ORBITAL DATACENTER SYSTEM

ATTACHMENT B

Orbital Debris Assessment Report (ODAR)

1. INTRODUCTION AND SUMMARY

This Orbital Debris Assessment Report ("ODAR") is submitted in support of the application of Orbital Compute Inc. ("Orbital") for authority to launch and operate the Orbital Datacenter System (the "System"). This report demonstrates compliance with the Commission's orbital debris mitigation requirements, NASA-STD-8719.14, and related guidelines.

The Orbital Datacenter System consists of up to 100,000 non-geostationary orbit satellites operating as a distributed datacenter at altitudes between 500 km and 850 km in sun-synchronous orbits.

Key Compliance Summary

Requirement	Standard	Orbital Status
Large object collision probability	< 0.001 per satellite lifetime	Compliant
Small debris loss-of-control probability	< 0.01 per satellite	Compliant
Post-mission disposal	FCC 5-year rule	Compliant
Re-entry casualty risk	< 1×10^{-4} per spacecraft	Compliant
Debris release during operations	None	Compliant
Explosion probability	< 0.001	Compliant

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2. MISSION OVERVIEW AND SPACECRAFT INFORMATION

2.1 Mission Description

The Orbital Datacenter System deploys free-flying satellites as nodes in a distributed computing network. Each satellite carries GPU compute payloads for AI inference workloads, powered by solar arrays and cooled by radiative dissipation.

2.2 Orbital Parameters

Parameter	Value
Orbit type	Sun-synchronous, near-circular
Altitude range	500–850 km
Inclination	~97.4° (500 km) to ~98.7° (850 km)
Shell width	Up to 50 km
LTAN	06:00 (nominal)
Operational lifetime	7 years per satellite

2.3 Spacecraft Description

Parameter	Value
Satellite mass (dry)	~1,500–2,500 kg (Orbital-1, 100 kW class)
Satellite dimensions	Stowed ~3 × 3 × 4 m; deployed span up to ~50–70 m incl. solar arrays and ~100 m² radiator
Cross-sectional area	~80–120 m² mean projected, deployed
Area-to-mass ratio	~0.04–0.07 m²/kg
Propulsion	Low-complexity, triple-redundant
Propellant type	Water-based or green propellant
Attitude control	Three-axis stabilized

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3. PROPULSION SYSTEM

The spacecraft employs a low-complexity, triple-redundant propulsion system designed for high reliability throughout the satellite lifecycle. The propulsion system carries sufficient propellant for:

- Orbit raising during commissioning phase
- Station-keeping operations including collision avoidance maneuvers

- Complete end-of-life disposal via controlled atmospheric re-entry
- Significant margin for contingency operations

The propulsion system design prioritizes:

- High thrust-to-weight ratio for responsive collision avoidance
- Low complexity to maximize reliability
- Triple redundancy to ensure disposal capability even after single or dual failures
- Water-based or green propellant to minimize stored chemical energy and explosion risk

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4. SPACECRAFT TRACKABILITY AND IDENTIFICATION

4.1 Trackability

All Orbital satellites exceed 10 cm in their smallest dimension and are presumed trackable by ground-based radar and optical surveillance systems. Each satellite incorporates:

- GNSS-based autonomous position determination
- Regular state vector reporting to ground control
- Real-time ground connectivity for rapid position updates
- Unique telemetry markers per satellite

4.2 Registration and Identification

- Assigned a temporary 9-digit identifier prior to launch
- Registered with the U.S. Space Command 18th Space Defense Squadron
- Published on Space-Track.org upon orbital insertion
- Transitioned to NORAD catalog numbers upon assignment

4.3 Information Sharing

- Maintain 24/7 contact information on Space-Track.org
- Continuous propagated ephemerides with planned maneuver notifications
- Coordination protocols with the 18th Space Defense Squadron
- Data sharing with all registered operators through standard channels

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5. COLLISION AVOIDANCE

5.1 Operational Coordination

Orbital will make all reasonable attempts to coordinate with other orbit users and will assume maneuver responsibility when:

- Coordination cannot be achieved in a timely manner
- Collision risk exceeds Orbital's internal thresholds
- The other object is non-maneuverable

5.2 Large Object Collision Avoidance (Requirement 4.5-1)

Orbital will assess and limit the probability of collision with large objects (≥10 cm diameter) to less than **0.001** over the total orbital lifetime of each satellite.

