SPACEFLIGHT

1505 Westlake Avenue North – Floor 6
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November 8, 2021

FILED ELECTRONICALLY VIA IBFS

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
45 L Street, N.E.
Washington, DC 20554

Re: Spaceflight, Inc.;
Letter to Application for Special Temporary Authority ("STA") to deploy and operate Sherpa-LTC1, File No. SAT-STA-20210812-00098

Dear Ms. Dortch:

Spaceflight, Inc. ("Spaceflight"), provides the following clarification regarding its recent submission[1] to the file for the above referenced application for special temporary authority for the Sherpa-LTC1 spacecraft.

This clarification is to note recent design changes incorporated by the manufacturer to the Sherpa-LTC1 spacecraft due to the unavailability of certain components. Spaceflight was informed of the necessary design change on October 8, 2021. Specifically, the internal construction of the oxidizer tanks changed resulting in an increase in mass as compared those in the original Shepa-LTC1 ODAR report.

The new human casualty probability now associated with the Sherpa-LTC1, including the new tanks, is 1 in 12,300, which is a lower probability than the one put forward in the original application for Sherpa-LTC1. This improved probability is due to another design change, which ties together the oxidizer tanks with titanium brackets to ensure the tanks land as one object and not three separate ones.

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[1] Letter dated Nov 3. 2021, from Will Lewis, Sr. Manager, Regulatory for Spaceflight, Inc. to Marlene H. Dortch, Secretary, Federal Communications Commission regarding Sherpa-LTC1 IBFS File No. SAT-STA-20210812-00098.

Spaceflight failed to note these changes in previous submissions because it was determined that, as a whole, the design changes would improve the Sherpa-LTC1's space safety profile and that these changes would be reflected in the raw outputs of the ODAR analysis. Spaceflight did not realize at the time that the raw ODAR output does not automatically provide a human casualty probability.

Attached here is a copy of the most recent ODAR report Spaceflight has submitted for the Sherpa-LTC1. Every value that has changed as a result of the manufacturer's design changes since original ODAR report has been highlighted in yellow[2] to facilitate an easier review. Please note that some values in the summary were updated to reflect the outputs of the ODAR analysis that were not caught during the prior submission.

Spaceflight regrets these errors and will be diligent about preventing them in the future. Spaceflight will notify the Commission of any further design changes to Sherpa-LTC1 as soon as they are finalized.

Questions with respect to this matter should be referred to the undersigned.

Sincerely,

/s/ Will Lewis

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[2] Please note that one component, LT lower 8-in separation system, was removed due to the previously reported changes in the manifest. Please also note that other changes to the raw ODAR inputs or outputs from the initial report are a result of previously reported changes to the Sherpa-LTC1 manifest and have been determined to have no bearing on Spaceflight's space safety profile.

Sherpa-LTC1 Orbital Debris Assessment Report (ODAR)

This report is presented in compliance with NASA-STD-8719.14B, APPENDIX A.

Report Version 1.2
November 8, 2021

Document Data is Not Restricted.

This document contains no proprietary, ITAR, or export-controlled information.

DAS Software Version Used in Analysis: v3.1.0
Report prepared by Will Lewis, Sr. Manager, Regulatory
Analysis prepared by Eric Lund, Lead Systems Engineer

VERSION APPROVAL and/or FINAL APPROVAL*:

Ryan Olcott
Mission Manager
Spaceflight, Inc.

*Approval signatures indicate acceptance of the ODAR-defined risk.

Table Contents

Self-assessment of the ODAR using the format in Appendix A.2 of NASA-STD- 8719.14:

A self-assessment is provided below in accordance with the assessment format provided in Appendix A.2 of NASA-STD-8719.14B.

Orbital Debris Self-Assessment Report Evaluation: Sherpa-LTC1 on January 2022 SpaceX Falcon 9 Rideshare Mission

Requirement #	Launch Vehicle				Spacecraft			Comments
	Compliant	Not Compliant	Incomplete	Standard Non-Compliant	Compliant or N/A	Not Compliant	Incomplete	
4.3-1.a	☐	☐	☐	☐	☒	☐	☐	No Debris Released in LEO.
4.3-1.b	☐	☐	☐	☐	☒	☐	☐	No Debris Released in LEO.
4.3-2	☐	☐	☐	☐	☒	☐	☐	No Debris Released in GEO.
4.4-1	☐	☐	☐	☐	☒	☐	☐	
4.4-2	☐	☐	☐	☐	☒	☐	☐	
4.4-3	☐	☐	☐	☐	☒	☐	☐	No planned breakups.
4.4-4	☐	☐	☐	☐	☒	☐	☐	No planned breakups.
4.5-1	☐	☐	☐	☐	☒	☐	☐	
4.5-2	☐	☐	☐	☐	☒	☐	☐	
4.6-1(a)	☐	☐	☐	☐	☒	☐	☐	
4.6-1(b)	☐	☐	☐	☐	☒	☐	☐	
4.6-1(c)	☐	☐	☐	☐	☒	☐	☐	
4.6-2	☐	☐	☐	☐	☒	☐	☐	Spacecraft does not go to GEO.
4.6-3	☐	☐	☐	☐	☒	☐	☐	Spacecraft does not go beyond LEO.
4.6-4	☐	☐	☐	☐	☒	☐	☐	
4.7-1	☐	☐	☐	☐	☒	☐	☐	
4.8-1					☒	☐	☐	No tethers used.

Assessment Report Format:

ODAR Technical Sections Format Requirements:

As Spaceflight, Inc. is based in the U.S., and governed by the rules and regulation of the U.S.; this ODAR follows the format recommended in NASA- STD-8719.14b, Appendix A.1 and includes the content indicated at a minimum in each Section 2 through 8 below for the January 2022 SpaceX Rideshare Mission. Sections 9 through 14 apply to the launch vehicle ODAR and are not covered here.

ODAR Section 1: Program Management and Mission Overview

Project Manager: Ryan Olcott

Foreign government or space agency participation: No foreign government or space agency participation.

Schedule of upcoming mission milestones:
Launch: January 2022

Mission Overview:
The January 2022 SpaceX Rideshare Mission ("Transporter-3") is a commercial rideshare mission, for which the primary objective of Spaceflight Inc. is deploying approximately 10 customer spacecraft into a planned sun-synchronous circular orbit of 525 km with a tolerance of ± 25 km. The launch vehicle will deploy an orbital transfer vehicle called "Sherpa-LTC1", which deploys the majority of its additional customer spacecraft within several hours of launch and launch separation. (*Each of these satellite customers are responsible for obtaining an FCC or other agency or administration authorization as appropriate and does not constitute debris*). This represents a worst-case scenario and ensures that any changes to the Sherpa-LTC1 manifest will be bounded by our ODAR analysis here.

Spaceflight's Sherpa-LTC1 is an upgraded version of the Sherpa vehicle variant, similar to the previously licensed Sherpa-LTE1. Sherpa-LTC1 will have attitude control, chemical propulsion, and the same forward port adapter to accommodate additional microsatellites as Sherpa-LTE1. The Sherpa-LTC1 demonstration mission consists of two mission phases. The first (primary) mission phase is the deployment of 6 customer spacecraft. This phase is anticipated to last for less than 6 hours after launch. During this phase, the Sherpa-LTC1 vehicle deploys customer spacecraft in the same way as the previously licensed Sherpa vehicles. The material difference between the Sherpa-LTC1 mission and previous Sherpa-FX missions is that instead of concluding the mission after finishing all deployments at the orbital altitude in which the vehicle was first inserted by the launch vehicle, Sherpa-LTC1 will undertake a demonstration mission phase to reduce the altitude of the spacecraft to a 500 km altitude. The remaining 4 customers will be deployed from Sherpa-LTC1 at this new orbit, and then Sherpa-LTC1 will rely on atmospheric drag to deorbit. This demonstration mission should take approximately 3 weeks, but Spaceflight will continue to gather valuable flight data from LTC-1 through the term of its Special Temporary Authority.

During the demonstration mission, a new modular system will be enabled and tested, in addition to the previously-flown onboard computer with sensors and effectors to provide command and control over the Sherpa vehicle. This command and control will make use of traditional, flight-proven, small satellite control systems (reaction wheels, star trackers, magnetic torque rods, etc.) to detumble and stabilize the Sherpa vehicle in a known attitude, then pointing the vehicle toward the sun for solar panel charging. The new modular system is a chemical propulsion deck from Benchmark Space Systems, which

will be commissioned to be used to lower the Sherpa vehicle altitude from 525 km to approximately 500 km and perform inclination adjustments. Orbit lowering will be accomplished through a series of retrograde thruster firings. This set of maneuvers will demonstrate propulsive capability of the Sherpa system, while providing key performance data for the Benchmark Space Systems propulsion system. From that altitude, Spaceflight will decommission Sherpa for reentry by atmospheric drag, which at this lower altitude will take about 8.6 years.

ODAR Configuration:
ODAR analysis was run for 2 potential scenarios (Nominal Mission and Failed Mission). The results presented here for the Failed Mission envelope the worst-case scenario and our final mission analyses shall be no worse than these initial baselined numbers. Since the physical architecture layout of the Sherpa vehicles is often not finalized until approximately Launch–3 months, due to customer remanifest, vehicle optimization, etc., Spaceflight seeks to initially present these worst-case, generalized results for the Sherpa-LTC1 vehicle now. Once the physical architecture has been finalized, Spaceflight shall rerun our ODAR analysis and provide an updated ODAR report to the Commission demonstrating that the finalized ODAR shows equal or improved results compared to those baselined in this submission. This approach seeks to demonstrate what the Commission can expect as a worst-case scenario initially and will also mitigate the potential for the Commission's review of the results of this analysis to become outdated as physical architecture changes during the course of mission preparation.

The terms *Nominal Mission* and *Failed Mission* are defined as follows:

- *Nominal Mission*: All customer deployments successful, demonstration mission successful.
- *Failed Mission:* All spacecraft deployments unsuccessful, demonstration mission unsuccessful, which represents a worst-case. In an entirely separate case, where spacecraft deployments are unsuccessful or partially unsuccessful, but the demonstration mission of altitude reduction is still viable, orbit lifetime would only be improved compared to this *Failed Mission* case where both primary and demonstration mission are unsuccessful. Thus, the *Failed Mission* case presented here is the worst-case scenario.[1]

In order to most accurately perform analysis within the constraints of the DAS tool, ODAR analyses contained in this report were run for the scenarios in the following table, showing comparison to the intended mission.

Scenario	DAS Analysis	Mission	Delta between DAS and Mission

[1] In addition to assuming the highest possible mass, Spaceflight has also assumed the highest target orbit and highest ballistic coefficient throughout the orbit lifetime of the vehicles.

Sherpa-LTC1 Nominal Mission	500 km operational orbit	550 km deployment, reduction to 500 km operational orbit	Initial time to commission subsystems (~ 3 weeks) at the initial 550 km is not captured in DAS due to DAS program constraints[2]
Sherpa-LTC1 Failed Mission	550 km, no PMD	550 km, no PMD	None

ODAR Summary:

- No debris released in normal operations;
- No credible scenario for breakups;
- The collision probability with other objects is compliant with NASA standards; and
- The estimated worst-case decay lifetime due to atmospheric drag is under 25 years, through the possible range altitudes and mission cases presented herein, as predicted by DAS 3.1.0.

	Nominal Mission	**Failed Mission**
Sherpa-LTC1	8.6 years	22.2 years

Launch vehicle and launch site: SpaceX Falcon 9**,** Cape Canaveral Air Force Station, Florida

Proposed launch date: January 2022

Mission duration:

Maximum Sherpa-LTC1 Nominal Transmitting Operations:

- < 6 months

Post-Mission Orbit lifetime:

- For a Nominal Mission ending at 500 km, Sherpa-LTC1 has a predicted post-mission orbit lifetime of 8.6 years.

