CTC-1 Orbital Debris Assessment Report (ODAR)

per NASA-STD 8719.14C

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Revision 0

Date July 19, 2025

Space Telecommunications, Inc.

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Required Signatures

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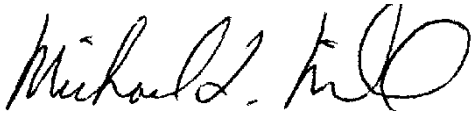
Date July 19, 2025	

Title: Author Michael L. Miller	
Date July 19, 2025	

Version History

Version	Date	Change Author	Change Summary
Rev 0	July 19, 2025	Michael L. Miller	Initial Release

1. Self Assessment

A self-assessment against NASA-STD-8719.14C spacecraft mission requirements is shown below for CTC-1.

Requirement	Resolution	Remarks
4.3-1.a MRD 25-year limit	N/A	No separating objects
4.3-1.b MRD<100 object x year limit	N/A	No separating objects
4.3-2 GEO MRD	N/A	No separating objects
4.4-1 <0.001 Explosion Risk	COMPLIANT	
4.4-2 Passivate Energy Sources	COMPLIANT	
4.4-3 Limit Intentional BU, Long Term	N/A	No planned breakups
4.4-4 Limit Intentional BU, Short Term	N/A	No planned breakups
4.5-1 <0.001 10cm Impact Risk	COMPLIANT	

Requirement	Resolution	Remarks
4.5-2 <0.01 Small MMOD Impacts	N/A	No planned controlled reentry, no critical subsystems to protect
4.6-1a-c LEO Disposal	COMPLIANT	
4.6-2 Storage or Earth-escape	N/A	
4.6-3 Long-term Reentry	N/A	
4.6-4 Disposal Reliability	COMPLIANT	
4.7-1 Reentry Risk	COMPLIANT	
4.8-1 Special Classes	N/A	Not considered a special class of space mission

Table 1-1: Self-Assessment of CTC-1

Debris Assessment Software (DAS) version 3.2.6 was used for evaluation of the CTC-1 against requirements.

2. ODAR Section 1: Program Management and Mission Overview

a. Identification of the Company and Program Executive

Company: Space Telecommunications, Inc.

Program Executive: Dr. Adam D. Wexler, Director of Systems Architecture

Address: 2803 Philadelphia Pike, Suite B PMB 7247, Claymont, Delaware 19703 USA

b. Identification of any foreign government or space agency participation in the mission and a summary of NASA's responsibility under the governing agreement(s)

None

c. Brief description of the mission

The overall goal of the CTC-1 mission, is to Demonstrate a 5th Generation (5G) communications Non-Terrestrial Network (NTN) with spacecraft in a Non-Geostationary Orbit (NGSO). Three identical satellites, CTC-1A, -1B and -1C, will be launched. This ODAR describes a single satellite, except where risk is concerned, the cumulative risk of 3 spacecraft is given.

d. Identification of the anticipated launch vehicle and launch site

The spacecraft will be launched aboard SpaceX Transporter 15, from Vandenberg Air Force Base.

e. Identification of the proposed launch date and mission duration

The spacecraft will be launched NET October 1, 2025, and the mission duration will be 2 years.

f. Description of the launch and deployment profile, including all parking, transfer, and operational orbits with apogee, perigee, and inclination

The spacecraft will be inserted into a circular Sun synch orbit at 510 km altitude, on an inclination from the equator of 97.4 degrees.

g. Description of the spacecraft's maneuver capability, including both attitude and orbit control. Give the time period during which the capabilities will be exercised.

Attitude control is accomplished using the Attitude Determination and Control Subsystem. This includes four reaction wheels for momentum, and 3 magnetorquers mounted on the structure for canceling environmental torques and unloading the momentum of the reaction wheels. The critical components are the magnetorquers, dual triaxis magnetometers, Earth horizon sensor, fine sun sensors, and reaction

wheels. Additional hardware being flown but not required for flight control includes three GPS receivers providing differential GPS measurements.

The spacecraft has no maneuver capability. There is no propulsion.

h. Reason for selection of operational orbit(s) (such as ground track, SSO, GEO sync, instrument resolution, co-locate with other spacecraft, …)

The orbit was selected for launch availability, and it is SSO.

There is no planned co-location with any other spacecraft.

i. Identification of any interaction or potential physical interference with other operational spacecraft (Note: This does not include potential for RF interaction unless it affects the risk of generating orbital debris.)

There is no expected interference with other operational spacecraft.

3. ODAR Section 2: Spacecraft Description

a. Physical description of the spacecraft, including spacecraft bus, payload instrumentation, and all appendages, such as solar arrays, antennas, and instrument or attitude control booms

The spacecraft is a 16U 2 X 2 X 4 CubeSat with the dimensions of 20 X 20 X 40 cm. The total mass is 21.3 kg. It contains the following systems:

Attitude Determination and Control System (ADCS): The attitude determination and control system controls the 3-dimensional attitude of the spacecraft. The system consists of four reaction wheels for momentum, and 3 magnetorquers mounted on the structure for canceling environmental torques and unloading the momentum of the reaction wheels. The critical components are the magnetorquers, dual triaxis magnetometers, Earth horizon sensor, fine sun sensors, and reaction wheels. Additional hardware being flown but not required for flight control includes three GPS receivers providing differential GPS measurements.

Command and Data Handling (CDH) Subsystem: The CDH subsystem consists of the computer in the detumble module, and the Single Board Computer (SBC) of the payload. The SBC processes commands from the ground station to the ADCS module, the inflatable antenna modules, and the UHF and S-band radios.

Communication Subsystems:

There are two distinct communications subsystems on the ctc-1 satellites – bus and demonstration.

Bus Comms Subsystem: The bus communications subsystem consists of a two-way UHF radio and its deployable antenna, a two-way S-band radio and its patch antenna.

Demonstration Comms Subsystem: The demonstration communications subsystem consists of a four transmit and four receive channel baseband SDR that directly generates the RF for the feeder and service links. The feeder link carries data to and from ground stations. The service link carries data to and from end user devices.

This radio also delivers the IF for frequency up/down conversion for the Inter Satellite Link (ISL) via the Reliasat converters. The ISL supports communication among the 3 satellites in the CTC-1 group. Two ISL transceivers on different frequencies are included, so that the middle satellite in the string can communicate with each of the others simultaneously.

The UHF radio is employed for low data rate TeleMetry and TeleCommand (TMTC) with a ground station. The S-band radio is employed for high data rate TMTC with a ground station.

Electrical Power Subsystem: The Power Subsystem is a direct energy transfer system using a solar array producing approximately 65 W of orbit average power to charge the 325.6 W-hr battery system. The solar arrays utilize standard NSL photovoltaic cells; the batteries are COTS NSL Lithium-Ion cells battery packs. The OBC sends signals to the Power Distribution Module to control load switching. The power subsystem has flight heritage, flexible arrays 10 years of flight heritage (FH), batteries have 5 years FH, EPS has 5 years FH.

Thermal Subsystem: Thermal subsystem controls hardware temperature with passive cooling via conduction to the spacecraft chassis and conductive coupling to radiators in the +Z (ram), -Z (anti-ram), and -Y (nadir) faces to dissipate heat loads under high power payload operation. Payload subsystems will operate during eclipse in conjunction with heaters to provide stable operating temperatures. Temperature sensors are located throughout the spacecraft and connect to the bus computer, which hosts thermal control algorithms to control the heaters and provide feedback to the payload control system.

Structure Subsystem: The structure is fabricated of anodized T6061 aluminum.

Propulsion Subsystem: No propulsion subsystem is included on this mission.

b. Detailed illustration of the entire spacecraft in the mission operation configuration with clear overall dimensional markings and marked internal component locations (dimension in mm).

