EXHIBIT B

ORBITAL DEBRIS ASSESSMENT REPORT FOR OUTPOST MISSION 0 SATELLITE

Orbital Debris Assessment Report

Outpost Mission 0 Satellite

Prepared using NASA Debris Assessment Software (DAS) version 3.2.3.

Compliance

Requirement	Compliant
4.3-1a	Compliant
4.3-1b	Compliant
4.3-2	N/A
4.4-1	Compliant
4.4-2	Compliant
4.4-3	N/A
4.4-4	N/A
4.5-1	Compliant
4.5-2	Compliant
4.6-1	Compliant
4.6-2	N/A
4.6-3	N/A
4.6-4	Compliant
4.7-1	Compliant
4.8-1a	N/A
4.8-1b	N/A

1 Program Management and Mission Overview

Mission Sponsor: Outpost Technologies Corporation; 1601 Colorado Avenue Santa Monica, CA 90404

Responsible managers:

- Vanessa Kuroda
- Andreas Rousing

Mission description: This mission is a technology evaluation and demonstration mission. It will validate that the basic spacecraft prototype can successfully launch, start up, and communicate with ground stations. This mission will also validate that Outpost is able to operate the spacecraft.

ODAR summary:

- No orbital debris to be released as part of normal operations
- No credible scenarios for spacecraft breakup
- Collision probability compliant
- Orbit decay lifetime less than 25 years
- Reentry debris casualty risk is zero

Anticipated launch vehicle and site: Exolaunch deployer on Transporter 8 launch onboard SpaceX Falcon 9 from Cape Canaveral, Florida

Proposed launch date: no earlier than June 10, 2023

Launch and deployment profile: delivered to circular sun-synchronous, low-Earth Orbit (LEO), with a nominal altitude of 525 km ±25 km altitude with LTDN 13:00 + 60 min

Maneuvering capability:

- Attitude control: none
- Orbit control: none

Reason for operational orbit: rideshare opportunity

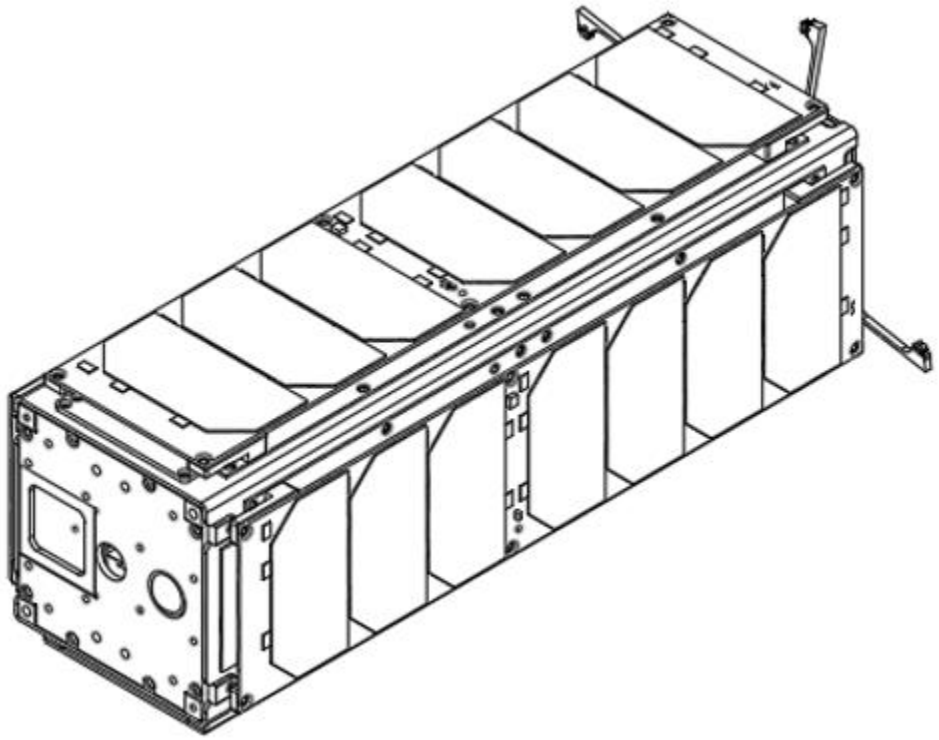
Proposed mission duration: the proposed mission duration of Outpost Mission 0 is less than 6 months. Outpost Mission 0 is anticipated to spend approximately 3.592 years total in LEO.

