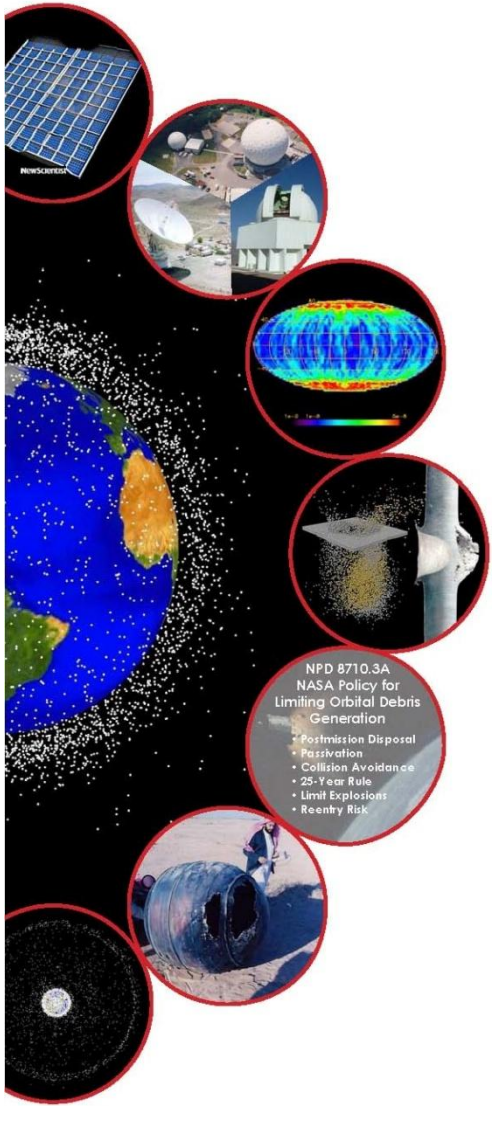
National Aeronautics and Space Administration