Launch and deployment profile, including all parking, transfer, and operational orbits with apogee, perigee, and inclination:

Sherpa-LTC1

	Apogee Altitude	**Perigee Altitude**	**Inclination**	**Duration**
Deployment Orbit	525 ± 25 km	525 ± 25 km	97.384 ± 0.1 deg	Mission Duration: ~3 weeks
Demonstration Mission Orbit	500 ± 25 km	500 ± 25 km	96.5 deg	Transit: ~3 weeks Mission Duration: 3 weeks with post-mission checkups occurring for the remaining 4 months
End-of-Life Orbit	500 ± 25 km	500 ± 25 km	96.5 deg	8.6 years (nominal)

[2] The orbit lifetime of the Sherpa-LTC1 *Nominal Mission* is under the 25-year orbit lifetime requirement with the initial 3-week phase considered.

ODAR Section 2: Spacecraft Description

Physical description of the spacecraft:

Sherpa-LTC1 is a propulsive orbital transfer vehicle that is designed to deploy auxiliary spacecraft and transit to different orbits. It is structurally alike to the previously licensed Sherpa-FX1[3] and Sherpa-FX2.[4] The separation system and customer payload layout on Sherpa-LTC1 can be variable, depending on the number of microsatellites and CubeSats manifested to the Mission. CubeSat and Microsatellite separation systems are interchangeable and can be affixed radially on the body of the Sherpa vehicle. A microsatellite, CubeSat dispenser, or other adapter for separation system mounting can be affixed on the outboard end of Sherpa-LTC1. Thus, Sherpa-LTC1 will deploy customers in the same fashion as the previously licensed Sherpa-FX1 and FX2. For this Mission, the currently planned configuration has 1 microsatellite on the outboard end of Sherpa-LTC1, with 9 CubeSats integrated in various dispensers attached radially on the body of Sherpa-LTC1.[5] The Sherpa-LTC1 Mission configuration also includes an S-band receive antenna and an L-band transmitter as part of its avionics.

Sherpa-LTC1 will be attached to a single port on a SpaceX-provided payload ring. The SpaceX Falcon 9 launch vehicle will have multiple rings with SpaceX's other customers stacked above and/or below the ring on which Spaceflight's Sherpa-LTC1 is attached. Once a separation signal is received by Sherpa-LTC1's separation system from SpaceX's Falcon 9 avionics, the Sherpa-LTC1 will separate. After Sherpa-LTC1's separation from SpaceX's Falcon 9 launch vehicle and a subsequent delay in accordance with SpaceX requirements, once activated, the R2A-Core will execute an onboard mission sequence to deploy the majority of the customer spacecraft. The internal volume of Sherpa-LTC1 will contain R2A-Core sequencer and batteries. Sherpa-LTC1 utilizes the R2A-Core system for its primary mission to command the deployment of approximately 6 customer spacecraft into SSO.

The R2A-Core also activates the EyeStar S3 Black Box Radio (provided by NearSpace Launch) and, specifically, the L-band transmitter which sends deployment confirmation telemetry to the Globalstar constellation for relay by commercial Globalstar and NearSpace Launch data services to Spaceflight.

Sherpa-LTC1 will also have 2 cameras onboard for the purposes of mission assurance and to confirm customer deployments.

Spaceflight's Sherpa-LTC1 mission consists of two mission phases. The Sherpa-LTC1 Primary Mission phase is the deployment of customer spacecraft at the initial 525 km altitude. This phase is anticipated to last for less than 6 hours. During this phase, the Sherpa-LTC1 vehicle will deploy customer spacecraft in the same way as the Sherpa-FX1, Sherpa-FX2 and Sherpa-LTE1 missions.

The material difference between the Sherpa-LTC1 mission and previous Sherpa-FX missions is that instead of concluding the mission after finishing all deployments at the orbital altitude in which the vehicle was first inserted by the launch vehicle, Sherpa-LTC1 will undertake a demonstration mission phase to reduce the altitude of the spacecraft to a 500 km altitude. The remaining customers' spacecraft will be deployed from Sherpa-LTC1 at this new orbit, and then Sherpa-LTC1 will rely on atmospheric drag to deorbit.

[3] SAT-STA-20200728-00089 Spaceflight, Inc. Sherpa-FX1 STA.
[4] SAT-STA-20210205-00017 Spaceflight, Inc. Sherpa-FX2 and Sherpa-LTE1 STA.
[5] None of the spacecraft to be deployed will themselves deploy additional spacecraft.

In a case where any combination of spacecraft are unable to make the mission, a non-separating mass model will either be inserted into a locked dispenser door or affixed directly to the Sherpa structure, depending on the missing spacecraft's form factor. These mass models are materially and physically the same as those evaluated in Spaceflight's previous Sherpa-FX2 license submission and therefore have not been included in this new risk analysis. In the Sherpa-FX2 STA, examples for a microsat mass model, entire 12U and 6U dispenser mass models, or a single CubeSat mass model within a flight dispenser were all shown to fully demise and not contribute to any human casualty risk. Some customers are responsible for providing their own mass model. If a case arises that a customer mass model will need to be integrated for flight, Spaceflight will re-run DAS analysis incorporating that specific mass model and its corresponding material properties to ensure demise and no worse risk of casualty than what is presented here, before integration onto the Sherpa-LTC1 structure.

Total satellite mass at launch, including all propellants and fluids, potential mass growth and uncertainties:

Item	Mass (kg)	Notes
Sherpa-LTC1	270	includes 39 kg usable propellant and 3 kg of residuals (unusable propellant + GN2 pressurant)
Lynk-05	55.6	MicroSat
Kleos KSF2a	6.8	6U CubeSat
Kleos KSF2b	6.8	6U CubeSat
Kleos KSF2c	6.8	6U CubeSat
Kleos KSF2d	6.8	6U CubeSat
LLITED	5	2x 1.5U CubeSat (combined total mass)
SPiN1 & OreSat0	3.3	2x 1U CubeSat (combined total mass)
VZLUSAT-2	3.9	3U CubeSat
Total Mass	**365**[6]	

Dry mass of satellite at launch, excluding solid rocket motor propellants, but including potential mass growth and uncertainties:

Sherpa-LTC1	323 kg

Dry mass of satellite at end of mission, excluding solid rocket motor propellants[7]:

Sherpa-LTC1	222 kg

[6] Satellite mass at launch is based on current manifest. Spaceflight's mass at launch will not exceed 365 kg for Sherpa-LTC1.
[7] Sherpa-LTC1's nominal mass at the end of its Demonstration Mission phase is 253 kg, and is inclusive of 23 kg of remaining propellant. This value is used conservatively (rather than Dry mass at end of mission), for DAS analysis. Prior to re-entry, Spaceflight will use up all remaining fuel before end-of-life, assuming LTC1 remains operational after the secondary mission.

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

Sherpa-LTC1 has a chemical propulsion assembly from Benchmark Space Systems.

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:

The Sherpa-LTC1 uses the following fluids:

- 34.3 kg high-test peroxide (oxidizer) at 300 psi
- 6.5 kg isopropyl alcohol (fuel) at 300 psi
- 1.2 kg nitrogen gas (pressurant) at 6,000 psi

Sherpa-LTC1's propulsion system propellants are high-test peroxide (HT) and isopropyl alcohol (IPA). The pressurant is nitrogen gas and there is no risk of hazardous persistent liquid droplets. Both propellants have non-zero vapor pressure. All exhaust products should be molecular in nature and there will be no particulates upon release.

When HTP liquid is exposed to vacuum, it will immediately evaporate into small crystals. Once exposed to sunlight, the crystals will sublimate into vapor and disperse, therefore no droplets will remain.

When liquid IPA is exposed to vacuum, it will immediately evaporate, but its freezing point is unlikely to be achieved in low Earth orbit, so it will remain a vapor and disperse and not form droplets or crystals. The gaseous nitrogen will remain gaseous and rapidly disperse. It will not refreeze in low Earth orbit.

Fluids in Pressurized Batteries: None.

Power System #1: Sherpa-LTC1 uses two of the same NiMH battery packs previously used on the Sherpa-FX1 mission.

Power System #2: Sherpa-LTC1 batteries contained in the attitude and control system, called Command and Control System (CCS), are four unpressurized Commercial off-the-shelf (COTS) Lithium-ion battery cells.

Power System #3: Sherpa-LTC1 also includes a high voltage electrical system which consists of two batteries made up of nine cells each in series.

Description of attitude control system and indication of the normal attitude of the spacecraft with respect to the velocity vector: Sherpa-LTC1 has attitude control.

Fifteen minutes after activation, the reaction wheels on Sherpa-LTC1 will be used, if necessary, to detumble the spacecraft from any initial deployment rates and the spacecraft will enter a sun pointing safe mode with the star tracker pointed anti-nadir. Sherpa-LTC1 also includes the following:

- A *sun pointing safe mode* that is optimized for solar power generation from the satellite. The spacecraft's large fixed panels will be oriented towards the sun and the star tracker will be clocked

anti-nadir. This mode will make use of magnetometers, sun sensors, gyroscope, reaction wheels, and magnetic torquers to orient the spacecraft correctly.

- A *sun pointing link mode* that is optimized for solar power generation and allows the satellite to maintain an intersatellite link with the OISL. The Sherpa-LTC1's large fixed panels will be oriented towards the sun and the star tracker will be clocked to point along the velocity vector. This mode will make use of magnetometers, sun sensors, gyroscope, reaction wheels, and magnetic torquers to orient the spacecraft correctly.
- A *velocity tracking mode,* which will be used to point the thrust head face along the velocity or anti-velocity vector to allow for phasing maneuvers between the two spacecraft. This mode will also be used to lower the Sherpa-LTC1's orbit at End-Of-Life. This mode will make use of the reaction wheels and a star tracker to orient the spacecraft.

Description of any range safety or other pyrotechnic devices: None.

Description of the electrical generation and storage system:

Sherpa-LTC1 contains Power Systems #1-3, described below.

Power System #1: Standard COTS lithium iron disulfide and nickel-metal hydride battery cells are charged prior to payload integration and provide electrical energy during the primary phase of the mission to separate customer spacecraft. Total energy capacity is ~228 W·hr and the maximum voltage is 36 VDC. These batteries have no ability to recharge once Sherpa-LTC1 is in orbit. The electrical load on this circuit has a low-voltage cut-off at ~23 VDC, below which the batteries have <1% energy capacity remaining. These batteries are at the very center of the structure. In the event of an unlikely battery explosion, the structure would contain any fragments or debris.

Power System #2: For the demonstration mission, standard COTS Lithium-Ion battery cells are charged before payload integration and provide electrical energy during eclipse and during high power consumption modes. All power required for the operation of the bus electronics (CCS) is supplied through an "all-parallel" battery arrangement that results in increased safety thanks to natural voltage balancing between cells. The capacity of this battery is 68 W-hrs. Sherpa-LTC1 includes 4 "backup" solar panels on non-typically-sun-pointing faces to provide power in the case of a safe mode tumble.

Power System #3: The main solar panels are equipped with 12 strings of 16 cells in series (192 cells total). The all-parallel bus battery is charged through these solar panels and through a higher voltage "payload battery" that consists of 2 batteries with 9 battery cells in series each. This results in a robust architecture where the bus electronics are effectively always being charged as if in sunlight, even in eclipse or intensive operations modes. The capacity of the payload battery is 252 W-hrs.

Typical bus operations consume 12 watts of power on average. The thruster can consume up to 400 Watts during operation. The charge/discharge cycle is managed by a power management system overseen by the Flight Computer and Electrical Power Subsystem, which is part of the CCS.

Identification of any other sources of stored energy not noted above: None.