Identified interactions with operational spacecraft: none

2 Spacecraft Description

a. Physical description: The Outpost Mission 0 satellite is a 3U cubesat with a deployable antenna on one end face and fixed solar panels. Basic physical dimensions are approximately 10 x 10 x 34 cm without the antenna deployed. The smallest dimension measures at least 10 cm by 10 cm without the antennas deployed. This dimension is greater than 10 cm and, therefore, the satellite is trackable.

b. Detailed illustration



c. Total mass at launch: approximately 4.045 kg

Dry mass at launch: the dry mass at launch is effectively the same as the total mass; the spacecraft contains no propellants.

d. Fluids on board: none

e. Propulsion systems: none

f. Attitude control systems: none

g. Range safety and pyrotechnic devices: none

h. Electrical generation and storage:

The spacecraft uses two battery packs, each of which consists of four Molicel INR-18650-P28A cells in series. Each cell has 2800 mAh capacity at 3.6 V nominal.

The spacecraft has four fixed solar panels.

The panels are connected to the battery packs through a charge controller and battery management system that monitors the battery health, managing charge and discharge behavior.

The system detects off-nominal conditions and shuts down battery packs to prevent unsafe conditions.

The EPS includes heaters to maintain the batteries at 10º C or higher. These heaters are powered directly by the batteries under control of the battery management system.

The batteries can be isolated from the rest of the electrical system under command from the flight computer. Once in shut down mode, the batteries require command from software to charge the batteries again.

i. Other stored energy sources: none

j. Radioactive materials: none

k. Proximity operations: none

3 Spacecraft Debris Released During Normal Operations

Assessment of Spacecraft Compliance with Requirements 4.3-1 and 4.3-2

Requirement 4.3-1 Mission Related Debris Passing Through LEO: Compliant: no debris is expected to be released during normal operations; expected on-orbit lifetime is 3.592 years as calculated by the NASA Debris Assessment Software.

Requirement 4.3-2: Not applicable. The mission will only operate in low-Earth orbit.

4 Spacecraft intentional breakups and potential for explosions

Requirement 4.4-1: Compliant. Analysis presented below.
Requirement 4.4-2: Compliant. Passivation approach presented below.
Requirement 4.4-3: not applicable (no planned breakups)
Requirement 4.4-4: not applicable (no planned breakups)

Details:

a. Potential causes for spacecraft breakup

One potential cause for breakup or explosion has been identified: the batteries in the EPS. This cause has been analyzed, showing no credible failure modes leading to accidental explosion.

b. Summary of failure modes and effects analysis of credible failure modes leading to explosion

Battery explosion: All failure modes below might result in battery explosion. However, in the unlikely event that a battery cell does explosively rupture, the small size, mass, and energy of these batteries coupled with the enclosures surrounding the batteries will ensure debris from the rupture should be contained within the spacecraft.

Battery failure mode: internal short circuit

- Mitigation: mount batteries where other structures are unlikely to impinge on the battery in way that would lead to mechanical deformation
- Mitigation: vibration and thermal testing
- Faults required: tests must be ineffective at detecting manufacturing defects; spacecraft structural failure

Battery failure mode: internal thermal rise due to high load discharge rate

- Mitigation: Molicel INR-18650-P28A cells used on this mission have flight heritage with NASA and have been manufacturer-tested with results in its test report documentation[1]
- Mitigation: battery management system monitors cell temperatures, discharges current, and shuts down a pack if monitored temperatures exceed a defined threshold
- Faults required: spacecraft thermal design must be incorrect and the battery management and disconnection functions must fail

Battery failure mode: excessive discharge rate or short circuit due to external device failure or terminal contact with conductors not at battery voltage

- Mitigation: all rails on EPS board have overcurrent protection and individual voltage/current sensing
- Mitigation: design of battery pack and insulators such that no contact with nearby board traces is possible without being caused by some other mechanical failure
- Mitigation: protoflight level environmental testing should reveal any mechanical battery failures
- Mitigation: current sense resistor actively monitors battery current at all phases of operation. Current thresholds are set in the battery monitoring circuit which only allow charge and discharge operation within the operating range
- Faults required: an external load must fail or short circuit and external over-current detection disconnection must all fail

Battery failure mode: inoperable vents

- Mitigation: battery venting is not inhibited by the battery holder design or the spacecraft design, so the battery can vent gasses to the external environment
- Combined faults required for realized failure: both the cell manufacturer and spacecraft assembler must fail to install proper venting to realize this failure mode

Battery failure mode: crushing

[1] *See generally Lithium Ion Battery Safety Testing Report*, Molicel, https://bit.ly/3I6RfAD (last visited Feb. 7, 2023).

