Chief flies farewell sortie with Balakot hero Abhinandan Varthaman

*Air Chief Marshal B S Dhanoa took the pilot's front seat and flew the entire sortie, while Abhinandan Varthaman occupied the co-pilot's rear seat*

*By Ajai Shukla*

New Delhi: Indian Air Force (IAF) Chief and veteran MiG-21 pilot, Air Chief Marshal B S Dhanoa, who will retire this month, flew his farewell sortie on Monday in a MiG-21 Bison fighter, with Wing Commander Abhinandan Varthaman as his co-pilot.

As the MiG-21 accelerated down the Pathankot airbase runway for its notoriously fast take-off, the sortie was laden with symbolism. Dhanoa and Varthaman are amongst the few IAF pilots who have flown combat missions against Pakistan Dhanoa during the 1999 Kargil conflict and Varthaman on February 27, the day after the IAF strike on Balakot in Pakistan. Both pilots have experienced ejection by parachute from their stricken MiG-21s. Finally, in a tradition-bound military, where sons often follow their fathers into service, Dhanoa has flown extensively with Varthaman's father — himself an Air Marshal who retired recently.

“I've flown with his (Varthaman's) father. It's an honour for me to do my last sortie in an IAF fighter aircraft with his son,” said Dhanoa after the sortie.

Varthaman was cleared to return to operational flying a couple of months ago, after recovering from injuries sustained during his ejection over Pakistan-occupied Kashmir (PoK). Varthaman was captured by Pakistani ground troops and released unharmed two days later.

His gallantry in combat and in Pakistani captivity brought him the award of a Vir Chakra on Independence Day. The IAF claims that, before Varthaman was shot down, he shot down a Pakistan Air Force (PAF) F-16 fighter.

While the PAF denies the claim, it would be a creditable achievement for a MiG-21, a four decade-old, Soviet-era fighter, to shoot down an F-16 — the PAF's premier combat aircraft.

During his tenure as IAF chief, Dhanoa who is regarded as a 'flyer's flyer' — has flown several sorties in the MiG-21, to bolster confidence in the IAF's oldest fighter. While it is not unknown for senior Air Marshals to fly ceremonial sorties as co-pilots in the rear seat of fighters, with the aircraft actually being flown by a younger front line pilot, Dhanoa often captains the sortie himself.

In Pathankot on Monday, Dhanoa took the pilot's front seat and flew the entire sortie, while Varthaman occupied the co-pilot's rear seat.

Notwithstanding Dhanoa's forthright advocacy of the MiG-21, the fighter has only a short tenure left in service. There are just four-five squadrons remaining in service (each squadron has about 20 aircraft), and they are likely to be phased out by 2022-23. They are to be replaced by the Tejas light combat aircraft, but the Tejas production line cannot yet manufacture the fighter in the numbers that are required.

The retirement of the MiG-21 fleet is likely to see the IAF's fighter strength dropping below 30 squadrons, against the 42 squadrons it is authorised.

[https://www.business-standard.com/article/current-affairs/iaf-chief-flies-farewell-sortie-with-balakot-hero-abhinandan-varthaman-119090201186\\_1.html](https://www.business-standard.com/article/current-affairs/iaf-chief-flies-farewell-sortie-with-balakot-hero-abhinandan-varthaman-119090201186_1.html)



Tue, 03 Sep 2019

## पठानकोट में तैनात हुआ अपाचे हेलीकॉप्टर, खासियत जान पाक के भी उड़ जाएंगे होश

नई दिल्ली: भारतीय वायुसेना और भी ताकतवर होगी क्योंकि वायुसेना के बेड़े में आठ अपाचे (Apache attack helicopter) के शामिल हो गए। अपाचे के शामिल होने से भारतीय वायुसेना की ताकत न सिर्फ बढ़ेगी बल्कि यह और भी घातक हो जाएगी। अपाचे हेलीकॉप्टर को पठानकोट एयरबेस पर भारतीय वायुसेना में शामिल कराया गया। अमेरिका से भारतीय वायुसेना से कुल 22 अपाचे हेलीकॉप्टर मिलेंगे। भारतीय वायुसेना (आईएएफ) की लड़ाकू क्षमता बढ़ाने के लिए आठ अमेरिका निर्मित 'अपाचे एएच-64ई लड़ाकू हेलीकॉप्टर को जब वायुसेना में आज शामिल कराया गया, तब एयर चीफ मार्शल बी. एस. धनोआ पठानकोट में मौजूद थे।

