EXHIBIT C

YAM-3 Orbital Debris Assessment Report (ODAR)

YAM-3-ODAR-1.0

This report is presented as compliance with NASA-STD-8719.14B (4/25/2019), APPENDIX A.

Loft Orbital Solutions Inc. (Loft Orbital)

715 Bryant Street, Suite 202
San Francisco, CA 94107

Document data is not restricted. This document contains no proprietary, International Traffic in Arms Regulations, or export-controlled information.

Debris Assessment Software (DAS) version used in analysis: v3.1.0

Revision Record				
Revision:	Date:	Affected Pages:	Changes:	Author(s):
1.0	9/1/2020	All – Initial	DAS Software Results Orbit Lifetime Analysis	D. Morse

Table of Contents

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

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

Section	Status	Comments
4.3-1, Mission-Related Debris Passing Through LEO	COMPLIANT	
4.3-2, Mission-Related Debris Passing Near GEO	COMPLIANT	
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	COMPLIANT	
4.4-2, Design for passivation after completion of mission operations while in orbit about Earth or the Moon	COMPLIANT	
4.4-3, Limiting the long-term risk to other space systems from planned breakups	COMPLIANT	
4.4-4, Limiting the short-term risk to other space systems from planned breakups	COMPLIANT	
4.5-1, Probability of Collision with Large Objects	COMPLIANT	
4.5-2, Probability of Damage from Small Objects	COMPLIANT	System will passively deorbit; therefore, no components are critical to deorbit.
4.6-1, Disposal for space structures passing through LEO	COMPLIANT	
4.6-2, Disposal for space structures passing through GEO	N/A	
4.6-3, Disposal for space structures between LEO and GEO	N/A	

4.6-4, Reliability of post-mission disposal operations	COMPLIANT	
4.8-1, Collision Hazards of Space Tethers	N/A	

Assessment Report Format:

ODAR Technical Sections Format Requirements:

Loft Orbital is a U.S. company. This ODAR follows the format in NASA-STD-8719.14B, Appendix A.1 and includes the content indicated as a minimum in each of sections 2 through 8 below for the YAM-3 satellite. Sections 9 through 14 apply to the launch vehicle ODAR and are not covered here.

ODAR Section 1: Program Management and Mission Overview

Program/project manager: Pieter van Duijn

Senior Management: Alexander B. Greenberg (Co-founder & Chief Operating Officer)

Launch and deployment profile, including all parking, transfer, and operational orbits with apogee, perigee, and inclination: The YAM-3 satellite will launch into a sun-synchronous circular orbit at a targeted orbital altitude of approximately 525 km. Loft Orbital, however, has assumed a 535 km worst-case deployment orbital altitude for purposes of this orbital debris analysis. The orbital decay of the YAM-3 satellite is provided at both 525 km and 535 km for completeness.

Schedule of upcoming mission milestones: Loft Orbital will be launching the YAM-3 satellite aboard a Falcon-9 launch vehicle. The current launch window is June 2021.

Mission Overview: The YAM-3 satellite will be launched into a sun-synchronous, Low Earth Orbit (LEO). The satellite bus will use reaction wheels, magnetic torque coils, a star tracker, magnetometers, sun sensors, and an inertial measurement unit to enable precision 3-axis pointing without the use of propulsion.

Launch Vehicle and Launch Site: YAM-3 will be launched aboard a Falcon-9 launch vehicle. The launch site is Cape Canaveral, FL. The Falcon-9 launch vehicle will transport multiple mission payloads to orbit as part of the SpaceX Rideshare program.

YAM-3 will be deployed into an approximately sun synchronous circular orbit. YAM-3 will deploy one QHA antenna once deployed from the launch vehicle. The spacecraft is expected to be deployed with the following orbital parameters:[1]

[1] As a worst-case scenario, Loft Orbital has assumed a 535-km deployment orbital altitude for purposes of this orbital debris analysis.

- Minimum Circular Altitude: 500 km
- Maximum Circular Altitude: 535 km
- Target Deployment Circular Altitude: 525 km
- Orbit Type: sun-synchronous
- Inclination: 97.6 degrees

YAM-3 has no on-board propulsion and therefore does not actively change its orbit. There is no parking or transfer orbit.

Mission Duration: The anticipated operational lifetime of the spacecraft is 5 years in LEO.

ODAR Section 2: Spacecraft Description:

Physical description of the satellite: Basic physical dimensions are 678 mm x 665 mm x 875 mm with a mass of approximately 83.0 kg. The solar panels generate up to 130W of electric power which is stored in a 250Wh COTS Li-Ion unpressurized battery assembly. The bus is 3-axis stabilized, employing star trackers, magnetometers, IMU, GPS, sun sensors for attitude knowledge, and reaction wheels and torque rods for attitude control.

The YAM-3 satellite will be separated from the Falcon-9 launch vehicle using the ExoLaunch CarboNIX 15, which provides debris free actuation.

The YAM-3 spacecraft is depicted in Figure 1.