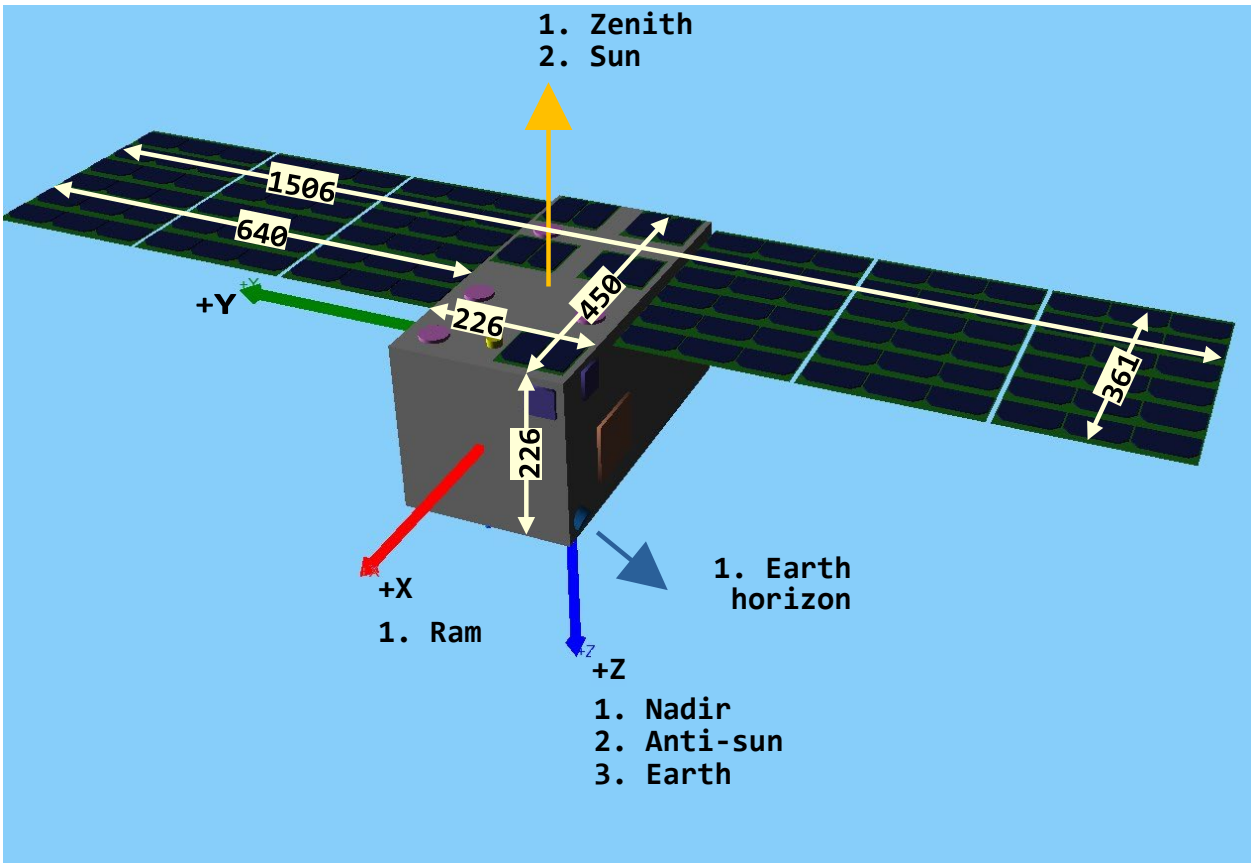


Figure 3-1: CTC-1 Spacecraft with Overall Dimensions

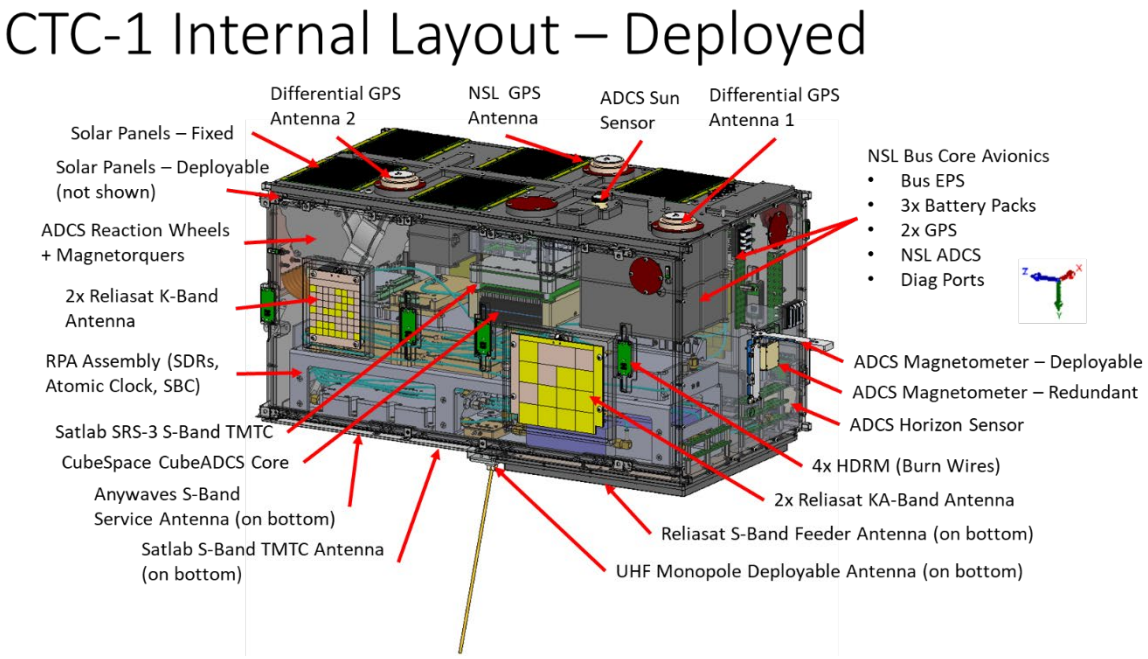


Figure 3-2: CTC-1 Spacecraft Component Locations

c. Total spacecraft mass at launch, including all propellants and fluids (there are none).

The total mass is 21.3 kg.

d. Description of all propulsion systems (cold gas, mono-propellant, bi-propellant, electric, nuclear)

N/A There is no propulsion system.

e. Identification, including mass and pressure, of all fluids (liquids and gases) planned to be on board and a description of the fluid loading plan or strategies, excluding fluids in sealed heat pipes. Description of all fluid systems, including size, type, and qualifications of fluid containers such as propellant and pressurization tanks, including pressurized batteries

N/A No fluids will be on board.

f. Description of all active and/or passive attitude control systems with an indication of the normal attitude of the spacecraft with respect to the velocity vector

The attitude determination and control system controls the 3-dimensional attitude of the spacecraft. The system consists of four reaction wheels for momentum, and 3 magnetorquers mounted on the structure for canceling environmental torques and unloading the momentum of the reaction wheels. The critical components are the magnetorquers, dual triaxis magnetometers, Earth horizon sensor, fine sun sensors, and reaction wheels.

During the mission the attitude of the spacecraft will vary depending on the function being addressed. See the Orbit Lifetime section below for a description of the attitudes associated with mission phases.

g. Description of any range safety or other pyrotechnic devices

There are no range safety or pyrotechnic devices on the spacecraft.

h. Description of the electrical generation and storage system

The Electric Power Subsystem is a direct energy transfer system using a solar array producing approximately 65 W of orbit average power to charge the 325.6 W-hr battery system. The solar arrays utilize standard NSL photovoltaic cells; the batteries are COTS NSL Lithium-Ion cells battery packs. The OBC sends signals to the Power Distribution Module to control load switching. The power subsystem has flight heritage: flexible arrays 10 years, batteries 5 years, EPS 5 years.

i. Identification of any other sources of stored energy not noted above

There are no other sources of energy storage on the spacecraft

j. Identification of any radioactive materials on board or make a positive statement that there are no radioactive materials onboard

There are no radioactive materials on spacecraft.

4. ODAR Section 3: Assessment of Spacecraft Debris Released during Normal Operations

    a. Identification of any object (>1 mm) expected to be released from the spacecraft any time after launch, including object dimensions, mass, and material

There are no separating objects from the spacecraft during any phase of the CTC-1 mission.

    b. Assessment of spacecraft compliance with Requirements 4.3-1 and 4.3-2

4.3-1a/b, Mission Related Debris Passing Through LEO: N/A

There are no planned separating objects from the spacecraft.

4.3-2, Mission Related Debris Passing Near GEO: N/A

There are no planned separating objects from the spacecraft.

5. ODAR Section 4: Assessment of Spacecraft Intentional Breakups and Potential for Explosions.

    a. Identification of all potential causes of spacecraft breakup during deployment and mission operations

During nominal deployment and mission operations, there are no credible scenarios that result in spacecraft breakup.

Following Bold Text: updates requested from Team 7/6

    b. Summary of failure modes and effects analyses of all credible failure modes which may lead to an accidental explosion

The spacecraft contains lithium-ion batteries as the only source of stored energy. Protections are in place to prevent on-orbit explosions.

Lithium-Ion Batteries

CTC-1 utilizes unpressurized UL-Listed 18650 lithium-ion cells arranged into battery packs. Battery packs also feature mitigations against elevated temperatures, overvoltage protection and current interrupt devices. These mitigations prevent any catastrophic failure mode and potential for on-orbit explosion to occur.

The cells undergo UN38.3 safety testing to further ensure battery integrity, including charge and discharge testing, internal resistance characterization, and cycle

performance. Low-performing or non-conformant cells are rejected, and cells with similar performance are grouped together into battery packs.

Cell Safety Devices

18650 cells include a set of standard safety features described below. These features are included in all 18650-format cells and provide mitigation against elevated temperatures and current.

- Positive Temperature Coefficient Device (PTC): The resistance of the PTC is low during normal operation and increases when the temperature rises above a critical level to reduce current flow.
- Current Interrupt Device (CID): a fuse-type device that cuts off the electrical circuit permanently when triggered by excessive cell pressure. This is enacted by releasing the connection of the positive terminal.

c. Detailed plan for any designed spacecraft breakup, including explosions and intentional collisions

the spacecraft is not designed for breakup and the mission does not include any planned explosions or collisions.

d. List of components which are passivated at EOM. List includes method of passivation and amount which cannot be passivated.

Batteries will not be passivated.

e. Rationale for all items which are required to be passivated but cannot be due to their design.

Per NASA's Process for Limiting Orbital Debris Objective 2-2, complete disconnection (hard passivation) is not required as energy generation and storage will be controlled (soft passivation) to a level which will not cause an explosion or deflagration large enough to release orbital debris or break up the spacecraft.

f. Assessment of spacecraft compliance with Requirements 4.4-1 through 4.4-4

Requirement 4.4-1: Limiting probability of accidental explosions: COMPLIANT

"For each spacecraft and launch vehicle orbital stage employed for a mission, the program or project shall demonstrate, via failure mode and effects analyses or equivalent analyses, that the integrated probability of explosion for all credible failure modes of each spacecraft and launch vehicle is less than 0.001 (excluding small particle impacts)."

The only stored energy is in the battery cells, and there is no credible scenario in which energy release in the batteries causes an explosion.

Therefore, the expected probability of accidental explosions is under 0.001 and is Compliant to this requirement.

Requirement 4.4-2: Passivate to limit probability of accidental explosions: COMPLIANT

Requirement 4.4-3: Limit the long-term risk to other space systems from planned breakups: N/A

There are no planned breakups.

Requirement 4.4-4: Limit the long-term risk to other space systems from planned breakups: N/A

There are no planned breakups.

6. ODAR Section 5: Assessment of Spacecraft Potential for On-Orbit Collisions

a. Calculation of spacecraft probability of collision with space objects larger than 10 cm in diameter during the orbital lifetime of the spacecraft
Calculation of spacecraft probability of collision with space objects, including orbital debris and meteoroids, of sufficient size to prevent post mission disposal

The probability of accidental collision with space objects larger than 10 cm in diameter was calculated for each phase of the mission and during post mission disposal.

Post mission, random tumbling is assumed. See Section 7 for calculation of the effective cross sectional area and the orbit range for each mission phase.

