ISRO MISSION FAILED – SCIENCE & TECHNOLOGY

NEWS: ISRO's PSLV-C61 mission failed to place EOS-09 into orbit due to a third-stage malfunction, raising concerns about India's space readiness.

WHAT'S IN THE NEWS?

Sun-Synchronous Polar Orbit (SSPO): Key Features and Uses

- Definition: SSPO is a near-polar orbit in which a satellite passes over the same region of the Earth at the same local solar time each day.
- Altitude Range: Typically maintained between 600 to 800 kilometers above the Earth's surface.
- Consistent Lighting: Ensures that the satellite captures images under nearly identical lighting conditions across different days, which is essential for comparison over time.
- Ideal Applications:
    - Earth Observation: Monitoring environmental and geographical changes.
    - Weather Forecasting: Accurate and timely weather data collection.
    - Remote Sensing: Useful in vegetation monitoring, urban planning, and resource management.

PSLV-C61 Mission: Overview and Objectives

- Launch Vehicle: PSLV-C61 was the 63rd flight of ISRO's Polar Satellite Launch Vehicle and the 27th in the XL configuration, which carries extended strap-on boosters for heavier payloads.
- Mission Objective: To deploy EOS-09, an Earth Observation Satellite, into a Sun-Synchronous Polar Orbit (SSPO) for continuous monitoring of Earth's surface.

PSLV-C61 Failure: Cause and Consequences

- Technical Cause: The failure was attributed to a drop in chamber pressure in the third-stage solid propulsion motor, disrupting normal ascent.
- Mission Outcome: The rocket failed to reach the target orbit and hence could not place EOS-09 into the intended SSPO.
- Recent Precedent: This failure occurred shortly after the NVS-02 navigation satellite launch failure in January 2025, indicating ongoing reliability challenges.

What is PSLV?

- About: The Polar Satellite Launch Vehicle (PSLV) is a highly reliable and cost-effective launch vehicle developed by ISRO.

        - It is used to transport satellites into various orbits, including sun-synchronous, geostationary, and navigation orbits.
    - Function: It carries satellites (payloads) into space, overcoming Earth's gravity through powerful propulsion systems. Once the desired orbit is reached, satellites are deployed from the vehicle.
    - Structure: PSLV has 4 stages:
        - PS1: Solid rocket motor with 6 strap-on boosters.
        - PS2: Liquid engine (Vikas engine).
        - PS3: Solid rocket motor for high thrust post-atmospheric phase.
        - PS4: Two liquid-fuel engines for final orbital insertion.
    - Variants: PSLV-XL (with extended strap-ons), PSLV-DL, PSLV-QL, etc., are selected based on payload weight and target orbit.
    - Significance: Known as ISRO's "workhorse" due to its versatility and high success rate.
        - Used in major missions like Chandrayaan-1 (2008) and Mars Orbiter Mission (2013).
        - Achieved global recognition by launching 104 satellites in a single mission (PSLV-C37, 2017).
    - Earlier Failure: The PSLV has failed twice in its history. The first failure was in 1993 (PSLV-D1) due to software issues, causing the IRS-1E satellite to crash into the ocean.
        - The second was in 2017 (PSLV-C39), when a heat shield separation failure trapped the IRNSS-1H satellite, preventing its deployment into orbit.

Earth Observation Satellites (EOS): Functions and Capabilities

- Primary Purpose: Designed to observe and collect data on Earth's surface, atmosphere, and oceans through remote sensing instruments.
- Typical Payloads: Optical cameras, infrared sensors, radar instruments like Synthetic Aperture Radar (SAR) for high-resolution, all-weather imaging.
- Applications:
    - Environmental monitoring
    - Land and water resource mapping
    - Urban and rural planning
    - Agricultural and forest management
    - Natural disaster detection and assessment

India's Earth Observation Satellite Series

- Managed by ISRO: The Indian Space Research Organisation operates a dedicated fleet of EOS satellites.
- Major EOS Missions:
    - Cartosat Series: High-resolution mapping for urban and rural planning.
    - Resourcesat: Agricultural and water resource assessment.
    - RISAT (Radar Imaging Satellite): All-weather surveillance with SAR capability.
    - Oceansat: Oceanographic studies and fisheries management.
    - EOS-01: Launched in 2020, used for agriculture, forestry, and disaster monitoring.

Strategic and Military Importance of Satellites

A. Real-Time Surveillance and Reconnaissance

- EOS-09 Capability: Equipped with SAR, capable of imaging during cloud cover and nighttime—crucial for constant surveillance.
- Strategic Applications: Enables border security, troop movement monitoring, and battlefield situational awareness.

B. Navigation and Precision Targeting Systems

- Global Systems:
    - USA – GPS: Widely used for missile guidance, navigation, and logistics.
    - Russia – GLONASS: Supports guided weapons and autonomous military platforms.
    - China – BeiDou: Integral to PLA's network-centric warfare systems.
- India – NavIC:
    - Developed for regional navigation autonomy.
    - Aims to reduce reliance on foreign systems for military operations and disaster management.

C. Secure Communication and Coordination

- Satellite Role: Facilitates encrypted, long-distance communication between troops and command units across mountainous or remote areas.
- Supports Command and Control: Ensures uninterrupted coordination during military operations or emergencies.

D. Civil-Military and Disaster Applications

- Dual-Use Capability:
    - Satellites provide critical data for disaster response (e.g., floods, earthquakes).

- Enable real-time infrastructure and resource monitoring, benefiting both civilian governance and military logistics.

Source: https://economictimes.indiatimes.com/news/science/isro-eos-09-launch-aborts-midway-isro-chief-v-narayanan-explains-why/articleshow/121244429.cms?from=mdr