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LVM3 M3/ OneWeb India-2 Mission accomplished successfully

ISRO successfully conducts the Reusable Launch Vehicle Autonomous Landing Mission (RLV LEX)

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Eminent Indian Aeronautical and Aerospace Personalities in India

Series:8

K. Radhakrishnan

Koppillil Radhakrishnan (born 29 August 1949) is an Indian space scientist who headed the Indian Space Research Organisation (ISRO) between November 2009 and December 2014 as Chairman of Space Commission, Secretary of the Department of Space and Chairman of ISRO. Prior to this, he was the Director of Vikram Sarabhai Space Centre (2007-2009) and Director of National Remote Sensing Agency (2005-2008) of the Department of Space. He had a brief stint of five years (2000-2005) in the Ministry of Earth Sciences as Director of Indian National Centre for Ocean Information Services (INCOIS).

Presently, he is the Chairperson of the Board of Governors of Indian Institute of Technology (IIT), Kanpur & Indian Institute of Technology (IIT), Ropar, and Chairman of the Standing

Continued.....

Committee of the IIT Council; Chairperson of the Oversight Committee of Science & Engineering Research Board (SERB-DST),] and Chairman, High-powered Committee of Indian Knowledge Systems, Ministry of Education-Government of India besides being a Member of Space Commission[12] and Honorary Distinguished Advisor in the Department of Space/ISRO.

He is a Fellow of the Indian National Academy of Engineering; Fellow of the National Academy of Sciences, India; Honorary Life Fellow of the Institution of Engineers, India; Honorary Fellow of the Institution of Electronics and Telecommunication Engineers, India; Member of the International Academy of Astronautics; Distinguished Fellow of Astronautical Society of India; Fellow of the Andhra Pradesh Academy of Sciences; Honorary Fellow of the Kerala Academy of Sciences; Fellow of the Indian Society of Remote Sensing; and Fellow of the Indian Geophysical Union.[6] He is an accomplished vocalist (Carnatic music) and Kathakali artist.

Penguin Random House India published his autobiography *My Odyssey: Memoirs of the Man Behind the Mangalyaan Mission* (ISBN 978-0-670-08906-2), co-authored by Radhakrishnan and Nilanjan Routh, in November 2016.

Education and personal life

Koppillil Radhakrishnan hails from Irinjalakuda in Thrissur district, Kerala. After his schooling at the National High School, Irinjalakuda, he did two-year Pre-degree studies (Mathematics, Physics, Chemistry) at Christ College, Irinjalakuda. He studied Electrical Engineering at the Government Engineering College, Thrissur and acquired BSc (Engg.) degree in First Class with Honours from Kerala University in 1970. He did post-graduate studies in management at Indian Institute of Management Bangalore in 1974-76. He obtained doctorate from the Indian Institute of Technology Kharagpur, in 2000, for the thesis : 'Some Strategies for the Management of Indian Earth Observation System'.

Radhakrishnan married Padmini Kizhakke Valappil from Irinjalakuda in 1983. Padmini worked with State Bank of Travancore from 1980 to 2010.

Indian Space Research Organisation

Radhakrishnan joined ISRO in May 1971 at the Space Science & Technology Centre at Thiruvananthapuram (the present Vikram Sarabhai Space Centre) as a design and development engineer of electro-mechanical devices. Later he worked on system planning and technology management for avionics systems of SLV-3, ASLV and PSLV.[16] During 1981-97, at the ISRO Headquarters, he oversaw the preparation and review of annual budgets of ISRO, formulation of decade profile and Five Year Plans for Indian Space programme and the related techno-economic analysis.

Remote Sensing Applications

As Project Director, he set up a chain of regional remote sensing service centres (RRSSC) at Bangalore, Nagpur, Kharagpur, Jodhpur and Dehradun for capacity building in central and state government agencies. While he was the Director, RRSSCs came to prominence in the national remote sensing application missions including the Integrated Mission for Sustainable Development (IMSD) aimed at generation of spatial database of natural resources and action plans for sustainable development of land and water resources.

Later, Radhakrishnan succeeded as the Mission Director of IMSD and moved to National Remote Sensing Agency in Hyderabad. IMSD was considered as largest remote sensing application experiment ever done in the world using a meticulous participatory approach. As the Director of National Remote Sensing Agency, he scripted India's modern multi-mission ground station for Earth Observation Satellites.[

Space Transportation System and Chandrayaan-1 Mission

While at Vikram Sarabhai Space Centre as its Director, he oversaw five successful launches of PSLV including development of its high-end version PSLV –XL that lofted Chandrayaan-1 in October 2008 as well as formulation of Indian Human Spaceflight programme.

Chief of India's Space Programme

As India's space chief from November 2009 to December 2014, Radhakrishnan led ISRO to achieve 37 space missions including several historic feats including Mars Orbiter Mission; flying Indian Cryogenic Engine on GSLV; the first experimental flight of the GSLV Mk III;[] a re-entry experiment of an un-manned crew module; and new space capabilities through IRNSS (1A, 1B, 1C) for navigation; GSAT-7 for strategic communication; and RISAT-1 for microwave radar imaging. ISRO completed two joint satellite missions (Megha Tropiques and SARAL) with the French National Space Agency and inked another agreement with NASA to jointly build an advanced Radar Imaging Satellite. India's standing in the global space market was enhanced as PSLV launched 18 commercial satellites for 11 countries. Through an inclusive organisational process, Radhakrishnan charted out clear programmatic directions and nurtured younger generation of leaders for carrying forward the legacy of ISRO. Re-defining the *Chandrayaan-2* mission with Indigenous lander and rover and extending the application of space technologies and tools to all central ministries are highlights of his leadership regime at ISRO.[] He worked to enhance the partnership with the Indian space industry for the production of operational launchers and satellites.