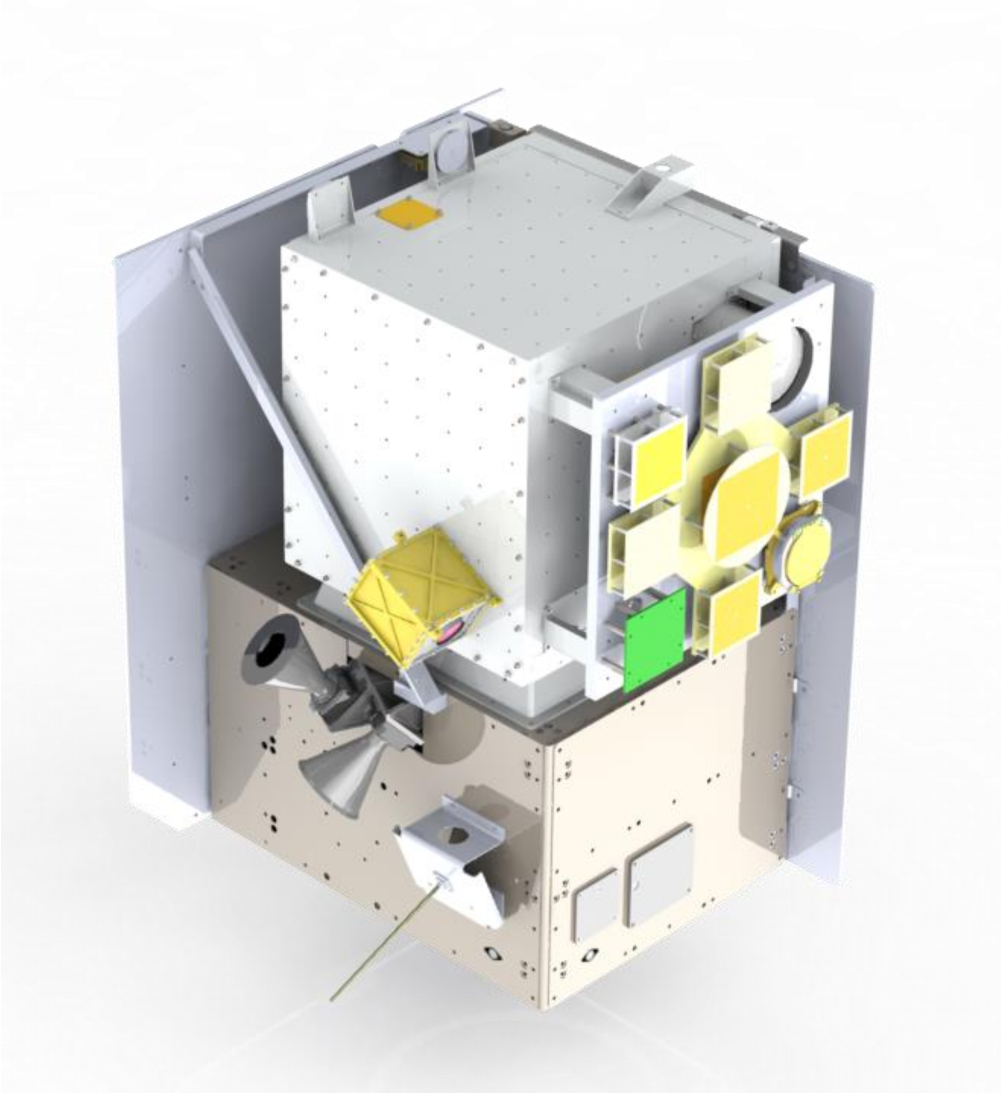

Figure 1 YAM-3 Spacecraft Configuration

Total satellite mass at launch, including all propellants and fluids: 83.0 kg.

Dry mass of satellite at launch: 83.0 kg (no propellants on board)

Description of all propulsion systems (cold gas, mono-propellant, bi-propellant, electric, nuclear): None

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: 440 mL of methanol in sealed heat pipes

Fluids in Pressurized Batteries: None

The YAM-3 satellite uses two unpressurized standard COTS Lithium-Ion batteries. Each battery has a height of 98 mm, a width of 96 mm, a length of 176 mm, and a mass of 1.6 kg.

Description of attitude control system and indication of the normal attitude of the spacecraft with respect to the velocity vector:

The long axis of the YAM-3 spacecraft can be oriented parallel to the nadir vector during imaging or other payload operations, but the satellite will typically be oriented in a sun-pointing attitude.

The YAM-3 spacecraft attitude will be controlled initially by torque rods, which will allow the satellite to be aligned relative to the Earth's magnetic field. These will allow the satellite to detumble and align with the magnetic field.

- A *safe mode* is optimized for solar power generation from the satellite. The spacecraft's deployable panel will be oriented towards the sun. This mode will make use of magnetometers, sun sensors, reaction wheels, and magnetic torquers to orient the spacecraft correctly.
- A *targeted tracking mode* will allow the satellite Nadir panel to be directed at any location on the Earth's surface. This mode will make use of reaction wheels and a star tracker to orient the spacecraft.
- An *LVLH mode* keeps the Nadir panel pointed towards the Earth's surface. This mode will make use of 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: Standard COTS Lithium-Ion battery cells are charged before payload integration and provide electrical energy during the mission. The cells are recharged by solar cells mounted on the solar arrays. The battery cell protection circuit manages the charging cycle.