The mass of 21.3 kg remains constant throughout the orbit lifetime.

Phase	A/m Ratio, m^2/kg	Start Date	Duration, Years	Start Perigee/ Apogee, km	End Perigee/ Apogee, km	Large Object Collision Risk from DAS
Commission	0.00437	2025.75	0.083	510/510	508.3/509	2.3645E-06
Experiment Period 1	0.00239	2025.83	1.000	508.3/509	501.5/503.15	2.5875E-06
High Drag	0.02648	2026.83	0.468	501.5/503.15	472.6/475.3	1.5159E-06
Experiment Period 2	0.00239	2027.30	0.450	472.6/475.3	469.9/473.4	0.97466E-6
Post Mission Tumble	0.0168	2027.75	3.9	469.9/473.4	Demise	2.4154E-06
					Total	9.8E-06

Table 6-1 Lifetime, and Large Object Collision Risk

Table 6-1 shows DAS estimates of orbit drop for each phase of the mission, based on the following attitude plan.

It also shows the total Large Object Collision Risk over all phases, of the mission. This is 9.8E-06 which is far less than the limir, so the requirement passes.

Commissioning Effective Area

Each face will be oriented in the RAM direction for some part of the commissioning period, which is estimated to be about 1 month.

Facing RAM	Percent	Area, m^2
A1	8	0.564
A2	2	0.102
A3	90	0.051
Weighted Average		0.093

Table 6-2 Calculation of Commissioning Effective Area

Experiment Phase 1 and Phase 2 Effective Area

The spacecraft will be oriented with the A3 face in the RAM direction for almost all the time while experiments are being conducted, a total of about 17 months.

High Drag Phase Effective Area

In order to draw down the orbit sufficiently to allow a comfortable margin for demise less than 5 years after mission completion, the spacecraft will be oriented with the A1 face in the RAM direction for about 5.6 months.

Post Mission Tumbling Effective Area

Random tumbling is assumed during the post mission demise phase. In ODAR Section 6 below, the effective Area is shown to be 0.358 m^2, and the Area to mass ratio is 0.0168 m^2/kg.

Table 6-1 shows the total probability of Large Object collision to be TBD, which is less than the required 0.001 probability.

The following plots show the orbit altitude vs time for each mission phase.