[पाक के छूटेंगे पसीने: आज वायुसेना में शामिल होंगे 8 अपाचे हेलीकॉप्टर](#)

बता दें कि अपाचे एएच-64ई दुनिया के सबसे उन्नत बहु-भूमिका वाले लड़ाकू हेलीकॉप्टर है और अमेरिकी सेना इसका इस्तेमाल करती है। आईएएफ के एक वरिष्ठ अधिकारी ने कहा, 'आठ अपाचे लड़ाकू हेलीकॉप्टर आईएएफ में शामिल होने जा रहे हैं, जो बल की लड़ाकू क्षमता को बढ़ाएंगे।'

Punjab: Apache helicopter of the Indian Air Force ready to be inducted at the Pathankot Air Base. The Indian Air Force will induct 22 of these choppers acquired from the US. [pic.twitter.com/ezJoGMarW7](https://pic.twitter.com/ezJoGMarW7)

— ANI (@ANI) [September 3, 2019](#)

### जानें अपाचे लड़ाकू हेलीकॉप्टर की खासियतें:

- अपाचे हेलीकॉप्टर को उड़ाने के लिए दो पायलटों का होना जरूरी है।
- अपाचे लड़ाकू हेलीकॉप्टर करीब 16 फुट ऊंचा और 18 फुट चौड़ा है।
- भारतीय वायुसेना में अपाचे पहला ऐसा हेलिकॉप्टर है जो मुख्य रूप से हमला करने का काम करेगा।
- अपाचे लड़ाकू हेलीकॉप्टर दुश्मन की किलेबंदी को भेदकर और उसकी सीमा में घुसकर हमला करने में सक्षम है।
- यह हेलिकॉप्टर 300 किमी प्रति घंटा उड़ सकता है और एजीएम-114 हेलिफायर मिसाइल से लैस है।
- ये अपाचे हेलीकॉप्टर्स दिन रात और किसी भी मौसम में ऑपरेशन कर सकते हैं।
- ऊंचे पहाड़ों में बने आतंकी कैंपों और दुश्मन सेना के ठिकानों पर ये हमला करने में सक्षम हैं।
- अपाचे एक बार में पौने तीन घंटे तक उड़ सकता है।
- अपाचे हेलीकॉप्टर को इस तरह से डिजाइन किया गया है कि इसे रडार पर पकड़ना मुश्किल हो सकता है।
- हेलीकॉप्टर में लगे रायफल में एक बार में 30 एमएम की 1,200 गोलियां भरी जा सकती हैं।
- अपाचे में 16 एंटी टैंक मिसाइल छोड़ने की क्षमता है।
- अपाचे हेलीकॉप्टर करीब 300 किलोमीटर प्रतिघंटे की रफ्तार से उड़ान भर सकता है और दुश्मन के इलाके में जाकर ये अपने टारगेट को आसानी से खत्म कर सकता है।

## चंद्रयान-2: 'चंदा मामा' के घर रवाना हुआ लैंडर विक्रम, अब पता चलेगी 'ननिहाल' की असली दूरी

लैंडर विक्रम चंद्रयान-2 के मॉड्यूल से सफलतापूर्वक अलग हो गया है। इसरो ने ट्वीट कर इसकी पुष्टि की है। इसरो के अनुसार, भारतीय समयानुसार आज लैंडर विक्रम दिन में करीब 1 बजकर 35 मिनट पर सफलतापूर्वक अलग हो गया।