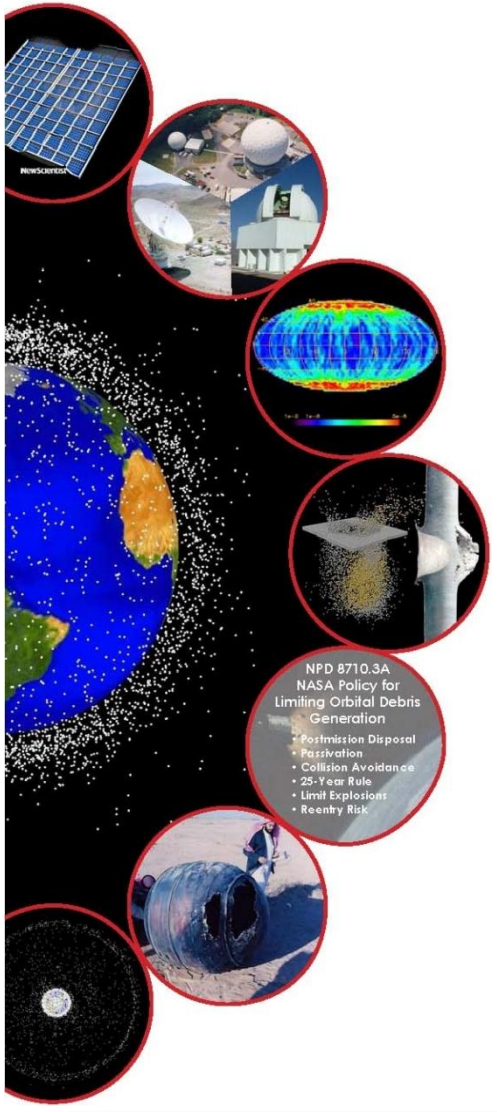


Orbital Debris and Space Safety

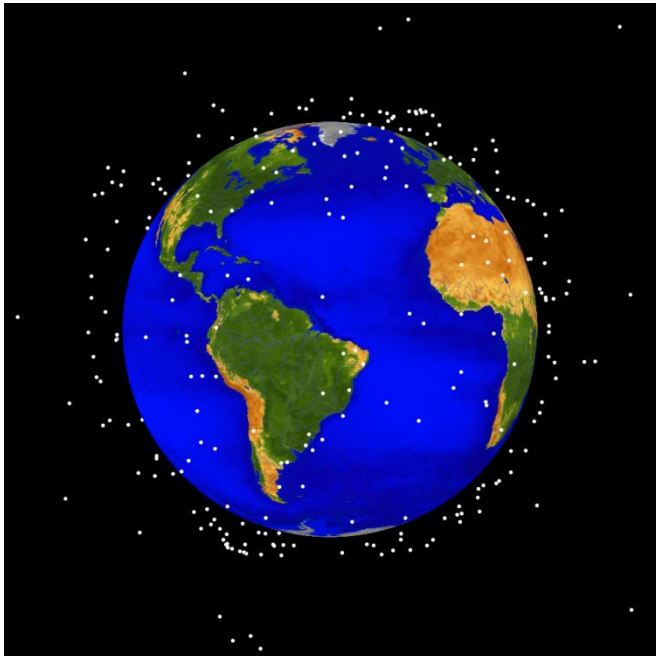
Senior Leadership ViTS Meeting
March 3, 2014

Orbital Debris Program Office
NASA Johnson Space Center

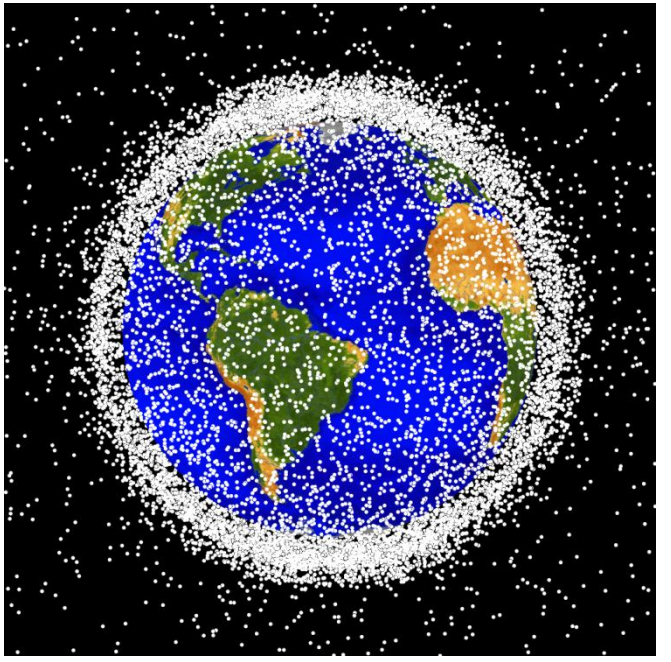
Near Earth Space Object Population



- **The increasing numbers of man-made objects in Earth orbit pose a hazard to the safe and reliable operation of both piloted and robotic space missions.**