During his leadership, ISRO received the 2014 Gandhi Peace Prize; the 2014 Indira Gandhi Prize for Peace, Disarmament and Development; the 2014 Knowledge Economy Network KEN Award; the 2014 CNN-IBN Indian of the Year-Lifetime Achievement Award; the 2014 Global Game Changer Award by the Marico Innovation Foundation; and the 2013 CNBC-18 India Business Leader Award-BRAND INDIA.

Mars Orbiter Mission (Mangalyaan)

Mars Orbiter Mission (MOM; aka *Mangalyaan*) was conceived, planned and executed, within four years (2010-2014), establishing India as the first country to have successful mission to Mars in its maiden attempt, and at significantly low cost (INR 4.5 Billion) .

Geosynchronous Satellite Launch Vehicle and Indian Cryogenic Stage

GSLV had a checkered history in its initial flights of 2001-2007 and they were powered by cryogenic upper stage of Russia. After failure of the Indian Cryogenic upper stage on GSLV in April 2010 (GSLV-D3) and recurrence one more failure of GSLV with Russian Cryogeinc upper stage (GSLV-F06) in December 2010, Radhakrishnan steered ISRO towards the landmark success in January 2014 GSLV-D5. This marked the beginning of the successful series of GSLV with Indian Cryogenic Upper Stage.

Ocean Observation and Information Services

Radhakrishnan had a stint of five years the Ministry of Earth Sciences to set up, Indian National Centre for Ocean Information Services (INCOIS). In the aftermath of the Indian Ocean Tsunami disaster of December 2004, he emerged as the Project Director to set up the Indian Ocean Tsunami Warning Centre.

Kathakali and Carnatic Music

K. Radhakrishnan (1987) Enacting the role of King Daksha, who is annoyed at Siva for taking away his daughter Sati in marriage.

Radhakrishnan singing at Guruvayoor Chembai Sangetholsavam 2018

Radhakrishnan is a Carnatic music and Kathakali enthusiast and performer.[28][29] Radhakrishnan was drawn into the world of performing arts from childhood. After formal training in Kerala Natanam, under Professor Thrippunithura Vijayabhanu, he had training in Kathakali dance under Guru Pallippuram Gopalan Nair, Kalanilayam Raghavan and Shri T.V.A Varier. Also, he was trained in Carnatic music by eminent musicians like Prof. Vechoor Harihara Subramania Iyer, Dr. R.K. Srikantan, Dr. Nookala Chinna Satyanarayana; currently he is student of Vidwan R.S. Ramakanth. Dr. Radhakrishnan has performed at Bengaluru Sangeethotsav, Sankranthi Music Festival of RK Srikantan Trust, Swaralaya, Bangalore Centre for Kathakali and Arts, JSS Sangeetha Sabha, Chembai Vaidyanatha Bhagavathar Music Festival at Chennai. He has been singing at the Guruvayoor Chembai Sangeetholsavam every year since 2008.

Positions held

He has held several key positions in ISRO and was one of the key people behind India's *Chandrayaan-1* moon mission.[14] He has held the following positions:

- Project Director, Regional Remote Sensing Service Centres under the umbrella of National Natural Resources Management System (1987–1989)
- Director, Regional Remote Sensing Service Centres under the umbrella of National Natural Resources Management System (1989–1997)
- Director, Budget and Economic Analysis, Indian Space Research Organisation/Department of Space, Bangalore, India (1987–1997)
- National Mission Director, Integrated Mission for Sustainable Development and a Deputy Director of the National

Remote Sensing Agency (1997–2000)

- Director, Indian National Centre for Ocean Information Services (2000–2005)
- Project Director, Indian Tsunami Warning System (2005)
- Vice Chairman - Intergovernmental Oceanographic Commission (IOC) of UNESCO (2001–2005)
- Founding Chairman, Indian Ocean Global Ocean Observing System (2001–2006)
- Regional Coordinator, Indian Ocean for the International Argo Project (2001–2005)
- Director, National Remote Sensing Agency, Department of Space (2005–2008)
- President, Indian Society of Remote Sensing (2005-2007)
- Vice President, Indian Geophysical Union (2007-2009)
- Member of the Indian delegation to the United Nations Committee on the Peaceful Uses of Outer Space (2006-2009)
- Director, Vikram Sarabhai Space Centre, Thiruvananthapuram, India (2007–2009)[33]
- Member, Space Commission (2008-2009)
- Chairman, 'Working Group of the Whole' of S&T Sub-Committee of UN COPUOS (2008 & 2009)
- Chairman, Space Commission & Secretary, Department of Space
- Chairman, Indian Space Research Organisation, Bangalore, India (2009-2014)

- Chairman, Board of Antrix Corporation, Bangalore, India (November 2009-July 2011)
- Chairman, Indian Institute of Space Science and Technology, Thiruvananthapuram, India (2009-2014)[35]
- Member, Planning Committee of National Natural Resources Management System (2009-2014)[6]
- Chairman, NNRMS Standing Committee on Technology & Training (2009-2014)
- President, Astronautical Society of India (2010-2014)
- Member of CSIR Society and Member of CSIR Governing Council (2010-2013)
- Chairman, Research Council of National Aerospace Laboratory (2010-2013)
- Ex-officio Member of Scientific Advisory Committee to Prime Minister (2009-2014)
- Ex-officio Member of Scientific Advisory Committee to Cabinet (2009-2014)
- Chairman, Indian Institutes of Engineering Science and Technology, Shibpur, India (2014–2017)
- Adviser, Department of Space/Indian Space Research Organisation (2016 & 2017)
- Honorary Distinguished Adviser, Department of Space/Indian Space Research Organisation (March 2018 – present)
- Chairman, Board of Management, Sant Longowal Institute of Engineering & Technology (present)
- Chairperson, Board of Governors of Indian Institute of Technology, Kanpur (February 2019 – present)
- Chairperson, Board of Governors of Indian Institute of Technology, Ropar]
- Chairman, Standing Committee of the IIT Council (December 2019 – present)
- Member, Space Commission (February 2022 – present)
- Chairperson, Oversight Committee of Science & Engineering Research Board SERB-DST (May 2022 - present
- Chairman, High-powered Committee of Indian Knowledge Systems, Ministry of Education (October 2022 - present)
- Chairman, Committee for strengthening the Assessment and Accreditation of Higher Educational Institutions, Ministry of Education (November 2022)

