Orbital Debris Mitigation and Passivation Requirements

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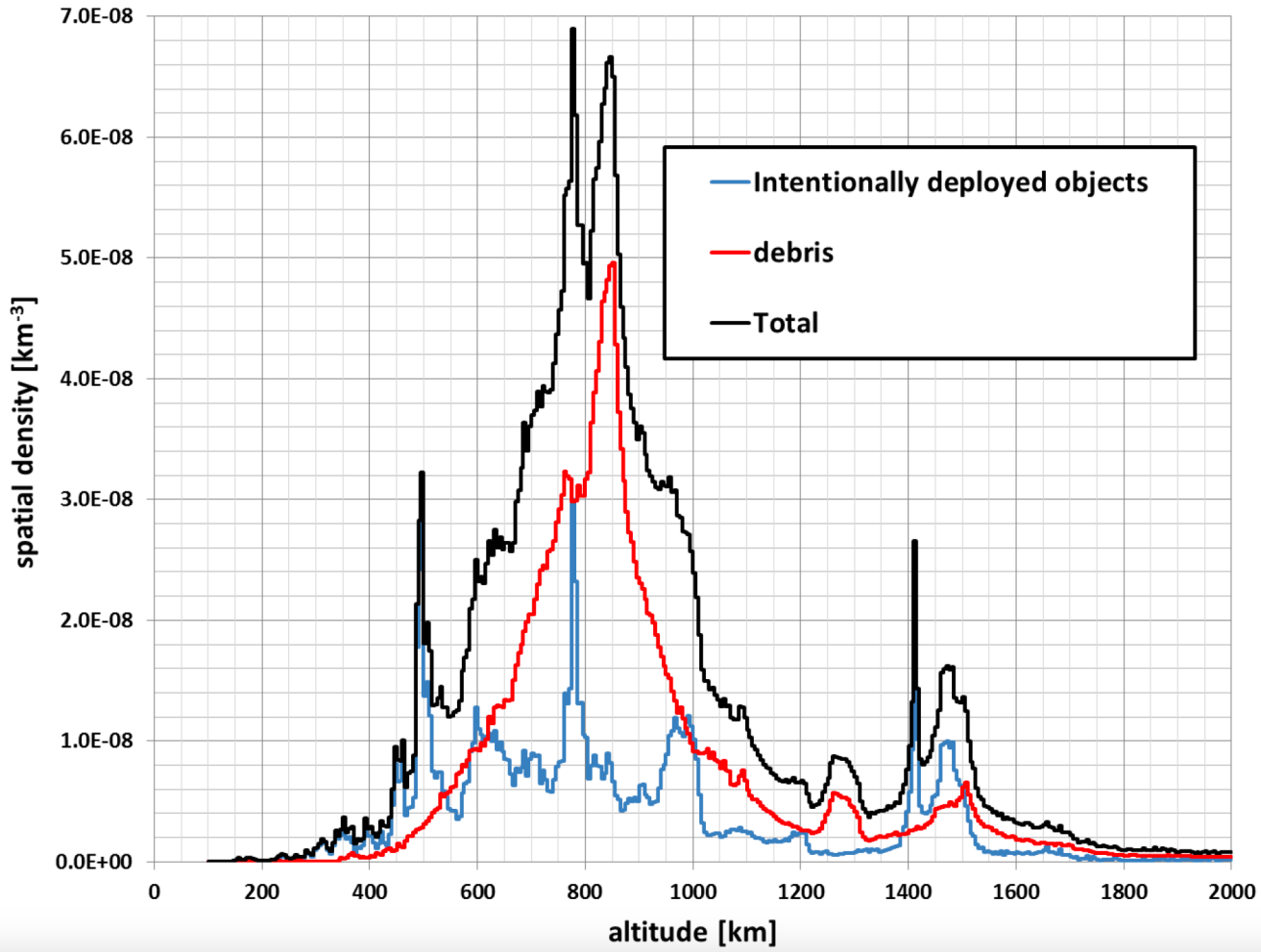
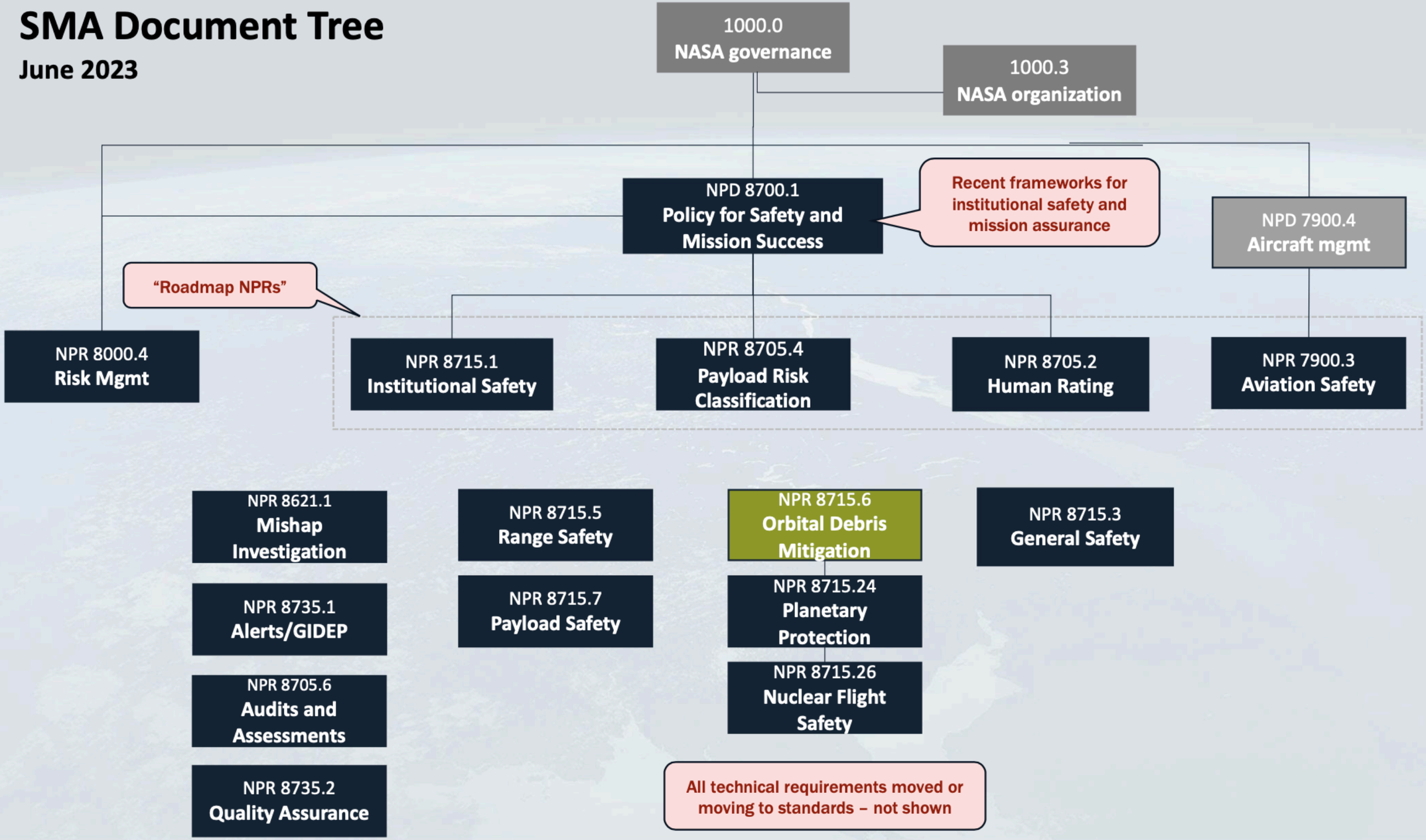
Briefing to NASA SmallSat In-Person LEARN Forum – October 2023

