Audacy Corp.
340 S. Lemon Ave., Suite 8787
Walnut, CA 91789
http://audacy.space
info@audacy.space

AUDACY ZERO
ORBITAL DEBRIS ASSESSMENT REPORT (ODAR)

Rev. 02

7/21/17

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

DAS Software Version Used in Analysis: v2.1.1

Submitted By:

Sam Avery
Project Lead, Audacy Zero
Audacy

Record of Revisions				
Rev	**Date**	**Affected Pages**	**Description of Change**	**Author(s)**
1	05/30/17	All	Initial release	Sam Avery
2	07/21/17	6-10, 18	Updated pictures, drawings, and wording to include a second double-deployed solar array	Sam Avery

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Orbital Debris Assessment Evaluation: Audacy Zero Mission

Requirement #	Launch Vehicle				Spacecraft			Comments
	Compliant	Not Compliant	Incomplete	Standard Non Compliant	Compliant	Not Compliant	Incomplete	
4.3-1.a	☐	☐	☒	☐	☒	☐	☐	No Debris Released in LEO. See note 1.
4.3-1.b	☐	☐	☒	☐	☒	☐	☐	No Debris Released in LEO. See note 1.
4.3-2	☐	☐	☒	☐	☒	☐	☐	No Debris Released in GEO. See note 1.
4.4-1	☐	☐	☒	☐	☒	☐	☐	See note 1.
4.4-2	☐	☐	☒	☐	☒	☐	☐	See note 1.
4.4-3	☐	☐	☒	☐	☒	☐	☐	No planned breakups. See note 1.
4.4-4	☐	☐	☒	☐	☒	☐	☐	No planned breakups. See note 1.
4.5-1	☐	☐	☒	☐	☒	☐	☐	See note 1.
4.5-2					☒	☐	☐	No critical subsystems needed for EOM disposal
4.6-1(a)	☐	☐	☒	☐	☒	☐	☐	See note 1.
4.6-1(b)	☐	☐	☒	☐	☒	☐	☐	See note 1.
4.6-1(c)	☐	☐	☒	☐	☒	☐	☐	See note 1.
4.6-2	☐	☐	☒	☐	☒	☐	☐	See note 1.
4.6-3	☐	☐	☒	☐	☒	☐	☐	See note 1.
4.6-4	☐	☐	☒	☐	☒	☐	☐	See note 1.
4.6-5	☐	☐	☒	☐	☒	☐	☐	See note 1.
4.7-1	☐	☐	☒	☐	☒	☐	☐	See note 1.
4.8-1					☒	☐	☐	No tethers used.

<u>Notes:</u>

1. The primary payload belongs to Planet/Terra Bella and all other portions of the launch vehicle are not developed with Audacy.

Assessment Report Format

ODAR Technical Sections Format Requirements:
Audacy Corporation is a US company. Therefore, this ODAR follows the format recommended in NASA-STD-8719.14, Appendix A.1 and includes the content indicated at a minimum in each section 2 through 8 below for the Audacy Zero satellite. Sections 9 through 14 apply to the launch vehicle ODAR and are not covered here.

I. Program Management and Mission Overview

Project Manager: Sam Avery

Foreign Government or space agency participation: None.

Schedule of Upcoming Mission Milestones:

Milestone	Date
Spacecraft Readiness Review	11/17/17
Launch	2/1/18

Mission Overview:

Audacy Zero is a 3U CubeSat demonstration mission to test out Audacy's user communications terminal and first ground station in the San Francisco Bay Area. The spacecraft is consistent with the CubeSat standard with stowed dimensions of 11.12 cm x 11.12 cm x 34.05 cm (L x W x H). The total mass is estimated to be 4.7 kg. Audacy Zero is launching to a 575 km sun-synchronous orbit, which can lead to a total mission lifetime of 4.4 years.

Audacy Zero will utilize a prototype communications terminal operating in the K and K_a bands with a high gain and a low gain antenna. Primary data transmission will focus on telemetry, tracking, and command (TT&C) from the communications terminal and subsystems to maintain successful operations and analysis of the terminal hardware. Payload data includes pictures and videos taken from an on-board camera and occasional transmissions from a secondary optical communications payload.