Major Awards and honours

- 2014: Radhakrishnan received the Padma Bhushan Award for contribution to Science and Engineering, especially in the field of Space Science and Technology.
- 2014: Named one of *Nature*'s ten "people who mattered" of 2014 on 18 December 2014, along with Radhika Nagpal, and others.
- 2003: K.R. Ramanathan Memorial Gold Medal of Indian Geophysical Union
- 2005: VASVIK Industrial Research Award
- 2006: Silver Jubilee Honour by Ministry of Earth Sciences
- 2008: BHASKARA Award of Indian Society of Remote Sensing
- 2008: Dr. Y. Nayudamma Memorial Award of the A.P Academy of Sciences
- 2009: Social Sciences Award of the International Academy of Astronautics
- 2010: Vikram Sarabhai Memorial Award of Indian Science Congress
- 2010: Distinguished Alumnus Award of IIT, Kharagpur
- 2010: Distinguished Alumnus Award of IIM, Bangalore
- 2014: ISRO's Lifetime Achievement Award
- 2014: The Allan D. Emil Award of International Astronautical Federation
- 2014: Ernst & Young Lifetime Achievement Award
- 2014: Technovation-Sarabhai Award of Indian Electronics & Semiconductor Association
- 2015: Lifetime Achievent Award of Union Bank of India
- 2015: Lifetime Outstanding Innovation Award Indore Management Association

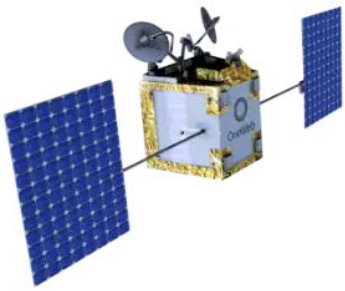
- 2015: Bharat Asmita Vigyan Tantragyaan Shreshta
- 2015: P.C. Chandra Purashkar for Lifetime Achievement
- 2016: Lifetime Achievement Award, Engineers' Forum, Nagpur
- 2017: Global Indian (Science) Award of Times Network
- 2018: Qimpro Platinum Standard 2018 (Business)

He has been conferred a doctorate by IIT Kharagpur and honorary doctorates by 12 Indian universities[

CURRENT AFFAIRS

LVM3 M3/ OneWeb India-2 Mission accomplished successfully

LVM3 M3/ OneWeb India-2 Mission is accomplished successfully. In its sixth consecutive successful flight of LVM3, the vehicle placed 36 satellites belonging to the OneWeb Group Company in their intended 450 km circular orbit with an inclination of 87.4 degrees. The vehicle took off with a total payload of 5,805 kg at 09:00:20 hours IST from the second launch pad at SDSC-SHAR, Sriharikota. It achieved satellite injection conditions in about 17 minutes and began injecting the satellites from the twentieth minute. The vehicle performed a sophisticated manoeuvre to orient in orthogonal directions and injected the satellites into precise orbits with defined time-gaps to avoid collision of the satellites.



Source: https://www.isro.gov.in/

ISRO receives the crew module structure simulated assembly

Today, ISRO received the Crew Module structure simulated assembly for the Integrated Air-Drop Test (IADT)meant for validating the sequence and performance of parachute systems in the Gaganyaan mission. The module was designed by Human Space Flight Centre (HSFC), ISRO and the hardware has been realized by Shri Venkateswara Aerospace Pvt. Ltd., Hyderabad. Shri Somanath S, Chairman, ISRO/ Secretary, DoS, and senior officials of ISRO graced the occasion. This un-pressurized single wall Crew Module structure simulates the shapeand size of the actual Gaganyaan crew module. Its structure accommodates major subsystems like parachute system, pyros, avionics, and buoyance

augmentation system for IADT. The IADT will be performed, at SDSC-SHAR, using an Indian Air Force helicopter by taking the Crew module to an altitude of 3.6 to 4km to validate the deceleration system (parachute & Pyro's) performance.

Source: https://www.isro.gov.in/

Inauguration of India – Bhutan SAT ground station

Today, the ground station for India – Bhutan Sat at Thimphu was inaugurated. This ground station will enable Bhutan to receive data from India-Bhutan SAT, pertaining to its territory, directly from the satellite and process in real-time. Shri Somanath S, Chairman ISRO/ Secretary DOS along with Lyonpo Tandi Dorji, Foreign Minister, Lyonpo Karma Donnen Wangdi, Minister of Industry, Commerce and Employment, Royal Government of Bhutan and Shri Sudhakar Delela, Indian Ambassador to Bhutan inaugurated it. Director of ISRO's National Remote Sensing Centre, and senior ISRO scientists involved in India-Bhutan SAT realization, ground station establishment and training were also present.