Orbital Debris at a Glance



SMA Document Tree

June 2023



Orbital Debris Policy Flowdown

NPD 1000.0
NASA Governance Handbook

NPD 8700.1
Policy for Safety and Mission Success

NPR 8715.6
Orbital Debris Mitigation

NASA-STD 8719.14
Technical Standard

- **Purpose (draft revision E)**

  "This NASA Procedural Requirements (NPR) directive defines responsibilities and procedural requirements for the **planning, implementation, and review of orbital debris mitigation measures** for NASA-sponsored spaceflight activities, consistent with the National Space Policy, the U.S. Government Orbital Debris Mitigation Standard Practices (ODMSP), and NASA's policy to protect the orbital space environment.

Policy Overview (1/2)

- **Preface and Introduction**
  - Applicability
  - Guiding Policies
  - Relief from Requirements
- **Roles and Responsibilities**
- **Procedural Requirements**
  - Formulation
  - Pre-Launch Review
  - Hardware Contributions
  - Launch Services
  - Mission Operations, Extensions, and Termination
  - Reentry and On-orbit Fragmentation Notifications

- NPR applies to all programs/projects that develop, acquire, or operate spaceflight systems or services intended to reach orbit
- Implements NSP 2020 language regarding compliance with Orbital Debris Mitigation Standard Practices
- Seeks to ensure:
  - Implementation of responsible mitigation standard
  - Independent review by appropriate authority
- NASA standard (8719.14) and ODAR/EOMP reviews apply only to spacecraft and launch vehicles operating under NASA's authority **(intent unchanged but clarified)**
- Allow ODMSP- or IADC-compliant standards for missions not under NASA authority **(adjusted)**

Policy Overview (2/2)

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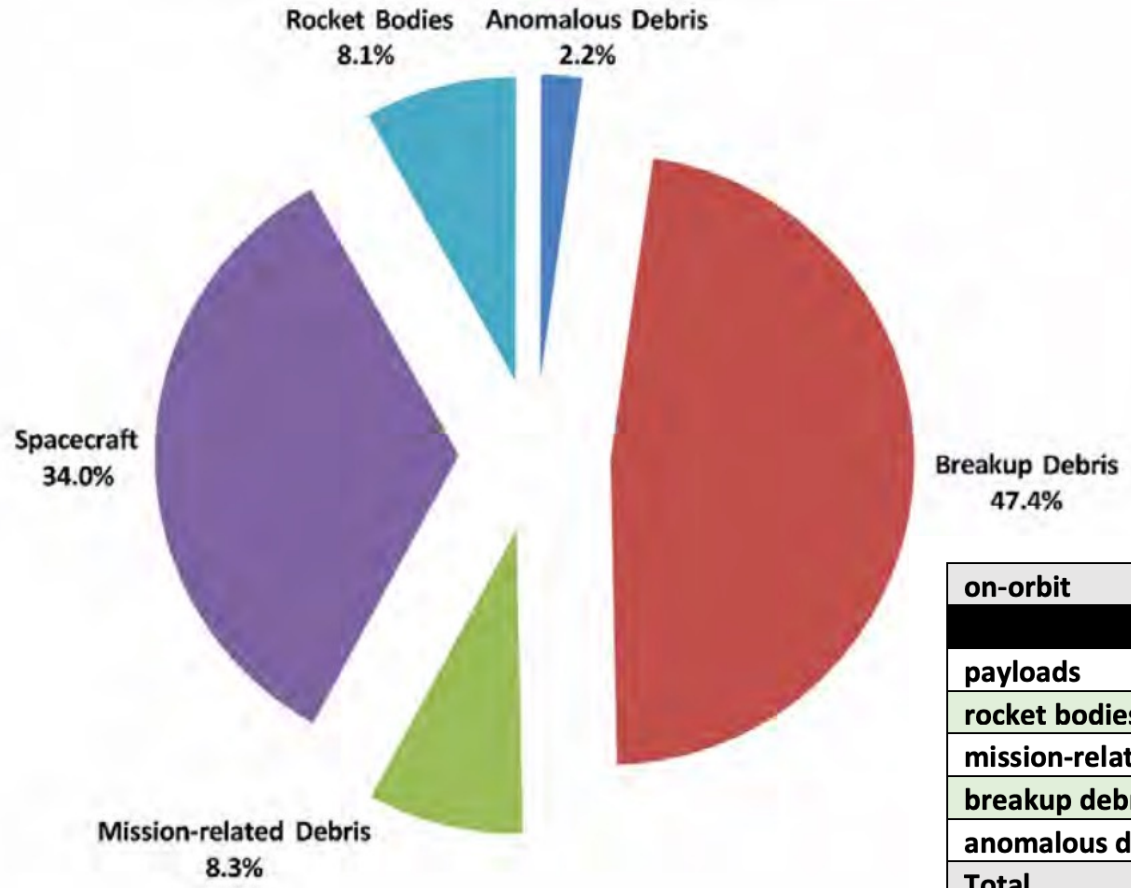
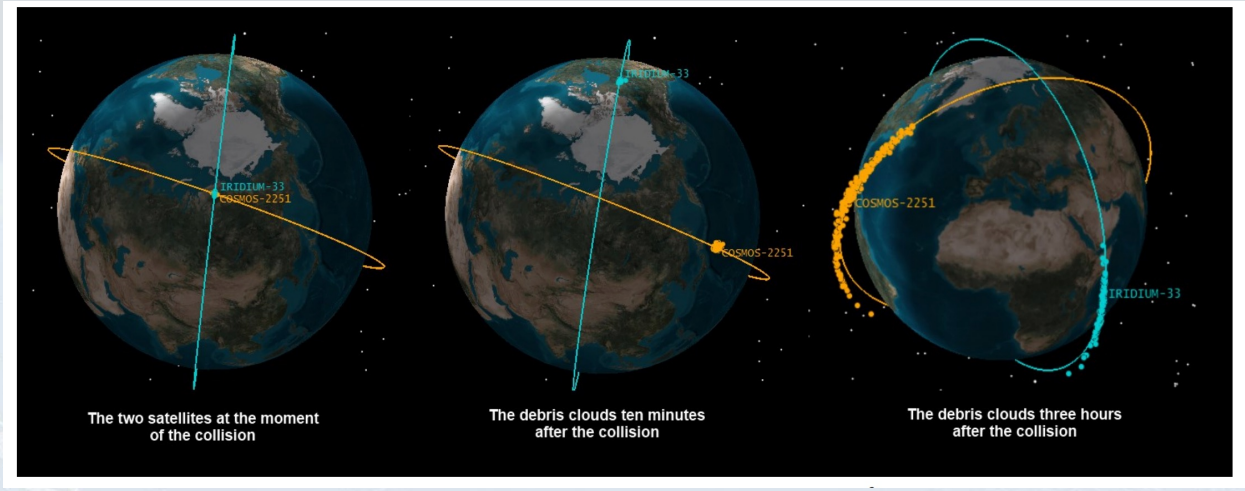
- Responsibilities consistent with NASA governance (1000.0) and Policy for Safety and Mission Success
- Programmatic chain responsible for planning and implementation
- Chief, SMA is responsible for oversight with support from Orbital Debris Program Office (ODPO)
- Relief may be requested by MDAA and is adjudicated in consultation with Administrator's Office