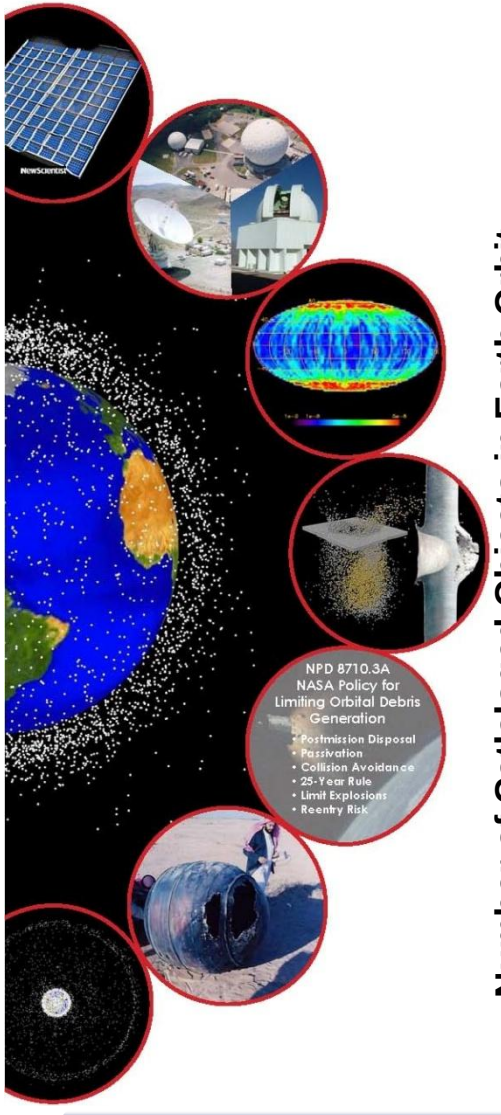
1963



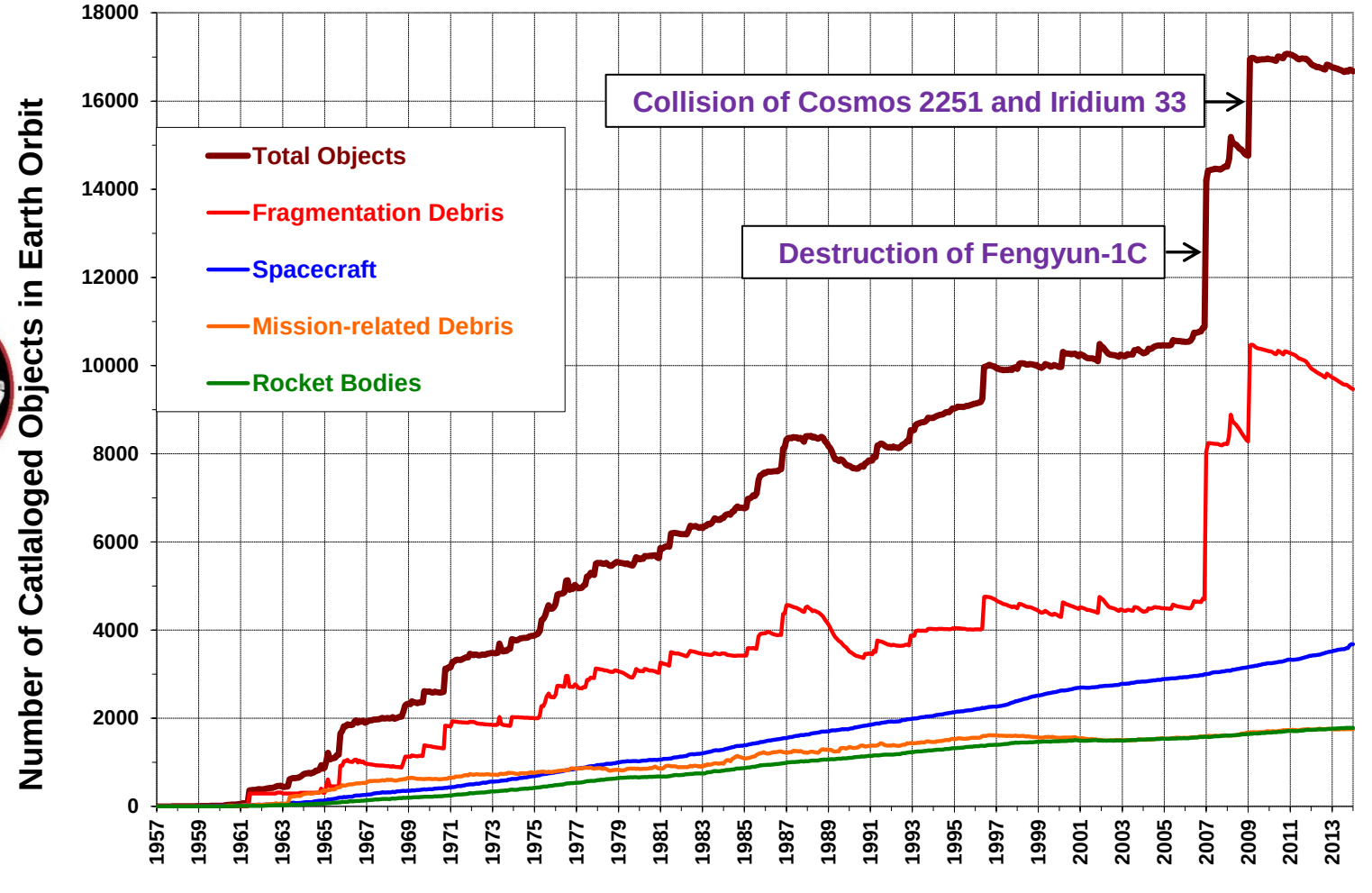
2013

(Objects shown are ~10 cm and larger)

