Rocket stages and Uncontrolled Re-entries

What is the issue?

More than 140 experts and dignitaries including Chairman of ISRO have signed an open letter published by the Outer Space Institute (OSI) calling for both national and multilateral efforts to restrict uncontrolled re-entries.

What are the different stages of a rocket launch?

- More than 6,000 satellites are there in orbit, most of them in low-earth (100-2,000 km) and geostationary (35,786 km) orbits.
- Rockets have multiple stages, they can be single stage or multistage (2 or more stages).
- Once a stage has increased the rocket's altitude and velocity by a certain amount, the rocket sheds its stage.
- There are 2 ways to shed the stages.
    1. Some rockets jettison all their larger stages before reaching the destination orbit; a smaller engine then moves the payload to its final orbit.
    2. Others carry the payload to the orbit, then perform a deorbit manoeuvre to begin their descent.
- In both cases, rocket stages come back down in controlled or uncontrolled ways.

What is uncontrolled re-entry?

- It is the phenomenon of rocket parts falling back to earth in unguided fashion once their missions are complete.
- Its path down is determined by its shape, angle of descent, air currents and other characteristics.

How does uncontrolled re-entries of rockets into the Earth's orbit cause damage?

- The rockets as it falls, will also disintegrate and some pieces burn up entirely while others don't.
- The debris can be deadly because of the speed they travel at.
- As the smaller pieces fan out, the potential radius of impact will increase on the ground.
- Most rocket parts have landed in oceans principally because earth's surface has more water than land.
- A 2021 report of the International Space Safety Foundation says that an impact anywhere on an airliner with debris of mass above 300 grams would produce a catastrophic failure, meaning all people on board would be killed.

What are the dangers highlighted in the letter written by the OSI?

- Conservative estimates place the casualty risk from uncontrolled rocket body re-entries as being on the order of 10% in the next decade.
- The countries in the 'Global South' face a "disproportionately higher" risk of casualties.
- If re-entering stages still hold fuel, atmospheric and terrestrial chemical contamination is another risk.
- There is no international binding agreement to ensure rocket stages always perform controlled re-entries nor on the technologies with which to do so.
- The Liability Convention 1972 requires countries to pay for damages, not prevent them.
- These technologies include wing-like attachments, de-orbiting brakes, and extra fuel on the re-entering body, and design changes that minimise debris formation.

What can make minimum damage?

- Any kind of re-entry will inevitably damage some ecosystem, still the OSI letter recommends that bodies aim for an ocean in order to avoid human casualties.
- Smaller satellites are easier to build and launch in large numbers.
- These smaller satellites experience more atmospheric drag and are likelier to burn up during re-entry.
- Tracking and predicting path of re-entry like ISRO did for RISAT-2 uncontrolled re-entry.

References

1. The Hindu - Rocket stages and uncontrolled re-entries

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