- Document planning, implementation and review responsibilities and mitigation standards **(new)**
- Adopt NASA-STD 8719.14 for missions to be operated under NASA authority

Orbital Debris Attribution



https://orbitaldebris.jsc.nasa.gov/library/HOOSF_16e.pdf

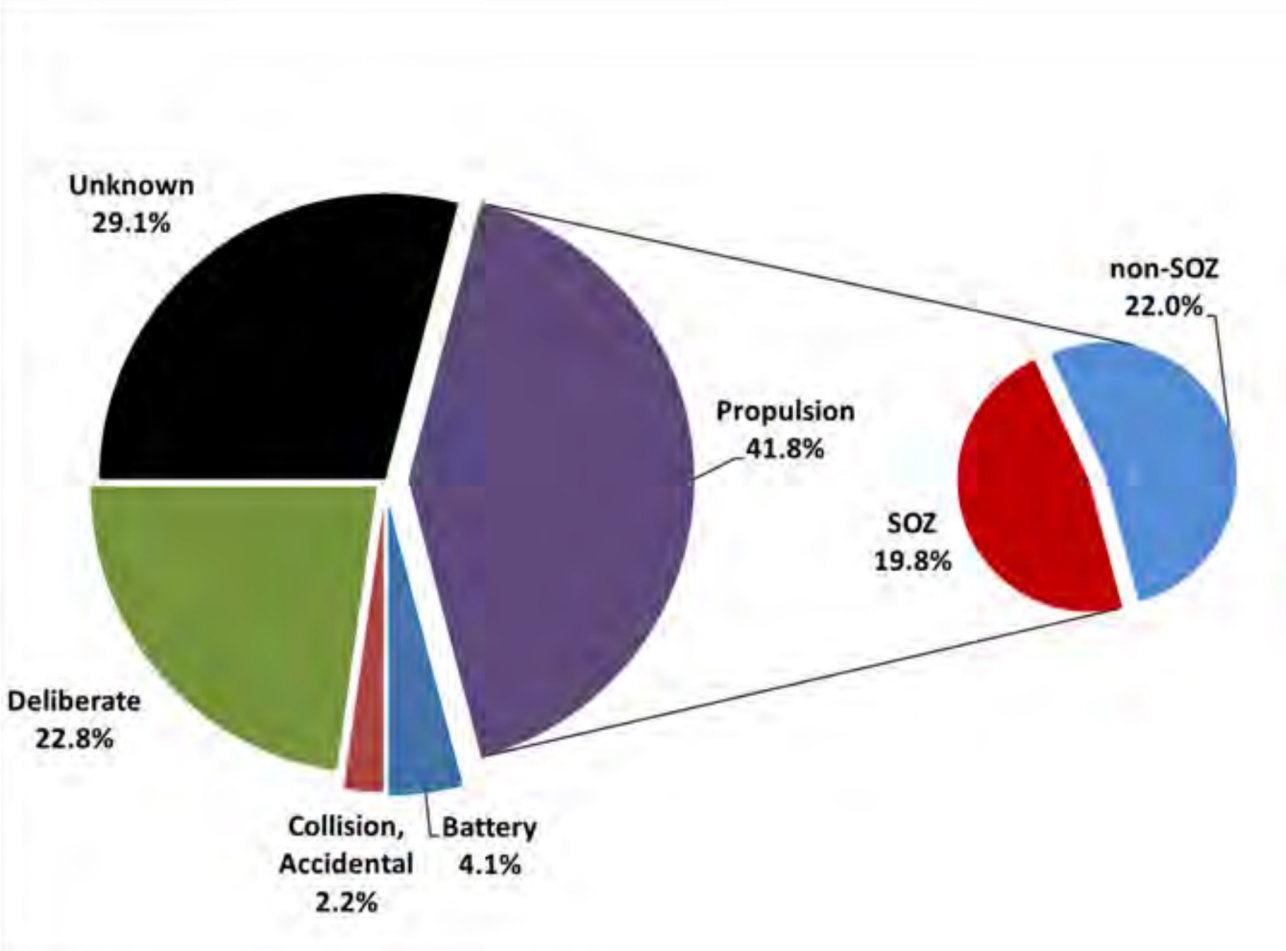


https://swfound.org/media/6575/swf_iridium_cosmos_collision_fact_sheet_updated_2012.pdf

Trackable Objects

on-orbit									
	US	CIS	France	PRC	India	Japan	ESRO/ESA	Other	Total
payloads	4413	1467	80	636	104	196	83	1664	**8643**
rocket bodies	613	957	155	194	39	54	7	42	**2061**
mission-related debris	751	795	151	336	6	38	14	17	**2108**
breakup debris	3450	4935	202	3311	70	11	28	55	**12062**
anomalous debris	316	221	7	4	0	1	12	2	**563**
Total	**9543**	**8375**	**595**	**4481**	**219**	**300**	**144**	**1780**	**25437**