Identification of any radioactive materials on board: None**.**

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

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 intentional releases other than customer spacecraft deployments (see Mission Overview).

Rationale/necessity for release of each object: N/A.

Time of release of each object, relative to launch time: N/A.

Release velocity of each object with respect to spacecraft: N/A.

Expected orbital parameters (apogee, perigee, and inclination) of each object after release: N/A.

Calculated orbital lifetime of each object, including time spent in Low Earth Orbit (LEO): N/A.

Assessment of spacecraft compliance with Requirements 4.3-1 and 4.3-2 (per DAS v3.1.0) 4.3-1,

Mission Related Debris Passing Through LEO: COMPLIANT

4.3-2, Mission Related Debris Passing Near GEO: COMPLIANT

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

Potential causes of spacecraft breakup during deployment and mission operations:

There is no credible scenario that would result in spacecraft breakup during normal deployment and operations.

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

An in-mission failure of a battery protection circuit could lead to a short circuit resulting in overheating and a very remote possibility of battery cell explosion. The battery safety systems discussed in the Failure Mode and Effects Analysis (FMEA) (see requirement 4.4-1 below) describe the combined faults that must occur for any of seven (7) independent, mutually exclusive failure modes to lead to explosion.

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

There are no planned breakups.

List of components which shall be passivated at End of Mission (EOM) including method of passivation and amount which cannot be passivated:

No components require passivation at EOM.

Rationale for all items which are required to be passivated, but cannot be due to their design:

N/A

Assessment of spacecraft compliance with Requirements 4.4-1 through 4.4-4:

***Requirement 4.4-1*:** Limiting the risk to other space systems from accidental explosions during deployment and mission operations while in orbit about Earth or the Moon:

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) (Requirement 56449).

Compliance statement:

Required Probability: 0.001.

Expected Probability: 0.000.

Supporting Rationale and FMEA details:

Battery explosion:

Effect: All failure modes below might theoretically result in battery explosion with the possibility of orbital debris generation. However, in the unlikely event that a battery cell does explosively rupture, the small size, mass, and potential energy, of the selected space-rated COTS battery cells is such that while the Sherpa-LTC1 could be expected to vent gases, most debris from the battery rupture should be contained within the battery

housing / containment device due to the lack of penetration energy.
Probability: Extremely Low. It is believed to be a much less than 0.1% probability that multiple independent (not common mode) faults must occur for each failure mode to cause the ultimate effect (explosion).

Failure mode 1: Internal short circuit.
Mitigation 1: Qualification and acceptance shock, vibration, thermal cycling, and vacuum tests followed by maximum system rate-limited charge and discharge to prove that no internal short circuit sensitivity exists.
Combined faults required for realized failure: Environmental testing and functional charge/discharge tests must both be ineffective in discovery of the failure mode.

Failure Mode 2: Internal thermal rise due to high load discharge rate.
Mitigation 2: Cells were tested in lab for high load discharge rates in a variety of flight-like configurations to determine the likelihood and impact of an out of control thermal rise in the cell. Cells were also tested in a hot environment to test the upper limit of the cell's capability. No failures were seen.
*Combined faults required for realized failure: S*pacecraft thermal design must be incorrect and external over-current detection and disconnect function must fail to enable this failure mode.

Failure Mode 3: Excessive discharge rate or short circuit due to external device failure or terminal contact with conductors not at battery voltage levels (due to abrasion or inadequate proximity separation).
Mitigation 3: This failure mode is negated by a) qualification-tested short circuit protection on each external circuit, b) design of battery packs and insulators such that no contact with nearby board traces is possible without being caused by some other mechanical failure, c) obviation of such other mechanical failures by proto- qualification and acceptance environmental tests (shock, vibration, thermal cycling, and thermal-vacuum tests).
Combined faults required for realized failure: An external load must fail/short- circuit and external over-current detection and disconnect function failure must all occur to enable this failure mode.

Failure Mode 4: Inoperable vents.
Mitigation 4: Battery vents are not inhibited by the battery holder design or the spacecraft.
Combined effects required for realized failure: The final assembler fails to install proper venting.

Failure Mode 5: Crushing.
Mitigation 5: This mode is negated by spacecraft design. There are no moving parts in the proximity of the batteries.
Combined faults required for realized failure: A catastrophic failure must occur in an external system and the failure must cause a collision sufficient to crush the batteries leading to an internal short circuit and the satellite must be in a naturally sustained

orbit at the time the crushing occurs.

Failure Mode 6: Low level current leakage or short-circuit through battery pack case or due to moisture-based degradation of insulators.
Mitigation 6: These modes are negated by a) battery holder/case design made of non-conductive plastic, and b) operation in vacuum such that no moisture can affect insulators.
Combined faults required for realized failure: Abrasion or piercing failure of circuit board coating or wire insulators and dislocation of battery packs and failure of battery terminal insulators and failure to detect such failure modes in environmental tests must occur to result in this failure mode.

Failure Mode 7: Excess temperatures due to orbital environment and high discharge combined.
Mitigation 7: The Sherpa-LTC1 thermal design will negate this possibility. Thermal rise has been analyzed in combination with space environment temperatures showing that batteries do not exceed normal allowable operating temperatures, which are well below temperatures of concern for explosions.

Combined faults required for realized failure: Thermal analysis and thermal design and mission simulations in thermal-vacuum chamber testing and over- current monitoring and control must all fail for this failure mode to occur.

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 to deplete all onboard sources of stored energy and disconnect all energy generation sources when they are no longer required for mission operations or post-mission disposal or control to a level which cannot cause an explosion or deflagration large enough to release orbital debris or break up the spacecraft (Requirement 56450).

Compliance statement:
Sherpa-LTC1 is designed such that when mission operations begin, all energy from the secondary batteries for the R2A Core will dissipate within 36 hours of the initiation of the primary mission. The primary batteries will also dissipate all energy within 36 hours of the initiation of the primary mission. Additionally, Sherpa-LTC1 battery charge circuits include overcharge protection and active thermal monitoring to limit the risk of battery failure. However, in the unlikely event that a battery cell does explosively rupture, the small size, mass, and potential energy, of these small batteries is such that while the spacecraft could be expected to vent gases, most debris from the battery rupture should be contained within the vessel due to the lack of penetration energy.

On Sherpa-LTC1, the CCS has the ability to fully disconnect the Lithium-Ion cells from the charging current of the solar arrays. At End-Of-Life, this feature will be used to completely passivate the batteries by removing all energy from them. In the unlikely event that a battery cell does explosively rupture, the small size, mass, and potential

energy, of these small batteries is such that while the spacecraft could be expected to vent gases, the debris from the battery rupture should be contained within the spacecraft due to the lack of penetration energy to the multiple enclosures surrounding the batteries.

Requirement 4.4-3. Limiting the long-term risk to other space systems from planned breakups:

Compliance statement:
This requirement is not applicable. There are no planned breakups.

Requirement 4.4-4: Limiting the short-term risk to other space systems from planned breakups:

Compliance statement:
This requirement is not applicable. There are no planned breakups.

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

Assessment of spacecraft compliance with Requirements 4.5-1 and 4.5-2 (per DAS v3.1.0, and calculation methods provided in NASA-STD-8719.14, section 4.5.4):

Requirement 4.5-1:

Assess probability of collision with intact space systems or large debris (>10cm)

Large Object Impact and Debris Generation Probability:

Spacecraft	Nominal Mission	Failed Mission	Status
Sherpa-LTC1	0.00001578	0.00007485	PASS

Requirement 4.5-2:

Assess and limit the probability of damage to critical components as a result of impact with small debris.

Spacecraft	Status
Sherpa-LTC1	COMPLIANT

Probability of Damage from Small Debris

While there are subsystems onboard the Sherpa-LTC1 vehicle which provide the ability to perform a post mission disposal maneuver, the vehicle is compliant with all orbit lifetime requirements without the use of a post mission disposal maneuver. However, altitude reduction and orbit adjustment will be employed as a part of the primary mission concept of operations (CONOPS) to deploy a customer at a lower altitude. We demonstrate in this report that the *Failed Mission* cases are still compliant with orbit lifetime requirements. The *Failed Mission* case shows that, akin to a Micrometeoroid orbital debris strike that incapacitates the attitude control or chemical propulsion system, Sherpa-LTC1 is still compliant with orbit lifetime requirements in the case that that attitude control or chemical propulsion system fails.

Identification of all systems or components required to accomplish any post-mission disposal operation, including passivation and maneuvering:

Sherpa-LTC1 will conduct controlled altitude reduction by means of enabling and testing new attitude control and chemical propulsion systems. The controlled descent of Sherpa-LTC1 for its Demonstration Mission will last no longer than three weeks. During this time, the previously demonstrated CCS and a new chemical propulsion system will be enabled and tested. The first system is an onboard computer with sensors and effectors to provide command and control over the Sherpa-LTC1 vehicle. This system will make use of traditional, flown, small satellite control systems (reaction wheels, star trackers, magnetic torque rods, etc.) to detumble and stabilize the Sherpa vehicle in a known attitude (if necessary), then pointing the vehicle to sun-normal for solar panel charging. Also, during this time, the second modular system, a chemical propulsion assembly from Benchmark Space Systems, will be commissioned to be used to lower the Sherpa-LTC1 vehicle altitude from the initial altitude to approximately 500 km. Orbit lowering will be accomplished through a series retrograde thruster firings. This set of

maneuvers will demonstrate rapid deorbit of the Sherpa-LTC1 system, while providing key performance data for the Benchmark Space Systems propulsion system. From that altitude, Spaceflight will decommission Sherpa-LTC1 for reentry and will abide by orbit lifetime requirements by deorbiting naturally via atmospheric drag.

Recontact Analysis. Although beyond the scope of a standard orbital debris analysis, Spaceflight has conducted extensive testing and modeling to limit the risk that individual spacecraft that will be deployed on this mission will re-contact with each other after release. That analysis is presented as attachment titled *Sherpa-LTC1 Long-Term Recontact Probability* to Spaceflight's STA application.

ODAR Section 6: Assessment of Spacecraft Post-mission Disposal Plans and Procedures

6.1 Description of spacecraft disposal option selected:

Sherpa-LTC1 will descend to a 500 km altitude for the deployment of the final payload and finally naturally decay via atmospheric drag.

6.2 Plan for any spacecraft maneuvers required to accomplish post-mission disposal:

Sherpa-LTC1 orbit lowering will be accomplished through a series of retrograde impulsive maneuvers. These maneuvers are not required to maintain compliance with ODAR requirements (see Figure 4) but will diminish the post-mission orbit lifetime of Sherpa-LTC1.

6.3 Calculation of area-to-mass ratio after post-mission disposal if the controlled reentry option is not selected:

Spacecraft Mass:

	Nominal Mission	Failed Mission
Sherpa-LTC1	253 kg	362 kg

Cross-sectional Area: (arithmetic mean for random tumbling attitude)

	Nominal Mission	Failed Mission
Sherpa-LTC1	1.2461 m²	1.4714 m²

Area to mass ratio: (arithmetic mean for random tumbling attitude)

	Nominal Mission	Failed Mission
Sherpa-LTC1	0.004944 m²/kg	0.003854 m²/kg

6.4 Assessment of spacecraft compliance with Requirements 4.6-1 through 4.6-5 (per DAS v 3.1.0 and NASA-STD-8719.14B section):

Requirement 4.6-1: Disposal for space structures passing through LEO:
A spacecraft or orbital stage with a perigee altitude below 2000 km shall be disposed of by one of three methods:
(Requirement 56557)
a. Atmospheric reentry option:

- *Leave the space structure in an orbit in which natural forces will lead to atmospheric reentry within 25 years after the completion of mission but no more than 30 years after launch; or*
- *Maneuver the space structure into a controlled de-orbit trajectory as soon as practical after completion of mission.*

b. Storage orbit option: Maneuver the space structure into an orbit with perigee altitude greater than 2000 km and apogee less than GEO - 500 km.
c. Direct retrieval: Retrieve the space structure and remove it from orbit within 10 years after completion of mission.