Launch Vehicle: SpaceX Falcon 9

Launch Site: Vandenberg Air Force Base, California, USA

Mission Duration: Up to 4.4 years until Audacy Zero reenters via atmospheric orbital decay assuming the expected atmospheric drag profile.

Launch and Deployment Profile: The Falcon 9 launch vehicle will launch into roughly circular 575 km 97.9° sun-synchronous orbit. Upon confirmation of final stage burn-out, the primary and secondary payloads will be dispensed from the payload fairing. The primary payload is from Terra Bella/Planet. Audacy Zero will deploy to the following orbit:

Apogee: 575 km

Perigee: 575 km

Inclination: 97.9°

Audacy Zero has no propulsion and will not actively change orbits or engage in a parking or transfer orbit.

II. Spacecraft Description

Physical Description:

The Audacy Zero CubeSat structure, electrical power system (EPS), batteries, solar arrays, on-board computer (OBC), attitude determination and control system (ADCS), and GPS are all provided by the CubeSat supplier Clyde Space from Glasgow, Scotland. Power storage is handled by 40 Wh lithium-ion batteries which are recharged using two deployable solar arrays. Attitude determination is handled using coarse and fine sun sensors along with magnetometers through the Earth's magnetic field. A render of Audacy Zero is shown in Figure 1 including the two double deployed solar arrays. An approximation of the subsystem layout is shown in the exploded view in Figure 2 below and drawings are included in Figure 3.

Audacy's communications hardware operates in the K and K_a bands with patch antennas for receive and transmit of payload and telemetry and command data.

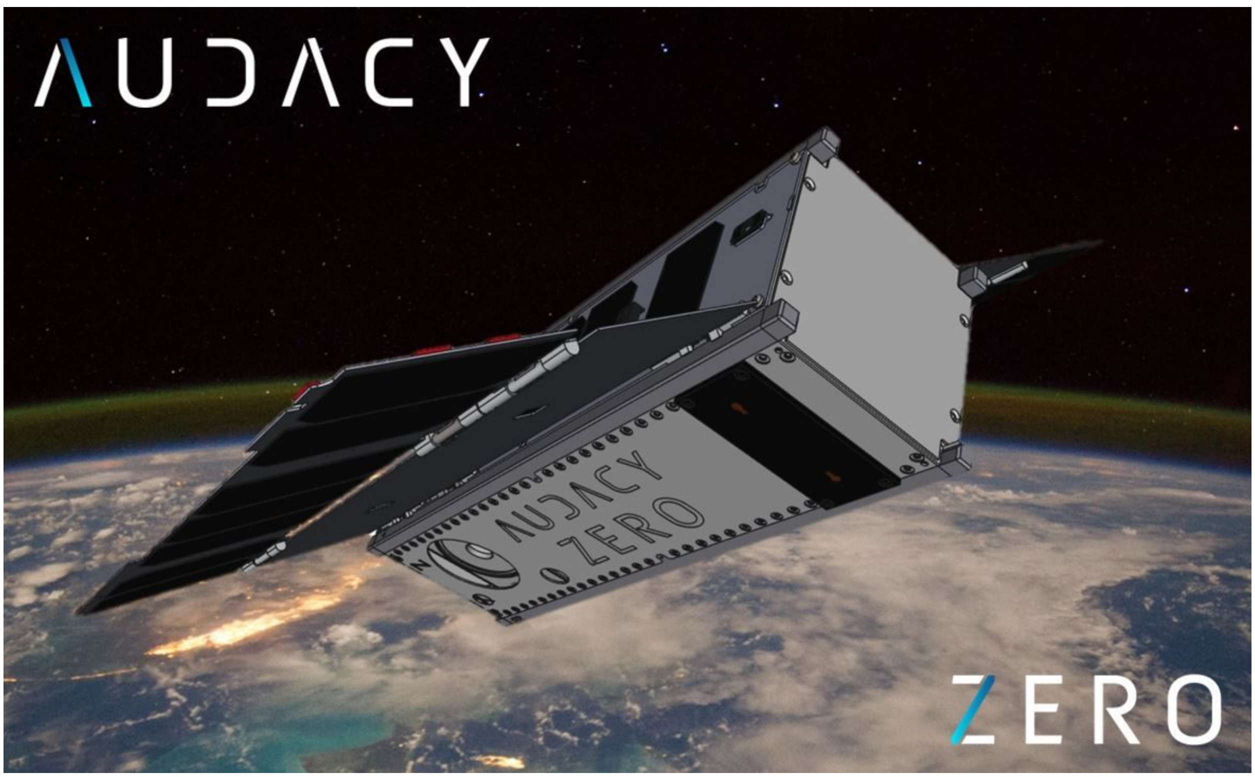

Figure 1: Audacy Zero render over the Earth.