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: None.

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:
In-mission failure of a battery cell 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 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. In addition to the battery protection mentioned above, the YAM-3 battery unit features two temperature sensors which monitor battery cells for high temperatures.

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:

- Reaction wheels – remove power and configure spacecraft to keep solar array pointed away from sun
- Sealed heat pipe – no passivation is planned or required

Rationale for all items which are required to be passivated, but cannot be due to their design:
YAM-3's satellite battery charge circuits include overcharge protection and a parallel design 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.

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; COMPLIANT.

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 COTS 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.

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.

Combined faults required for realized failure: Spacecraft 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, and 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 spacecraft 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 overcurrent 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: The reaction wheels will be spun down to passivate the YAM-3 satellite. YAM-3's battery charge circuits include overcharge protection and a parallel design to limit the risk of battery failure. However, in the unlikely event that 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.

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-8719.14B, section 4.5.4):

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

"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)."

Large Object Impact and Debris Generation Probability: 0.0000038478; COMPLIANT.

Requirement 4.5-2. Limiting debris generated by collisions with small objects when operating in Earth or lunar orbit:

"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 postmission disposal requirements is less than 0.01 (Requirement 56507)."

Small Object Impact and Debris Generation Probability: Not applicable; the spacecraft will be disposed of by atmospheric entry and does not require a specific spacecraft orientation and drag state to meet the disposal requirements. Therefore, no element or component of the spacecraft system is required to complete post-mission operations.

Identification of all systems or components required to accomplish any post-mission disposal operation, including passivation and maneuvering: None

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

6.1 Description of spacecraft disposal option selected: The satellite will de-orbit naturally by atmospheric re-entry. There is no propulsion system.

6.2 Plan for any spacecraft maneuvers required to accomplish post-mission disposal: None

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

Spacecraft Mass: 83.0 kg

Cross-sectional Area: 0.5419 m^2

(Calculated by DAS 3.1.0). Area to mass ratio: 0.5419/83.0 = 0.0065292 m^2/kg

6.4 Assessment of spacecraft compliance with Requirements 4.6-1 through 4.6-5 (per DAS v3.1.0and NASA-STD-8719.14B section 4.6): 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."

Analysis: The YAM-3 satellite's method of disposal is COMPLIANT using method "a." In the worst-case orbit altitude of 535 x 535 km near-circular orbit, the passive deorbit time is 5.388 years after launch with orbit history as shown in Figure 2. This orbital decay period meets the FCC's 6-year de-orbit requirement for satellites authorized under the FCC's new small satellite streamlined licensing rules.[2] It should be noted that this is assuming a launch date of June 2021. Because de-orbit lifetime will vary depending on the launch date, Loft Orbital will ensure that any changes in launch schedule do not affect compliance with the FCC's 6-year de-orbit requirement.

YAM-3 will nominally be deployed in a 525 x 525 km near-circular orbit, reentering in approximately 4.057 years after launch with orbit history as shown in Figure 3 (analysis assumes a noon-midnight Sun synchronous orbit with solar array tracking).

---

[2] *See Streamlining Licensing Procedures for Small Satellites*, Report and Order, 34 FCC Rcd 13077 (2019) (new 47 C.F.R. § 25.122); *see also* Exhibit A, Narrative.