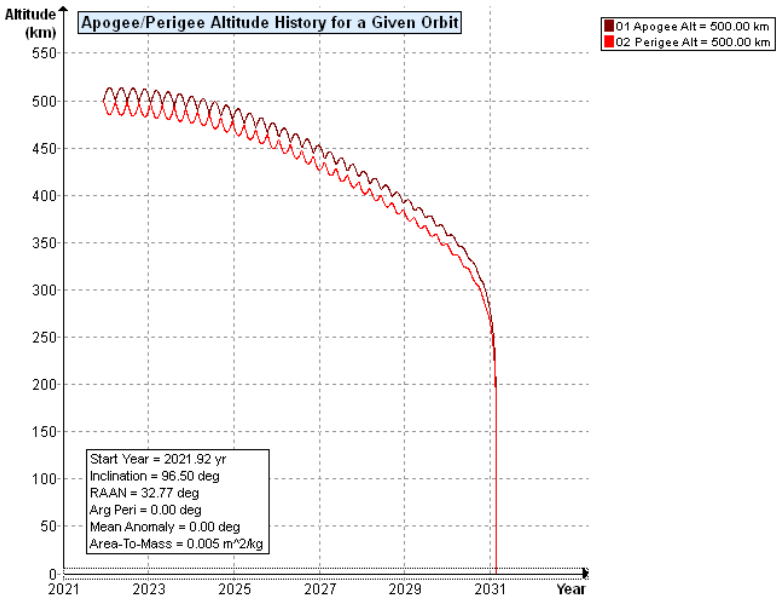

Figure 1 - Sherpa-LTC1 orbit history (Nominal Mission at 525 km) once it has reached its final secondary altitude of 500 km. Due to the limitations of DAS the initial primary mission (<1 day at 550 km), commissioning of subsystems and transit to secondary drop off at 500 km (~3 weeks) could not be depicted. That additional 3-week portion of the mission would be appended to the beginning of this graph.

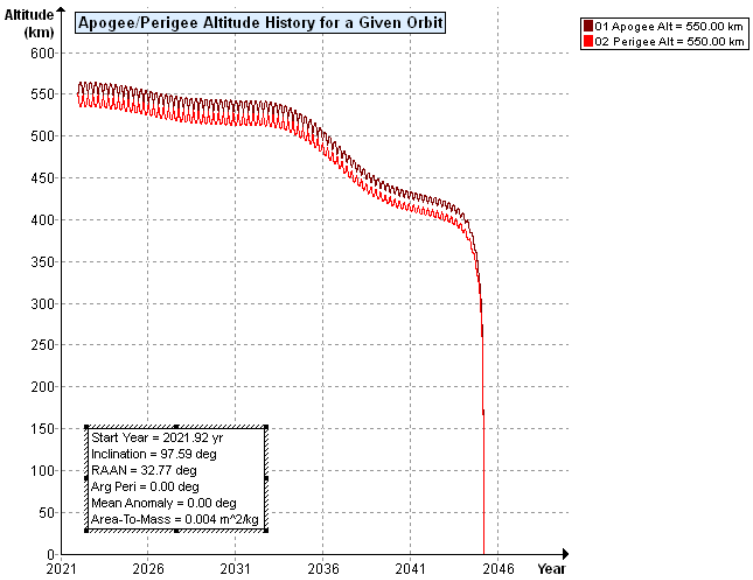

Figure 2 - Sherpa-LTC1 (Failed Mission at 550 km) orbit history.

Analysis: Sherpa-LTC1 reentry is COMPLIANT using method “a”.

Satellite Name	**Sherpa-LTC1**

BOL Orbit (Drop off)	550 x 550 km
Operational Orbit	500 x 500 km
EOM Orbit	500 x 500 km
Total Lifetime for Nominal Mission	8.6 years
Total Lifetime if Mission Failure	22.2 years

Requirement 4.6-2. Disposal for space structures near GEO.

Analysis: Not applicable.

Requirement 4.6-3. Disposal for space structures between LEO and GEO. **Analysis:** Not applicable.

Requirement 4.6-4. Reliability of Post-mission Disposal Operations

Reliability:
The attitude determination and control system (ADCS) on Sherpa-LTC1 is a flown heritage system operating with a highly flexible flight software package. In addition, the chemical propulsion system has accumulated many thousands of seconds of integrated test time, in vacuum. In order to perform the disposal acceleration burn, the spacecraft requires the proper functioning of its ADCS subsystem as well as its Benchmark Space Systems propulsion system in order to successfully execute the planned deorbit maneuver. Accordingly, redundancy and reliability have been carefully considered in these disposal-critical areas.

Functional redundancy is provided in the attitude determination subsystem. The Sherpa-LTC1 uses a blend of the high-accuracy gyro, sun sensors, and magnetometers as a secondary method.

Attitude control is accomplished with the reaction wheels. Three wheels, one oriented along each axis, are used for precision pointing. The magnetic torquers provide momentum desaturation for the reaction wheels. The Sherpa-LTC1 requires the ability to fire magnetic torquers along a minimum of two independent axes to maintain attitude control. A total of six torque coils are included in the spacecraft in two groups with different reliability chains to prevent a systematic failure. In the unlikely case of a reaction wheel failure, the magnetic torquers can be used for primary attitude control to continue the deorbit maneuver. Once Sherpa-LTC1 arrives at 500 km, its EOM orbit, it will rely on atmospheric drag to fully de-orbit.

Spaceflight shows DAS analysis cases here for: (i) its planned or Nominal Mission (successful deployment of all spacecraft planned to be deployed, inclusive of the Demonstration mission deployment, and successful orbit reduction); (ii) an off-nominal Mission Failure case where no spacecraft are deployed and the chemical propulsion system is not commissioned and altitude decays naturally via atmospheric drag. In each case DAS returns a total on-orbit lifetime of 25 years or less.

In an entirely separate case not shown here, where Sherpa-LTC1 deployments are unsuccessful, but the demonstration mission of altitude reduction is still viable, orbit lifetime would only be

improved compared to this Failed Mission. Thus, the Failed Mission case presented here is the worst-case scenario. Since this hybrid scenario is bounded by the others, it is not discussed further.

As with SSO-A, Sherpa-FX1, Sherpa-FX2 and Sherpa-LTE1, Spaceflight has a team of highly qualified engineers, and a well-established process for rideshare missions such as this. Spaceflight finds that an avionics failure in the middle of the separation sequence is highly unlikely and has previously demonstrated flight heritage on the Sherpa-FX1, Sherpa-FX2, and Sherpa-LTE1 missions. If the primary avionics systems were to fail, it will most likely succumb to the launch environment, which occurs prior to any deployments from the Sherpa-LTC1 vehicle resulting in the Mission Failure cases. Furthermore, in case the ability to reduce the Sherpa-LTC1 orbit to 500km is unsuccessful, we demonstrate requirement compliance via atmospheric drag.

Finally, Spaceflight believes a successful mission, “Nominal Mission” case, is most probable. The analysis contained above shows compliance with FCC regulations and guidelines.

ODAR Section 7: Assessment of Spacecraft Reentry Hazards

Assessment of spacecraft compliance with Requirement 4.7-1:

> ***Requirement 4.7-1:*** Limit the risk of human casualty:
> *The potential for human casualty is assumed for any object with an impacting kinetic energy in excess of 15 joules:*
> *a) For uncontrolled reentry, the risk of human casualty from surviving debris shall not exceed 0.0001 (1:10,000) (Requirement 56626).*

Summary Analysis Results:
DAS calculates Sherpa-LTC1 and its separation systems and subcomponents (listed in further detail in the full DAS results appended to this report) have a 1:12,300 risk of human casualty and thus the Sherpa-LTC1 meets the requirement. Components which may survive reentry are the following:

Input	Output
name = RWA rotor quantity = 3 parent = 1 materialID = 62 type = Box Aero Mass = 0.400000 Thermal Mass = 0.400000 Diameter/Width = 0.135000 Length = 0.135000 Height = 0.037000	name = RWA rotor Demise Altitude = 0.000000 Debris Casualty Area = 1.502729 Impact Kinetic Energy = 128.080551
name = PropSysItem002 (OX Tank Assembly) quantity = 1 parent = 1 materialID = 54 type = Box Aero Mass = 25.500000 Thermal Mass = 25.500000 Diameter/Width = 0.457000 Length = 0.490000 Height = 0.360000	name = PropSysItem002 (OX Tank Assembly) Demise Altitude = 0.000000 Debris Casualty Area = 1.097043 Impact Kinetic Energy = 26954.027344
name = PropSysItem003 (Fuel Tank) quantity = 1 parent = 1 materialID = 54 type = Cylinder Aero Mass = 8.500000 Thermal Mass = 8.500000 Diameter/Width = 0.237600 Length = 0.357390	name = PropSysItem003 (Fuel Tank) Demise Altitude = 0.000000 Debris Casualty Area = 0.794600 Impact Kinetic Energy = 8304.789063
name = PropSysItem004 (pressurant tanks) quantity = 2 parent = 1 materialID = 65 type = Cylinder Aero Mass = 1.010380 Thermal Mass = 1.010380 Diameter/Width = 0.085000 Length = 0.300000	name = PropSysItem004 (pressurant tanks) Demise Altitude = 0.000000 Debris Casualty Area = 1.154249 Impact Kinetic Energy = 420.786102

name = PropSysItem012 (thruster assembly) quantity = 4 parent = 1 materialID = 47 type = Cylinder Aero Mass = 0.245000 Thermal Mass = 0.245000 Diameter/Width = 0.076000 Length = 0.166000	name = PropSysItem012 (thruster assembly) Demise Altitude = 0.000000 Debris Casualty Area = 2.029605 Impact Kinetic Energy = 48.213413

For the "Mission Failed" case, as the Sherpa vehicle begins to demise, customer payloads will break free and should demise as described in the ODAR assessments they would have provided during their own licensing efforts. Consistent with Spaceflight's prior missions, Spaceflight relies upon its customers' own authorizations for reentry hazards each for their own spacecraft.

Requirements 4.7-1b, and 4.7-1c below are non-applicable requirements because the Sherpa-LTC1 Mission does not use controlled reentry.

4.7-1, b) **NOT APPLICABLE.** For controlled reentry, the selected trajectory shall ensure that no surviving debris impact with a kinetic energy greater than 15 joules is closer than 370 km from foreign landmasses, or is within 50 km from the continental U.S., territories of the U.S., and the permanent ice pack of Antarctica (Requirement 56627).

4.7-1 c) **NOT APPLICABLE.** For controlled reentries, the product of the probability of failure of the reentry burn (from Requirement 4.6-4.b) and the risk of human casualty assuming uncontrolled reentry shall not exceed 0.0001 (1:10,000) (Requirement 56628).

ODAR Section 8: Assessment for Tether Missions

Not applicable. There are no tethers in the mission.