Causes of Known Breakups



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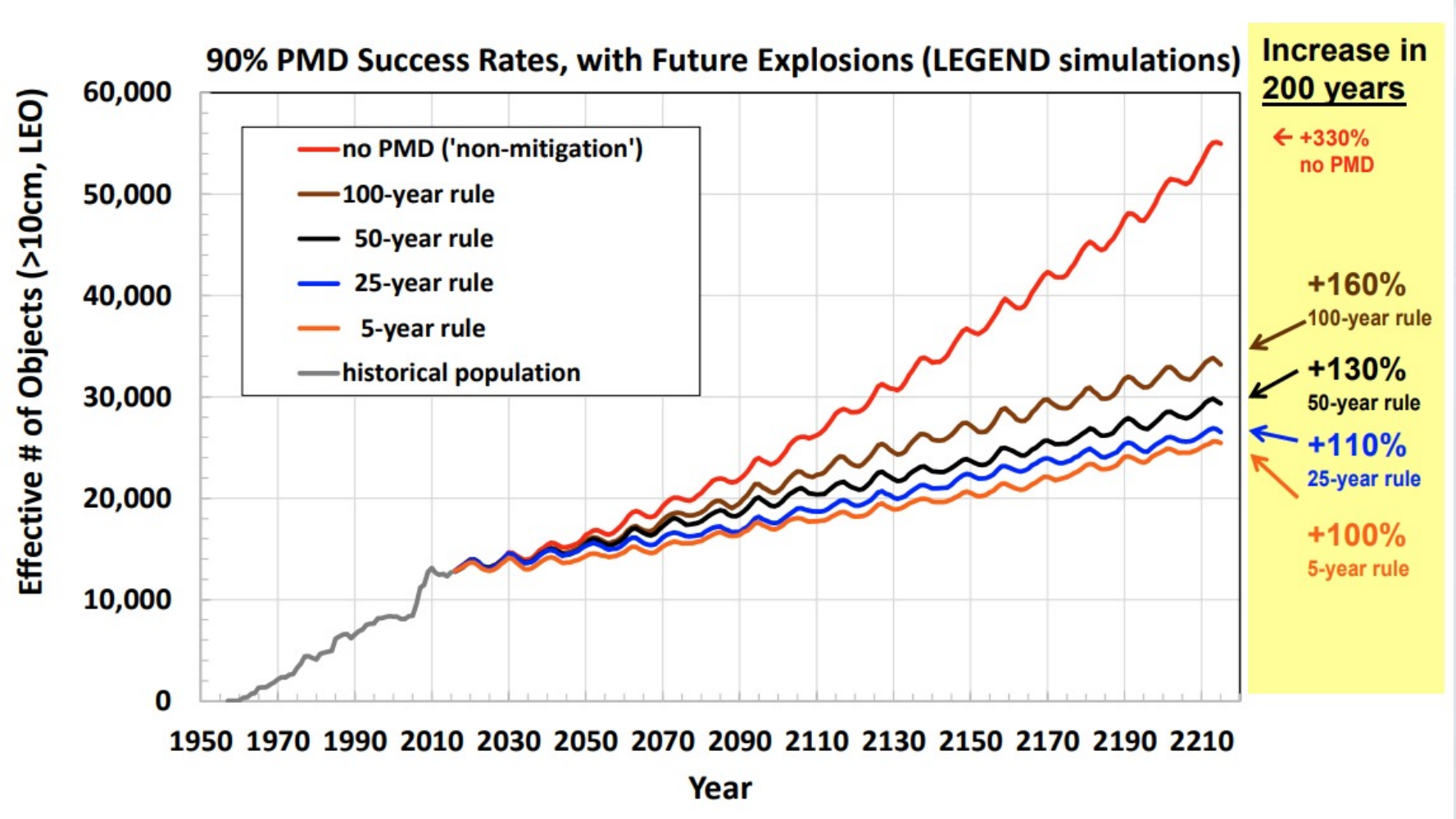
Deeper Dive into OD Mitigation: Passivation & NASA STD 8719.14C

4.4.2.1.3 Requirement 4.4-2: Design for passivation after completion of mission operations while in orbit about Earth or the Moon: Design of all spacecraft and launch vehicle orbital stages shall include the ability and a plan to either 1) deplete all onboard sources of stored energy and disconnect all energy generation sources when they are no longer required for mission operations or postmission disposal or 2) control to a level which cannot cause an explosion or deflagration large enough to release orbital debris or break up the spacecraft. The design of depletion burns and ventings should minimize the probability of accidental collision with tracked objects in space.

4.4-2 in this standard addresses the need to remove stored energy from spacecraft and LVs EOM to prevent debris-producing explosions and deflagrations (i.e., fragmentation) due to either internal failure modes (e.g., battery overcharging, tank overpressurization) or external causes (e.g., MOD impact, solar heating).

25-year rule vs. 5-year rule



Questions?