- Mitigation: prevented by design. No moving parts are near the battery assembly
- Faults required: a catastrophic failure must occur in a system external to the batteries and the failure must cause collision sufficient to crush the batteries leading to an internal short circuit

Battery failure mode: excess battery cell temperature due to orbital environment and high discharge combined

- Mitigation: temperature sensors actively monitor all battery cell temperatures at all phases of operation. Temperature thresholds are set in the battery management monitoring circuit which only allows charge and discharge operation within the operating range
- Mitigation: active temperature monitoring by the battery management system will shut down a battery pack before it exceeds allowable operating temperatures, removing discharge-related causes
- Faults required: incorrect thermal analysis and thermal design, ineffective qualification testing in thermal-vacuum chamber, and over-current and temperature monitoring and control must all fail

c. Designed spacecraft breakup: there are no components designed for breakup

Components passivated at EOM: only applies to the batteries in the EPS. The two stages of battery passivation are controlled from the flight computer at the end of the mission. Once the mission ends, the flight computer disables battery charging in the solar panel front-end management chip through an EEPROM memory register. The result is the batteries are disconnected from the solar panels but they can still discharge into the system and heater. The heaters will then dissipate remaining energy in the batteries down to < 100 mAh remaining stored energy.

d. Components that cannot be passivated: none

5 Spacecraft potential for on-orbit collisions

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

- Requirement Text: *For each spacecraft and launch vehicle orbital stage in or passing through LEO, the program or project shall demonstrate that, during the orbital lifetime of each spacecraft and orbital stage, the probability of accidental collision with space objects larger than 10 cm in diameter is less than 0.001 (Requirement 56506).*
- Compliance statement: Large object impact and debris generation probability = 1.2023×10^{-7}, much less than 0.001
- This value was calculated at the highest possible 550 km altitude to show compliance at the worst case (log file below)
- Description and efficacy of debris avoidance capability: the spacecraft has no propulsion or attitude control systems for performing debris avoidance. Outpost will register its Mission 0

satellite with the US Space Force's 18th Space Control Squadron. Outpost will also contact and work with any entity who owns a spacecraft that has the potential to collide with Outpost's satellite to avoid collision

Requirement 4.5-2: Limiting the probability of damage from small objects when operating in Earth or lunar orbit

- Requirement Text: *For each spacecraft, the program or project shall demonstrate that, during the mission of the spacecraft, the probability of accidental collision with orbital debris and meteoroids sufficient to prevent compliance with the applicable post-mission disposal requirements is less than 0.01 (Requirement 56507).*
- Compliance Statement: the spacecraft relies on passive orbital decay for post mission disposal, so no parts exist that can be damaged that would impede disposal.

Output from DAS log:
02 06 2023; 17:50:15PM Processing Requirement 4.5-1: Return Status : Passed

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

INPUT

Space Structure Name = Spacecraft
Space Structure Type = Payload
Perigee Altitude = 550.000 (km)
Apogee Altitude = 550.000 (km)
Inclination = 97.500 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0097 (m^2/kg)
Start Year = 2023.600 (yr)
Initial Mass = 4.045 (kg)
Final Mass = 4.045 (kg)
Duration = 0.500 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = True

OUTPUT

Collision Probability = 1.2023E-07
Returned Message: Normal Processing
Date Range Message: Normal Date Range

Status = Pass

==========

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

02 06 2023; 17:50:20PM Project Data Saved To File
02 06 2023; 17:50:33PM Requirement 4.5-2: Compliant

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

6 Spacecraft post-mission disposal plans and procedures

Requirement 4.6-1 (Disposal for space structures in or passing through LEO): met

(a) Natural reentry: projected orbital lifetime as calculated by the NASA DAS tool: 3.592 years
(b) Direct reentry: not used
(c) Direct retrieval: not used

Requirement 4.6-2 (Disposal for space structure near GEO): not applicable

(a) Storage between LEO and GEO: not applicable
(b) Storage above GEO: not applicable
(c) Earth escape: not applicable

Requirement 4.6-3 (Disposal for space structures between LEO and GEO): not applicable

Requirement 4.6-4 (Reliability of post-mission disposal operations): met

Details:

a. **Disposal option selected:** natural reentry. The orbit of Outpost Mission 0 will decay because of atmospheric drag, and the satellite will eventually deorbit by atmospheric re-entry.