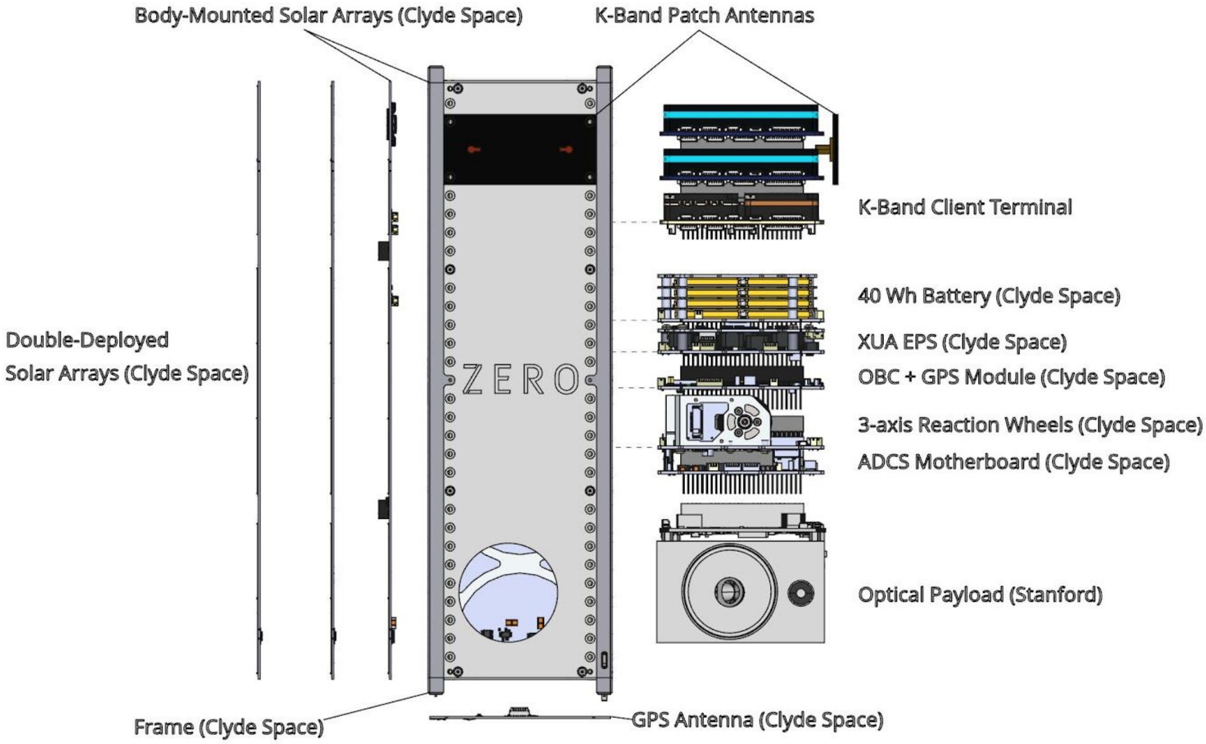

Figure 2: Audacy Zero exploded view with subsystem labels.