Source: https://www.isro.gov.in/

Controlled Re-entry Experiment of Megha-Tropiques-1

ISRO is gearing up for a challenging experiment of controlled re-entry of a decommissioned low Earth orbiting satellite, namely Megha-Tropiques-1 (MT1), on March 7, 2023. MT1 was launched on October 12, 2011, as a joint satellite venture of ISRO and the French space agency, CNES for tropical weather and climate studies. Although the mission life of the satellite originally was to 3 years, the satellite continued to provide valuable data services for more than a decade supporting regional and global climate models till 2021. UN/IADC space debris mitigation guidelines recommend deorbiting a LEO (Low Earth Orbit) object at its end-of-life, preferably through controlled re-entry to a safe impact zone, or by bringing it to an orbit where the orbital lifetime is less than 25 years.It is also recommended to carry out "passivation" of on-board energy sources to minimise the risk of any post-mission accidental break-up. The orbital lifetime of MT1, weighing about 1000 kg, would have been more than 100 years in its 20 deg inclined operational orbit of 867 km altitude. About 125 kg on-board fuel remained unutilised at its end-of-mission that could pose risks for accidental break-up. This left-over fuel was estimated to be sufficient to achieve a fully controlled atmospheric re-entry to impact an uninhabited location in the Pacific Ocean. Controlled re-entries involve deorbiting to very low altitudes to ensure impact occurs within a targeted safe zone.Usually, large satellites/rocket bodies which are likely to survive aero-thermal fragmentation upon re-entry are made to undergo controlled re-entry to limit ground casualty risk. However, all such satellites are specifically designed to undergo controlled re-entry at end-of-life. MT1 was not designed for EOL operations through controlled re-entry which made the entire exercise extremely challenging. Furthermore, the on-board constraints of the aged satellite, where several systems had lost redundancy and showed degraded performance, and maintaining subsystems under harsher environmental conditions at much lower than originally designed orbital altitude added to the operational complexities. Innovative workarounds were implemented by the operations team based on the study, deliberations, and exchanges among the mission, operations, flight dynamics, aerodynamics, propulsion, controls, navigation, thermal, and other sub-system design teams across the ISRO centres, who worked in synergy to surmount these challenges. An uninhabited area in the Pacific Ocean between 5°S to 14°S latitude and

119°W to 100°W longitude was identified as the targeted re-entry zone for MT1.Since Aug 2022, 18 orbit manoeuvres were performed to progressively lower the orbit. In between the de-orbiting, aero-braking studies at different solar panel orientations were also carried out to gain better insights into the physical process of atmospheric drag affecting the orbital decay of the satellite.The final de-boost strategy has been designed after taking into consideration several constraints, including visibility of the re-entry trace over ground stations, ground impact within the targeted zone, and allowable operating conditions of subsystems, especially the maximum deliverable thrust and the maximum firing duration of the thrusters. The final two de-boost burns followed by the ground impact are expected to take place between 16:30 IST to 19:30 IST on March 7, 2023. Aero-thermal simulations show that no large fragments of the satellites are likely to survive the aerothermal heating during the re-entry. As a responsible space agency committed to safe and sustainable operations in outer space, ISRO proactively takes efforts for better compliance with the UN/IADC space debris mitigation guidelines on post-mission disposal of LEO objects.The re-entry experiment of MT1 has been undertaken as a part of the ongoing efforts as this satellite with sufficient left-over fuel presented a unique opportunity to test the relevant methodologies and understand the associated operational nuances of post mission disposal by direct re-entry into the Earth's atmosphere.

Source: https://www.isro.gov.in/

Megha-Tropiques-1 (MT1) Controlled Re-entry Successful and impacted on the Pacific Ocean

The controlled re-entry experiment for the decommissioned Megha-Tropiques-1 (MT-1) was carried out successfully on March 7, 2023. The satellite was launched on October 12, 2011, as a collaborative effort between ISRO and the French space agency CNES for carrying out tropical weather and climate studies. Since August 2022, the satellite's perigee was progressively lowered through a series of 20 manoeuvres spending about 120 kg of fuel. Multiple Manoeuvres including the final de-boost strategy were designed after taking into consideration several constraints, including visibility of the re-entry trace over ground stations, ground impact within the targeted zone, and allowable operating conditions of subsystems, especially the maximum deliverable thrust and the maximum firing duration constraint on thrusters. All manoeuvre plans were screened to ensure that there would be no post manoeuvre close approaches with other space objects, especially with the crewed space stations like International Space Stations and the Chinese Space Station. The final two de-boost burns were executed at 11:02 UTC and 12:51 UTC respectively on 7th March 2023 by firing four 11 Newton thrusters on-board the satellite for about 20 minutes each. The final perigee was estimated to be less than 80 km indicating that the satellite would enter the denser layers of the Earth's atmosphere and subsequently undergo structural disintegration. The re-entry aero-thermal flux analysis confirmed that there would be no surviving large debris fragments. From the latest telemetry, it is confirmed that the satellite has re-entered the Earth's atmosphere and would have disintegrated over the Pacific Ocean, the final impact region estimated is in the deep Pacific Ocean within the expected latitude & longitude boundaries. The entire sequence of events was carried out from the Mission Operations Complex in ISTRAC. In recent years, ISRO has taken up proactive measures to improve the compliance level with the internationally accepted guidelines on space debris mitigation. Efforts are underway to build indigenous capabilities for tracking and monitoring space objects to safeguard Indian space assets. ISRO System for Safe and Sustainable Space Operations Management (IS4OM) has been established to spearhead such activities. The controlled re-entry exercise bears yet another testimony to India's continued efforts towards ensuring the long-term sustainability of outer space activities.