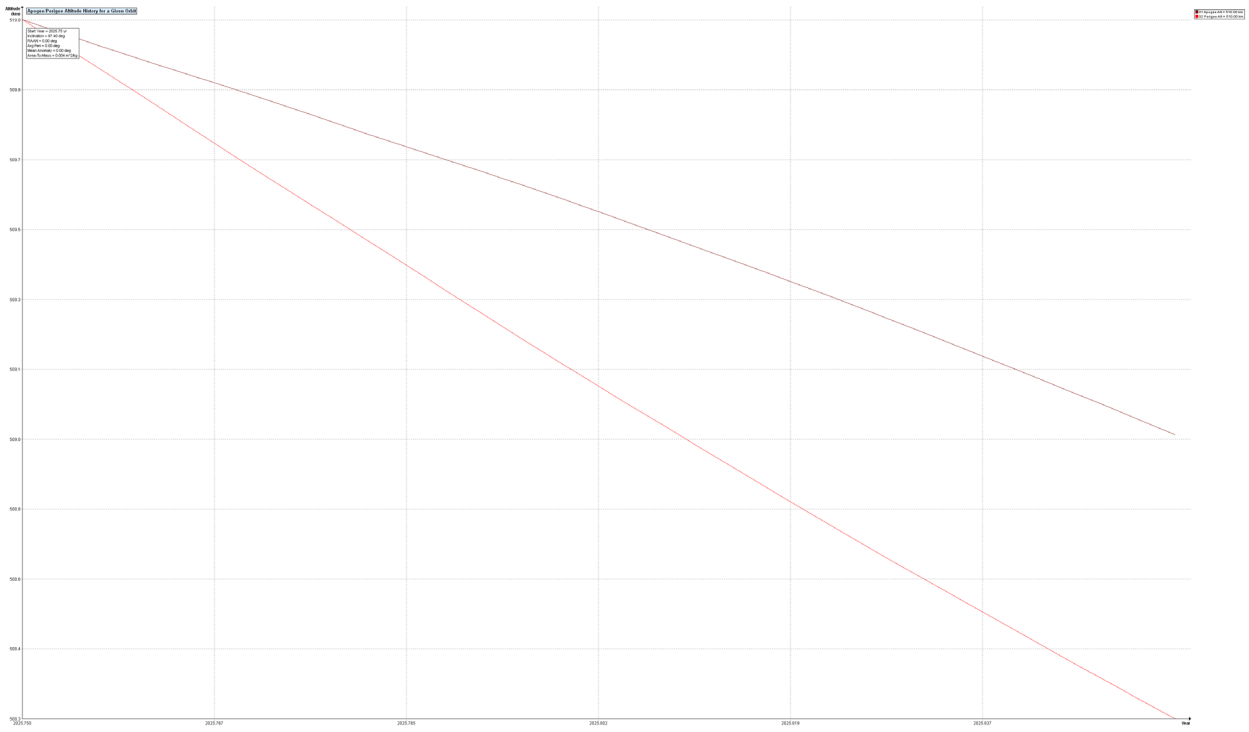


Figure 6-1 Commissioning Orbit Altitude vs. Time

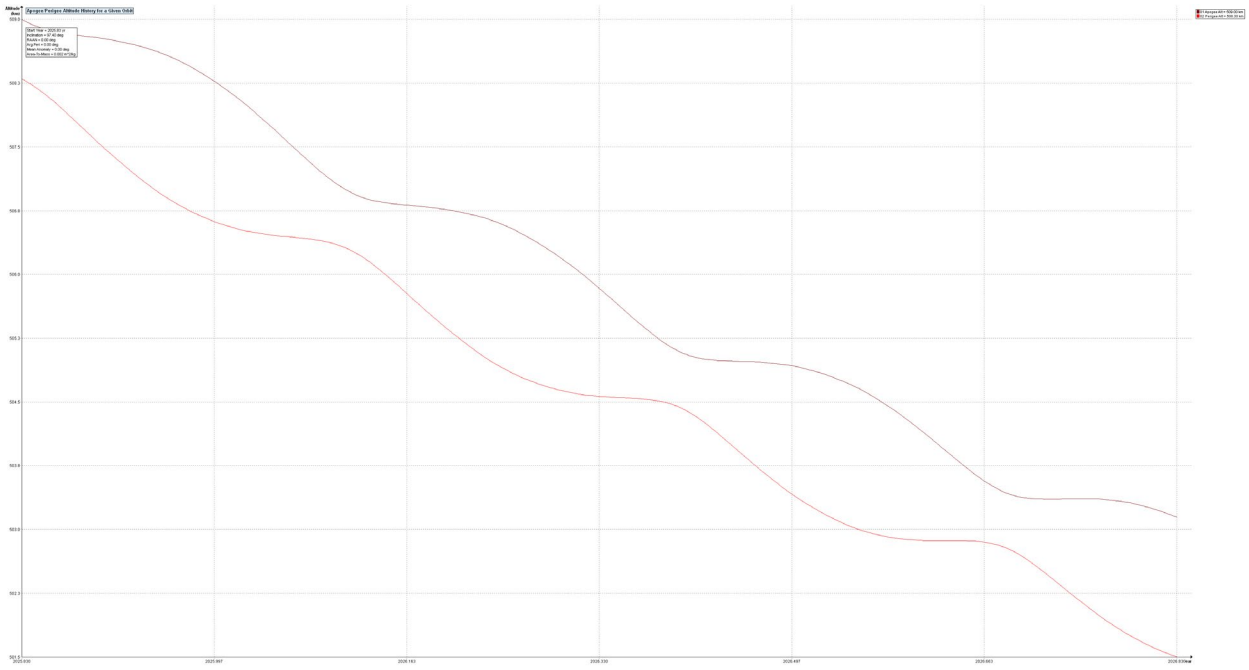


Figure 6-2 Experiment Period 1 Orbit Altitude vs. Time

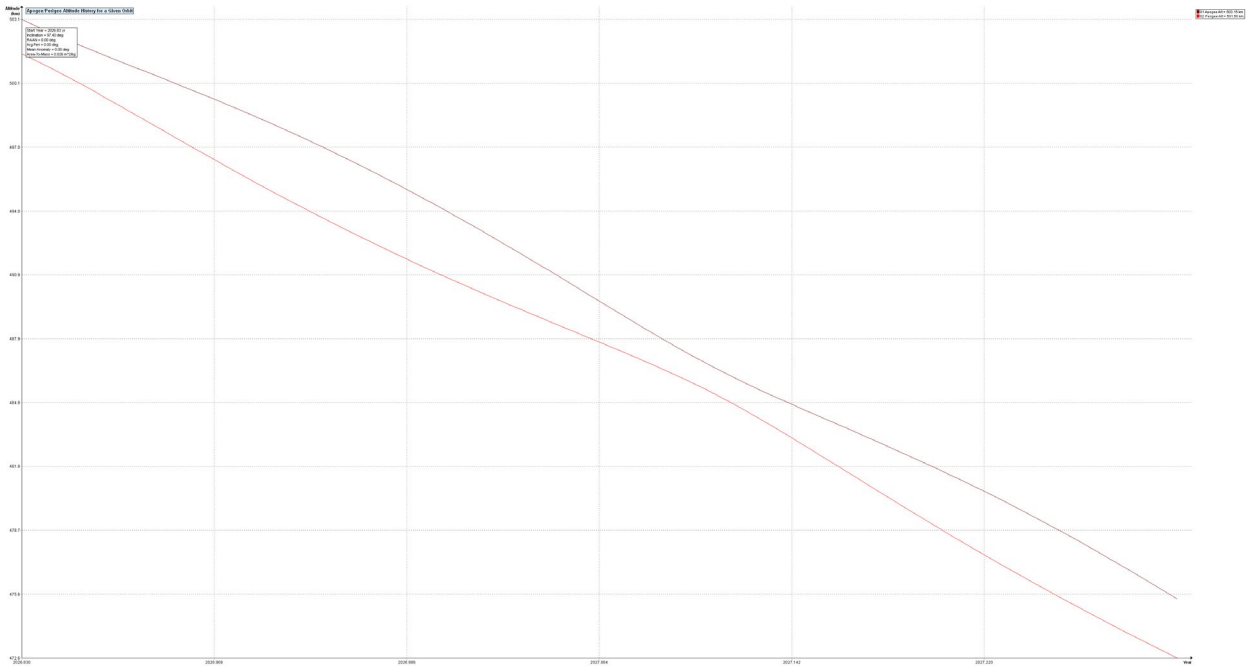


Figure 6-3 High Drag Period Orbit Altitude vs. Time

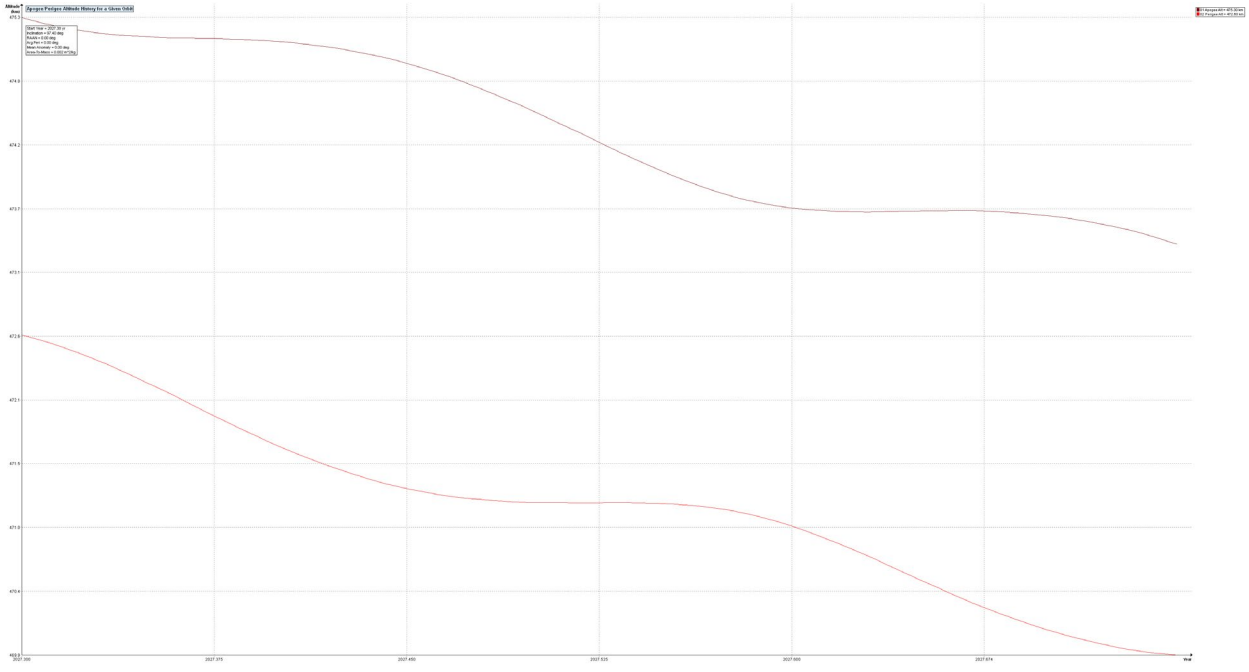


Figure 6-4 Experiment Period 2 Orbit Altitude vs. Time

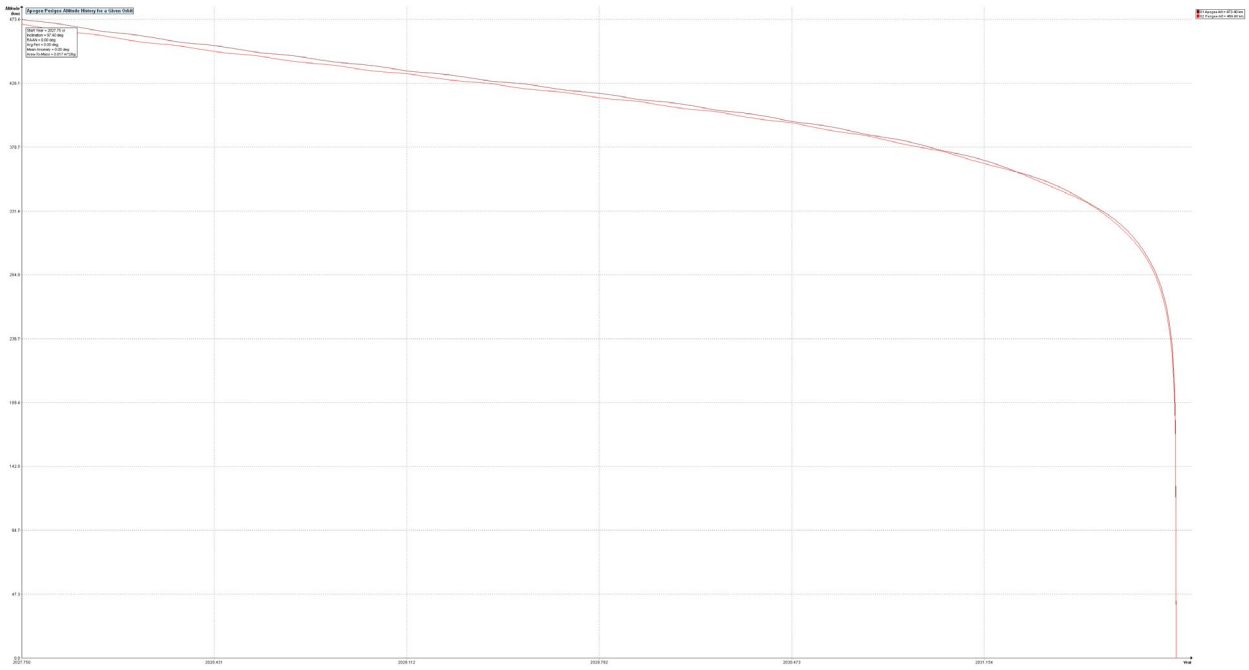


Figure 6-5 Post Experiment Tumbling Period Orbit Altitude vs. Time

b. Assessment of spacecraft compliance with Requirements 4.5-1 and 4.5-2

Requirement 4.5-1: Limit debris generated by collisions with large objects when operating in Earth orbit: Compliant

Requirement 4.5-2: Limit debris generated by collisions with small objects when operating in Earth orbit: N/A post mission disposal by passive demise does not require any systems to be functional.

7. ODAR Section 6: Assessment of Spacecraft Post Mission Disposal Plans and Procedures

a. Description of spacecraft disposal option selected

Post mission disposal will be achieved by passive demise. Per DAS, this will occur 3.9 years after the end of the 2 year mission.

No systems or components are required to accomplish post mission disposal by passive demise.

No maneuvering of the vehicle is needed to accomplish a post mission disposal by passive demise.

b. Calculation of area-to-mass ratio after post mission disposal.

Mass: 21.3 kg

Face	Dimensions, m	Area, m^2
A1	(1.506 x 0.361) + ((0.45-0.361) x 0.226)	0.544 + 0.020 = 0.564
A2	0.45 x 0.226	0.102
A3	0.226 x 0.226	0.051

Table 7-1 Areas by Face

Tumbling Effective Cross Section Area: During the post mission disposal period with random tumbling, the effective cross sectional area A_{eff} can be estimated as follows:

$A_{eff} = (A_1 + A_{2+} A_3) /2, = 0.358\ m^2$

Area to mass ratio: 0.0168 m^2/kg.

At the beginning of the post mission disposal phase, which is the end of the 2-year mission, the spacecraft will have lowered orbit due to drag, to 469.9 km Perigee, 473.4 km Apogee, See Table 6-1 in the previous section.

Based on this, DAS shows that demise is estimated to occur 3.9 years after the end of the mission, which is less than the 5 years required..

c. Assessment of spacecraft compliance with Requirements 4.6-1 through 4.6-4

Requirement 4.6-1, Disposal for space structures passing through LEO: Compliant

Per DAS, the passive demise occurs 3.9 years after the end of the mission, which is less than the limit of 5 years after the end of the mission set by FCC.

Requirement 4.6-2, Disposal for space structures near GEO: N/A

Requirement 4.6-3, Disposal for space structures between LEO and GEO: N/A

Requirement 4.6-4, Reliability of post-mission disposal operations: N/A

8. ODAR Section 7: Assessment of Spacecraft Reentry Hazards

a. Detailed description of spacecraft components by size, mass, material, shape, and original location on the space vehicle, if the atmospheric reentry option is selected

Table 8-1 lists spacecraft components used in the DAS reentry analysis.