Raw DAS Output – Nominal Mission

```
10 12 2021; 17:15:53PM        Activity Log Started
10 12 2021; 17:15:54PM        Opened Project C:\Users\elund\Box\Eric Lund\Missions and Programs\SXRS-
6\DAS ODAR Rev C Nominal\
10 12 2021; 17:16:07PM        Mission Editor Changes Applied
10 12 2021; 17:16:08PM        Project Data Saved To File
10 12 2021; 17:16:09PM        Project Data Saved To File
10 12 2021; 17:16:11PM        Processing Requirement 4.3-1:            Return Status :  Not Run

======================
No Project Data Available
======================

=============== End of Requirement 4.3-1 ===============
10 12 2021; 17:16:14PM        Processing Requirement 4.3-2: Return Status : Passed

======================
No Project Data Available
======================

=============== End of Requirement 4.3-2 ===============
10 12 2021; 20:05:27PM        Processing Requirement 4.5-1:            Return Status :  Passed

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

**INPUT**

            Space Structure Name = Sherpa-LTC1
            Space Structure Type = Payload
            Perigee Altitude = 500.000 (km)
            Apogee Altitude = 500.000 (km)
            Inclination = 96.500 (deg)
            RAAN = 0.000 (deg)
            Argument of Perigee = 0.000 (deg)
            Mean Anomaly = 0.000 (deg)
            Final Area-To-Mass Ratio = 0.0049 (m^2/kg)
            Start Year = 2022.027 (yr)
            Initial Mass = 365.000 (kg)
            Final Mass = 253.000 (kg)
            Duration = 0.030 (yr)
            Station-Kept = False
            Abandoned = True

**OUTPUT**

            Collision Probability = 1.4519E-05
            Returned Message: Normal Processing
            Date Range Message: Normal Date Range
            Status = Pass

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

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

10 12 2021; 20:05:32PM        Project Data Saved To File
10 12 2021; 20:05:37PM        Requirement 4.5-2:  Compliant

=============== End of Requirement 4.5-2 ===============

10 12 2021; 20:05:38PM        Processing Requirement 4.6    Return Status :  Passed

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

**INPUT**

            Space Structure Name = Sherpa-LTC1
            Space Structure Type = Payload

            Perigee Altitude = 500.000000 (km)
            Apogee Altitude = 500.000000 (km)
            Inclination = 96.500000 (deg)
            RAAN = 0.000000 (deg)
            Argument of Perigee = 0.000000 (deg)
            Mean Anomaly = 0.000000 (deg)
            Area-To-Mass Ratio = 0.004944 (m^2/kg)
            Start Year = 2022.027000 (yr)
            Initial Mass = 365.000000 (kg)
            Final Mass = 253.000000 (kg)
            Duration = 0.030000 (yr)
            Station Kept = False
            Abandoned = True
            PMD Perigee Altitude = 494.938244 (km)
            PMD Apogee Altitude = 504.986533 (km)
            PMD Inclination = 96.500705 (deg)
            PMD RAAN = 9.451918 (deg)
            PMD Argument of Perigee = 158.901021 (deg)
            PMD Mean Anomaly = 0.000000 (deg)

**OUTPUT**

            Suggested Perigee Altitude = 494.938244 (km)
            Suggested Apogee Altitude = 504.986533 (km)
            Returned Error Message = Passes LEO reentry orbit criteria.

            Released Year = 2030 (yr)
            Requirement = 61
            Compliance Status = Pass

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

=============== End of Requirement 4.6 ===============
10 12 2021; 20:05:46PM        *********Processing Requirement 4.7-1
            Return Status :  Passed
```

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

name = Sherpa-LTC1
quantity = 1
parent = 0
materialID = 5
type = Cylinder
Aero Mass = 253.000000
Thermal Mass = 253.000000
Diameter/Width = 0.813000

name = LT upper 24-in separation sytem
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 1.800000
Thermal Mass = 1.800000
Diameter/Width = 0.610000
Length = 0.610000
Height = 0.031000

name = 24inch Jchannel spacer ring
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 5.260000
Thermal Mass = 5.260000
Diameter/Width = 0.666750
Length = 0.666750
Height = 0.082550

name = solar panel wing
quantity = 6
parent = 1
materialID = 8
type = Box
Aero Mass = 2.350000
Thermal Mass = 2.350000
Diameter/Width = 0.546350
Length = 0.548500
Height = 0.060000

name = LT Hex Plate
quantity = 2
parent = 1
materialID = 8
type = Box
Aero Mass = 12.000000
Thermal Mass = 12.000000
Diameter/Width = 0.822000
```

Length = 0.822000
Height = 0.070000

name = LT Interior Wall
quantity = 6
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 1.162000
Thermal Mass = 1.162000
Diameter/Width = 0.118000
Length = 0.318000

name = LT Corner Brace
quantity = 6
parent = 1
materialID = 8
type = Box
Aero Mass = 2.040000
Thermal Mass = 2.040000
Diameter/Width = 0.151000
Length = 0.178000
Height = 0.151000

name = LT avionics port adapter plate
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 1.920000
Thermal Mass = 1.920000
Diameter/Width = 0.311000
Length = 0.350000

name = LT QuadPack adapter plate
quantity = 4
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 1.727000
Thermal Mass = 1.727000
Diameter/Width = 0.297000
Length = 0.311000

name = LT antenna bracket w antennas
quantity = 2
parent = 1
materialID = 8
type = Box
Aero Mass = 1.428000
Thermal Mass = 1.428000
Diameter/Width = 0.300000
Length = 0.400000
Height = 0.150000

name = LT R2A-Core
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 3.200000
Thermal Mass = 3.200000
Diameter/Width = 0.285000
Length = 0.285000
Height = 0.090000

name = LT battery module
quantity = 2
parent = 1
materialID = 5
type = Box
Aero Mass = 2.650000
Thermal Mass = 2.650000
Diameter/Width = 0.100000
Length = 0.139000
Height = 0.100000

name = LT NSL Black Box Std
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 0.290000
Thermal Mass = 0.290000
Diameter/Width = 0.054000
Length = 0.089000
Height = 0.047000

name = empty QuadPack 2.3
quantity = 2
parent = 1
materialID = 5
type = Box
Aero Mass = 6.300000
Thermal Mass = 6.300000
Diameter/Width = 0.250000
Length = 0.440000
Height = 0.250000

name = empty QuadPack 4.3
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 7.600000
Thermal Mass = 7.600000
Diameter/Width = 0.250000
Length = 0.440000

```
Height = 0.250000

name = 6U mass model
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 16.000000
Thermal Mass = 16.000000
Diameter/Width = 0.260000
Length = 0.260000
Height = 0.158100

name = CubeSat mass model frames
quantity = 4
parent = 1
materialID = 5
type = Box
Aero Mass = 0.664000
Thermal Mass = 0.664000
Diameter/Width = 0.100000
Length = 0.120000
Height = 0.100000

name = LT PRA
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 11.998000
Thermal Mass = 11.998000
Diameter/Width = 0.626000
Length = 0.626000
Height = 0.070000

name = LT 15-3 Spacer Ring
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 6.350000
Thermal Mass = 6.350000
Diameter/Width = 0.198000
Length = 0.198000
Height = 0.076200

name = LT lower 15-in separation system
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 2.057000
Thermal Mass = 2.057000
Diameter/Width = 0.206154
```

Length = 0.206154
Height = 0.045466

name = torque rod
quantity = 3
parent = 1
materialID = 38
type = Cylinder
Aero Mass = 0.450000
Thermal Mass = 0.450000
Diameter/Width = 0.020000
Length = 0.300000

name = AD avionics
quantity = 5
parent = 1
materialID = 8
type = Box
Aero Mass = 3.000000
Thermal Mass = 3.000000
Diameter/Width = 0.120000
Length = 0.150000
Height = 0.100000

name = RWA enclosure
quantity = 3
parent = 1
materialID = 5
type = Box
Aero Mass = 0.570000
Thermal Mass = 0.570000
Diameter/Width = 0.140000
Length = 0.150000
Height = 0.042000

name = RWA rotor
quantity = 3
parent = 1
materialID = 62
type = Box
Aero Mass = 0.400000
Thermal Mass = 0.400000
Diameter/Width = 0.135000
Length = 0.135000
Height = 0.037000

name = propulsion deck plate
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 4.100000
Thermal Mass = 4.100000
Diameter/Width = 0.544000

Length = 0.544000
Height = 0.022000

name = camera bracket
quantity = 2
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.620000
Thermal Mass = 0.620000
Diameter/Width = 0.146000
Length = 0.177800

name = IMPERX camera
quantity = 2
parent = 1
materialID = 5
type = Box
Aero Mass = 0.115000
Thermal Mass = 0.115000
Diameter/Width = 0.037000
Length = 0.072000
Height = 0.037000

name = camera lens assembly
quantity = 2
parent = 1
materialID = 58
type = Cylinder
Aero Mass = 0.134000
Thermal Mass = 0.134000
Diameter/Width = 0.034000
Length = 0.047000

name = LTC J-channel
quantity = 1
parent = 1
materialID = 8
type = Cylinder
Aero Mass = 4.640000
Thermal Mass = 4.640000
Diameter/Width = 0.628650
Length = 0.628650

name = PropSysItem001
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 4.648000
Thermal Mass = 4.648000
Diameter/Width = 0.572000
Length = 0.572000

```
name = PropSysItem002
quantity = 1
parent = 1
materialID = 54
type = Box
Aero Mass = 25.500000
Thermal Mass = 25.500000
Diameter/Width = 0.457000
Length = 0.490000
Height = 0.360000

name = PropSysItem003
quantity = 1
parent = 1
materialID = 54
type = Cylinder
Aero Mass = 8.500000
Thermal Mass = 8.500000
Diameter/Width = 0.237600
Length = 0.357390

name = PropSysItem004
quantity = 2
parent = 1
materialID = 65
type = Cylinder
Aero Mass = 1.010380
Thermal Mass = 1.010380
Diameter/Width = 0.085000
Length = 0.300000

name = PropSysItem005
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.928000
Thermal Mass = 0.928000
Diameter/Width = 0.250000
Length = 0.250000
Height = 0.013000

name = PropSysItem006
quantity = 3
parent = 1
materialID = 59
type = Box
Aero Mass = 0.151667
Thermal Mass = 0.151667
Diameter/Width = 0.051000
Length = 0.105000
Height = 0.020000

name = PropSysItem007
```

quantity = 4
parent = 1
materialID = 64
type = Cylinder
Aero Mass = 0.156000
Thermal Mass = 0.156000
Diameter/Width = 0.200000
Length = 0.340000

name = PropSysItem008
quantity = 10
parent = 1
materialID = 37
type = Box
Aero Mass = 0.232000
Thermal Mass = 0.232000
Diameter/Width = 0.025400
Length = 0.076000
Height = 0.025400

name = PropSysItem009
quantity = 1
parent = 1
materialID = 59
type = Box
Aero Mass = 0.078000
Thermal Mass = 0.078000
Diameter/Width = 0.025660
Length = 0.080520
Height = 0.022200

name = PropSysItem011
quantity = 3
parent = 1
materialID = 8
type = Box
Aero Mass = 0.152900
Thermal Mass = 0.152900
Diameter/Width = 0.156000
Length = 0.220000
Height = 0.014600

name = PropSysItem012
quantity = 4
parent = 1
materialID = 47
type = Cylinder
Aero Mass = 0.245000
Thermal Mass = 0.245000
Diameter/Width = 0.076000
Length = 0.166000

name = PropSysItem013
quantity = 1