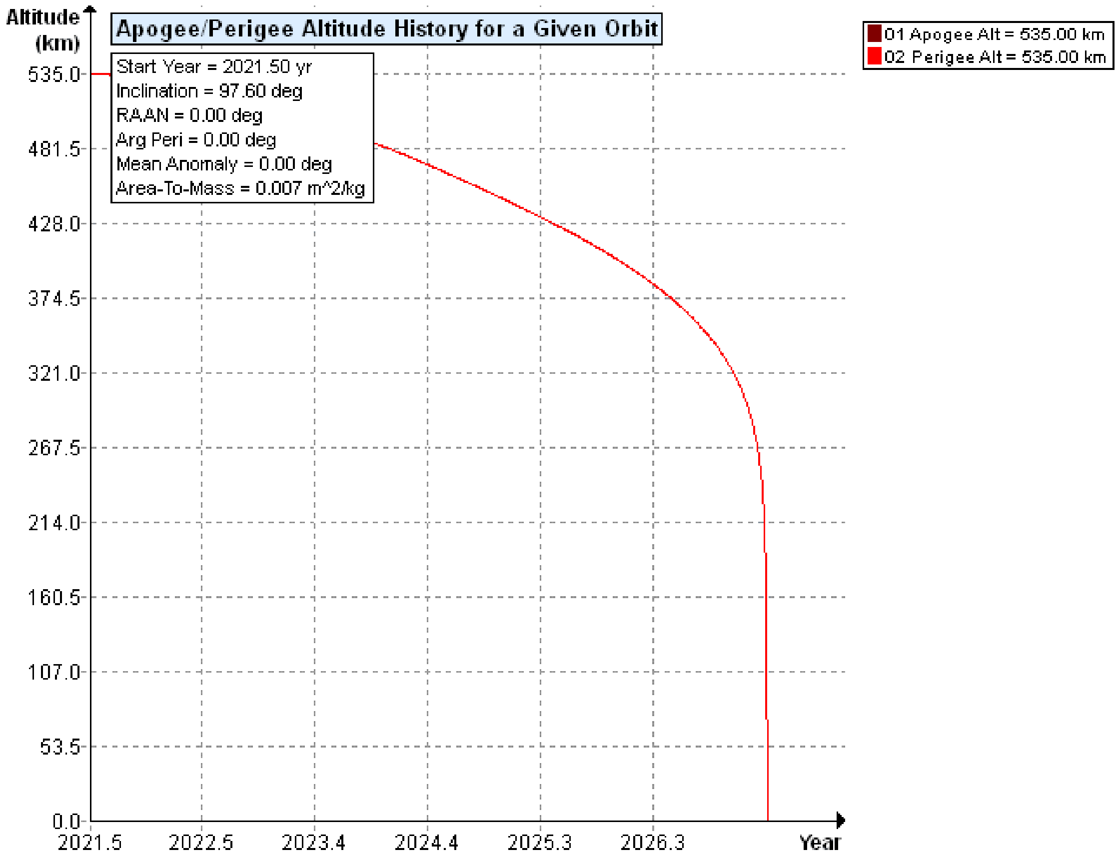

Figure 2 YAM-3 Orbit History – at Maximum Orbit Altitude of 535 km x 535 km SSO

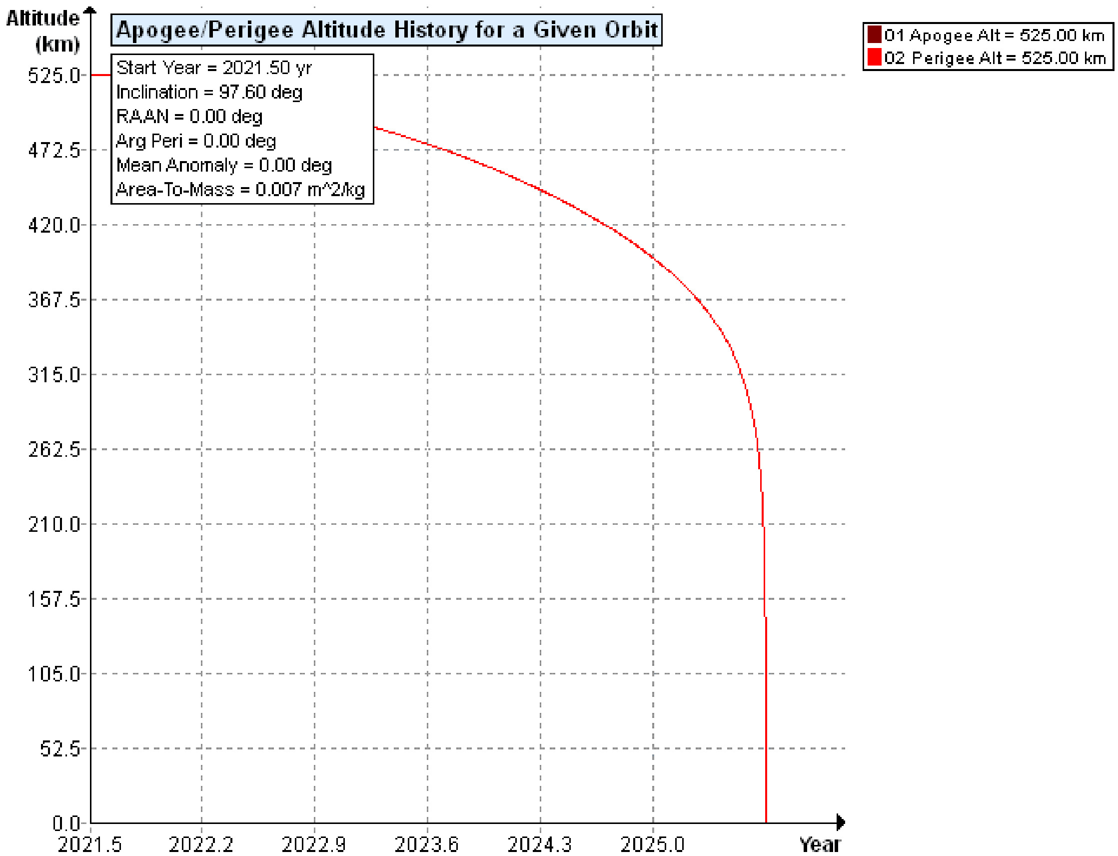

Figure 3 YAM-3 Orbit History – at Nominal Orbit Altitude of 525 km x 525 km SSO

Requirement 4.6-2. Disposal for space structures near GEO:
Analysis is not applicable.