Table 8-1: CTC-1 Components List

ID	Name	Parent	Qty	Material	Shape	Mass, kg	Width, m	Length, m	Height, m
1	CTC1-1_bus_box	0	1	Aluminum 6061-T6	Box	21.3	0.23	0.434	0.23
2	Y1 Structure Member	1	1	Aluminum 6061-T6	Box	1.394	0.226	0.434	0.006
3	Y2 Structure Member	1	1	Aluminum 6061-T6	Box	0.956	0.226	0.434	0.006
4	X1 Structure Member	1	1	Aluminum 6061-T6	Box	0.98	0.213	0.434	0.004
5	X2 Structure Member	1	1	Aluminum 6061-T6	Box	0.977	0.213	0.434	0.004
6	Z1 Structure Member	1	1	Aluminum 6061-T6	Box	0.33	0.226	0.226	0.003
7	Z2 Stucture Member	1	1	Aluminum 6061-T6	Box	0.387	0.226	0.226	0.003
8	Y Diag Cover Plate	1	1	Aluminum 6061-T6	Box	0.016	0.035	0.105	0.002
9	Y Cable Cover Plate	1	1	Aluminum 6061-T6	Box	0.037	0.2	0.3	0.002
10	X IAS Access Panel	1	1	Aluminum 6061-T6	Box	0.01	0.025	0.05	0.003
11	NSL EPS Assembly	1	1	Aluminum 6061-T6	Box	0.525	0.09	0.09	0.06
12	18650 Battery Assembly	1	3	Aluminum 6061-T6	Box	0.85	0.091	0.101	0.045
13	NSL GPS Assembly	1	3	Aluminum 6061-T6	Box	0.09	0.04	0.073	0.026
14	NSL1889 GPS Antenna	1	3	Fiberglass	Cylinder	0.1	0.04	0.048	
15	ADCS CubeSpace Gen 2 CubeADCS Core case	1	1	Aluminum 6061-T6	Box	0.2	0.088	0.094	0.024
16	ADCS CubeSpace Gen 2 CubeADCS Core board	15	1	Fiberglass	Flat Plate	0.015	0.088	0.094	
17	ADCS CubeSpace CubeSense Earth	1	1	Aluminum 6061-T6	Box	0.018	0.024	0.035	0.019
18	ADCS CubeSpace CubeSense Sun	1	1	Aluminum 6061-T6	Box	0.015	0.024	0.035	0.022
19	ADCS CubeSpace CubeMag Deploy	1	1	Aluminum 6061-T6	Box	0.014	0.017	0.082	0.005
20	ADCS CubeSpace CubeMag Compact	1	1	Aluminum 6061-T6	Box	0.008	0.024	0.024	0.007
21	ADCS CubeSpace CubeTorqer CR0020	1	3	Iron	Cylinder	0.054	0.013	0.15	
22	ADCS CubeSpace CubeWheel PYR CW0500 case	1	1	Aluminum 6061-T6	Box	0.424	0.1	0.1	0.1

ID	Name	Parent	Qty	Material	Shape	Mass, kg	Width, m	Length, m	Height, m
23	ADCS CubeSpace CubeWheel PYR CW0500 rotor	22	4	Brass- Red	Box	0.25	0.05	0.08	0.02
24	ADCS harness - BU ruff estimate	1	1	Copper Alloy	Cylinder	0.25	0.018	0.12	
25	ADCS CubeADCS Interface Board	15	1	Fiberglass	Box	0.047	0.091	0.096	0.003
26	Satlab SRS-3 S-Band TRX	1	1	Aluminum 6061-T6	Box	0.19	0.087	0.093	0.017
27	Printec SAS-2 S-Band TRX Ant	1	1	Fiberglass	Box	0.112	0.08	0.1	0.008
28	1U Solar Panel	1	5	Fiberglass	Flat Plate	0.027	0.08	0.1	
29	4x2U Solar Panel	1	6	Fiberglass	Flat Plate	0.264	0.206	0.375	
30	Angle Brackets	1	32	Brass- Red	Box	0.001	0.006	0.006	0.005
31	NSL ADCS	1	1	Aluminum 6061-T6	Box	0.94	0.091	0.096	0.045
32	NSL ADCS IR Sensor	1	3	Aluminum 6061-T6	Box	0.006	0.019	0.023	0.01
33	NSL ADCS FG Mag	1	1	Aluminum 6061-T6	Box	0.005	0.015	0.025	0.01
34	PIN Diode	1	1	Fiberglass	Box	0.005	0.015	0.025	0.0075
35	Copper Plate	1	1	Copper Alloy	Box	0.191	0.085	0.085	0.003
36	Burn Wire PCB	1	8	Fiberglass	Flat Plate	0.001	0.014	0.032	
37	Inhibit Switches	1	8	Stainless Steel (generic)	Box	0.002	0.0103	0.02	0.0065
38	RBF Switch Assembly	1	1	Aluminum 6061-T6	Box	0.003	0.012	0.014	0.007
39	Diag (g125-2241096f5)	1	12	Aluminum 6061-T6	Box	0.002	0.01	0.015	0.005
40	SMA Bulkheads	1	4	Aluminum 6061-T6	Cylinder	0.005	0.006	0.1	
41	Cabling (Estimate)	1	10	Silver Element	Cylinder	0.1	0.006	0.5	
42	EC2216 Epoxy	1	1	Lead Element	Flat Plate	0.1	0.075	0.075	
43	Cable Route Asm 2	1	20	Fiberglass	Box	0.01	0.016	0.077	0.006
44	Cable Route Asm 3	1	3	Fiberglass	Box	0.006	0.016	0.041	0.006
45	Cable Route Asm 4	1	4	Fiberglass	Box	0.008	0.008	0.077	0.008
46	RPA_base_plate	1	1	Aluminum 6061-T6	Flat Plate	0.64	0.096	0.404	
47	RPA_SBC-1461_case	1	1	Aluminum 6061-T6	Box	0.09	0.067	0.083	0.014
48	RPA_SBC-1461_board	48	1	Fiberglass	Flat Plate	0.02	0.067	0.083	
49	RPA_SDR_1001_case	1	1	Aluminum 6061-T6	Box	0.09	0.067	0.083	0.014
50	RPA_SDR_1001_board	50	1	Fiberglass	Flat Plate	0.026	0.067	0.083	
51	RPA_ERZ-LNA-0100-0310-30-2	1	2	Aluminum 6061-T6	Box	0.059	0.03	0.06	0.013

ID	Name	Parent	Qty	Material	Shape	Mass, kg	Width, m	Length, m	Height, m
52	RPA_ERZ-HPA-0200-0400-30	1	1	Aluminum 6061-T6	Box	0.032	0.031	0.05	0.008
53	RPA_DP1337	1	1	Aluminum 6061-T6	Box	0.162	0.052	0.055	0.0315
54	RPA_DP1338A	1	2	Aluminum 6061-T6	Box	0.277	0.04	0.131	0.028
55	RPA_UDC400	1	1	Aluminum 6061-T6	Box	0.415	0.095	0.095	0.038
56	RPA_UDC300	1	1	Aluminum 6061-T6	Box	0.415	0.095	0.095	0.038
57	RPA_ZN4PD-63LW-S+	1	1	Aluminum 6061-T6	Box	0.085	0.09	0.09	0.014
58	RPA_DCS-206-G	1	2	Steel A-286	Box	0.026	0.014	0.03	0.008
59	RPA_FIHI-2903C00	1	2	Aluminum 6061-T6	Box	0.017	0.018	0.035	0.01
60	RPA_TMT010-307-06-18	1	2	Copper Alloy	Flat Plate	0.075	0.03	0.1	
61	RPA_ERZ-HPA-0200-0400-43	1	1	Aluminum 6061-T6	Box	0.475	0.094	0.124	0.022
62	RPA_shelf_with_legs	1	1	Aluminum 6061-T6	Flat Plate	0.126	0.096	0.4	
63	RPA_UHF_radio_assy	1	1	Aluminum 6061-T6	Flat Plate	0.09	0.063	0.09	
64	RPA_data_aggregator	1	1	Aluminum 6061-T6	Box	0.055	0.066	0.084	0.01
65	RPA_upper_plate	1	1	Aluminum 6061-T6	Flat Plate	0.053	0.09	0.2	
66	RPA_harness - BU ruff estimate	1	1	Copper Alloy	Cylinder	1.13	0.018	0.55	
67	RPA_AnyWaves - S-band patch antenna	1	1	Aluminum 6061-T6	Box	0.14	0.084	0.084	0.012

Table 8-1: CTC-1 Components List

b. Summary of objects expected to survive an uncontrolled reentry, using NASA Debris Assessment Software (DAS), NASA Object Reentry Survival Analysis Tool (ORSAT), or comparable software

Based on DAS, no components are expected to survive reentry.

c. Calculation of probability of human casualty for the expected year of uncontrolled reentry and the spacecraft orbital inclination

The risk of human casualty is 0.

d. Assessment of spacecraft compliance with Requirement 4.7-1

4.7-1, Limit the risk of human casualty: Compliant

9. ODAR Section 8: Assessment for Special Classes of Space Missions

Specify the special mission class(es) and detail how the ODAR addresses additional measures applied to the mission.

The requirements for special classes of space missions do not apply to the CTC-1 mission.

Assessment of compliance with Requirement 4.8-1

Requirement 4.8-1, Assessment of compliance for special classes of space missions: N/A

CTC-1 is not considered a special class of space mission.

10. ODAR Section 9-14: Launch Vehicle

Sections 9 through 14 pertain to the Launch Vehicle for CTC-1 and are not covered in this document.