### हाइलाइट्स

- भारत के महत्वाकांक्षी चंद्र मिशन चंद्रयान-2 से अलग होने के साथ ही आज विक्रम लैंडर 'चंदा मामा' से मिलने के लिए रवाना हो गया
- विक्रम लैंडर 7 सितंबर को चंद्रमा के दक्षिणी ध्रुव पर सॉफ्ट लैंडिंग करेगा और इसके 4 घंटे बाद रोवर प्रज्ञान बाहर आएगा
- विक्रम के चांद को छूने के साथ ही चंद्रमा से पृथ्वी की वास्तविक दूरी पता चल जाएगी, यह 14 दिनों में 500 मीटर की दूरी तय करेगा

**बेंगलुरु :** भारत के महत्वाकांक्षी चंद्र मिशन चंद्रयान-2 से अलग होने के साथ ही आज विक्रम लैंडर 'चंदा मामा' से मिलने के लिए रवाना हो गया। विक्रम लैंडर 7 सितंबर को चंद्रमा के दक्षिणी ध्रुव पर सॉफ्ट लैंडिंग करेगा और इसके 4 घंटे बाद रोवर प्रज्ञान बाहर आएगा जो कि चंद्रमा की सतह पर 14 दिनों में कुल 500 मीटर की दूरी तय करेगा। विक्रम के चांद को छूने के साथ ही वैज्ञानिकों को चंद्रमा से पृथ्वी की वास्तविक दूरी पता चल जाएगी, जो अभी उनके लिए अबूझ पहली बना हुआ है।

दरअसल, अमेरिकी अंतरिक्ष एजेंसी नासा ने चंद्रयान-2 के साथ अपना एक [लूनर लेजर रेट्रोरेफ्लेक्टर एरे](#) भेजा है जो वैज्ञानिकों को चंद्रमा की पृथ्वी से असली दूरी बताएगा। नासा के एक शीर्ष अधिकारी लोरी ग्लेज ने कहा कि हम चंद्रमा की सतह पर ज्यादा से ज्यादा लेजर रेट्रोरेफ्लेक्टर एरे भेजना चाहते हैं। उन्होंने बताया कि रेट्रोरेफ्लेक्टर एक तरह के परिष्कृत शीशे होते हैं जो पृथ्वी से भेजी गई लेजर लाइट के सिग्नल को वापस भेजते हैं।

### चंद्रयान-2 को अलविदा बोल चांद की ओर बढ़ चला लैंडर 'विक्रम'

वैज्ञानिकों की मुताबिक लेजर लाइट्स के वापस पृथ्वी पर आने पर लैंडर के वास्तविक स्थान का पता लग जाएगा। इससे पृथ्वी से चंद्रमा की वास्तविक दूरी का सटीक आकलन किया जा सकेगा। चंद्रमा की सतह पर इस तरह के 5 उपकरण पहले से मौजूद हैं लेकिन उनमें कुछ गड़बड़ियां हैं। इसी वजह से चंद्रमा की वास्तविक दूरी का पता नहीं चल पाता है।

## बेहद खास है चंद्रयान-2 का रेट्रोरेफ्लेक्टर

इटली के भौतिक विज्ञानी डेल एंजेलो के मुताबिक चंद्रमा की सतह पर मौजूद रेट्रोरेफ्लेक्टर काफी बड़े हैं लेकिन चंद्रयान-2 के साथ भेजा गया रेट्रोरेफ्लेक्टर लेजर की कम किरणों को बर्बाद करता है। इसी वजह से अब चंद्रमा की सतह की सटीक माप की जा सकेगी। इससे अलावा जब प्रज्ञान रोवर चंद्रमा की सतह पर भ्रमण करेगा तो जमीन की ऊंचाई का पता चलेगा।