Source: https://www.isro.gov.in/

Maiden Successful Flight-test of DRDO's Indigenous Power Take off Shaft Conducted on LCA Tejas in Bengaluru

Maiden successful flight-test of Power Take off (PTO) Shaft was conducted on Light Combat Aircraft (LCA Tejas) Limited Series Production (LSP) - 3 aircraft in Bengaluru on March 14, 2023. The PTO shaft is indigenously designed and developed by Combat Vehicles Research & 4 Development Establishment (CVRDE), Chennai of Defence Research and Development Organisation (DRDO). The PTO shaft, which is a critical component in the aircraft, will support the requirements of future fighter aircraft & their variants and offers competitive cost & reduced time of availability. With this successful test, the DRDO has achieved a greater technological feat by realisation of complex high-speed rotor technology which only few countries have achieved. The PTO shaft was designed with unique innovative patented

'Frequency Spanning Technique' which enables it to negotiate different operating engine speeds. The light weight high speed, lubrication free PTO shaft transmits higher power between aircraft engine gear box and Aircraft Mounted Accessory Gear Box while accommodating misalignments that arise in the drive line. Aeronautical Development Agency, Centre for Military Airworthiness and Certification, Directorate General of Aeronautical Quality Assurance and Hindustan Aeronautics Limited teamed along with CVRDE to achieve this feat. The PTO shaft technology has already been transferred to Godrej & Boyce, Mumbai and Lakshmi Technology and Engineering, Coimbatore. Raksha Mantri Shri Rajnath Singh has complimented the DRDO, PSUs and the Industry, saying that the successful realisation of PTO shaft is another major milestone towards 'Aatmanirbhar Bharat'. Secretary, Department of Defence R&D and Chairman DRDO Dr Samir V Kamat stated that the success showcased the country's research capability and will actively support the test aircraft programmes.

Source: https://pib.gov.in/PressReleasePage.aspx?PRID=1906869

TECHNOLOGY

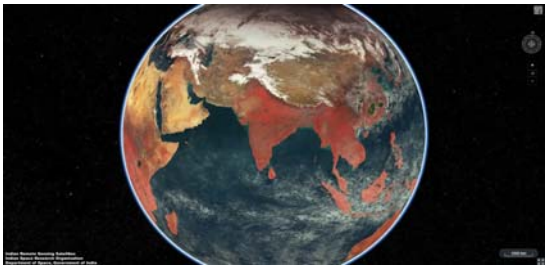
ISRO successfully conducts the Reusable Launch Vehicle Autonomous Landing Mission (RLV LEX)

ISRO successfully conducted the Reusable Launch Vehicle Autonomous Landing Mission (RLV LEX). The test was conducted at the Aeronautical Test Range (ATR), Chitradurga, Karnataka in the early hours on April 2, 2023. The RLV took off at 7:10 am IST by a Chinook Helicopter of the Indian Air Force as an underslung load and flew to a height of 4.5 km (above MSL). Once the predetermined pillbox parameters were attained, based on the RLV's Mission Management Computer command, the RLV was released in mid-air, at a down range of 4.6 km. Release conditions included 10 parameters covering position, velocity, altitude and body rates, etc. The release of RLV was autonomous. RLV then performed approach and landing maneuvers using the Integrated Navigation, Guidance & control system and completed an autonomous landing on the ATR air strip at 7:40 AM IST. With that, ISRO successfully achieved the autonomous landing of a space vehicle. The autonomous landing was carried out under the exact conditions of a Space Re-entry vehicle's landing —high speed, unmanned, precise landing from the same return path— as if the vehicle arrives from space. Landing parameters such as Ground relative velocity, the sink rate of Landing Gears, and precise body rates, as might be experienced by an orbital re-entry space vehicle in its return path, were achieved. The RLV LEX demanded several state-of-the-art technologies including accurate Navigation hardware and software, Pseudolite system, Ka-band Radar Altimeter, NavIC receiver, indigenous Landing Gear, Aerofoil honey-comb fins and brake parachute system. In a first in the world, a winged body has been carried to an altitude of 4.5 km by a helicopter and released for carrying out an autonomous landing on a runway. RLV is essentially a space plane with a low lift to drag ratio requiring an approach at high glide angles that necessitated a landing at high velocities of 350 kmph. LEX utilized several indigenous systems. Localized Navigation systems based on pseudolite systems, instrumentation, and sensor systems, etc. were developed by ISRO. Digital Elevation Model (DEM) of the landing site with a Ka-band Radar Altimeter provided accurate altitude information. Extensive wind tunnel tests and CFD simulations enabled aerodynamic characterization of RLV prior to the flight. Adaptation of contemporary technologies developed for RLV LEX turns other operational launch vehicles of ISRO more cost-effective. ISRO had demonstrated the re-entry of its winged vehicle RLV-TD in the HEX mission in May 2016. The re-entry of a hypersonic sub-orbital vehicle marked a major accomplishment in developing Reusable Launch Vehicles. In HEX, the vehicle landed on a hypothetical runway over the Bay of Bengal. Precise landing on a runway was an aspect not included in the HEX mission. The LEX mission achieved the final approach phase that coincided with the re-entry return flight path exhibiting an autonomous, high speed (350 kmph) landing. The LEX began with an Integrated Navigation test in 2019 and followed multiple Engineering Model Trials and Captive Phase tests in subsequent years. Along with ISRO, IAF, CEMILAC, ADE, and ADRDE contributed to this test. The IAF team hand in hand with the Project team and multiple sorties were conducted to perfect the achievement of release conditions. Dr. S Unnikrishnan Nair, Director, VSSC, and Shri Shyam Mohan N, Programme Director, ATSP guided the teams. Dr. Jayakumar M, Project Director, RLV was the Mission Director, and Shri Muthupandian J, Associate Project Director, RLV was the Vehicle Director for the mission. Shri Ramakrishna, Director, ISTRAC was present on the

occasion. Chairman, ISRO/Secretary, DOS Shri S Somanath witnessed the test and congratulated the team. With LEX, the dream of an Indian Reusable Launch Vehicle arrives one step closer to reality.