```
parent = 1
materialID = 54
type = Flat Plate
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.053000
Length = 0.053000

name = PropSysItem014
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.081000
Thermal Mass = 0.081000
Diameter/Width = 0.047300
Length = 0.076000
Height = 0.041600

name = PropSysItem015
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.080000
Thermal Mass = 0.080000
Diameter/Width = 0.047000
Length = 0.076000
Height = 0.042000

name = PropSysItem017
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.077000
Thermal Mass = 0.077000
Diameter/Width = 0.047000
Length = 0.076000
Height = 0.042000

name = PropSysItem018
quantity = 1
parent = 1
materialID = 59
type = Box
Aero Mass = 0.087000
Thermal Mass = 0.087000
Diameter/Width = 0.020160
Length = 0.057660
Height = 0.017460

name = PropSysItem019
quantity = 1
```

parent = 1
materialID = 59
type = Box
Aero Mass = 0.063650
Thermal Mass = 0.063650
Diameter/Width = 0.035140
Length = 0.053800
Height = 0.014300

name = PropSysItem020
quantity = 1
parent = 1
materialID = 59
type = Box
Aero Mass = 0.080000
Thermal Mass = 0.080000
Diameter/Width = 0.018300
Length = 0.060000
Height = 0.015880

name = PropSysItem021
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.072150
Thermal Mass = 0.072150
Diameter/Width = 0.041500
Length = 0.067000
Height = 0.031750

name = PropSysItem022
quantity = 4
parent = 1
materialID = 59
type = Box
Aero Mass = 0.064000
Thermal Mass = 0.064000
Diameter/Width = 0.030000
Length = 0.030000
Height = 0.016000

name = PropSysItem023
quantity = 4
parent = 1
materialID = 59
type = Box
Aero Mass = 0.063500
Thermal Mass = 0.063500
Diameter/Width = 0.032500
Length = 0.053000
Height = 0.014300

name = PropSysItem024

quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.057400
Thermal Mass = 0.057400
Diameter/Width = 0.085000
Length = 0.085000
Height = 0.015000

name = PropSysItem025
quantity = 6
parent = 1
materialID = 59
type = Box
Aero Mass = 0.087500
Thermal Mass = 0.087500
Diameter/Width = 0.018330
Length = 0.054360
Height = 0.015880

name = PropSysItem026
quantity = 7
parent = 1
materialID = 59
type = Box
Aero Mass = 0.036143
Thermal Mass = 0.036143
Diameter/Width = 0.028800
Length = 0.044700
Height = 0.011180

name = PropSysItem027
quantity = 4
parent = 1
materialID = 8
type = Box
Aero Mass = 0.018675
Thermal Mass = 0.018675
Diameter/Width = 0.073300
Length = 0.073300
Height = 0.016000

name = PropSysItem028
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.054000
Thermal Mass = 0.054000
Diameter/Width = 0.085000
Length = 0.092100
Height = 0.017500

name = PropSysItem029
quantity = 1
parent = 1
materialID = 59
type = Cylinder
Aero Mass = 0.042160
Thermal Mass = 0.042160
Diameter/Width = 0.006350
Length = 0.350000

name = PropSysItem030
quantity = 1
parent = 1
materialID = 59
type = Cylinder
Aero Mass = 0.037000
Thermal Mass = 0.037000
Diameter/Width = 0.006350
Length = 0.319000

name = PropSysItem031
quantity = 32
parent = 1
materialID = 54
type = Box
Aero Mass = 0.005094
Thermal Mass = 0.005094
Diameter/Width = 0.011300
Length = 0.013000
Height = 0.011300

name = PropSysItem032
quantity = 32
parent = 1
materialID = 57
type = Box
Aero Mass = 0.007688
Thermal Mass = 0.007688
Diameter/Width = 0.010000
Length = 0.025400
Height = 0.010000

name = PropSysItem033
quantity = 36
parent = 1
materialID = 59
type = Cylinder
Aero Mass = 0.011444
Thermal Mass = 0.011444
Diameter/Width = 0.003180
Length = 9.652000

name = PropSysItem034
quantity = 9

parent = 1
materialID = 59
type = Cylinder
Aero Mass = 0.026667
Thermal Mass = 0.026667
Diameter/Width = 0.006350
Length = 2.127000

name = PropSysItem035
quantity = 15
parent = 1
materialID = 59
type = Cylinder
Aero Mass = 0.003037
Thermal Mass = 0.003037
Diameter/Width = 0.001590
Length = 2.947000

name = PropSysItem036
quantity = 2
parent = 1
materialID = 59
type = Box
Aero Mass = 0.034000
Thermal Mass = 0.034000
Diameter/Width = 0.021000
Length = 0.021000
Height = 0.015000

name = PropSysItem037
quantity = 2
parent = 1
materialID = 59
type = Box
Aero Mass = 0.034000
Thermal Mass = 0.034000
Diameter/Width = 0.014000
Length = 0.051000
Height = 0.012000

name = PropSysItem038
quantity = 4
parent = 1
materialID = 64
type = Box
Aero Mass = 0.033000
Thermal Mass = 0.033000
Diameter/Width = 0.215000
Length = 0.215000
Height = 0.012000

name = PropSysItem039
quantity = 1
parent = 1

materialID = 59
type = Box
Aero Mass = 0.030000
Thermal Mass = 0.030000
Diameter/Width = 0.016400
Length = 0.038100
Height = 0.014200

name = PropSysItem041
quantity = 2
parent = 1
materialID = 59
type = Box
Aero Mass = 0.027000
Thermal Mass = 0.027000
Diameter/Width = 0.025000
Length = 0.038000
Height = 0.015300

name = PropSysItem042
quantity = 5
parent = 1
materialID = 59
type = Box
Aero Mass = 0.026000
Thermal Mass = 0.026000
Diameter/Width = 0.020000
Length = 0.030000
Height = 0.010000

name = PropSysItem043
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.025000
Thermal Mass = 0.025000
Diameter/Width = 0.067000
Length = 0.067000

name = PropSysItem045
quantity = 5
parent = 1
materialID = 59
type = Box
Aero Mass = 0.024500
Thermal Mass = 0.024500
Diameter/Width = 0.012000
Length = 0.035560
Height = 0.011600

name = PropSysItem046
quantity = 10
parent = 1

materialID = 59
type = Box
Aero Mass = 0.011500
Thermal Mass = 0.011500
Diameter/Width = 0.012900
Length = 0.019200
Height = 0.011180

name = PropSysItem047
quantity = 12
parent = 1
materialID = 54
type = Box
Aero Mass = 0.007738
Thermal Mass = 0.007738
Diameter/Width = 0.007000
Length = 0.067500
Height = 0.007000

name = PropSysItem049
quantity = 4
parent = 1
materialID = 59
type = Box
Aero Mass = 0.020000
Thermal Mass = 0.020000
Diameter/Width = 0.012900
Length = 0.030500
Height = 0.011280

name = PropSysItem050
quantity = 8
parent = 1
materialID = 59
type = Box
Aero Mass = 0.010000
Thermal Mass = 0.010000
Diameter/Width = 0.009170
Length = 0.031500
Height = 0.007940

name = PropSysItem051
quantity = 24
parent = 1
materialID = 59
type = Box
Aero Mass = 0.002875
Thermal Mass = 0.002875
Diameter/Width = 0.025000
Length = 0.025000
Height = 0.000790

name = PropSysItem052
quantity = 2

parent = 1
materialID = 59
type = Box
Aero Mass = 0.043000
Thermal Mass = 0.043000
Diameter/Width = 0.025000
Length = 0.025000
Height = 0.017600

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

name = Sherpa-LTC1
Demise Altitude = 77.999863
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = LT upper 24-in separation sytem
Demise Altitude = 76.243614
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = 24inch Jchannel spacer ring
Demise Altitude = 73.533722
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = solar panel wing
Demise Altitude = 75.851440
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = LT Hex Plate
Demise Altitude = 66.220924
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = LT Interior Wall
Demise Altitude = 74.154472
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = LT Corner Brace
Demise Altitude = 74.012230
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = LT avionics port adapter plate
Demise Altitude = 74.345192
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = LT QuadPack adapter plate
Demise Altitude = 74.250031
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = LT antenna bracket w antennas
Demise Altitude = 76.742035
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = LT R2A-Core
Demise Altitude = 72.046654
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = LT battery module
Demise Altitude = 69.359177
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = LT NSL Black Box Std
Demise Altitude = 75.675392
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = empty QuadPack 2.3
Demise Altitude = 73.345284
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = empty QuadPack 4.3
Demise Altitude = 72.337090
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = 6U mass model
Demise Altitude = 52.676983
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = CubeSat mass model frames
Demise Altitude = 75.496613
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = LT PRA
Demise Altitude = 65.431084
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = LT 15-3 Spacer Ring
Demise Altitude = 62.192684
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = LT lower 15-in separation system
Demise Altitude = 71.434723
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = torque rod
Demise Altitude = 69.756836
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = AD avionics
Demise Altitude = 69.512184
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = RWA enclosure
Demise Altitude = 75.519554
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = RWA rotor
Demise Altitude = 0.000000
Debris Casualty Area = 1.502729
Impact Kinetic Energy = 128.087692

****

name = propulsion deck plate
Demise Altitude = 73.300835
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = camera bracket
Demise Altitude = 75.089455
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = IMPERX camera
Demise Altitude = 76.619057
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = camera lens assembly
Demise Altitude = 72.307495
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = LTC J-channel
Demise Altitude = 76.963387
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = PropSysItem001
Demise Altitude = 72.408836
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = PropSysItem002
Demise Altitude = 0.000000
Debris Casualty Area = 1.097043
Impact Kinetic Energy = 26952.521484

****

name = PropSysItem003
Demise Altitude = 0.000000
Debris Casualty Area = 0.794600
Impact Kinetic Energy = 8305.488281

****

name = PropSysItem004
Demise Altitude = 0.000000
Debris Casualty Area = 1.154249
Impact Kinetic Energy = 420.724365

****

name = PropSysItem005
Demise Altitude = 75.579117
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = PropSysItem006
Demise Altitude = 74.197701
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem007
Demise Altitude = 77.947472
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem008
Demise Altitude = 73.585732
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem009
Demise Altitude = 75.972176
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem011
Demise Altitude = 77.536728
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem012
Demise Altitude = 0.000000
Debris Casualty Area = 2.029605
Impact Kinetic Energy = 48.212425

****
name = PropSysItem013
Demise Altitude = 71.208221
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem014
Demise Altitude = 77.253540
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem015
Demise Altitude = 77.265320
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = PropSysItem017
Demise Altitude = 77.293114
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem018
Demise Altitude = 74.872787
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem019
Demise Altitude = 75.286674
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem020
Demise Altitude = 74.987305
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem021
Demise Altitude = 77.116226
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem022
Demise Altitude = 73.567047
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem023
Demise Altitude = 75.294975
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem024
Demise Altitude = 77.441605
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem025
Demise Altitude = 74.541901
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = PropSysItem026
Demise Altitude = 75.950897
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem027
Demise Altitude = 77.788704
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem028
Demise Altitude = 77.533768
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem029
Demise Altitude = 77.346344
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem030
Demise Altitude = 77.374146
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem031
Demise Altitude = 76.252106
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem032
Demise Altitude = 77.032684
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem033
Demise Altitude = 77.996407
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem034
Demise Altitude = 77.934013
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = PropSysItem035
Demise Altitude = 77.985619
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem036
Demise Altitude = 74.328362
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem037
Demise Altitude = 76.092445
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem038
Demise Altitude = 77.979149
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem039
Demise Altitude = 76.103973
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem041
Demise Altitude = 76.330162
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem042
Demise Altitude = 75.720161
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem043
Demise Altitude = 77.569580
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem045
Demise Altitude = 76.071053
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

```
name = PropSysItem046
Demise Altitude = 76.311691
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PropSysItem047
Demise Altitude = 77.352020
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PropSysItem049
Demise Altitude = 76.186951
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PropSysItem050
Demise Altitude = 76.812752
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PropSysItem051
Demise Altitude = 77.560013
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PropSysItem052
Demise Altitude = 74.315063
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************

================ End of Requirement 4.7-1 ================
10 12 2021; 20:05:47PM        Project Data Saved To File
10 12 2021; 20:05:54PM        Project Data Saved To File
```

Raw DAS Output – Failed Mission

```
10 12 2021; 15:42:22PM	Activity Log Started
10 12 2021; 15:42:22PM	Opened Project C:\Users\elund\Box\Eric Lund\Missions and Programs\SXRS-6\DAS ODAR Rev C DoA\
10 12 2021; 15:42:33PM	Processing Requirement 4.3-1:		Return Status :  Not Run