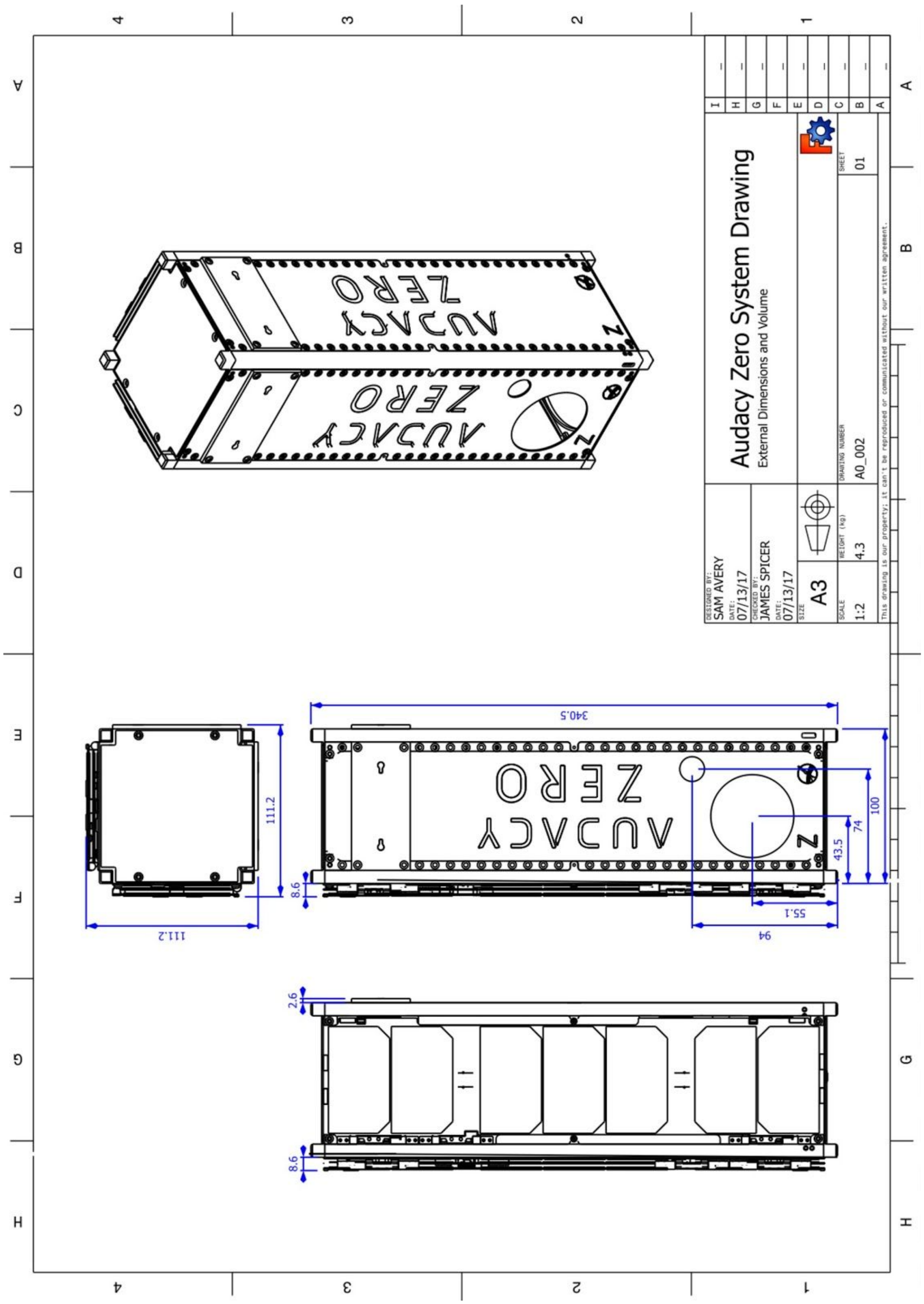

Figure 3: Audacy Zero drawings in the stowed configuration (deployable solar arrays).

Spacecraft Total Mass at Launch: ~ 4.7 kg

Spacecraft Dry Mass at Launch: ~ 4.7 kg

Description of Propulsion Systems: None.

Body Dimensions: ~11.12 cm x 11.12 cm x 34.05 cm (stowed) (see Figure 2)

Deployed Solar Array Dimensions: 30 cm x 20 cm (deployed at a 45° angle) (see Figure 3)

Identification of all Fluids: None.

Fluids in Pressurized Batteries: None. Audacy Zero uses unpressurized lithium-ion cells.

Description of Attitude Determination and Control: Audacy Zero includes 3-axis magnetorquers for reaction wheel desaturation and detumbling with a B-dot algorithm and 3-axis reaction wheels for fine pointing at around 1° pointing accuracy. Attitude determination is handled using magnetometers, fine sun sensors, and coarse sun sensors to achieve less than 1° pointing knowledge.

Description of Range Safety or Pyrotechnic Devices: None.