b. **Systems or components required to accomplish post-mission disposal:** none; spacecraft is to be passivated, and an End-of-Mission (EOM) maneuver is not required to ensure deorbit within 25 years.

c. **Area-to-mass ratio after post mission disposal:** Assuming random tumbling, the smallest calculated cross-sectional area (no deployments, off-nominal scenario) is 0.03912 m^2, resulting in an area-to-mass ratio of 0.0097 m^2/kg, used for worst case orbital lifetime calculations. The nominal/maximum drag area with nominal deployments is 0.0126 m^2/kg, resulting in an area-to-mass ratio of 0.01185 m^2/kg, which is shown for nominal orbital lifetime calculations below.

d. **Plan for controlled reentry:** not applicable

At EOM, Outpost Mission 0 will passivate and decay via natural re-entry. From the nominal 525 km altitude, the orbital lifetime is 3.592 years. In the worst-case scenario where Outpost Mission 0 is delivered to the highest 550 km orbit and remains in a stowed configuration due to a hardware failure or DOA, it will naturally deorbit in approximately 10.686 years.

Output from DAS log for nominal scenario:
02 08 2023; 01:03:19AM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2023.600000 (yr)
Perigee Altitude = 525.000000 (km)
Apogee Altitude = 525.000000 (km)
Inclination = 97.500000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.012600 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 3.592060 (yr)
Time Spent in LEO during Lifetime = 3.592060 (yr)
Last year of Propagation = 2027 (yr)
Returned Error Message: Object reentered

Output from DAS log for worst case altitude (550 km), DOA scenario (smallest area-to-mass ratio with no deployments):
02 08 2023; 00:45:48AM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2023.600000 (yr)
Perigee Altitude = 550.000000 (km)
Apogee Altitude = 550.000000 (km)
Inclination = 97.500000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.009700 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 10.685832 (yr)
Time Spent in LEO during Lifetime = 10.685832 (yr)
Last year of Propagation = 2034 (yr)

Returned Error Message: Object reentered

7 Spacecraft reentry hazards

Requirement 4.7-1: (Limit number and size of debris fragments that survive atmospheric reentry)

a. Uncontrolled reentry: compliant
b. Controlled reentry: does not apply
c. Controlled reentry: does not apply
d. Reentry in higher orbits: does not apply

Details:

a. Detailed description of spacecraft component by size, mass, material, shape, and location: see report output below
b. Summary of objects expected to survive an uncontrolled reentry: no components are expected to survive; lowest demise altitude is predicted at approximately 75 km (75.760865 km)
c. Calculation of risk of human casualty: no components are expected to reach the Earth's surface

Output from DAS log:

01 23 2023; 13:12:46PM **********Processing Requirement 4.7-1
Return Status : Passed

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

name = Spacecraft
quantity = 1
parent = 0
materialID = 23
type = Box
Aero Mass = 4.045
Thermal Mass = 4.045
Diameter/Width = 0.100000
Length = 0.340000
Height = 0.100000

name = Frame
quantity = 1
parent = 1
materialID = 23
type = Box
Aero Mass = 0.112000
Thermal Mass = 0.112000
Diameter/Width = 0.100000

Length = 0.340000
Height = 0.100000

name = Enclosures
quantity = 6
parent = 1
materialID = 8
type = Box
Aero Mass = 0.110000
Thermal Mass = 0.110000
Diameter/Width = 0.090000
Length = 0.090000
Height = 0.012000

name = End caps
quantity = 2
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.185000
Thermal Mass = 0.185000
Diameter/Width = 0.090000
Length = 0.090000

name = -z Standoffs
quantity = 2
parent = 1
materialID = 8
type = Box
Aero Mass = 0.101000
Thermal Mass = 0.101000
Diameter/Width = 0.080000
Length = 0.080000
Height = 0.030000

name = +z Standoff
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.020000
Thermal Mass = 0.020000
Diameter/Width = 0.060000
Length = 0.060000

