Reentry Casualty Risk (< 1:10,000 / 15 J): Design-for-Demise vs. Controlled Ocean Reentry

Pillar: Disposal Regime | **Basis:** NASA-STD-8719.14C / FCC Part 25 / ODMSP | **Primary Source:** NASA ODPO / FCC | **As Of:** Active Nov 2026 (15 J Kinetic Energy Gate)

Uncontrolled atmospheric reentry is permitted only if predicted human casualty expectation (Ec) across all surviving fragments exceeding 15 joules remains below 1 in 10,000 (0.0001); otherwise, operators must execute a controlled reentry over uninhabited ocean.

Documented Instrument & Engineering Record

• The 15-joule threshold: Under NASA-STD-8719.14C and U.S. Government ODMSP, any surviving piece striking Earth with kinetic energy > 15 joules contributes to the human casualty area.

• Why aluminum demises and titanium survives: Aluminum alloys melt around ~660 °C during peak aerothermal heating, whereas titanium (~1,668 °C), stainless steel (~1,400–1,500 °C), and tungsten balance weights frequently survive to ground impact.

• Two compliance paths: Designers either substitute demisable materials (Design-for-Demise) or budget enough delta-v for a targeted deorbit burn into the South Pacific Ocean Uninhabited Area (SPOUA).

• Constellation multiplier: When a single constellation deploys thousands of satellites, regulators scrutinize both per-satellite Ec and aggregate fleet casualty risk.

Design-for-Demise vs. Controlled Reentry Tradeoffs

Compliance Strategy	Engineering Mechanism	Primary Tradeoff
Design-for-Demise	Replace Ti/SS with Al/composite; thin walls	Higher material/thermal engineering cost
Controlled Ocean Reentry	Targeted perigee burn into SPOUA	Requires high-thrust prop + large EOL delta-v
ORSAT High-Fidelity Run	3D thermal-structural ablation modeling	Replaces conservative DAS sphere assumptions

Mission Designer, Compliance Lead & Founder Takeaways

• Never assume a small CubeSat or SmallSat automatically passes 1:10,000; a single dense titanium star-tracker baffle or steel flywheel can fail DAS.

• WA satellite manufacturers (SpaceX Redmond, Amazon Leo, BlackSky) publish demisability commitments in FCC ODMP filings.

• Running ORSAT early in preliminary design avoids last-minute ballast or propellant penalties before launch licensing.

Cross-Cluster Links & Primary Sources

• **SpaceX Redmond Census Profile:** https://bcesg.org/spacex-redmond-washington-space-cluster-profile/

• **Amazon Leo (Redmond) Census Profile:** https://bcesg.org/amazon-leo-washington-space-cluster-profile/

• **NASA ODAR Contract Deliverable Guide:** https://bcesg.org/wa-space-orbital-nasa-odar-contract-deliverable/

• **NASA Standards: NASA-STD-8719.14:** https://standards.nasa.gov/standard/nasa/nasa-std-871914

• **NASA ODPO: Orbital Debris Mitigation:** https://orbitaldebris.jsc.nasa.gov/mitigation/

• **eCFR: 47 CFR § 25.283:** https://www.ecfr.gov/current/title-47/chapter-I/subchapter-B/part-25/subpart-D/section-25.283

Provenance Note: Thresholds (< 1:10,000 Ec, > 15 J kinetic energy) verified against NASA-STD-8719.14C and NASA ODPO guidance as of 2026-11-16.