Appendix A – DAS Activity Log

COMMISSIONING

```
07 08 2025; 19:25:35PM Activity Log Started
07 08 2025; 19:25:35PM Opened Project C:\Users\Mike\Documents\All
SatLicensing\CTC-1\ODAR\DAS Models Adjusted Phases\DAS Phase
Commissioning\
07 08 2025; 19:25:43PM Closed Project C:\Users\Mike\Documents\All
SatLicensing\CTC-1\ODAR\DAS Models Adjusted Phases\DAS Phase
Commissioning\
07 08 2025; 19:25:43PM Activity Log Started
07 08 2025; 19:25:43PM Opened Project C:\Users\Mike\Documents\All
SatLicensing\CTC-1\ODAR\DAS Models Adjusted Phases\DAS Phase
Commissioning\
07 08 2025; 19:28:14PM Project Data Saved To File
07 08 2025; 19:28:16PM Mission Editor Changes Applied
07 08 2025; 19:28:16PM Project Data Saved To File
07 08 2025; 19:31:55PM Processing Requirement 4.5-1:     Return Status :
Passed

==============
Run Data
==============

**INPUT**

      Space Structure Name = CTC-1 Commissioning
      Space Structure Type = Payload
      Perigee Altitude = 510.000 (km)
      Apogee Altitude = 510.000 (km)
      Inclination = 97.400 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass Ratio = 0.0044 (m^2/kg)
      Start Year = 2025.750 (yr)
      Initial Mass = 21.300 (kg)
      Final Mass = 21.300 (kg)
      Duration = 0.083 (yr)
      Station-Kept = False
      Abandoned = True
      Long-Term Reentry = False

**OUTPUT**

      Collision Probability = 2.3645E-06
      Returned Message: Normal Processing
      Date Range Message: Normal Date Range
      Status = Pass

==============
```

```
============== End of Requirement 4.5-1 ===============

07 08 2025; 19:32:48PM Mission Editor Changes Applied
07 08 2025; 19:32:48PM Project Data Saved To File
07 08 2025; 19:32:48PM Project Data Saved To File
07 08 2025; 19:36:51PM Science and Engineering - Apogee/Perigee History
for a Given Orbit

**INPUT**

      Perigee Altitude = 510.000000 (km)
      Apogee Altitude = 510.000000 (km)
      Inclination = 97.400000 (deg)
      RAAN = 0.000000 (deg)
      Argument of Perigee = 0.000000 (deg)
      Mean Anomaly = 0.000000 (deg)
      Area-To-Mass Ratio = 0.004370 (m^2/kg)
      Start Year = 2025.750000 (yr)
      Integration Time = 0.083000 (yr)

**OUTPUT**

      Plot
07 08 2025; 19:38:18PM Project Data Saved To File
```

EXPERIMENT 1

```
07 19 2025; 16:45:58PM Activity Log Started
07 19 2025; 16:45:58PM Opened Project C:\Users\Mike\Documents\All
SatLicensing\CTC-1\ODAR\DAS Models Adjusted Phases\DAS Phase Experiment 1\
07 19 2025; 16:47:36PM Science and Engineering - Apogee/Perigee History
for a Given Orbit

**INPUT**

      Perigee Altitude = 508.300000 (km)
      Apogee Altitude = 509.000000 (km)
      Inclination = 97.400000 (deg)
      RAAN = 0.000000 (deg)
      Argument of Perigee = 0.000000 (deg)
      Mean Anomaly = 0.000000 (deg)
      Area-To-Mass Ratio = 0.002390 (m^2/kg)
      Start Year = 2025.830000 (yr)
      Integration Time = 1.000000 (yr)

**OUTPUT**

      Plot
07 19 2025; 17:19:03PM Processing Requirement 4.5-1:     Return Status :
Passed

==============
Run Data
```

==========

INPUT

Space Structure Name = CTC-1 Phase Experiment 1
Space Structure Type = Payload
Perigee Altitude = 508.300 (km)
Apogee Altitude = 509.000 (km)
Inclination = 97.400 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0024 (m^2/kg)
Start Year = 2025.830 (yr)
Initial Mass = 21.300 (kg)
Final Mass = 21.300 (kg)
Duration = 1.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 2.5875E-06
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

========== End of Requirement 4.5-1 ==========

07 19 2025; 17:19:49PM Project Data Saved To File
07 19 2025; 17:20:06PM Activity Log Started
07 19 2025; 17:20:06PM Opened Project C:\Users\Mike\Documents\All SatLicensing\CTC-1\ODAR\DAS Models Adjusted Phases\DAS Phase Experiment 1\
07 19 2025; 17:20:15PM Closed Project C:\Users\Mike\Documents\All SatLicensing\CTC-1\ODAR\DAS Models Adjusted Phases\DAS Phase Experiment 1\

HIGH DRAG

07 08 2025; 20:30:17PM Activity Log Started
07 08 2025; 20:30:17PM Opened Project C:\Users\Mike\Documents\All SatLicensing\CTC-1\ODAR\DAS Models Adjusted Phases\DAS Phase High Drag\
07 08 2025; 20:32:14PM Project Data Saved To File
07 08 2025; 20:32:49PM Mission Editor Changes Applied
07 08 2025; 20:32:49PM Project Data Saved To File
07 08 2025; 20:37:17PM Processing Requirement 4.5-1: Return Status : Passed

==========
Run Data
==========

INPUT

Space Structure Name = CTC-1 Phase High Drag
Space Structure Type = Payload
Perigee Altitude = 501.500 (km)
Apogee Altitude = 503.150 (km)
Inclination = 97.400 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0265 (m^2/kg)
Start Year = 2026.830 (yr)
Initial Mass = 21.300 (kg)
Final Mass = 21.300 (kg)
Duration = 0.468 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 1.5159E-06
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

========== End of Requirement 4.5-1 ==========

07 08 2025; 20:40:50PM Science and Engineering - Apogee/Perigee History for a Given Orbit

INPUT

Perigee Altitude = 501.500000 (km)
Apogee Altitude = 503.150000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Area-To-Mass Ratio = 0.026500 (m^2/kg)
Start Year = 2026.830000 (yr)
Integration Time = 0.468000 (yr)

OUTPUT

Plot
07 08 2025; 20:42:20PM Project Data Saved To File

EXPERIMENT 2

```
07 19 2025; 17:29:10PM Activity Log Started
07 19 2025; 17:29:10PM Opened Project C:\Users\Mike\Documents\All
SatLicensing\CTC-1\ODAR\DAS Models Adjusted Phases\DAS Phase Experiment 2\
07 19 2025; 17:29:15PM Closed Project C:\Users\Mike\Documents\All
SatLicensing\CTC-1\ODAR\DAS Models Adjusted Phases\DAS Phase Experiment 2\
07 19 2025; 17:29:15PM Activity Log Started
07 19 2025; 17:29:15PM Opened Project C:\Users\Mike\Documents\All
SatLicensing\CTC-1\ODAR\DAS Models Adjusted Phases\DAS Phase Experiment 2\
07 19 2025; 17:29:42PM Science and Engineering - Apogee/Perigee History
for a Given Orbit

**INPUT**

      Perigee Altitude = 472.600000 (km)
      Apogee Altitude = 475.300000 (km)
      Inclination = 97.400000 (deg)
      RAAN = 0.000000 (deg)
      Argument of Perigee = 0.000000 (deg)
      Mean Anomaly = 0.000000 (deg)
      Area-To-Mass Ratio = 0.002390 (m^2/kg)
      Start Year = 2027.300000 (yr)
      Integration Time = 0.450000 (yr)

**OUTPUT**

      Plot
07 19 2025; 17:35:04PM Processing Requirement 4.5-1:     Return Status :
Passed

==============
Run Data
==============

**INPUT**

      Space Structure Name = CTC-1 Phase Experiment 1
      Space Structure Type = Payload
      Perigee Altitude = 472.600 (km)
      Apogee Altitude = 475.300 (km)
      Inclination = 97.400 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass Ratio = 0.0024 (m^2/kg)
      Start Year = 2027.300 (yr)
      Initial Mass = 21.300 (kg)
      Final Mass = 21.300 (kg)
      Duration = 0.450 (yr)
      Station-Kept = False
```

```
      Abandoned = True
      Long-Term Reentry = False

**OUTPUT**

      Collision Probability = 9.7466E-07
      Returned Message: Normal Processing
      Date Range Message: Normal Date Range
      Status = Pass

==============

=============== End of Requirement 4.5-1 ===============

07 19 2025; 17:35:59PM Project Data Saved To File
07 19 2025; 17:36:22PM Activity Log Started
07 19 2025; 17:36:22PM Opened Project C:\Users\Mike\Documents\All
SatLicensing\CTC-1\ODAR\DAS Models Adjusted Phases\DAS Phase Experiment 2\
07 19 2025; 17:37:36PM Closed Project C:\Users\Mike\Documents\All
SatLicensing\CTC-1\ODAR\DAS Models Adjusted Phases\DAS Phase Experiment 2\
```

TUMBLING TO DEMISE

```
07 19 2025; 17:37:36PM Activity Log Started
07 19 2025; 17:37:36PM Opened Project C:\Users\Mike\Documents\All
SatLicensing\CTC-1\ODAR\DAS Models Adjusted Phases\DAS Phase Post Mission
Tumble to Demise\
07 19 2025; 17:38:09PM Project Data Saved To File
07 19 2025; 17:38:19PM Project Data Saved To File
07 19 2025; 17:38:29PM Project Data Saved To File
07 19 2025; 17:38:45PM Mission Editor Changes Applied
07 19 2025; 17:38:45PM Project Data Saved To File
07 19 2025; 17:38:45PM Project Data Saved To File
07 19 2025; 17:39:27PM Science and Engineering - Apogee/Perigee History
for a Given Orbit

**INPUT**

      Perigee Altitude = 469.900000 (km)
      Apogee Altitude = 473.400000 (km)
      Inclination = 97.400000 (deg)
      RAAN = 0.000000 (deg)
      Argument of Perigee = 0.000000 (deg)
      Mean Anomaly = 0.000000 (deg)
      Area-To-Mass Ratio = 0.016800 (m^2/kg)
      Start Year = 2027.750000 (yr)
      Integration Time = 5.000000 (yr)

**OUTPUT**

      Plot
```

07 19 2025; 17:51:02PM Processing Requirement 4.5-1: Return Status : Passed

==========
Run Data
==========

INPUT

Space Structure Name = CTC-1 Post Mission Tumbling
Space Structure Type = Payload
Perigee Altitude = 469.900 (km)
Apogee Altitude = 473.400 (km)
Inclination = 97.400 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0168 (m^2/kg)
Start Year = 2027.750 (yr)
Initial Mass = 21.300 (kg)
Final Mass = 21.300 (kg)
Duration = 5.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 2.4154E-06
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

========== End of Requirement 4.5-1 ==========

07 19 2025; 18:13:51PM Processing Requirement 4.6 Return Status : Passed

==========
Project Data
==========

INPUT

Space Structure Name = CTC-1 Post Mission Tumbling
Space Structure Type = Payload