Source: https://www.isro.gov.in/

Global false colour composite mosaic generated from EOS-06 data

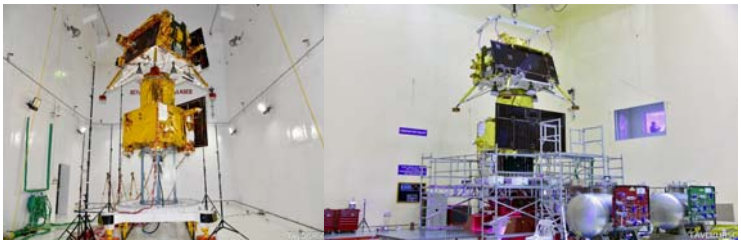


NRSC/ISRO has generated global False Colour Composite (FCC) mosaic from the images captured by the Ocean Colour Monitor (OCM) payload on board EOS-06. The mosaic with 1 km spatial resolution is generated by combining 2939 individual images, after processing 300 GB data to show the Earth as seen during Feb 1-15, 2023. OCM senses the Earth in 13 distinct wavelengths to provide information about global vegetation cover on Land and Ocean Biota for global oceans.

Source: https://www.isro.gov.in/

Chandrayaan-3 successfully undergoes Integrated Module Dynamic Tests

In yet another milestone, Chandrayaan-3 spacecraft successfully completed the essential tests that validated its capability to withstand the harsh vibration and acoustic environment that the spacecraft would face during its launch. These tests were conducted during the first week of March 2023 at the test facilities located at the UR Rao Satellite Centre in Bengaluru. These tests are an essential part of the qualification & acceptance process for any spacecraft. These tests were particularly challenging, considering the fact that the Chandrayaan-3 spacecraft is a composite of three modules viz. Propulsion Module, Lander Module and the Rover module. The vibration and acoustic tests carried out on the integrated spacecraft has provided sufficient confidence on the structural integrity and survivability in the launch environment.



Source: https://www.isro.gov.in/

ISRO conducts Rail Track Rocket Sled deployment tests of the Gaganyaan Pilot and Apex Cover Separation parachutes

ISRO conducted the Rail Track Rocket Sled deployment tests of the Gaganyaan Pilot and Apex Cover Separation (ACS) parachutes in cluster configurations at the Terminal Ballistics Research Laboratory (TBRL), Chandigarh, on March 1 and 3, 2023. The first test simulated the clustered deployment of two pilot parachutes. One parachute was subjected to a minimum angle with respect to flow conditions and the second parachute was subjected to a maximum angle with respect to flow. These pilot parachutes are used in the Gaganyaan mission to extract and deploy the main parachutes independently. The second test simulated the clustered deployment of two ACS parachutes under maximum dynamic pressure conditions. The test also simulated clustered deployment at a 90-degree angle of attack conditions for the crew module. The ACS parachutes are used in the Gaganyaan mission for the separation of the apex cover mounted on the Crew Module. Both pilot and ACS parachutes were deployed using a pyrotechnic mortar device. The Gaganyaan parachute system development has been a joint effort by VSSC, Thiruvananthapuram and Aerial Delivery Research and Development Establishment (ADRDE), Agra.

Source: https://www.isro.gov.in/

BUSINESS

SARAL completes a decade of service and continuing

SARAL (Satellite with ARgos and ALtika) is an Indo-French cooperative mission. ISRO has provided the small satellite bus platform to which CNES payload composed of ARGOS-3 and AltiKa instruments (altimeter, radiometer, DORIS, LRA) are integrated. SARAL was launched on February 25, 2013, from SDSC-SHAR, Sriharikota onboard PSLV-C20. The intended mission life was 5 years. Imagined at the turn of the millennium, AltiKa is a technological breakthrough that offered a Ka-band altimeter for the first time to measure the topography of the surface of the oceans. Altika enabled imaging the coasts, rivers and lakes with better resolution than its predecessors. Lesser penetration depth of Ka-band waves into the snow or ice than that of the lower frequency counterparts facilitated more accurate measurement

of the altitudes. Besides contributing to the observation of the oceanic circulation of mesoscale (between 50 and 500 km) essential to understanding the dynamics of the ocean and its climatic impacts, AltiKa data are also widely used by glaciologists and hydrologists. Thanks to the efforts of ISRO, CNES, and EUMETSAT operational teams, SARAL is relentlessly pursuing its work as an ocean surveyor for the benefit of the international scientific community and the Copernicus Marine Service.