Description of the Electrical Generation and Storage System: Clyde Space COTS lithium-ion battery cells are charged before mission integration to provide initial power source. Body-mounted and deployed solar arrays are used for power generation and recharging of the batteries.

Identification of other Stored Energy: None.

Identification of Radioactive Materials: None.

III. 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: No intentional releases.

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 v2.1.1)

4.3-1, Mission Related Debris Passing Through LEO: COMPLIANT

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

IV. 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. The deployment of the double-deployed solar arrays will feature a simple spring-loaded hinge and stopper system. The probability of a detachment during deployment is negligible.

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: None.

Rationale for all items which are required to be passivated, but cannot be due to their design: Due to passive reentry and burn up, the lithium-ion batteries (total mass less than 350 grams) are deemed not necessary to passivate for EOM aside from preventing re-charging capability.

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 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 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.

Probability: Estimated to be less than 0.1% given 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 Protoflight shock, vibration, thermal cycling, and vacuum tests followed by maximum 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 discharge rate.

Mitigation 2: Cells from Clyde Space have been tested in lab for high discharge rates in a variety of flight like configurations to determine if the feasibility of an out of control thermal rise in the cell. Cells have been tested in a hot environment (40° C) with no observed failures.

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) overcurrent 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 protoqualification and acceptance environmental tests (shock, vibration, thermal cycling, and thermal-vacuum tests).

Combined faults required for realized failure: An external load must fail/shortcircuit AND external over-current detection and disconnect function 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 that could cause a crushing effect.

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 failures 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 postmission disposal or control to a level which can not cause an explosion or deflagration large enough to release orbital debris or break up the spacecraft (Requirement 56450).

Compliance statement:
Audacy Zero's 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.

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

Compliance statement:
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:
Not applicable. There are no planned breakups.

V. Assessment of Spacecraft Potential for On-Orbit Collisions

Assessment of spacecraft compliance with Requirements 4.5-1 and 4.5-2 (per DAS v2.0.1, and calculation methods provided in NASA-STD-8719.14, 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: 0.00000; 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: 0.00000; COMPLIANT

Identification of all systems or components required to accomplish any postmission disposal operation, including passivation and maneuvering: None.

VI. Assessment of Spacecraft Postmission 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 postmission disposal: None.

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

Spacecraft Mass: ~4.7kg

Cross-sectional Area: 0.065 m^2 (estimated average area in tumbling)

Area to mass ratio: 0.065 / 4.7 = 0.014 m^2/kg

6.4 Assessment of spacecraft compliance with Requirements 4.6-1 through 4.6-5 (per DAS v 2.0.1 and NASA-STD-8719.14 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.

Analysis: Audacy Zero's reentry is COMPLIANT using method "a." Audacy Zero will be left in a 575 km circular orbit, reentering in approximately 1600 days (4.4 years) after launch with orbit history as shown in Figure 4 (analysis assumes a nadir-pointing attitude).