=====================
No Project Data Available
=====================

=============== End of Requirement 4.3-1 ===============
10 12 2021; 15:42:35PM	Processing Requirement 4.3-2: Return Status : Passed

=====================
No Project Data Available
=====================

=============== End of Requirement 4.3-2 ===============
10 12 2021; 16:43:19PM	Processing Requirement 4.5-1:		Return Status :  Passed

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

**INPUT**

		Space Structure Name = Sherpa-LTC1_DoA
		Space Structure Type = Payload
		Perigee Altitude = 550.000 (km)
		Apogee Altitude = 550.000 (km)
		Inclination = 97.594 (deg)
		RAAN = 0.000 (deg)
		Argument of Perigee = 0.000 (deg)
		Mean Anomaly = 0.000 (deg)
		Final Area-To-Mass Ratio = 0.0039 (m^2/kg)
		Start Year = 2022.027 (yr)
		Initial Mass = 365.000 (kg)
		Final Mass = 365.000 (kg)
		Duration = 0.010 (yr)
		Station-Kept = False
		Abandoned = True

**OUTPUT**

		Collision Probability = 6.7464E-05
		Returned Message: Normal Processing
		Date Range Message: Normal Date Range
		Status = Pass

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

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

10 12 2021; 16:43:22PM Processing Requirement 4.6 Return Status : Passed

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

INPUT

Space Structure Name = Sherpa-LTC1_DoA
Space Structure Type = Payload

Perigee Altitude = 550.000000 (km)
Apogee Altitude = 550.000000 (km)
Inclination = 97.594000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Area-To-Mass Ratio = 0.003854 (m^2/kg)
Start Year = 2022.027000 (yr)
Initial Mass = 365.000000 (kg)
Final Mass = 365.000000 (kg)
Duration = 0.010000 (yr)
Station Kept = False
Abandoned = True
PMD Perigee Altitude = 548.389731 (km)
PMD Apogee Altitude = 551.598981 (km)
PMD Inclination = 97.593471 (deg)
PMD RAAN = 3.586708 (deg)
PMD Argument of Perigee = 176.814470 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Suggested Perigee Altitude = 548.389731 (km)
Suggested Apogee Altitude = 551.598981 (km)
Returned Error Message = Passes LEO reentry orbit criteria.

Released Year = 2044 (yr)
Requirement = 61
Compliance Status = Pass

==========

========== End of Requirement 4.6 ==========
10 12 2021; 16:43:30PM *********Processing Requirement 4.7-1
Return Status : Passed

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

name = Sherpa-LTC1_DoA
quantity = 1
parent = 0
materialID = 5

type = Cylinder
Aero Mass = 365.000000
Thermal Mass = 365.000000
Diameter/Width = 0.813000

name = LT upper 24-in separation sytem
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 1.800000
Thermal Mass = 1.800000
Diameter/Width = 0.610000
Length = 0.610000
Height = 0.031000

name = 24inch Jchannel spacer ring
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 5.260000
Thermal Mass = 5.260000
Diameter/Width = 0.666750
Length = 0.666750
Height = 0.082550

name = solar panel wing
quantity = 6
parent = 1
materialID = 8
type = Box
Aero Mass = 2.350000
Thermal Mass = 2.350000
Diameter/Width = 0.546350
Length = 0.548500
Height = 0.060000

name = LT Hex Plate
quantity = 2
parent = 1
materialID = 8
type = Box
Aero Mass = 12.000000
Thermal Mass = 12.000000
Diameter/Width = 0.822000
Length = 0.822000
Height = 0.070000

name = LT Interior Wall
quantity = 6
parent = 1
materialID = 8
type = Flat Plate

Aero Mass = 1.162000
Thermal Mass = 1.162000
Diameter/Width = 0.118000
Length = 0.318000

name = LT Corner Brace
quantity = 6
parent = 1
materialID = 8
type = Box
Aero Mass = 2.040000
Thermal Mass = 2.040000
Diameter/Width = 0.151000
Length = 0.178000
Height = 0.151000

name = LT avionics port adapter plate
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 1.920000
Thermal Mass = 1.920000
Diameter/Width = 0.311000
Length = 0.350000

name = LT QuadPack adapter plate
quantity = 4
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 1.727000
Thermal Mass = 1.727000
Diameter/Width = 0.297000
Length = 0.311000

name = LT antenna bracket w antennas
quantity = 2
parent = 1
materialID = 8
type = Box
Aero Mass = 1.428000
Thermal Mass = 1.428000
Diameter/Width = 0.300000
Length = 0.400000
Height = 0.150000

name = LT R2A-Core
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 3.200000
Thermal Mass = 3.200000

Diameter/Width = 0.285000
Length = 0.285000
Height = 0.090000

name = LT battery module
quantity = 2
parent = 1
materialID = 5
type = Box
Aero Mass = 2.650000
Thermal Mass = 2.650000
Diameter/Width = 0.100000
Length = 0.139000
Height = 0.100000

name = LT NSL Black Box Std
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 0.290000
Thermal Mass = 0.290000
Diameter/Width = 0.054000
Length = 0.089000
Height = 0.047000

name = empty QuadPack 2.3
quantity = 2
parent = 1
materialID = 5
type = Box
Aero Mass = 6.300000
Thermal Mass = 6.300000
Diameter/Width = 0.250000
Length = 0.440000
Height = 0.250000

name = empty QuadPack 4.3
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 7.600000
Thermal Mass = 7.600000
Diameter/Width = 0.250000
Length = 0.440000
Height = 0.250000

name = 6U mass model
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 16.000000

Thermal Mass = 16.000000
Diameter/Width = 0.260000
Length = 0.260000
Height = 0.158100

name = CubeSat mass model frames
quantity = 4
parent = 1
materialID = 5
type = Box
Aero Mass = 0.664000
Thermal Mass = 0.664000
Diameter/Width = 0.100000
Length = 0.120000
Height = 0.100000

name = LT PRA
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 11.998000
Thermal Mass = 11.998000
Diameter/Width = 0.626000
Length = 0.626000
Height = 0.070000

name = LT 15-3 Spacer Ring
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 6.350000
Thermal Mass = 6.350000
Diameter/Width = 0.198000
Length = 0.198000
Height = 0.076200

name = LT lower 15-in separation system
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 2.057000
Thermal Mass = 2.057000
Diameter/Width = 0.206154
Length = 0.206154
Height = 0.045466

name = torque rod
quantity = 3
parent = 1
materialID = 38
type = Cylinder

Aero Mass = 0.450000
Thermal Mass = 0.450000
Diameter/Width = 0.020000
Length = 0.300000

name = AD avionics
quantity = 5
parent = 1
materialID = 8
type = Box
Aero Mass = 3.000000
Thermal Mass = 3.000000
Diameter/Width = 0.120000
Length = 0.150000
Height = 0.100000

name = RWA enclosure
quantity = 3
parent = 1
materialID = 5
type = Box
Aero Mass = 0.570000
Thermal Mass = 0.570000
Diameter/Width = 0.140000
Length = 0.150000
Height = 0.042000

name = RWA rotor
quantity = 3
parent = 1
materialID = 62
type = Box
Aero Mass = 0.400000
Thermal Mass = 0.400000
Diameter/Width = 0.135000
Length = 0.135000
Height = 0.037000

name = propulsion deck plate
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 4.100000
Thermal Mass = 4.100000
Diameter/Width = 0.544000
Length = 0.544000
Height = 0.022000

name = camera bracket
quantity = 2
parent = 1
materialID = 8
type = Flat Plate

Aero Mass = 0.620000
Thermal Mass = 0.620000
Diameter/Width = 0.146000
Length = 0.177800

name = IMPERX camera
quantity = 2
parent = 1
materialID = 5
type = Box
Aero Mass = 0.115000
Thermal Mass = 0.115000
Diameter/Width = 0.037000
Length = 0.072000
Height = 0.037000

name = camera lens assembly
quantity = 2
parent = 1
materialID = 58
type = Cylinder
Aero Mass = 0.134000
Thermal Mass = 0.134000
Diameter/Width = 0.034000
Length = 0.047000

name = LTC J-channel
quantity = 1
parent = 1
materialID = 8
type = Cylinder
Aero Mass = 4.640000
Thermal Mass = 4.640000
Diameter/Width = 0.628650
Length = 0.628650

name = PropSysItem001
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 4.648000
Thermal Mass = 4.648000
Diameter/Width = 0.572000
Length = 0.572000

name = PropSysItem002
quantity = 1
parent = 1
materialID = 54
type = Box
Aero Mass = 25.500000
Thermal Mass = 25.500000
Diameter/Width = 0.457000

Length = 0.490000
Height = 0.360000

name = PropSysItem003
quantity = 1
parent = 1
materialID = 54
type = Cylinder
Aero Mass = 8.500000
Thermal Mass = 8.500000
Diameter/Width = 0.237600
Length = 0.357390

name = PropSysItem004
quantity = 2
parent = 1
materialID = 65
type = Cylinder
Aero Mass = 1.010380
Thermal Mass = 1.010380
Diameter/Width = 0.085000
Length = 0.300000

name = PropSysItem005
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.928000
Thermal Mass = 0.928000
Diameter/Width = 0.250000
Length = 0.250000
Height = 0.013000

name = PropSysItem006
quantity = 3
parent = 1
materialID = 59
type = Box
Aero Mass = 0.151667
Thermal Mass = 0.151667
Diameter/Width = 0.051000
Length = 0.105000
Height = 0.020000

name = PropSysItem007
quantity = 4
parent = 1
materialID = 64
type = Cylinder
Aero Mass = 0.156000
Thermal Mass = 0.156000
Diameter/Width = 0.200000
Length = 0.340000

name = PropSysItem008
quantity = 10
parent = 1
materialID = 37
type = Box
Aero Mass = 0.232000
Thermal Mass = 0.232000
Diameter/Width = 0.025400
Length = 0.076000
Height = 0.025400

name = PropSysItem009
quantity = 1
parent = 1
materialID = 59
type = Box
Aero Mass = 0.078000
Thermal Mass = 0.078000
Diameter/Width = 0.025660
Length = 0.080520
Height = 0.022200

name = PropSysItem011
quantity = 3
parent = 1
materialID = 8
type = Box
Aero Mass = 0.152900
Thermal Mass = 0.152900
Diameter/Width = 0.156000
Length = 0.220000
Height = 0.014600

name = PropSysItem012
quantity = 4
parent = 1
materialID = 47
type = Cylinder
Aero Mass = 0.245000
Thermal Mass = 0.245000
Diameter/Width = 0.076000
Length = 0.166000

name = PropSysItem013
quantity = 1
parent = 1
materialID = 54
type = Flat Plate
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.053000
Length = 0.053000

```
name = PropSysItem014
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.081000
Thermal Mass = 0.081000
Diameter/Width = 0.047300
Length = 0.076000
Height = 0.041600

name = PropSysItem015
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.080000
Thermal Mass = 0.080000
Diameter/Width = 0.047000
Length = 0.076000
Height = 0.042000

name = PropSysItem017
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.077000
Thermal Mass = 0.077000
Diameter/Width = 0.047000
Length = 0.076000
Height = 0.042000

name = PropSysItem018
quantity = 1
parent = 1
materialID = 59
type = Box
Aero Mass = 0.087000
Thermal Mass = 0.087000
Diameter/Width = 0.020160
Length = 0.057660
Height = 0.017460

name = PropSysItem019
quantity = 1
parent = 1
materialID = 59
type = Box
Aero Mass = 0.063650
Thermal Mass = 0.063650
Diameter/Width = 0.035140
Length = 0.053800
Height = 0.014300
```

name = PropSysItem020
quantity = 1
parent = 1
materialID = 59
type = Box
Aero Mass = 0.080000
Thermal Mass = 0.080000
Diameter/Width = 0.018300
Length = 0.060000
Height = 0.015880

name = PropSysItem021
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.072150
Thermal Mass = 0.072150
Diameter/Width = 0.041500
Length = 0.067000
Height = 0.031750

name = PropSysItem022
quantity = 4
parent = 1
materialID = 59
type = Box
Aero Mass = 0.064000
Thermal Mass = 0.064000
Diameter/Width = 0.030000
Length = 0.030000
Height = 0.016000

name = PropSysItem023
quantity = 4
parent = 1
materialID = 59
type = Box
Aero Mass = 0.063500
Thermal Mass = 0.063500
Diameter/Width = 0.032500
Length = 0.053000
Height = 0.014300

name = PropSysItem024
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.057400
Thermal Mass = 0.057400
Diameter/Width = 0.085000
Length = 0.085000