Height = 0.017500

name = Stack bracket
quantity = 2
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.044000
Thermal Mass = 0.044000
Diameter/Width = 0.090000
Length = 0.090000

name = Stack rods
quantity = 8
parent = 1
materialID = 54
type = Cylinder
Aero Mass = 0.007720
Thermal Mass = 0.007720
Diameter/Width = 0.003000
Length = 0.140000

name = PCBs
quantity = 17
parent = 1
materialID = 23
type = Flat Plate
Aero Mass = 0.035000
Thermal Mass = 0.035000
Diameter/Width = 0.090000
Length = 0.090000

name = Solar panels
quantity = 4
parent = 1
materialID = 23
type = Flat Plate
Aero Mass = 0.110000
Thermal Mass = 0.110000
Diameter/Width = 0.085000
Length = 0.325000

name = Endcap brackets
quantity = 8

parent = 1
materialID = 8
type = Box
Aero Mass = 0.008000
Thermal Mass = 0.008000
Diameter/Width = 0.013500
Length = 0.030000
Height = 0.010000

name = Solar panel brackets
quantity = 8
parent = 1
materialID = 8
type = Box
Aero Mass = 0.016000
Thermal Mass = 0.016000
Diameter/Width = 0.030000
Length = 0.085000
Height = 0.007500

name = Interstack brackets
quantity = 2
parent = 1
materialID = 8
type = Box
Aero Mass = 0.028000
Thermal Mass = 0.028000
Diameter/Width = 0.090000
Length = 0.090000
Height = 0.010000

name = Face plates
quantity = 4
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.081000
Thermal Mass = 0.081000
Diameter/Width = 0.090000
Length = 0.300000

name = Fasteners
quantity = 156
parent = 1

materialID = 54
type = Cylinder
Aero Mass = 0.000550
Thermal Mass = 0.000550
Diameter/Width = 0.003000
Length = 0.010000

name = Torque rods
quantity = 2
parent = 1
materialID = 54
type = Cylinder
Aero Mass = 0.009050
Thermal Mass = 0.009050
Diameter/Width = 0.005000
Length = 0.063500

name = Battery casing piece 1
quantity = 6
parent = 1
materialID = 8
type = Box
Aero Mass = 0.028000
Thermal Mass = 0.028000
Diameter/Width = 0.092500
Length = 0.092500
Height = 0.007800

name = Battery casing piece 2
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.017500
Thermal Mass = 0.017500
Diameter/Width = 0.092500
Length = 0.092500
Height = 0.001500

name = Battery casing piece 3
quantity = 2
parent = 1
materialID = 8
type = Box

Aero Mass = 0.033500
Thermal Mass = 0.033500
Diameter/Width = 0.092500
Length = 0.092500
Height = 0.010000

name = Battery frame pieces
quantity = 6
parent = 1
materialID = 8
type = Box
Aero Mass = 0.022000
Thermal Mass = 0.022000
Diameter/Width = 0.010000
Length = 0.080000
Height = 0.010000

name = Batteries
quantity = 8
parent = 1
materialID = 57
type = Cylinder
Aero Mass = 0.042000
Thermal Mass = 0.042000
Diameter/Width = 0.026000
Length = 0.065000

name = Antenna
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.078300
Thermal Mass = 0.078300
Diameter/Width = 0.100000
Length = 0.100000
Height = 0.006000

name = Wires/harnessing
quantity = 30
parent = 1
materialID = 19
type = Cylinder
Aero Mass = 0.000702

Thermal Mass = 0.000702
Diameter/Width = 0.001000
Length = 0.100000

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

name = Spacecraft
Demise Altitude = 77.994682
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Frame
Demise Altitude = 77.747801
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Enclosures
Demise Altitude = 77.397320
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = End caps
Demise Altitude = 76.825959
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = -z Standoffs
Demise Altitude = 77.477160
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = +z Standoff
Demise Altitude = 77.816563
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Stack bracket

Demise Altitude = 77.716510
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Stack rods
Demise Altitude = 77.002643
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PCBs
Demise Altitude = 77.421944
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Solar panels
Demise Altitude = 77.360586
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Endcap brackets
Demise Altitude = 77.671920
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Solar panel brackets
Demise Altitude = 77.809205
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Interstack brackets
Demise Altitude = 77.838262
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Face plates
Demise Altitude = 77.817197
Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

****
name = Fasteners
Demise Altitude = 77.128085
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Torque rods
Demise Altitude = 76.256913
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Battery casing piece 1
Demise Altitude = 77.845367
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Battery casing piece 2
Demise Altitude = 77.895275
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Battery casing piece 3
Demise Altitude = 77.816821
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Battery frame pieces
Demise Altitude = 77.569911
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Batteries
Demise Altitude = 75.760865
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Antenna
Demise Altitude = 77.601263
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Wires/harnessing
Demise Altitude = 77.809625
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

========== End of Requirement 4.7-1 ==========

8 Special classes of space missions

Requirement 4.8-1(a) (tether systems): does not apply
Requirement 4.8-1(b) (satellites smaller than 10 cm x 10 cm x 10 cm): does not apply