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

Requirement 4.6-4. Reliability of Post-mission Disposal Operations:
Analysis is not applicable. The satellite will reenter passively without post-mission disposal operations within the allowable timeframe.

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 reports that the YAM-3 satellite is COMPLIANT with the requirement with a casualty risk of 1:100000000. Experimentation has demonstrated that 1:100000000 is the smallest human casualty risk that the DAS software will report. Since the analysis shows all but one of the components of the YAM-3 satellite demising above an altitude of 60 km[3] and both the Debris Casualty Area and the Impact Kinetic Energy are reported as 0.0 in all cases, this reflects no chance of human casualty.

The DAS Output Summary Follows:

08 31 2020; 18:27:47PM Processing Requirement 4.3-2: Return Status : Passed

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

============== End of Requirement 4.3-2 ===============
08 31 2020; 18:31:48PM Processing Requirement 4.5-1: Return Status : Passed

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

INPUT

Space Structure Name = YAM-3
Space Structure Type = Payload
Perigee Altitude = 525.000 (km)
Apogee Altitude = 525.000 (km)
Inclination = 97.600 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.006529 (m^2/kg)
Start Year = 2021.500 (yr)
Initial Mass = 83.000 (kg)
Final Mass = 83.000 (kg)
Duration = 5.000 (yr)
Station-Kept = False
Abandoned = True

OUTPUT

[3] Solar cells that reach the Earth's surface will possess less than 15 joules of energy.

Collision Probability = 3.84781E-06
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

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

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

08 31 2020; 18:32:35PM Processing Requirement 4.6 Return Status : Passed

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

INPUT

Space Structure Name = YAM-3
Space Structure Type = Payload

Perigee Altitude = 525.000000 (km)
Apogee Altitude = 525.000000 (km)
Inclination = 97.600000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Area-To-Mass Ratio = 0.006529 (m^2/kg)
Start Year = 2021.500000 (yr)
Initial Mass = 83.000000 (kg)
Final Mass = 83.000000 (kg)
Duration = 5.000000 (yr)
Station Kept = False
Abandoned = True
PMD Perigee Altitude = -1.000000 (km)
PMD Apogee Altitude = -1.000000 (km)
PMD Inclination = 0.000000 (deg)
PMD RAAN = 0.000000 (deg)
PMD Argument of Perigee = 0.000000 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Suggested Perigee Altitude = 525.000000 (km)
Suggested Apogee Altitude = 525.000000 (km)
Returned Error Message = Reentry during mission (no PMD req.).

Released Year = 2024 (yr)
Requirement = 61
Compliance Status = Pass

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

=============== End of Requirement 4.6 ===============
08 31 2020; 18:32:43PM *********Processing Requirement 4.7-1
Return Status : Passed

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

name = YAM-3
quantity = 1
parent = 0
materialID = 8
type = Box
Aero Mass = 83.000000
Thermal Mass = 83.000000
Diameter/Width = 1.000000
Length = 1.000000
Height = 1.000000

name = Y-Panels
quantity = 2
parent = 1
materialID = 5
type = Flat Plate
Aero Mass = 2.030000
Thermal Mass = 2.030000
Diameter/Width = 0.390000
Length = 0.422000

name = X-Panels
quantity = 2
parent = 1
materialID = 5
type = Flat Plate
Aero Mass = 1.840000
Thermal Mass = 1.840000
Diameter/Width = 0.394000
Length = 0.394000

name = Z-Panels
quantity = 2

parent = 1
materialID = 5
type = Flat Plate
Aero Mass = 1.840000
Thermal Mass = 1.840000
Diameter/Width = 0.394000
Length = 0.394000

name = Shelf-Panel
quantity = 1
parent = 1
materialID = 5
type = Flat Plate
Aero Mass = 0.135000
Thermal Mass = 0.135000
Diameter/Width = 0.361000
Length = 0.394000

name = Shelf-Brackets
quantity = 2
parent = 1
materialID = 9
type = Flat Plate
Aero Mass = 0.170000
Thermal Mass = 0.170000
Diameter/Width = 0.059000
Length = 0.394000

name = Mezzanine-Panel
quantity = 1
parent = 1
materialID = 5
type = Flat Plate
Aero Mass = 1.250000
Thermal Mass = 1.250000
Diameter/Width = 0.394000
Length = 0.394000

name = Mezzanine-Brackets
quantity = 4
parent = 1
materialID = 8
type = Box
Aero Mass = 0.080000
Thermal Mass = 0.080000
Diameter/Width = 0.045000