Perigee Altitude = 469.900000 (km)
Apogee Altitude = 473.400000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)

```
      Argument of Perigee = 0.000000 (deg)
      Mean Anomaly = 0.000000 (deg)
      Area-To-Mass Ratio = 0.016800 (m^2/kg)
      Start Year = 2027.750000 (yr)
      Initial Mass = 21.300000 (kg)
      Final Mass = 21.300000 (kg)
      Duration = 5.000000 (yr)
      Station Kept = False
      Abandoned = True
      PMD Perigee Altitude = -1.000000 (km)
      PMD Apogee Altitude = -1.000000 (km)
      PMD Inclination = 0.000000 (deg)
      PMD RAAN = 0.000000 (deg)
      PMD Argument of Perigee = 0.000000 (deg)
      PMD Mean Anomaly = 0.000000 (deg)
      Long-Term Reentry = False

**OUTPUT**

      Suggested Perigee Altitude = 469.900000 (km)
      Suggested Apogee Altitude = 473.400000 (km)
      Returned Error Message = Reentry during mission (no PMD req.).

      Released Year = 2031 (yr)
      Requirement = 61
      Compliance Status = Pass

==============

=============== End of Requirement 4.6 ===============
07 19 2025; 18:13:51PM *********Processing Requirement 4.7-1
      Return Status :  Passed

***********INPUT****
 Item Number = 1

name = CTC-1 Post Mission Tumbling
quantity = 1
parent = 0
materialID = 8
type = Box
Aero Mass = 21.299999
Thermal Mass = 21.299999
Diameter/Width = 0.230000
Length = 0.434000
Height = 0.230000

name = Y1 Structure Member
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 1.394000
```

```
Thermal Mass = 1.394000
Diameter/Width = 0.226000
Length = 0.434000
Height = 0.006000

name = Y2 Structure Member
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.956000
Thermal Mass = 0.956000
Diameter/Width = 0.226000
Length = 0.434000
Height = 0.006000

name = X1 Structure Member
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.980000
Thermal Mass = 0.980000
Diameter/Width = 0.213000
Length = 0.434000
Height = 0.004000

name = X2 Structure Member
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.977000
Thermal Mass = 0.977000
Diameter/Width = 0.213000
Length = 0.434000
Height = 0.004000

name = Z1 Structure Member
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.330000
Thermal Mass = 0.330000
Diameter/Width = 0.226000
Length = 0.226000
Height = 0.003000

name = Z2 Stucture Member
quantity = 1
parent = 1
materialID = 8
```

```
type = Box
Aero Mass = 0.387000
Thermal Mass = 0.387000
Diameter/Width = 0.226000
Length = 0.226000
Height = 0.003000

name = Y Diag Cover Plate
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.016000
Thermal Mass = 0.016000
Diameter/Width = 0.035000
Length = 0.105000
Height = 0.002000

name = Y Cable Cover Plate
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.037000
Thermal Mass = 0.037000
Diameter/Width = 0.200000
Length = 0.300000
Height = 0.002000

name = X IAS Access Panel
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.010000
Thermal Mass = 0.010000
Diameter/Width = 0.025000
Length = 0.050000
Height = 0.003000

name = NSL EPS Assembly
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.525000
Thermal Mass = 0.525000
Diameter/Width = 0.090000
Length = 0.090000
Height = 0.060000

name = 18650 Battery Assembly
quantity = 3
```

```
parent = 1
materialID = 8
type = Box
Aero Mass = 0.850000
Thermal Mass = 0.850000
Diameter/Width = 0.091000
Length = 0.101000
Height = 0.045000

name = NSL GPS Assembly
quantity = 3
parent = 1
materialID = 8
type = Box
Aero Mass = 0.090000
Thermal Mass = 0.090000
Diameter/Width = 0.040000
Length = 0.073000
Height = 0.026000

name = NSL1889 GPS Antenna
quantity = 3
parent = 1
materialID = 23
type = Cylinder
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.040000
Length = 0.048000

name = ADCS CubeSpace Gen 2 CubeADCS Core case
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.262000
Thermal Mass = 0.200000
Diameter/Width = 0.088000
Length = 0.094000
Height = 0.024000

name = ADCS CubeSpace Gen 2 CubeADCS Core board
quantity = 1
parent = 15
materialID = 23
type = Flat Plate
Aero Mass = 0.015000
Thermal Mass = 0.015000
Diameter/Width = 0.088000
Length = 0.094000

name = ADCS CubeADCS Interface Board
quantity = 1
```

```
parent = 15
materialID = 23
type = Box
Aero Mass = 0.047000
Thermal Mass = 0.047000
Diameter/Width = 0.091000
Length = 0.096000
Height = 0.003000

name = ADCS CubeSpace CubeSense Earth
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.018000
Thermal Mass = 0.018000
Diameter/Width = 0.024000
Length = 0.035000
Height = 0.019000

name = ADCS CubeSpace CubeSense Sun
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.015000
Thermal Mass = 0.015000
Diameter/Width = 0.024000
Length = 0.035000
Height = 0.022000

name = ADCS CubeSpace CubeMag Deploy
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.014000
Thermal Mass = 0.014000
Diameter/Width = 0.017000
Length = 0.082000
Height = 0.005000

name = ADCS CubeSpace CubeMag Compact
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.008000
Thermal Mass = 0.008000
Diameter/Width = 0.024000
Length = 0.024000
Height = 0.007000
```

```
name = ADCS CubeSpace CubeTorqer CR0020
quantity = 3
parent = 1
materialID = 38
type = Cylinder
Aero Mass = 0.054000
Thermal Mass = 0.054000
Diameter/Width = 0.013000
Length = 0.150000

name = ADCS CubeSpace CubeWheel PYR CW0500 case
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 1.424000
Thermal Mass = 0.424000
Diameter/Width = 0.100000
Length = 0.100000
Height = 0.100000

name = ADCS CubeSpace CubeWheel PYR CW0500 rotor
quantity = 4
parent = 23
materialID = 13
type = Box
Aero Mass = 0.250000
Thermal Mass = 0.250000
Diameter/Width = 0.050000
Length = 0.080000
Height = 0.020000

name = ADCS harness - BU ruff estimate
quantity = 1
parent = 1
materialID = 19
type = Cylinder
Aero Mass = 0.250000
Thermal Mass = 0.250000
Diameter/Width = 0.018000
Length = 0.120000

name = Satlab SRS-3 S-Band TRX
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.190000
Thermal Mass = 0.190000
Diameter/Width = 0.087000
Length = 0.093000
Height = 0.017000
```

```
name = Printec SAS-2 S-Band TRX Ant
quantity = 1
parent = 1
materialID = 23
type = Box
Aero Mass = 0.112000
Thermal Mass = 0.112000
Diameter/Width = 0.080000
Length = 0.100000
Height = 0.008000

name = 1U Solar Panel
quantity = 5
parent = 1
materialID = 23
type = Flat Plate
Aero Mass = 0.027000
Thermal Mass = 0.027000
Diameter/Width = 0.080000
Length = 0.100000

name = 4x2U Solar Panel
quantity = 6
parent = 1
materialID = 23
type = Flat Plate
Aero Mass = 0.264000
Thermal Mass = 0.264000
Diameter/Width = 0.206000
Length = 0.375000

name = Angle Brackets
quantity = 32
parent = 1
materialID = 13
type = Box
Aero Mass = 0.001000
Thermal Mass = 0.001000
Diameter/Width = 0.006000
Length = 0.006000
Height = 0.005000

name = NSL ADCS
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.940000
Thermal Mass = 0.940000
Diameter/Width = 0.091000
Length = 0.096000
Height = 0.045000
```

```
name = NSL ADCS IR Sensor
quantity = 3
parent = 1
materialID = 8
type = Box
Aero Mass = 0.006000
Thermal Mass = 0.006000
Diameter/Width = 0.019000
Length = 0.023000
Height = 0.010000

name = NSL ADCS FG Mag
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.005000
Thermal Mass = 0.005000
Diameter/Width = 0.015000
Length = 0.025000
Height = 0.010000

name = PIN Diode
quantity = 1
parent = 1
materialID = 23
type = Box
Aero Mass = 0.005000
Thermal Mass = 0.005000
Diameter/Width = 0.015000
Length = 0.025000
Height = 0.007500

name = Copper Plate
quantity = 1
parent = 1
materialID = 19
type = Box
Aero Mass = 0.191000
Thermal Mass = 0.191000
Diameter/Width = 0.085000
Length = 0.085000
Height = 0.003000

name = Burn Wire PCB
quantity = 8
parent = 1
materialID = 23
type = Flat Plate
Aero Mass = 0.001000
Thermal Mass = 0.001000
Diameter/Width = 0.014000
Length = 0.032000
```

```
name = Inhibit Switches
quantity = 8
parent = 1
materialID = 54
type = Box
Aero Mass = 0.002000
Thermal Mass = 0.002000
Diameter/Width = 0.010250
Length = 0.020000
Height = 0.006500

name = RBF Switch Assembly
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.003000
Thermal Mass = 0.003000
Diameter/Width = 0.012000
Length = 0.014000
Height = 0.007000

name = Diag (g125-2241096f5)
quantity = 12
parent = 1
materialID = 8
type = Box
Aero Mass = 0.002000
Thermal Mass = 0.002000
Diameter/Width = 0.010000
Length = 0.015000
Height = 0.005000

name = SMA Bulkheads
quantity = 4
parent = 1
materialID = 8
type = Cylinder
Aero Mass = 0.005000
Thermal Mass = 0.005000
Diameter/Width = 0.006000
Length = 0.100000

name = Cabling (Estimate)
quantity = 10
parent = 1
materialID = 52
type = Cylinder
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.006000
Length = 0.500000
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```
name = EC2216 Epoxy
quantity = 1
parent = 1
materialID = 39
type = Flat Plate
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.075000
Length = 0.075000

name = Cable Route Asm 2
quantity = 20
parent = 1
materialID = 23
type = Box
Aero Mass = 0.010000
Thermal Mass = 0.010000
Diameter/Width = 0.016000
Length = 0.077000
Height = 0.006000

name = Cable Route Asm 3
quantity = 3
parent = 1
materialID = 23
type = Box
Aero Mass = 0.006000
Thermal Mass = 0.006000
Diameter/Width = 0.016000
Length = 0.041000
Height = 0.006000

name = Cable Route Asm 4
quantity = 4
parent = 1
materialID = 23
type = Box
Aero Mass = 0.008000
Thermal Mass = 0.008000
Diameter/Width = 0.008000
Length = 0.077000
Height = 0.008000

name = RPA_base_plate
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.640000
Thermal Mass = 0.640000
Diameter/Width = 0.096000
Length = 0.404000
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```
name = RPA_SBC-1461_case
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.110000
Thermal Mass = 0.090000
Diameter/Width = 0.067000
Length = 0.083000
Height = 0.014000

name = RPA_SBC-1461_board
quantity = 1
parent = 47
materialID = 23
type = Flat Plate
Aero Mass = 0.020000
Thermal Mass = 0.020000
Diameter/Width = 0.067000
Length = 0.083000

name = RPA_SDR_1001_case
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.116000
Thermal Mass = 0.090000
Diameter/Width = 0.067000
Length = 0.083000
Height = 0.014000

name = RPA_SDR_1001_board
quantity = 1
parent = 49
materialID = 23
type = Flat Plate
Aero Mass = 0.026000
Thermal Mass = 0.026000
Diameter/Width = 0.067000
Length = 0.083000

name = RPA_ERZ-LNA-0100-0310-30-2
quantity = 2
parent = 1
materialID = 8
type = Box
Aero Mass = 0.059000
Thermal Mass = 0.059000
Diameter/Width = 0.030000
Length = 0.060000
Height = 0.013000
```

```
name = RPA_ERZ-HPA-0200-0400-30
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.032000
Thermal Mass = 0.032000
Diameter/Width = 0.031000
Length = 0.050000
Height = 0.008000

name = RPA_DP1337
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.162000
Thermal Mass = 0.162000
Diameter/Width = 0.052000
Length = 0.055000