The collision avoidance system integrates:

- Three-axis attitude control with redundant propulsion
- Space situational awareness data feeds
- Conjunction assessment and collision avoidance (COLA) ground operations
- High-thrust propulsion for responsive maneuvering

5.3 Small Object Collision Risk (Requirement 4.5-2)

The probability of loss of control due to collision with small debris or meteoroids shall be less than **0.01** per satellite, as calculated using NASA DAS or higher-fidelity tools.

5.4 ISS and Tiangong Coordination

Orbital will coordinate with NASA regarding transit through orbital altitudes occupied by the International Space Station, Tiangong, and any other inhabited spacecraft.

5.5 Conjunction Warning Response

Upon receipt of a conjunction warning, Orbital will:

1. Review the alert and assess collision risk
2. Contact active spacecraft operators involved
3. Share ephemeris and operational data
4. Adjust spacecraft attitude and operations as needed
5. Assume maneuver responsibility when coordination fails and risk exceeds thresholds
6. Mitigate high-risk events to at least 1.5 orders of magnitude below the action threshold

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6. DEBRIS RELEASE AND INTENTIONAL BREAKUP

6.1 Debris Release During Normal Operations

Zero debris will be released during normal spacecraft operations. The spacecraft design incorporates:

- No planned debris release mechanisms
- No tethers
- No proximity operations
- No separate deployable components requiring release devices
- Non-explosive separation mechanisms for launch vehicle integration

6.2 Intentional Breakup

No intentional breakup operations are planned at any point during the satellite lifecycle.

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7. EXPLOSION RISK AND STORED ENERGY

7.1 System Design

The spacecraft is designed with inherently low explosion risk:

- Propellant tanks are low pressure with low stored energy (water-based or green propellant)
- Batteries have minimal capacity sized only for critical bus systems during eclipse periods
- No high-pressure gas systems
- No pyrotechnic devices

7.2 Battery Failure Mode Analysis

Required probability of battery-related explosion: < **0.001** | Expected probability: < **0.001** ✓

Failure Mode	Mitigation	Combined Fault Requirement
Internal cell short circuit	Protoflight testing, functional testing, charge cycles	Environmental testing AND functional testing must both fail
Internal thermal rise	Lab testing for high discharge, hot environment testing	Thermal design incorrect AND over-current detection fails

Failure Mode	Mitigation	Combined Fault Requirement
Excessive discharge/short	Short circuit protection, insulator design	External load failure AND over-current detection fails
Inoperable vents	Venting not inhibited by design	Cell manufacturer OR integrator failure
Current leakage	Non-conductive holder, vacuum operation	Insulation piercing AND pack dislocation AND detection fails
Excess temperature	Thermal analysis, testing, monitoring	Thermal analysis AND design AND testing AND monitoring all fail

7.3 End-of-Life Passivation

At end of mission, all stored energy will be removed:

- Residual propellant removed via depressurization and venting
- Propellant line valves left open
- All batteries placed in permanent discharge state
- Solar panels disconnected from electrical power system via electronic switch

Items unable to be passivated: **None identified.**

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8. POST-MISSION DISPOSAL

8.1 Disposal Method

Primary method: Controlled atmospheric re-entry via active deorbit maneuvers as soon as practical after mission completion.
Compliance: FCC 5-year post-mission disposal requirement (47 C.F.R. § 25.114(d)(14)).

8.2 Disposal Procedure

1. Satellite performs collision avoidance screening for disposal trajectory
2. Active deorbit maneuvers lower perigee to initiate atmospheric re-entry
3. Propellant reserves dedicated to disposal phase ensure reliable execution
4. Full passivation performed after achieving disposal orbit

8.3 Worst-Case Failure Scenario

In the event of complete satellite failure at maximum operational altitude (850 km), natural atmospheric drag ensures orbital decay with an estimated orbit lifetime well within the NASA 25-year guideline for uncontrolled re-entry.