Length = 0.081000
Height = 0.045000

name = Interface Ring
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.860000
Thermal Mass = 0.860000
Diameter/Width = 0.457000
Length = 0.457000
Height = 0.025400

name = Spacer
quantity = 1
parent = 1
materialID = 23
type = Flat Plate
Aero Mass = 0.140000
Thermal Mass = 0.140000
Diameter/Width = 0.360000
Length = 0.360000

name = PAM-Fasteners
quantity = 100
parent = 1
materialID = 57
type = Cylinder
Aero Mass = 0.001000
Thermal Mass = 0.001000
Diameter/Width = 0.007000
Length = 0.020000

name = PICU
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.840000
Thermal Mass = 0.840000
Diameter/Width = 0.096000
Length = 0.132000
Height = 0.092000

name = PICU Adapter Plate

quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.240000
Thermal Mass = 0.240000
Diameter/Width = 0.096000
Length = 0.132000

name = PCDU
quantity = 1
parent = 1
materialID = 9
type = Box
Aero Mass = 2.500000
Thermal Mass = 2.500000
Diameter/Width = 0.150000
Length = 0.160000
Height = 0.076000

name = Harness
quantity = 1
parent = 1
materialID = 19
type = Box
Aero Mass = 1.070000
Thermal Mass = 1.070000
Diameter/Width = 0.120000
Length = 0.120000
Height = 0.050000

name = MLI
quantity = 5
parent = 1
materialID = 44
type = Flat Plate
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.400000
Length = 0.400000

name = P1-Rx Antenna
quantity = 1
parent = 1
materialID = 23
type = Flat Plate

Aero Mass = 1.050000
Thermal Mass = 1.050000
Diameter/Width = 0.389000
Length = 0.389000

name = P1-TX Antenna
quantity = 1
parent = 1
materialID = 8
type = Cylinder
Aero Mass = 0.200000
Thermal Mass = 0.200000
Diameter/Width = 0.094000
Length = 0.029000

name = P1-RX Electronics
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 1.450000
Thermal Mass = 1.450000
Diameter/Width = 0.110000
Length = 0.210000
Height = 0.075000

name = P1-TX Electronics
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.880000
Thermal Mass = 0.880000
Diameter/Width = 0.131000
Length = 0.165000
Height = 0.027000

name = P2-Imager 1
quantity = 1
parent = 1
materialID = 8
type = Cylinder
Aero Mass = 1.850000
Thermal Mass = 1.850000
Diameter/Width = 0.100000
Length = 0.174000

name = P2-Imager 2
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.800000
Thermal Mass = 0.800000
Diameter/Width = 0.110000
Length = 0.110000
Height = 0.084000

name = P2-Electronics Box
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.430000
Thermal Mass = 0.430000
Diameter/Width = 0.082000
Length = 0.082000
Height = 0.036000

name = P3-Electronics Box
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.750000
Thermal Mass = 0.750000
Diameter/Width = 0.100000
Length = 0.100000
Height = 0.085000

name = P4-Electronics Box
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.850000
Thermal Mass = 0.850000
Diameter/Width = 0.100000
Length = 0.100000
Height = 0.100000

name = P5-Electronics Box

quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.490000
Thermal Mass = 0.490000
Diameter/Width = 0.090000
Length = 0.129000
Height = 0.041000

name = P5-Antenna
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.120000
Thermal Mass = 0.120000
Diameter/Width = 0.100000
Length = 0.100000

name = P6-Electronics Box
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 1.450000
Thermal Mass = 1.450000
Diameter/Width = 0.110000
Length = 0.210000
Height = 0.075000

name = P6-Antenna 1
quantity = 1
parent = 1
materialID = 8
type = Cylinder
Aero Mass = 0.170000
Thermal Mass = 0.170000
Diameter/Width = 0.100000
Length = 0.100000

name = P6-Splitter
quantity = 1
parent = 1
materialID = 8
type = Box

Aero Mass = 0.320000
Thermal Mass = 0.320000
Diameter/Width = 0.064000
Length = 0.064000
Height = 0.039000

name = P6-Antenna 2
quantity = 1
parent = 1
materialID = 19
type = Flat Plate
Aero Mass = 0.150000
Thermal Mass = 0.150000
Diameter/Width = 0.090000
Length = 0.090000

name = P4-Antenna
quantity = 1
parent = 1
materialID = 19
type = Flat Plate
Aero Mass = 0.150000
Thermal Mass = 0.150000
Diameter/Width = 0.098000
Length = 0.098000

name = Payload Deck
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 6.890000
Thermal Mass = 6.890000
Diameter/Width = 0.446000
Length = 0.586000

name = Star Tracker
quantity = 2
parent = 1
materialID = 5
type = Cylinder
Aero Mass = 0.158000
Thermal Mass = 0.158000
Diameter/Width = 0.100000
Length = 0.120000

name = IMU
quantity = 2
parent = 1
materialID = 8
type = Box
Aero Mass = 0.055000
Thermal Mass = 0.055000
Diameter/Width = 0.038600
Length = 0.044800
Height = 0.021500

name = Magnetometer
quantity = 2
parent = 1
materialID = 8
type = Box
Aero Mass = 0.080000
Thermal Mass = 0.080000
Diameter/Width = 0.043000
Length = 0.099170
Height = 0.017000

name = DC-DC Converter-1
quantity = 8
parent = 1
materialID = 8
type = Box
Aero Mass = 0.137000
Thermal Mass = 0.137000
Diameter/Width = 0.077500
Length = 0.083000
Height = 0.018230