Height = 0.031500

name = RPA_DP1338A
quantity = 2
parent = 1
materialID = 8
type = Box
Aero Mass = 0.277000
Thermal Mass = 0.277000
Diameter/Width = 0.040000
Length = 0.131000
Height = 0.028000

name = RPA_UDC400
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.415000
Thermal Mass = 0.415000
Diameter/Width = 0.095000
Length = 0.095000
Height = 0.038000

name = RPA_UDC300
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.415000
Thermal Mass = 0.415000
Diameter/Width = 0.095000
```

```
Length = 0.095000
Height = 0.038000

name = RPA_ZN4PD-63LW-S+
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.085000
Thermal Mass = 0.085000
Diameter/Width = 0.090000
Length = 0.090000
Height = 0.014000

name = RPA_DCS-206-G
quantity = 2
parent = 1
materialID = 57
type = Box
Aero Mass = 0.026000
Thermal Mass = 0.026000
Diameter/Width = 0.014000
Length = 0.030000
Height = 0.008000

name = RPA_FIHI-2903C00
quantity = 2
parent = 1
materialID = 8
type = Box
Aero Mass = 0.017000
Thermal Mass = 0.017000
Diameter/Width = 0.018000
Length = 0.035000
Height = 0.010000

name = RPA_TMT010-307-06-18
quantity = 2
parent = 1
materialID = 19
type = Flat Plate
Aero Mass = 0.075000
Thermal Mass = 0.075000
Diameter/Width = 0.030000
Length = 0.100000

name = RPA_ERZ-HPA-0200-0400-43
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.475000
Thermal Mass = 0.475000
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```
Diameter/Width = 0.094000
Length = 0.124000
Height = 0.022000

name = RPA_shelf_with_legs
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.126000
Thermal Mass = 0.126000
Diameter/Width = 0.096000
Length = 0.400000

name = RPA_UHF_radio_assy
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.090000
Thermal Mass = 0.090000
Diameter/Width = 0.063000
Length = 0.090000

name = RPA_data_aggregator
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.055000
Thermal Mass = 0.055000
Diameter/Width = 0.066000
Length = 0.084000
Height = 0.010000

name = RPA_upper_plate
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.053000
Thermal Mass = 0.053000
Diameter/Width = 0.090000
Length = 0.200000

name = RPA_harness - BU ruff estimate
quantity = 1
parent = 1
materialID = 19
type = Cylinder
Aero Mass = 1.130000
Thermal Mass = 1.130000
Diameter/Width = 0.018000
```

```
Length = 0.550000

name = RPA_AnyWaves - S-band patch antenna
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.140000
Thermal Mass = 0.140000
Diameter/Width = 0.084000
Length = 0.084000
Height = 0.012000

**************OUTPUT****
Item Number = 1

name = CTC-1 Post Mission Tumbling
Demise Altitude = 77.999933
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Y1 Structure Member
Demise Altitude = 77.113211
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Y2 Structure Member
Demise Altitude = 77.389775
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = X1 Structure Member
Demise Altitude = 77.346882
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = X2 Structure Member
Demise Altitude = 77.346908
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Z1 Structure Member
Demise Altitude = 77.607580
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Z2 Stucture Member
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Demise Altitude = 77.541233
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Y Diag Cover Plate
Demise Altitude = 77.869399
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Y Cable Cover Plate
Demise Altitude = 77.979728
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = X IAS Access Panel
Demise Altitude = 77.809531
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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name = NSL EPS Assembly
Demise Altitude = 76.637363
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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name = 18650 Battery Assembly
Demise Altitude = 75.793116
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = NSL GPS Assembly
Demise Altitude = 77.464639
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = NSL1889 GPS Antenna
Demise Altitude = 75.305578
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = ADCS CubeSpace Gen 2 CubeADCS Core case
Demise Altitude = 77.293177
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
```

```
name = ADCS CubeSpace Gen 2 CubeADCS Core board
Demise Altitude = 77.112830
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = ADCS CubeADCS Interface Board
Demise Altitude = 76.740987
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = ADCS CubeSpace CubeSense Earth
Demise Altitude = 77.713130
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = ADCS CubeSpace CubeSense Sun
Demise Altitude = 77.773255
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = ADCS CubeSpace CubeMag Deploy
Demise Altitude = 77.785544
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = ADCS CubeSpace CubeMag Compact
Demise Altitude = 77.731590
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = ADCS CubeSpace CubeTorqer CR0020
Demise Altitude = 75.686455
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = ADCS CubeSpace CubeWheel PYR CW0500 case
Demise Altitude = 77.253392
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = ADCS CubeSpace CubeWheel PYR CW0500 rotor
Demise Altitude = 75.102993
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000
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************************************
name = ADCS harness - BU ruff estimate
Demise Altitude = 73.926033
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Satlab SRS-3 S-Band TRX
Demise Altitude = 77.257704
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Printec SAS-2 S-Band TRX Ant
Demise Altitude = 76.782222
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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name = 1U Solar Panel
Demise Altitude = 77.665365
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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name = 4x2U Solar Panel
Demise Altitude = 77.444679
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Angle Brackets
Demise Altitude = 77.546298
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = NSL ADCS
Demise Altitude = 75.466096
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Impact Kinetic Energy = 0.000000

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name = NSL ADCS IR Sensor
Demise Altitude = 77.791423
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Impact Kinetic Energy = 0.000000

************************************
name = NSL ADCS FG Mag
Demise Altitude = 77.821218
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000
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name = PIN Diode
Demise Altitude = 77.500272
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Copper Plate
Demise Altitude = 76.037198
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Burn Wire PCB
Demise Altitude = 77.886368
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Inhibit Switches
Demise Altitude = 77.586405
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = RBF Switch Assembly
Demise Altitude = 77.761456
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Diag (g125-2241096f5)
Demise Altitude = 77.815314
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = SMA Bulkheads
Demise Altitude = 77.881082
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Cabling (Estimate)
Demise Altitude = 77.604163
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = EC2216 Epoxy
Demise Altitude = 77.898261
Debris Casualty Area = 0.000000
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Impact Kinetic Energy = 0.000000

************************************
name = Cable Route Asm 2
Demise Altitude = 77.591402
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Cable Route Asm 3
Demise Altitude = 77.596867
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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name = Cable Route Asm 4
Demise Altitude = 77.624908
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = RPA_base_plate
Demise Altitude = 77.136570
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Impact Kinetic Energy = 0.000000

************************************
name = RPA_SBC-1461_case
Demise Altitude = 77.537874
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = RPA_SBC-1461_board
Demise Altitude = 77.198967
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = RPA_SDR_1001_case
Demise Altitude = 77.543746
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = RPA_SDR_1001_board
Demise Altitude = 77.101655
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = RPA_ERZ-LNA-0100-0310-30-2
Demise Altitude = 77.379185
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Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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name = RPA_ERZ-HPA-0200-0400-30
Demise Altitude = 77.556303
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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name = RPA_DP1337
Demise Altitude = 76.964759
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = RPA_DP1338A
Demise Altitude = 77.007578
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = RPA_UDC400
Demise Altitude = 76.777225
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = RPA_UDC300
Demise Altitude = 76.777225
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = RPA_ZN4PD-63LW-S+
Demise Altitude = 77.647874
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = RPA_DCS-206-G
Demise Altitude = 75.434776
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = RPA_FIHI-2903C00
Demise Altitude = 77.592305
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = RPA_TMT010-307-06-18
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Demise Altitude = 76.542305
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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name = RPA_ERZ-HPA-0200-0400-43
Demise Altitude = 76.720245
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = RPA_shelf_with_legs
Demise Altitude = 77.828413
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = RPA_UHF_radio_assy
Demise Altitude = 77.441520
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = RPA_data_aggregator
Demise Altitude = 77.701756
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = RPA_upper_plate
Demise Altitude = 77.875567
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = RPA_harness - BU ruff estimate
Demise Altitude = 73.780744
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = RPA_AnyWaves - S-band patch antenna
Demise Altitude = 77.343829
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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=============== End of Requirement 4.7-1 ===============
07 19 2025; 18:14:53PM Project Data Saved To File
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