21 जुलाई, 1969 को जब चंद्रमा की सतह पर पहली बार अमेरिकी अंतरिक्ष यात्री नील आर्मस्ट्रांग ने अपोलो 11 के जरिए कदम रखा तो उन्होंने अपने पीछे सतह पर लेजर रेट्रोरेफ्लेक्टर को छोड़ दिया था। इस लेजर रेट्रोरेफ्लेक्टर पर पृथ्वी की ओर केंद्रीत करके दो फुट चौड़े पैनल पर 100 शीशे लगाए गए थे। बताया जाता है कि करीब 50 साल बाद भी ये रेट्रोरेफ्लेक्टर अभी काम कर रहे हैं।

## चंद्रयान-2 के मॉड्यूल से लैंडर विक्रम अलग

बता दें कि भारतीय अंतरिक्ष विज्ञान के लिए आज का दिन बेहद महत्वपूर्ण है। चंद्रयान-2 के मॉड्यूल से लैंडर विक्रम सफलतापूर्वक अलग हो गया। इसरो ने भी ट्वीट कर इसकी पुष्टि की है। इसरो के अनुसार, भारतीय समयानुसार आज लैंडर विक्रम दिन में करीब 1 बजकर 35 मिनट पर सफलतापूर्वक अलग हो गया। अंतरिक्ष वैज्ञानिकों ने इस अलगाव को मायके से ससुराल के लिए रवाना होने जैसा बताया है।

वैज्ञानिकों ने उच्च स्तरीय बैठक के बाद लैंडर विक्रम के अलग होने के लिए जो समय निर्धारित किया था, उसी वक्त पर अलगाव सफलतापूर्वक हुआ। शनिवार को इसरो वैज्ञानिकों की उच्च स्तरीय बैठक हुई थी। समीक्षा बैठक में शामिल एक अधिकारी ने कहा, 'लैंडर और रोवर के अलग होने का समय सोमवार को दोपहर 1.30 बजे रखा गया है।' आज निर्धारित समय के करीब ही दोपहर 1 बजकर 35 मिनट पर यह लैंडर विक्रम अलग हुआ।

live**mint**

Tue, 03 Sep 2019

# India over the moon as Chandrayaan-2 moves a step closer to landing

By Srishti Choudhary

- *The lander's orbit needs to achieve an exactly 90° inclination before it lands*
- *After this, Lander Vikram would slowly begin to prepare for its powered descent on the moon*

New Delhi: After spending more than six weeks in space, lander Vikram separated from the Chandrayaan-2 orbiter to prepare for its historic Moon landing on 7 September.

The separation process was completed at 1.15pm on Monday after Indian Space Research Organisation (Isro) brought the spacecraft closer to the moon, the space agency said. The lander is currently located in an orbit of 119x127km, while the Chandrayaan-2 orbiter continues to traverse its existing orbit.

"All the systems of Chandrayaan-2 orbiter and lander are healthy," the space agency said.

Vikram, weighing nearly 1,471kg, also carries the six-wheeled rover Pragyan, which weighs 27kg. It will now prepare for the soft landing near the south pole of the Moon.

But before that, scientists will perform a small three second manoeuvre on Tuesday to check if all the parameters of the lander are normal. This will be followed by two de-orbit manoeuvres to gradually reduce the altitude at which Vikram will orbit the moon and finally achieve an orbit of 36x110km.

The challenge for Isro is to ensure that the orbit of the lander achieves an inclination of exactly 90° before it begins to execute a successful soft landing near the lunar south pole. Even if there is a slight variation, it could miss the landing at the targeted site. And any change of site could raise difficulties, because if it lands on an inclined surface where the slope is more than 12°, the lander could topple.

The powered descent will begin on the intervening night of 6-7 September between 1.30 and 2.30am before which the lander would screen the lunar surface with its sensors and compare those images with what Isro has loaded onto it.

Vikram has the capability to communicate with Indian Deep Space Network (IDSN) at Byalalu, 25km from Bengaluru, as well as with the orbiter and rover. After the landing, all communication between Earth and Vikram will take place only through the orbiter.

