PLUTUS IAS

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PSLV-C61 MISSION FAILS: A RARE GLITCH IN ISRO'S TRUSTED LAUNCHER

WHY IN THE NEWS?

The Indian Space Research Organisation (ISRO) recently faced a setback with the failure of the PSLV-C61 mission. This mission aimed to launch the Earth observation satellite EOS-09 but failed during the third stage of the flight. The incident marks a rare occurrence for the PSLV, a launch vehicle known for its high reliability and consistent success in satellite missions.

BACKGROUND & MISSION OVERVIEW

Parameter	Details
Mission Name	PSLV-C61 / EOS-09

Parameter	Details
Launch Date	May 18, 2025, 5:59 a.m. IST
Launch Site	Satish Dhawan Space Centre, Sriharikota
Satellite Weight	1,696.24 kg
Vehicle Configuration	PSLV-XL (Extra Large)

OBJECTIVES OF EOS-09

1. All-weather Earth Observation: Provide seamless Earth observation capabilities using C-band Synthetic Aperture Radar (SAR), unaffected by clouds, rain, or time of day.
2. High-Resolution Imaging: Capture high-resolution radar images of the Earth's surface for precise monitoring and analysis.
3. Disaster Management Support: Aid in early warning, response, and assessment during natural disasters like floods, cyclones, and landslides.
4. Agricultural Monitoring: Facilitate crop assessment, yield estimation, and pest/disease detection through periodic radar-based imaging.
5. Forestry and Biodiversity Tracking: Monitor forest cover, deforestation, encroachment, and biodiversity-related changes over time.
6. Soil Moisture and Hydrological Mapping: Support soil moisture estimation, water body mapping, and groundwater recharge studies, crucial for water resource management.
7. Climate and Environmental Studies: Generate continuous datasets for climate change research, glacier monitoring, and long-term environmental analysis.
8. Enhanced Remote Sensing Reliability: Ensure consistent, uninterrupted remote sensing outputs irrespective of weather or light conditions.
9. National Security and Surveillance: Strengthen India's border surveillance, strategic asset monitoring, and infrastructure planning using radar imaging.

FAILURE DETAILS OF PSLV-C61 MISSION

1. Stage of Failure: The malfunction occurred during the third stage, which uses a solid rocket motor.
2. Role of Third Stage: Provides the thrust to achieve desired orbital velocity and trajectory.
3. Technical Anomaly: Initial findings point to a drop in chamber pressure in the third-stage motor.
4. Investigation Status: A Failure Analysis Committee has been set up by ISRO to determine the root cause.
5. Mission Outcome: The satellite could not be inserted into the planned Sun Synchronous Polar Orbit (SSPO).
6. Historical Context: This marks only the third PSLV failure since 1993, underlining its historical success.

SIGNIFICANCE OF THE FAILURE

1. PSLV's Reputation: The PSLV has been considered ISRO's most reliable and versatile launch vehicle since its first flight in 1993.
2. Strong Track Record: Prior to this mission, PSLV had achieved 63 successful launches without major anomalies.

3. Rare Failure: This mission marks only the third failure in PSLV's operational history spanning over three decades.
4. Long Gap Since Last Failure: The previous PSLV failure occurred in 2017 during the PSLV-C39 mission, making this a rare anomaly after nearly 8 years of consistent success.
5. Mission Criticality: EOS-09 was a strategically important Earth observation satellite, intended to enhance India's remote sensing capabilities.
6. Impact on ISRO's Image: The failure is a significant setback for ISRO's otherwise impeccable PSLV record and space launch reliability.
7. Operational Implications: It underlines the increasing complexity and risk involved in modern space missions.
8. Need for Technological Vigilance: Emphasizes the importance of rigorous testing, validation, and failure analysis to maintain high reliability in future missions.

WAY FORWARD

1. Comprehensive Failure Analysis: ISRO will undertake an in-depth investigation through the Failure Analysis Committee to identify the exact technical causes behind the third-stage anomaly.
2. Strengthening Quality Control: Review and enhance quality assurance and testing protocols, especially for critical components like the solid rocket motor in the third stage.
3. Technology Upgradation: Accelerate research and development to improve propulsion system reliability and adopt newer materials and techniques to prevent similar issues.
4. Enhanced Monitoring Systems: Implement advanced real-time monitoring and telemetry systems during launches to detect early signs of anomalies and take corrective action swiftly.
5. Mission Risk Assessment: Refine mission risk analysis frameworks by incorporating lessons learned from recent failures to mitigate future uncertainties.
6. Capacity Building & Training: Strengthen technical expertise through specialized training programs for engineers and mission controllers, focusing on anomaly detection and crisis management.
7. Backup Plans and Contingencies: Develop robust contingency strategies including backup launch vehicles or satellites to minimize impact on national priorities during mission failures.
8. Transparent Communication: Maintain clear and timely communication with stakeholders and the public about progress in investigations and corrective measures to sustain trust in ISRO's capabilities.
9. Future Mission Safeguards: Incorporate redundant systems and fail-safes in upcoming PSLV missions, including enhanced checks for propulsion stages to uphold PSLV's legacy of reliability.

CONCLUSION

The failure of the PSLV-C61 mission is a reminder that even the most reliable systems are vulnerable in high-risk fields like space exploration. While this incident interrupts ISRO's otherwise stellar track record, it also provides an opportunity to introspect, upgrade, and strengthen mission protocols. With comprehensive failure analysis, technological improvements, and continued commitment to excellence, ISRO is well-positioned to bounce back stronger and more resilient in future missions. The agency's vision of making India a space power remains intact, supported by decades of innovation, dedication, and public trust.

PRELIMS QUESTIONS

Q. With reference to the PSLV-C61/EOS-09 mission, consider the following statements:
1. The PSLV-C61 mission was launched to place the EOS-09 satellite into a Sun Synchronous Polar Orbit.
2. The third stage of the PSLV uses a cryogenic engine for high thrust delivery.

3. EOS-09 was equipped with Synthetic Aperture Radar (SAR) for all-weather, day-and-night imaging.

Which of the above statements is/are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

Answer: B

MAINS QUESTIONS

Q. The failure of the PSLV-C61 mission marks a rare anomaly in ISRO's otherwise successful launch history. Examine the key objectives of the EOS-09 satellite, discuss the implications of the mission failure, and suggest steps to enhance the reliability of future satellite missions.

(250 words, 15 marks)