Source: https://www.isro.gov.in/

HAL to supply 70 trainer aircraft to IAF for over Rs 6,800 crore

In a major push towards indigenisation, the Union Cabinet on Wednesday approved purchasing 70 HTT-40 basic trainer aircraft from the Hindustan Aeronautics Limited (HAL) at a cost of Rs 6,800 crore to train rookie pilots joining the Indian Air Force The state-owned aviation major will supply the home-grown trainer aircraft over the next six years, supplementing the IAF's basic trainer fleet, which currently comprises 75 Pilatus PC-7 Mk-II aircraft. "The Union Cabinet has approved procurement of 70 HTT-40 Basic Trainer Aircraft from HAL for the IAF at a cost of Rs 6,828.36 crore," a Defence Ministry spokesperson said in a statement. Designed to have good low-speed handling qualities and better training effectiveness, the fully aerobatic tandem-seat turbo trainer has air-conditioned cockpit, modern avionics, hot refuelling, running changeover and zero-zero ejection seats. The induction of the aircraft is expected to meet the shortage of IAF's basic trainer aircraft for new pilots. The procurement will include associated equipment and training aids including simulators. About a decade ago, the same aircraft was virtually written off due to its disappointing development history, compelling the IAF to consider placing a follow-on order for another 36-38 Pilatus aircraft. Even though the follow-on order didn't materialise so far, the Defence Ministry rooted for the home-grown trainer. Being an indigenous solution, the HTT-40 is configurable for upgrades to incorporate the futuristic requirements of the armed forces. The current version has 56% indigenous content which will progressively be raised to over 60% through indigenisation of major components and subsystems. The Cabinet approval, however, was 36 aircraft less than what was cleared by the Defence Acquisition Council chaired by Rajnath Singh in August, 2020, when a proposal to buy 106 HTT-40 at a cost of Rs 8,722 crore was approved. Two years later in October 2022, this was modified to 70 aircraft at a cost of Rs 6,800 crore without any explanation. While the aircraft had cleared critical regulatory tests, Chief of the Air Staff Air Chief Marshal V R Chaudhari and his predecessor Air Chief Marshal R S Bhadauria (rtd) had flown the aircraft. The procurement of two types of trainer aircraft takes place following a 2008 IAF proposal when the Service initiated a case of procuring 181 basic trainer aircraft. The Union Cabinet also approved the purchase of three cadet training ships for the Indian Navy from Larsen & Toubro at a cost of more than Rs 3,000 crore. These ships will cater to the training of officer cadets, including women, at sea after their basic training to meet the future requirements of the Indian Navy. To be constructed at the L&T shipyard in Kattupalli, Chennai, the delivery of these ships is scheduled to commence from 2026.

Source: https://www.deccanherald.com/

Defence ministry inks Rs 6,800-cr contract with HAL to procure 70 basic trainer aircraft

The defence ministry on Tuesday sealed a deal with Hindustan Aeronautics Limited (HAL) to procure 70 HTT-40 basic trainer aircraft at a cost of over Rs 6,800 crore for the Indian Air Force. The ministry also finalised a contract with the Larsen & Toubro Ltd (L&T) for acquisition of three cadet training ships worth over Rs 3,100 crore. Both the procurement proposals were cleared by the prime minister-led Cabinet Committee on Security (CCS) on March 1. "The ministry of defence on March 7 signed contracts with Hindustan Aeronautics Limited (HAL) and Larsen & Toubro Limited (L&T) for procurement of 70 HTT-40 basic trainer aircraft and three cadet training ships respectively in the presence of Defence Minister Rajnath Singh," the ministry said. While the HAL will provide 70 HTT-40 aircraft over a period of six years, the delivery of ships is scheduled to commence from 2026.Defence Secretary Giridhar Aramane, along with other senior civil and military officials of the ministry, and representatives of the HAL and L&T were present at the contract signing ceremony. The HTT-40 is a turbo prop aircraft possessing good low speed handling qualities and provides better training effectiveness, according to the ministry. The HTT-40 contains approximately 56 per cent indigenous content which will progressively increase to over 60 per cent through indigenisation of major components and subsystems, officials said. "The aircraft will meet the shortage of basic trainer aircraft of Indian Air Force for training of newly-inducted pilots. The procurement will include associated equipment and training aids including simulators," the ministry said in a statement. "Being an indigenous solution, the aircraft is configurable for upgrades to incorporate the futuristic

requirements of the Indian Armed Forces. The aircraft will be supplied over a period of six years," it said. It said the HAL would engage the domestic private industry, including MSMEs, in its supply chain. "The procurement has the potential to provide direct and indirect employment to thousands of people spread over more than 100 MSMEs," the ministry said. On the cadet training ships, the ministry said they will cater to the training of officer cadets, including women, at sea after their basic training to meet the future requirements of the Indian Navy. "The ships would also provide training to cadets from friendly countries with the aim to strengthen diplomatic relations," it said. "The ships can also be deployed for evacuation of people from distress areas, Search and Rescue and Humanitarian Assistance and Disaster Relief (HADR) operations. The delivery of ships is scheduled to commence from 2026," the ministry said. The ships will be indigenously designed, developed and constructed at L&T shipyard in Kattupalli, Chennai. "The project will generate an employment of 22.5 lakh man-days over a period of four-and-half years. This will encourage active participation of Indian shipbuilding and associated industries, including MSMEs," the ministry said.

Source: https://www.deccanherald.com/

Maritime Partnership Exercise (MPX) with French Navy

Indian Navy's indigenously built guided missile frigate, INS Sahyadri participated in a Maritime Partnership Exercise (MPX) with French Navy (FN) ships FS Dixmude, a Mistral Class Amphibious Assault Ship and FS La Fayette, a La Fayette Class Frigate, in the Arabian Sea on 10 – 11 March 2023. The exercise witnessed a wide spectrum of evolutions at sea which included cross deck landings, boarding exercises and seamanship evolutions. The seamless conduct of the exercise reaffirmed the interoperability and high level of cooperation between the two navies. INS Sahyadri is fitted with state-of –the art weapons and sensors, which makes her capable of detecting and neutralising air, surface and sub-surface threats. The ship is a part of Indian Navy's Eastern Fleet based at Visakhapatnam, under operational control of FOCinC (East).