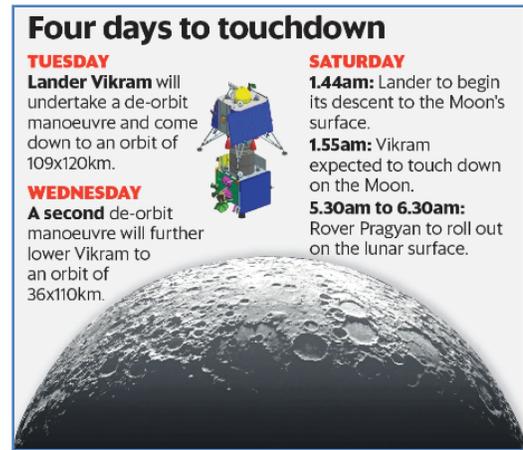
The space agency has also made efforts to strengthen the sensor characterization of lander to make it more autonomous. According to Isro chairman K. Sivan, this would help reduce chances of any false decisions on account of human error.

If all goes as planned, the Indian spacecraft would land near the south pole between two craters at 1:55am on 7 September. But it would still take some time before rover Pragyan would roll out from lander Vikram, which is likely to happen between 5.30-6.30am.

Chandrayaan-2 took off from the Satish Dhawan Space Centre in Sriharikota aboard India's most powerful rocket—the GSLV Mk111—on 22 July in the country's second mission to the Moon. The orbiter, lander and rover have all been indigenously designed and manufactured.

The stakes are high as it is India's first attempt a soft landing on the lunar body—a feat achieved by only three nations so far—the US, Russia and China. An Israeli attempt in April was unsuccessful.

<https://www.livemint.com/news/india/lander-vikram-successfully-separates-from-chandrayaan-2-orbiter-1567412081647.html>



**Four days to touchdown**

**TUESDAY**  
Lander Vikram will undertake a de-orbit manoeuvre and come down to an orbit of 109x120km.

**WEDNESDAY**  
A second de-orbit manoeuvre will further lower Vikram to an orbit of 36x110km.

**THURSDAY**  
Lander Vikram will begin its descent to the Moon's surface.

**FRIDAY**  
1.55am: Vikram expected to touch down on the Moon.

**SATURDAY**  
1.44am: Lander to begin its descent to the Moon's surface.  
1.55am: Vikram expected to touch down on the Moon.  
5.30am to 6.30am: Rover Pragyan to roll out on the lunar surface.



# 4 days to D-Day: World waits with bated breath for Chandrayaan-2 Moon landing

By Surendra Singh

## Highlights

- *If the Moon landing is successful, India will become the country in the world to land in lunar south pole, the region that is supposed to be rich in minerals and water ice*
- *Soon after Vikram lander got separated from the orbiter at 1.15pm in the circular orbit of Moon on Monday, Isro chairman K Sivan told TOI, "After the successful separation operation, people in Isro are very much excited and enjoying"*

New Delhi : With less than four days to go for Chandrayaan-2 moon landing it's not only scientists of Indian Space Research Organisation who are keeping their fingers crossed. Space enthusiasts from across the world are eagerly waiting to watch the historic event. If the Moon landing is successful, India will become the first country in the world to land in lunar south pole, the region that is supposed to be rich in minerals and water ice.

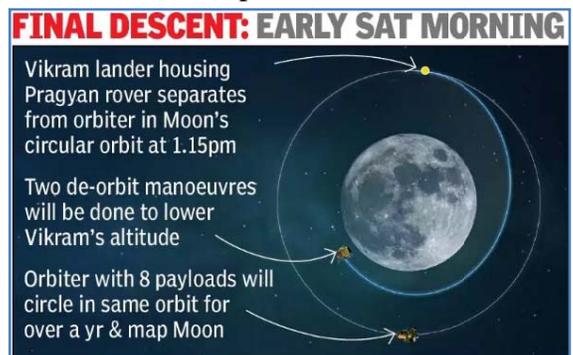
Soon after Vikram lander got separated from the orbiter at 1.15pm in the circular orbit of Moon on Monday, Isro chairman K Sivan told TOI, "After the successful separation operation, people in Isro are very much excited and enjoying. They are eagerly waiting for the big day." He said both lander and rover are "moving at a relative velocity of 0.8m per second in the same 119 km x 127 km orbit and the distance between the two is going to increase"