name = Antenna Deck
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.648090
Thermal Mass = 0.648090
Diameter/Width = 0.450000
Length = 0.500000

name = X-Band Antenna
quantity = 1
parent = 1

materialID = 8
type = Flat Plate
Aero Mass = 0.300000
Thermal Mass = 0.300000
Diameter/Width = 0.103400
Length = 0.150000

name = S-Band Antenna
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.120000
Thermal Mass = 0.120000
Diameter/Width = 0.083800
Length = 0.083800

name = Coarse Sun Sensor
quantity = 6
parent = 1
materialID = 8
type = Cylinder
Aero Mass = 0.005000
Thermal Mass = 0.005000
Diameter/Width = 0.015300
Length = 0.064000

name = Fine Sun Sensor
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 0.035000
Thermal Mass = 0.035000
Diameter/Width = 0.032000
Length = 0.034000
Height = 0.021000

name = UHF Whip Antenna
quantity = 1
parent = 1
materialID = 14
type = Cylinder
Aero Mass = 0.000460
Thermal Mass = 0.000460
Diameter/Width = 0.006450

Length = 0.158750

name = UHF Whip Antenna Cover
quantity = 1
parent = 1
materialID = 23
type = Cylinder
Aero Mass = 0.006477
Thermal Mass = 0.006477
Diameter/Width = 0.004750
Length = 0.203200

name = MLB Upper Half
quantity = 1
parent = 1
materialID = 9
type = Box
Aero Mass = 0.521600
Thermal Mass = 0.521600
Diameter/Width = 0.344340
Length = 0.344340
Height = 0.026100

name = Avionics Deck
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 5.400000
Thermal Mass = 5.400000
Diameter/Width = 0.450000
Length = 0.500000

name = PCU
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 0.990000
Thermal Mass = 0.990000
Diameter/Width = 0.147000
Length = 0.202000
Height = 0.050000

name = Battery
quantity = 2

parent = 1
materialID = 8
type = Box
Aero Mass = 1.600000
Thermal Mass = 1.600000
Diameter/Width = 0.098000
Length = 0.176000
Height = 0.096000

name = X-band radio
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 1.000000
Thermal Mass = 1.000000
Diameter/Width = 0.115000
Length = 0.160000
Height = 0.046000

name = S-band Radio
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.200000
Thermal Mass = 0.200000
Diameter/Width = 0.050000
Length = 0.135000
Height = 0.025000

name = UHF Radio
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.141700
Thermal Mass = 0.141700
Diameter/Width = 0.057150
Length = 0.082550
Height = 0.015748

name = FC
quantity = 1
parent = 1
materialID = 8

type = Box
Aero Mass = 3.980000
Thermal Mass = 3.980000
Diameter/Width = 0.121920
Length = 0.219600
Height = 0.116000

name = Reaction wheels
quantity = 4
parent = 1
materialID = 8
type = Box
Aero Mass = 0.226000
Thermal Mass = 0.226000
Diameter/Width = 0.140000
Length = 0.140000
Height = 0.041900

name = Torque Rods
quantity = 3
parent = 1
materialID = 54
type = Cylinder
Aero Mass = 0.420000
Thermal Mass = 0.420000
Diameter/Width = 0.022220
Length = 0.227000

name = GPS Receiver
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.240700
Thermal Mass = 0.240700
Diameter/Width = 0.079400
Length = 0.092100
Height = 0.025100

name = Solar Array
quantity = 2
parent = 1
materialID = 8
type = Box
Aero Mass = 2.355000
Thermal Mass = 1.855000

Diameter/Width = 0.665000
Length = 0.845000
Height = 0.020000

name = Solar cells
quantity = 100
parent = 56
materialID = 24
type = Box
Aero Mass = 0.010000
Thermal Mass = 0.010000
Diameter/Width = 0.067000
Length = 0.085000
Height = 0.005000

name = Radiating Side Panel
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 1.170000
Thermal Mass = 1.170000
Diameter/Width = 0.400000
Length = 0.431000

name = Support Strut
quantity = 2
parent = 1
materialID = 8
type = Box
Aero Mass = 0.144000
Thermal Mass = 0.144000
Diameter/Width = 0.150000
Length = 0.582000
Height = 0.020000

name = Front Side Panel
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 1.440000
Thermal Mass = 1.440000
Diameter/Width = 0.380000
Length = 0.567000

name = Prop Deck
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 8.500000
Thermal Mass = 8.500000
Diameter/Width = 0.446000
Length = 0.586000
Height = 0.030000

name = Cabling
quantity = 100
parent = 1
materialID = 20
type = Cylinder
Aero Mass = 0.060000
Thermal Mass = 0.060000
Diameter/Width = 0.005000
Length = 0.500000