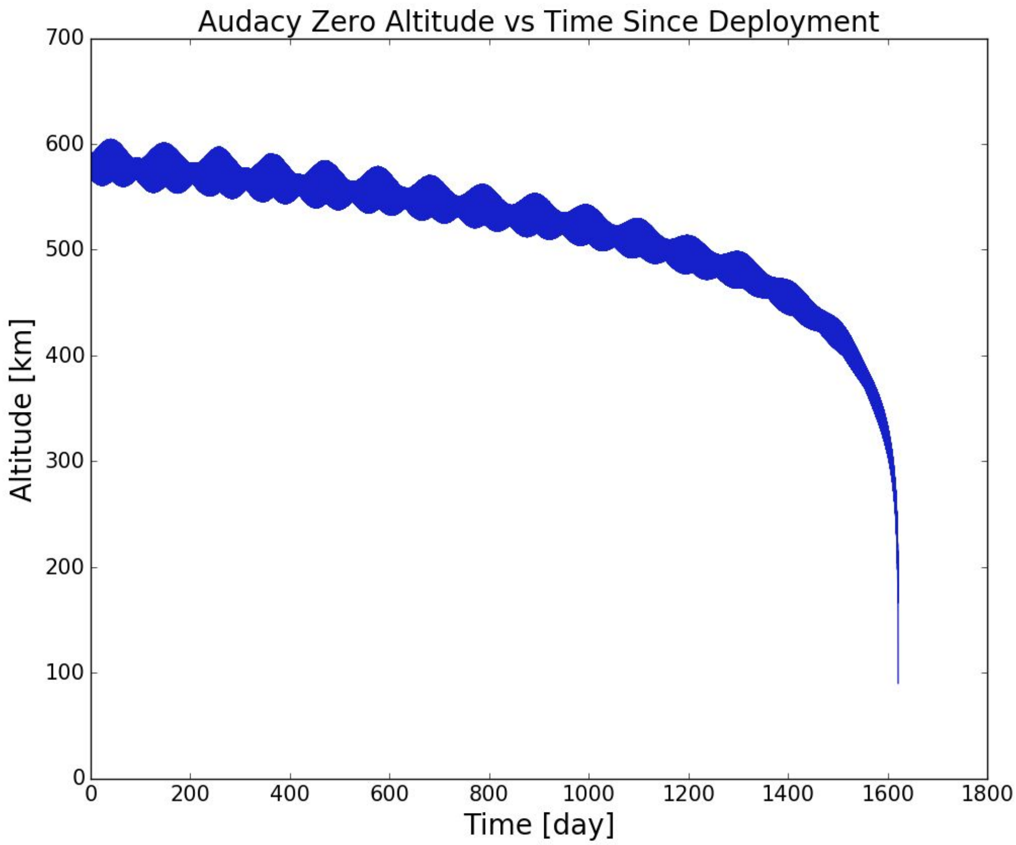

Figure 4: Audacy Zero Orbit Altitude Plot

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 Postmission Disposal Operations

Analysis: Not applicable. The satellite will reenter passively without post mission disposal operations within allowable timeframe.

VII. 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 v2.1.1 reports that Audacy Zero is compliant with the requirement. Total human casualty probability is reported by the DAS software as 1:100,000,000 since every subsystem is expected to burn up on reentry. This is expected to represent the absolute maximum casualty risk, as calculated with DAS's limited modeling capability.

The analysis included below is based on the original use of a single double-deployed solar array. Since the second double-deployed solar array is identical to the first, and the overall mass hasn't changed significantly, the analysis should still accurately represent the mission.

Analysis using DAS v2.1.1:

DAS Activity Log

05 18 2017; 10:49:03AM Processing Requirement 4.3-1: Return Status : Not Run

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No Project Data Available

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=============== End of Requirement 4.3-1 ===============

05 18 2017; 10:49:04AM Processing Requirement 4.3-2: Return Status : Passed

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No Project Data Available

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=============== End of Requirement 4.3-2 ===============

05 18 2017; 10:49:06AM Requirement 4.4-3: Compliant

=============== End of Requirement 4.4-3 ===============

05 18 2017; 11:05:37AM Processing Requirement 4.5-1: Return Status : Passed

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

Run Data

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INPUT

Space Structure Name = Audacy Zero

Space Structure Type = Payload

Perigee Altitude = 575.000000 (km)

Apogee Altitude = 575.000000 (km)

Inclination = 97.900000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Mean Anomaly = 0.000000 (deg)

Final Area-To-Mass Ratio = 0.014000 (m^2/kg)

Start Year = 2018.000000 (yr)

Initial Mass = 4.700000 (kg)

Final Mass = 4.700000 (kg)

Duration = 4.400000 (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

Collision Probability = 0.000002

Returned Error Message: Normal Processing

Date Range Error Message: Normal Date Range

Status = Pass

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

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

05 18 2017; 11:37:54AM Requirement 4.5-2: Compliant

05 18 2017; 11:37:56AM Processing Requirement 4.6 Return Status : Passed

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

Project Data

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

INPUT

Space Structure Name = Audacy Zero

Space Structure Type = Payload

Perigee Altitude = 575.000000 (km)

Apogee Altitude = 575.000000 (km)

Inclination = 97.900000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Mean Anomaly = 0.000000 (deg)

Area-To-Mass Ratio = 0.014000 (m^2/kg)

Start Year = 2018.000000 (yr)

Initial Mass = 4.700000 (kg)

Final Mass = 4.700000 (kg)

Duration = 4.400000 (yr)

Station Kept = False

Abandoned = True

PMD Perigee Altitude = 538.967065 (km)

PMD Apogee Altitude = 562.953941 (km)

PMD Inclination = 97.842604 (deg)

PMD RAAN = 183.005457 (deg)

PMD Argument of Perigee = 60.477056 (deg)

PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Suggested Perigee Altitude = 538.967065 (km)

Suggested Apogee Altitude = 562.953941 (km)

Returned Error Message = Passes LEO reentry orbit criteria.