At 500 km, natural decay occurs in approximately **3–5 years** even without active deorbit maneuvers — at or near the FCC 5-year post-mission disposal threshold.

8.4 Reliability of Disposal Operations

Probability of successful disposal: **≥ 0.99** per satellite. Achieved through:

- Fault-tolerant TT&C systems
- Onboard autonomy for contingency operations
- Propellant reserves covering credible single-failure scenarios
- Triple-redundant propulsion

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9. ATMOSPHERIC RE-ENTRY HAZARD

9.1 Designed for Demise

Orbital satellites are designed for complete demisability upon atmospheric re-entry.

Compliance criteria:

- No surviving components impacting the ground with kinetic energy exceeding 15 joules
- Re-entry casualty risk less than $\mathbf{1\times10^{-4}}$ per spacecraft

9.2 Re-entry Analysis

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10. LAUNCH AND DEPLOYMENT PROFILE

10.1 Launch

Satellites will be launched as secondary payloads on commercial launch vehicles (initially SpaceX rideshare missions). Initial deployment at altitudes below operational orbit ensures rapid natural deorbit in the event of early-stage failures.

10.2 Commissioning

1. Spacecraft commissioning and checkout at deployment altitude
2. Orbit raising maneuvers to operational altitude

3. Primary payload activation and testing
4. Entry into operational service

10.3 Failure Scenario Analysis

Failure Point	Natural Decay	Compliance
Pre-orbit-raise	Rapid (deployment altitude)	✓
Operational at 500 km	~3–5 years	✓ NASA 25-year guideline
Operational at 850 km	~15–20 years	✓ NASA 25-year guideline

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11. PHYSICAL INTERACTION AND SPECIAL CONSIDERATIONS

11.1 Proximity Operations

No planned proximity operations or docking with other spacecraft.

11.2 Radioactive Materials

No radioactive materials are carried on any spacecraft.

11.3 Liquids

Spacecraft contain liquids (thermal management and propulsion fluids) at less than 2 atmospheres pressure, without significant stored chemical energy.

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12. REGULATORY AND STANDARDS COMPLIANCE

- **FCC:** 47 C.F.R. § 25.114 — fully addressed in this ODAR
- **NASA:** NASA-STD-8719.14B (MMOD Protection Standard)
- **UN COPUOS:** Space Debris Mitigation Guidelines
- **IADC:** Inter-Agency Space Debris Coordination Committee guidelines

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13. CONJUNCTION ASSESSMENT AND MANEUVER PLANNING

13.1 SSA Data Integration

Orbital will utilize SSA data from U.S. Space Force Space Delta 2 through established channels. Real-time tracking data integrated into onboard autonomous collision avoidance algorithms.

13.2 Collision Probability Thresholds

A collision probability exceeding $\mathbf{1\times10^{-4}}$ (0.01%) triggers conjunction assessment review. Conservative planning margins ensure reliable avoidance of predicted conjunctions.

13.3 Autonomous Maneuver Execution

Each satellite carries onboard software enabling autonomous collision avoidance if ground command is unavailable. Autonomous logic incorporates pre-computed maneuver solutions, command timeout logic, and failsafe positioning algorithms.

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14. GROUND OPERATIONS AND MONITORING

- 24/7 NOC staffed with satellite operations engineers
- Automated alerting for anomalies, trajectory deviations, and conjunction warnings
- FCC notification within 48 hours of any event affecting orbital debris compliance
- State vector updates transmitted to ground control every orbit, published to Space-Track.org at least daily

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21. SUMMARY AND COMPLIANCE STATEMENT

Orbital Compute Inc. certifies that the Orbital Datacenter System has been designed in compliance with all applicable FCC orbital debris mitigation requirements and NASA debris mitigation guidelines.

Respectfully submitted,

Euwyn Poon
CEO & Founder
Orbital Compute Inc.