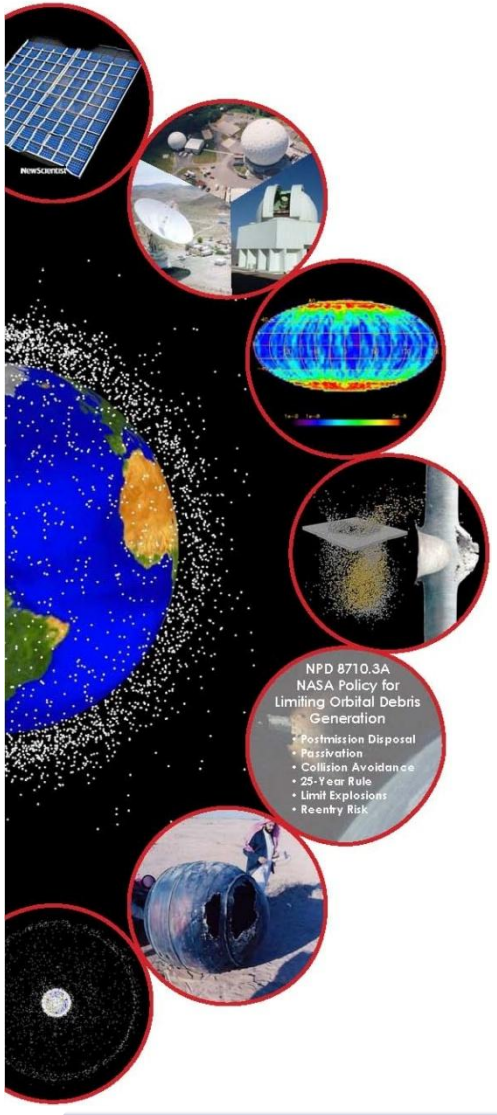
Near Earth Space Object Population



- **Humans continue to launch objects into space at a rate faster than they are removed by natural processes.**