Former National Aeronautics and Space Administration (Nasa) astronaut Donald A Thomas, who is currently visiting India, said, "Chandrayaan-2 will be the first spacecraft to land near south pole and this is where Nasa hopes to land an astronaut in about five years from now. Not just Nasa, but the whole world would be interested in knowing about Moon and the universe by following Chandrayaan-2."

A veteran of four space flights who had logged over 1,040 hours in space, Thomas said: "We (Nasa) had landed near Moon's equator before but never at the south pole. The south pole is a very special location, we think there is ice in some of the craters that are permanently shadowed. If we find ice there, then we can have water and from that oxygen and hydrogen."

Another Nasa veteran Jerry M Linenger, who flew on a space shuttle and space station Mir, would also come to India for a special live show on Chandrayaan-2 being organised by National "The show will be an interesting interplay of live coverage and pre-shot stories narrating the iconic nature of the (Chandrayaan-2) mission," National Geographic said in a statement.

In the wee hours of Saturday, PM Narendra Modi will witness the historic event from Bengaluru-based Isro's Telemetry, Tracking and Command Network (ISTRAC) control room. The PM will be accompanied by 60 students who have been selected from across the country on the basis of a space quiz.



Delhi boy Manogya Singh Suyansh, a student of Kendriya Vidyalaya, who has been selected for the event, said, "I am excited to watch Chandrayaan-2 landing as well as to meet the PM. Since childhood, I had the curiosity to know about space. I want to get admission to an IIT and be an astronaut in the future."

<https://timesofindia.indiatimes.com/india/4-days-to-d-day-world-waits-with-bated-breath-for-chandrayaan-2-moon-landing/articleshow/70952958.cms>



Tue, 03 Sep 2019

## China's Lunar Rover finds a 'gel-like' substance on the far side of the Moon

*By Michelle Starr*

Chinese lunar rover Yutu-2 has rolled over a strange mystery on the far side of the Moon. At the bottom of a small, recent impact crater, the rover found a shiny unknown substance the Chinese space agency described as a "gel with a mysterious lustre".

Although Chinese scientists have not yet revealed what it might be, the best guess from external scientists, according to Space.com, is that the material is glass that formed in the heat of the impact that left the crater.

On July 28 - three days after the start of the two-week lunar day - the Yutu-2 science team at the Beijing Aerospace Control Center were preparing to power down the rover for a 'midday nap', a process that prevents the delicate machinery from overheating when the Sun is directly overhead.

But team member Yu Tianyi noticed something unusual in the crater while checking a panorama photographed by Yutu-2. So the researchers kept the rover awake just a little bit longer, rolling it over to the crater for a better look.

There, they found a glistening substance. According to the rover's drive diary, this material differed from the surrounding regolith in shape, colour and texture. (Sadly, they have released no photographs of it just yet, but you can see the crater itself in the images here.)

The rover was put down for its nap after checking out the crater, and reawakened to make the most of the afternoon sunlight. During this time, it examined the crater using its Visible and Near-Infrared Spectrometer (VNIS), which analyses the light reflecting off surfaces to determine their chemical composition.

We still don't have answers from that analysis, but the surface of the Moon is quite dry, so it's possible the stuff found by the rover is more of a hardened molten material than a squishy, jelly-like substance. Which, even if they weren't on the near side, would rule out a pile of tardigrades.

Yutu-2 went back to sleep on August 7 for the duration of the lunar night, since it runs on solar power. It awoke on August 25 for the next lunar day, and has been continuing its journey west in search of new discoveries.

<https://www.sciencealert.com/china-s-lunar-rover-has-found-a-gel-like-substance-on-the-far-side-of-the-moon>