Source: https://pib.gov.in/PressReleasePage.aspx?PRID=1906097

Australian PM Visits INS Vikrant

The Australian Prime Minister, Hon'ble Anthony Albanese, visited INS Vikrant in Mumbai on 09 Mar 23 as part of his visit to India from 08 to 11 Mar 23. This is his first bilateral visit to India after he assumed charge in May 22. The Australian PM was received onboard by Admiral R Hari Kumar, Chief of the Naval Staff. Vice Admiral Dinesh K Tripathi, Flag Officer Commanding-in-Chief, Western Naval Command was also present. The Hon'ble PM was accorded a guard of honour onboard and briefed about the roles and capabilities of INS Vikrant. He was also introduced to the Light Combat Aircraft. He then interacted with a cross-section of personnel of the Indian Navy. While addressing the media, he underscored the strong diplomatic and military ties between the two countries and announced that Australia, for the first time, will host the 27th edition of the annual multilateral naval wargaming exercise, MALABAR, that is scheduled later this year among the navies of the USA, India, Japan and Australia. The MALABAR Exercise is an annual multilateral naval wargaming exercise that began in 1992 between the navies of India and the United States. Japan joined the exercise in 2015, while Australia became part of it in 2020. Australia and India upgraded their bilateral relationship from a Strategic Partnership in 2009 to Comprehensive Strategic Partnership (CSP) in 2020. Over the years, they have put in place several institutional mechanisms to promote their bilateral cooperation, including high-level visits, annual meetings of Prime Ministers, the Foreign Ministers' Framework Dialogue, 2+2 Defence and Foreign Ministers' Dialogue, Joint Trade and Commerce Ministerial Commission, Defence Policy Talks, Australia-India Education Council interactions, Defence Services Staff Talks, Energy Dialogue, and consultations of Joint Working Groups on different issues. In Jun 20, the two sides signed the pact that enables reciprocal access to military bases for logistics support, the Mutual Logistics Support Agreement (MLSA) that allows the militaries of the two countries to use each other's bases for repair and replenishment of supplies, besides scaling up overall defence cooperation.

Source: https://pib.gov.in/PressReleasePage.aspx?PRID=1905903

Hyderabad Firm with DRDO Labs Develops India's First Quadruped Robot and Exo-skeleton Svaya Robotics

A company based in Hyderabad, in association with two DRDO labs — the Research and Development Establishment, Pune (R&DE) and Defence Bio-engineering & Electro Medical Laboratory, Bengaluru, (DEBEL) — has developed India's first quadruped robot and wearable exo-skeleton. The company said it has developed the quadruped robot and wearable exo-skeleton as technology demonstrators with design inputs from R&DE and DEBEL respectively. Both are dual-use robots and have multiple use cases in both industry and healthcare, Svaya Robotics said on Monday in a release on the visit of G. Satheesh Reddy, Scientific Adviser to Union Defence DRDO News 2 Minister and former chairman of DRDO and senior scientists of the two DRDO labs to its facility here. Seeking to highlight the significance of 'Make in India', the company said such robots were now being imported by the country from the U.S. and Switzerland. They are made for structured environments with limited capabilities and not suited for deployment in difficult to manoeuvre terrains and field operational conditions that Indian defence and security forces are uniquely faced with, Svaya said. Expressing happiness at the progress Svaya made, Mr. Reddy said "development partnerships like these are essential to accelerate development of advanced robotics in India and take them into field trials fast and also keep developing them for dual-use in both defence and industry." Robotics would be playing a very important role in enabling Indian defence in both augmenting soldiers and also in providing unmatched remote reconnaissance capabilities, he said. Svaya said the quadruped robot was indigenously developed in collaboration with DRDO. It is made for navigating in unstructured terrains to provide remote reconnaissance and inspection for the defence and security forces which otherwise are not safe for humans to operate in, founder and MD Vijay R. Seelam said. The exo-skeleton is being developed by Svaya to suit Indian soldier's anthropometry and augment soldier strength for both walking long distances without fatigue and to lift heavy loads without expending much effort, he said.

Source: https://www.thehindu.com/news/cities/Hyderabad/hyderabad-firm-with-drdo-labs-developsindias-first-quadruped-robot-and-exo-skeleton/article66616035.ece

EVENT

4th Indian Planetary Science Conference held at PRL, Ahmedabad

The Indian Planetary Science Association (IPSA) organized the 4th Indian Planetary Science Conference (IPSC-2023) during March 22-24, 2023 at the Physical Research Laboratory (PRL), Ahmedabad. The conference highlighted the recent advances in Planetary Sciences, results and studies related to the atmosphere, surface and interior of planetary bodies in the solar system, including planetary processes and early solar system evolution. The conference was inaugurated by Shri S. Somanath, Secretary DOS & Chairman ISRO and Shri A.S. Kiran Kumar, Chairman PRL Council of Management on March 22, 2023. The Key-Note address was delivered by Shri A.S. Kiran Kumar where he emphasized generating human resources for efficient utilization of space science and planetary data. In his inaugural talk on "Indian Capabilities for Space Science and Planetary Exploration", Shri S. Somanath recollected the significance of scientific outcomes from Chandrayaan-1, Chandrayaan-2, Mars Orbiter Mission, and AstroSat and the interest they created in the community. He endorsed the capability of Indian researchers to build complex scientific instruments. Outlining the Science in the offing through upcoming missions, such as Chandrayaan-3, and Aditya L1 he urged enhanced participation of academia for complete utilization of the outcomes ad early publications. He briefed the missions being discussed, like, Venus Mission, Mars Landing Mission, LuPEX, DISHA, and XPoSAT. The IPSC-2023 was attended by about 225 delegates from different parts of the country representing various institutions, both academic and research, as well as universities and colleges. A few participants from the industry also attended the IPSC-2023. Around 130 research papers covering various domains of planetary science were presented in 9 different sessions during the three-day conference. The topics include the Lunar science and exploration results from missions, Surface and atmospheric processes on Mars and Venus, Payload development and instrumentation, Studies on solar system processes, Meteorites & small bodies, Astrobiology, Astrochemistry and Exoplanets. The deliberations included

around 60 oral and invited and 70 poster presentations. As a prelude to the IPSC 2023, a two-day workshop was organized by PRL, where 50 students of M.Sc., M.Tech., and B.Tech. from 50 different institutions were selected and imparted training on different aspects of planetary science and exploration, along with hands-on experience. IPSC-2023 was concluded with a discussion and feedback session with the participants. Early Career Researcher Awards were presented to seven young researchers during the concluding session.

Source: https://www.isro.gov.in/