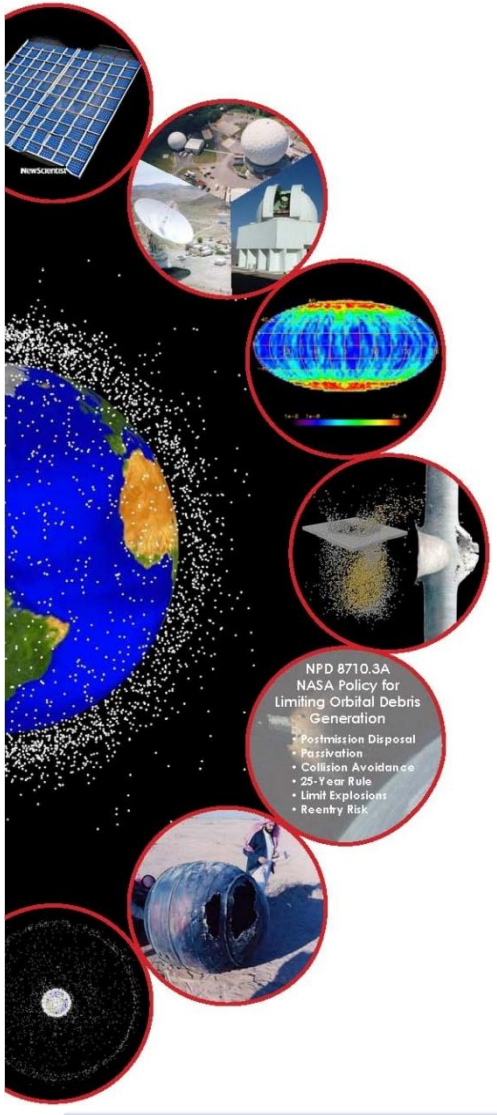


Orbital Debris Mitigation



- **NPR 8715.6A and NS 8719.14A establish requirements for orbital debris mitigation, *i.e.*, curtailment of creation of new orbital debris, intentionally or accidentally.**
  - **Primarily designed to protect the environment, not the mission.**
  - **However, they can enhance mission reliability as well.**
- **Each program/project must submit Orbital Debris Assessment Reports (ODAR) at PDR, CDR, and prior to launch.**
  - **Reports include on-orbit and reentry risk assessments.**
- **Reports are reviewed by sponsoring mission directorate, OSMA, and others.**
  - **Risks accepted by sponsoring mission directorate.**
- **Waivers can be submitted based upon mission requirements and cost-effectiveness.**
  - **Average 4 waivers per year; most for minor risks.**
  - **Technology is not the driver; old design habits are.**

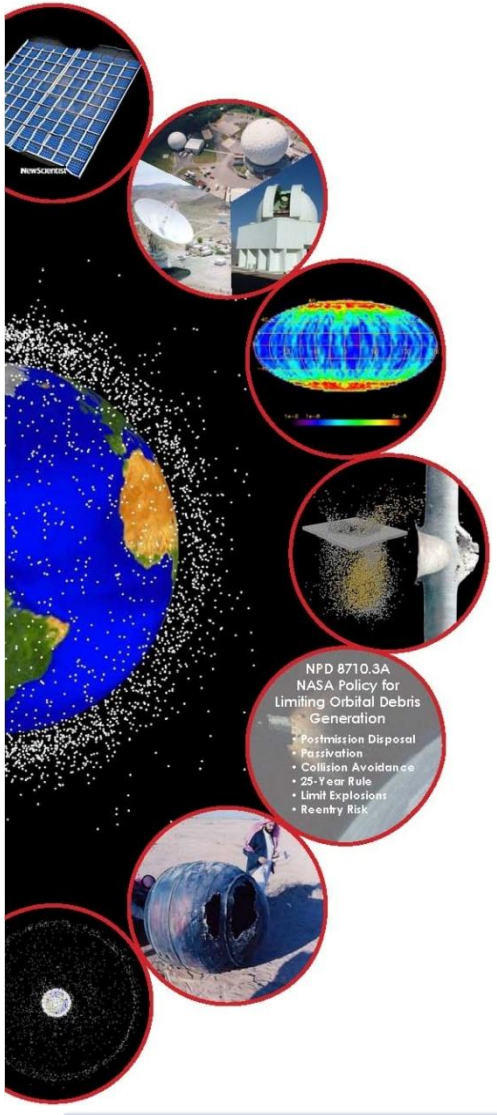
Orbital Debris Mitigation



- **From the beginning, NASA has taken the lead in the formulation of orbital debris mitigation guidelines.**
  - NASA mitigation measures have served as the template and foundation for all other mitigation guidelines.
    - US Government Orbital Debris Mitigation Standard Practices (2001).
    - Space-faring nations - IADC Space Debris Mitigation Practices (2002).
    - United Nations - Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space (2007).

- **NASA has not always done as well as we should in conforming to our own guidelines.**
  - **Addressing orbital debris issues before PDR.**
  - **Removing on-board energy sources at end of mission.**
    - Venting pressurized tanks.
    - Disconnecting batteries.
  - **Conforming to End-of-Mission Plans.**

Countermeasures



- **Collision avoidance maneuvers against known space objects (~10 cm or larger) are now standard operational procedure (NPR 8715.6A), but more than 99% of the threat population is not tracked.**
  - **29 collision avoidance maneuvers for NASA or NASA partner robotic spacecraft conducted in 2013 against threats 10 cm or larger (*i.e.*, tracked objects).**
  - **Extensive dedicated shielding protects critical ISS components against debris smaller than 1 cm. Residual risk is from debris 1-10 cm which are hazardous but too small to track.**
  - **Most robotic spacecraft are vulnerable to debris ~5 mm or larger.**
- **Collision avoidance for new launches (Launch COLA) is performed at request of project manager.**
- **Remediation of the near-Earth environment is the long-term goal.**
  - **Technical and cost challenges are significant.**
  - **Feasible concepts remain under investigation by both NASA and DoD, per National Space Policy direction.**