Height = 0.015000

name = PropSysItem025
quantity = 6
parent = 1
materialID = 59
type = Box
Aero Mass = 0.087500
Thermal Mass = 0.087500
Diameter/Width = 0.018330
Length = 0.054360
Height = 0.015880

name = PropSysItem026
quantity = 7
parent = 1
materialID = 59
type = Box
Aero Mass = 0.036143
Thermal Mass = 0.036143
Diameter/Width = 0.028800
Length = 0.044700
Height = 0.011180

name = PropSysItem027
quantity = 4
parent = 1
materialID = 8
type = Box
Aero Mass = 0.018675
Thermal Mass = 0.018675
Diameter/Width = 0.073300
Length = 0.073300
Height = 0.016000

name = PropSysItem028
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.054000
Thermal Mass = 0.054000
Diameter/Width = 0.085000
Length = 0.092100
Height = 0.017500

name = PropSysItem029
quantity = 1
parent = 1
materialID = 59
type = Cylinder
Aero Mass = 0.042160
Thermal Mass = 0.042160
Diameter/Width = 0.006350

Length = 0.350000

name = PropSysItem030
quantity = 1
parent = 1
materialID = 59
type = Cylinder
Aero Mass = 0.037000
Thermal Mass = 0.037000
Diameter/Width = 0.006350
Length = 0.319000

name = PropSysItem031
quantity = 32
parent = 1
materialID = 54
type = Box
Aero Mass = 0.005094
Thermal Mass = 0.005094
Diameter/Width = 0.011300
Length = 0.013000
Height = 0.011300

name = PropSysItem032
quantity = 32
parent = 1
materialID = 57
type = Box
Aero Mass = 0.007688
Thermal Mass = 0.007688
Diameter/Width = 0.010000
Length = 0.025400
Height = 0.010000

name = PropSysItem033
quantity = 36
parent = 1
materialID = 59
type = Cylinder
Aero Mass = 0.011444
Thermal Mass = 0.011444
Diameter/Width = 0.003180
Length = 9.652000

name = PropSysItem034
quantity = 9
parent = 1
materialID = 59
type = Cylinder
Aero Mass = 0.026667
Thermal Mass = 0.026667
Diameter/Width = 0.006350
Length = 2.127000

name = PropSysItem035
quantity = 15
parent = 1
materialID = 59
type = Cylinder
Aero Mass = 0.003037
Thermal Mass = 0.003037
Diameter/Width = 0.001590
Length = 2.947000

name = PropSysItem036
quantity = 2
parent = 1
materialID = 59
type = Box
Aero Mass = 0.034000
Thermal Mass = 0.034000
Diameter/Width = 0.021000
Length = 0.021000
Height = 0.015000

name = PropSysItem037
quantity = 2
parent = 1
materialID = 59
type = Box
Aero Mass = 0.034000
Thermal Mass = 0.034000
Diameter/Width = 0.014000
Length = 0.051000
Height = 0.012000

name = PropSysItem038
quantity = 4
parent = 1
materialID = 64
type = Box
Aero Mass = 0.033000
Thermal Mass = 0.033000
Diameter/Width = 0.215000
Length = 0.215000
Height = 0.012000

name = PropSysItem039
quantity = 1
parent = 1
materialID = 59
type = Box
Aero Mass = 0.030000
Thermal Mass = 0.030000
Diameter/Width = 0.016400
Length = 0.038100
Height = 0.014200

name = PropSysItem041
quantity = 2
parent = 1
materialID = 59
type = Box
Aero Mass = 0.027000
Thermal Mass = 0.027000
Diameter/Width = 0.025000
Length = 0.038000
Height = 0.015300

name = PropSysItem042
quantity = 5
parent = 1
materialID = 59
type = Box
Aero Mass = 0.026000
Thermal Mass = 0.026000
Diameter/Width = 0.020000
Length = 0.030000
Height = 0.010000

name = PropSysItem043
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.025000
Thermal Mass = 0.025000
Diameter/Width = 0.067000
Length = 0.067000

name = PropSysItem045
quantity = 5
parent = 1
materialID = 59
type = Box
Aero Mass = 0.024500
Thermal Mass = 0.024500
Diameter/Width = 0.012000
Length = 0.035560
Height = 0.011600

name = PropSysItem046
quantity = 10
parent = 1
materialID = 59
type = Box
Aero Mass = 0.011500
Thermal Mass = 0.011500
Diameter/Width = 0.012900
Length = 0.019200
Height = 0.011180

name = PropSysItem047
quantity = 12
parent = 1
materialID = 54
type = Box
Aero Mass = 0.007738
Thermal Mass = 0.007738
Diameter/Width = 0.007000
Length = 0.067500
Height = 0.007000

name = PropSysItem049
quantity = 4
parent = 1
materialID = 59
type = Box
Aero Mass = 0.020000
Thermal Mass = 0.020000
Diameter/Width = 0.012900
Length = 0.030500
Height = 0.011280

name = PropSysItem050
quantity = 8
parent = 1
materialID = 59
type = Box
Aero Mass = 0.010000
Thermal Mass = 0.010000
Diameter/Width = 0.009170
Length = 0.031500
Height = 0.007940

name = PropSysItem051
quantity = 24
parent = 1
materialID = 59
type = Box
Aero Mass = 0.002875
Thermal Mass = 0.002875
Diameter/Width = 0.025000
Length = 0.025000
Height = 0.000790

name = PropSysItem052
quantity = 2
parent = 1
materialID = 59
type = Box
Aero Mass = 0.043000
Thermal Mass = 0.043000
Diameter/Width = 0.025000
Length = 0.025000
Height = 0.017600

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

name = Sherpa-LTC1_DoA
Demise Altitude = 77.998497
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = LT upper 24-in separation sytem
Demise Altitude = 76.547646
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = 24inch Jchannel spacer ring
Demise Altitude = 74.252357
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = solar panel wing
Demise Altitude = 76.204132
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = LT Hex Plate
Demise Altitude = 68.250778
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = LT Interior Wall
Demise Altitude = 74.736061
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = LT Corner Brace
Demise Altitude = 74.619308
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = LT avionics port adapter plate
Demise Altitude = 74.911232
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = LT QuadPack adapter plate
Demise Altitude = 74.818748

Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = LT antenna bracket w antennas
Demise Altitude = 76.941170
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = LT R2A-Core
Demise Altitude = 72.877945
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = LT battery module
Demise Altitude = 70.514427
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = LT NSL Black Box Std
Demise Altitude = 76.039101
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = empty QuadPack 2.3
Demise Altitude = 74.024498
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = empty QuadPack 4.3
Demise Altitude = 73.145653
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = 6U mass model
Demise Altitude = 55.557877
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = CubeSat mass model frames
Demise Altitude = 75.888779
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = LT PRA
Demise Altitude = 67.159103

Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = LT 15-3 Spacer Ring
Demise Altitude = 63.999554
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = LT lower 15-in separation system
Demise Altitude = 72.333336
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = torque rod
Demise Altitude = 70.365257
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = AD avionics
Demise Altitude = 70.650925
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = RWA enclosure
Demise Altitude = 75.902794
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = RWA rotor
Demise Altitude = 0.000000
Debris Casualty Area = 1.502729
Impact Kinetic Energy = 128.082855

****
name = propulsion deck plate
Demise Altitude = 74.004944
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = camera bracket
Demise Altitude = 75.546539
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = IMPERX camera
Demise Altitude = 76.840546

Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = camera lens assembly
Demise Altitude = 73.011803
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = LTC J-channel
Demise Altitude = 77.126884
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem001
Demise Altitude = 73.247787
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem002
Demise Altitude = 0.000000
Debris Casualty Area = 1.097043
Impact Kinetic Energy = 26954.027344

****
name = PropSysItem003
Demise Altitude = 0.000000
Debris Casualty Area = 0.794600
Impact Kinetic Energy = 8304.789063

****
name = PropSysItem004
Demise Altitude = 0.000000
Debris Casualty Area = 1.154249
Impact Kinetic Energy = 420.758118

****
name = PropSysItem005
Demise Altitude = 75.950897
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem006
Demise Altitude = 74.833961
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem007
Demise Altitude = 77.953903

Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem008
Demise Altitude = 74.215088
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem009
Demise Altitude = 76.311195
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem011
Demise Altitude = 77.613754
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem012
Demise Altitude = 0.000000
Debris Casualty Area = 2.029605
Impact Kinetic Energy = 48.211052

****
name = PropSysItem013
Demise Altitude = 71.988281
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem014
Demise Altitude = 77.372810
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem015
Demise Altitude = 77.382446
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem017
Demise Altitude = 77.408089
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem018
Demise Altitude = 75.339905

```
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PropSysItem019
Demise Altitude = 75.720482
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PropSysItem020
Demise Altitude = 75.443565
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PropSysItem021
Demise Altitude = 77.256111
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PropSysItem022
Demise Altitude = 74.145798
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PropSysItem023
Demise Altitude = 75.727013
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PropSysItem024
Demise Altitude = 77.531563
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PropSysItem025
Demise Altitude = 75.052742
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PropSysItem026
Demise Altitude = 76.301628
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PropSysItem027
Demise Altitude = 77.822189
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Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem028
Demise Altitude = 77.608704
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem029
Demise Altitude = 77.459381
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem030
Demise Altitude = 77.481628
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem031
Demise Altitude = 76.560432
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem032
Demise Altitude = 77.196342
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem033
Demise Altitude = 77.995522
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem034
Demise Altitude = 77.945847
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem035
Demise Altitude = 77.989204
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem036
Demise Altitude = 74.840195

Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem037
Demise Altitude = 76.403137
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem038
Demise Altitude = 77.983391
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem039
Demise Altitude = 76.413849
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem041
Demise Altitude = 76.622856
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem042
Demise Altitude = 76.075218
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem043
Demise Altitude = 77.636185
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem045
Demise Altitude = 76.384651
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem046
Demise Altitude = 76.587265
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PropSysItem047
Demise Altitude = 77.462631

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Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PropSysItem049
Demise Altitude = 76.479607
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PropSysItem050
Demise Altitude = 77.008987
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PropSysItem051
Demise Altitude = 77.651108
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PropSysItem052
Demise Altitude = 74.827202
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************

=============== End of Requirement 4.7-1 ===============
10 12 2021; 16:43:30PM      Project Data Saved To File
10 12 2021; 16:43:34PM      Project Data Saved To File
10 12 2021; 17:15:09PM      Activity Log Started
10 12 2021; 17:15:10PM      Opened Project C:\Users\elund\Box\Eric Lund\Missions and Programs\SXRS-
6\DAS ODAR Rev C DoA\
10 12 2021; 17:15:30PM      Closed Project C:\Users\elund\Box\Eric Lund\Missions and Programs\SXRS-
6\DAS ODAR Rev C DoA\
```

END of Sherpa-LTC1 Orbital Debris Assessment Report (ODAR)