Released Year = 2024 (yr)

Requirement = 61

Compliance Status = Pass

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

=============== End of Requirement 4.6 ===============

05 18 2017; 11:38:31AM *********Processing Requirement 4.7-1

Return Status : Passed

***********INPUT****

Item Number = 1

name = Audacy Zero

quantity = 1

parent = 0

materialID = 9

type = Box

Aero Mass = 4.700000

Thermal Mass = 4.700000

Diameter/Width = 0.190000

Length = 0.325000

Height = 0.120000

name = Body Solar Panel

quantity = 2

parent = 1

materialID = 24

type = Flat Plate

Aero Mass = 0.160000

Thermal Mass = 0.160000

Diameter/Width = 0.100000

Length = 0.300000

name = Deployed Solar Panel

quantity = 1

parent = 1

materialID = 24

type = Flat Plate

Aero Mass = 0.320000

Thermal Mass = 0.320000

Diameter/Width = 0.200000

Length = 0.300000

name = Reaction Wheels

quantity = 3

parent = 1

materialID = 54

type = Cylinder

Aero Mass = 0.040000

Thermal Mass = 0.040000

Diameter/Width = 0.027500

Length = 0.010000

name = Frame

quantity = 1

parent = 1

materialID = 9

type = Box

Aero Mass = 0.390000

Thermal Mass = 0.390000

Diameter/Width = 0.100000

Length = 0.325000

Height = 0.100000

name = Batteries

quantity = 1

parent = 1

materialID = 23

type = Box

Aero Mass = 0.350000

Thermal Mass = 0.350000

Diameter/Width = 0.100000

Length = 0.100000

Height = 0.027000

name = Optical Terminal

quantity = 1

parent = 1

materialID = 9

type = Box

Aero Mass = 0.500000

Thermal Mass = 0.500000

Diameter/Width = 0.100000

Length = 0.100000

Height = 0.070000

name = Electrical Power System

quantity = 1

parent = 1

materialID = 23

type = Box

Aero Mass = 0.150000

Thermal Mass = 0.150000

Diameter/Width = 0.100000

Length = 0.100000

Height = 0.028000

name = Radio Terminal

quantity = 1

parent = 1

materialID = 9

type = Box

Aero Mass = 0.700000

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DAS Activity Log

Thermal Mass = 0.700000

Diameter/Width = 0.100000

Length = 0.100000

Height = 0.070000

name = On-Board Computer

quantity = 1

parent = 1

materialID = 23

type = Box

Aero Mass = 0.060000

Thermal Mass = 0.060000

Diameter/Width = 0.100000

Length = 0.100000

Height = 0.030000

name = End Solar Panel

quantity = 1

parent = 1

materialID = 24

type = Flat Plate

Aero Mass = 0.100000

Thermal Mass = 0.100000

Diameter/Width = 0.100000

Length = 0.100000

**************OUTPUT****

Item Number = 1

name = Audacy Zero

Demise Altitude = 77.997467

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

****

name = Body Solar Panel

Demise Altitude = 77.487167

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

****

name = Deployed Solar Panel

Demise Altitude = 77.239769

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

****

name = Reaction Wheels

Demise Altitude = 69.516403

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

****

name = Frame

Demise Altitude = 76.521782

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

****

name = Batteries

Demise Altitude = 73.813972

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

****

name = Optical Terminal

Demise Altitude = 72.392189

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

****

name = Electrical Power System

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DAS Activity Log

Demise Altitude = 76.134293

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

****

name = Radio Terminal

Demise Altitude = 70.425697

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

****

name = On-Board Computer

Demise Altitude = 77.253319

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

****

name = End Solar Panel

Demise Altitude = 77.198936

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

****

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

VIII. Assessment of Tether Missions

Not applicable. There are no tethers in the Audacy Zero mission.