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

name = YAM-3
Demise Altitude = 77.995979
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Y-Panels
Demise Altitude = 68.856430
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = X-Panels
Demise Altitude = 69.140732
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Z-Panels
Demise Altitude = 69.140732
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Shelf-Panel
Demise Altitude = 77.385284
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Shelf-Brackets
Demise Altitude = 76.002693
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Mezzanine-Panel
Demise Altitude = 72.037529
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Mezzanine-Brackets
Demise Altitude = 76.087799
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Interface Ring
Demise Altitude = 75.113060
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Spacer
Demise Altitude = 77.552505
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PAM-Fasteners
Demise Altitude = 77.338158
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PICU
Demise Altitude = 70.962479

Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PICU Adapter Plate
Demise Altitude = 73.205795
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PCDU
Demise Altitude = 62.606422
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Harness
Demise Altitude = 68.563751
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = MLI
Demise Altitude = 77.930519
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = P1-Rx Antenna
Demise Altitude = 74.949036
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = P1-TX Antenna
Demise Altitude = 72.793556
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = P1-RX Electronics
Demise Altitude = 69.252174
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = P1-TX Electronics
Demise Altitude = 68.957092
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = P2-Imager 1
Demise Altitude = 65.381599
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = P2-Imager 2
Demise Altitude = 69.820030
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = P2-Electronics Box
Demise Altitude = 69.338226
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = P3-Electronics Box
Demise Altitude = 69.693604
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = P4-Electronics Box
Demise Altitude = 69.462868
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = P5-Electronics Box
Demise Altitude = 71.703583
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = P5-Antenna
Demise Altitude = 74.828468
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = P6-Electronics Box
Demise Altitude = 69.252174
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = P6-Antenna 1
Demise Altitude = 75.677322
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = P6-Splitter
Demise Altitude = 69.783867
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = P6-Antenna 2
Demise Altitude = 74.414238
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = P4-Antenna
Demise Altitude = 74.750168
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Payload Deck
Demise Altitude = 54.241142
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Star Tracker
Demise Altitude = 75.896889
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = IMU
Demise Altitude = 74.742821

Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Magnetometer
Demise Altitude = 75.506836
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = DC-DC Converter-1
Demise Altitude = 74.231895
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Antenna Deck
Demise Altitude = 75.856026
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = X-Band Antenna
Demise Altitude = 72.936722
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = S-Band Antenna
Demise Altitude = 73.924469
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Coarse Sun Sensor
Demise Altitude = 77.563744
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Fine Sun Sensor
Demise Altitude = 74.872437
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = UHF Whip Antenna
Demise Altitude = 77.987701
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = UHF Whip Antenna Cover
Demise Altitude = 77.622711
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = MLB Upper Half
Demise Altitude = 75.965912
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Avionics Deck
Demise Altitude = 57.570904
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = PCU
Demise Altitude = 70.301888
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Battery
Demise Altitude = 68.327187
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = X-band radio
Demise Altitude = 68.807259
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = S-band Radio
Demise Altitude = 74.136719
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = UHF Radio
Demise Altitude = 73.562721
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = FC
Demise Altitude = 62.131184
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Reaction wheels
Demise Altitude = 75.377167
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Torque Rods
Demise Altitude = 65.757126
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = GPS Receiver
Demise Altitude = 72.707863
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Solar Array
Demise Altitude = 74.996788
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Solar cells
Demise Altitude = 0.000000
Debris Casualty Area = 42.944077
Impact Kinetic Energy = 0.353450

****
name = Radiating Side Panel
Demise Altitude = 73.412468

Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Support Strut
Demise Altitude = 77.374016
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Front Side Panel
Demise Altitude = 73.695435
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Prop Deck
Demise Altitude = 49.629250
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Cabling
Demise Altitude = 76.889511
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

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

Requirements 4.7-1b, and 4.7-1c:
These requirements are non-applicable requirements because the YAM-3 satellite does not use controlled reentry.

4.7-1, b): *"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)."*

Not applicable to YAM-3. The spacecraft does not use controlled reentry, and no debris is expected to survive.

4.7-1 c): *"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)."*

Not applicable to YAM-3. It does not use controlled reentry, and no debris is expected to survive.

ODAR Section 8: Assessment for Tether Missions

Not applicable. There are no tethers used in the YAM-3 mission.

END of ODAR for YAM-3

Appendix A: Acronyms

Arg peri	Argument of Perigee
CDR	Critical Design Review
cm	centimeter
COTS	Commercial Off-The-Shelf (items)
DAS	Debris Assessment Software
EOM	End Of Mission
FRR	Flight Readiness Review
GEO	Geosynchronous Earth Orbit
ITAR	International Traffic In Arms Regulations
kg	kilogram
km	kilometer
LEO	Low Earth Orbit
Li-Ion	Lithium Ion
m^2	Meters squared
ml	milliliter
mm	millimeter
N/A	Not Applicable.
NET	Not Earlier Than
ODAR	Orbital Debris Assessment Report
OSMA	Office of Safety and Mission Assurance
PDR	Preliminary Design Review
PL	Payload
ISIPOD	ISIS CubeSat Deployer
PSIa	Pounds Per Square Inch, absolute
RAAN	Right Ascension of the Ascending Node
SMA	Safety and Mission Assurance
Ti	Titanium
Yr	year