Exhibit B – Orbital Debris Assessment Report ("ODAR")

SWARM Orbital Debris Assessment Report

SWARM TECHNOLOGIES MISSION PROFILE
PREPARED BY: SWARM TECHNOLOGIES INC
REVISION 1, August 29, 2019

ODAR Signature Approval

Program/ Project Manager	Sara Spangelo
Signature	
Date	August 29, 2019

ODAR Section 1: Program Management and Mission Overview

Program/ Project Manager	Sara Spangelo
Mission Description	This mission is a technology demo for two-way communications satellites and data relay.
Foreign Government Involvement	None
Project Milestones	The project milestones for the Swarm satellite aligns with the launch of the vehicles into orbit, including a delivery of the spacecraft two months prior to launch.
Proposed Launch Date:	December 1, 2019
Proposed Launch Vehicles	Electron Number of Satellites: 12 Altitude: 505 km Inclination: 97.4 (SSO) Period: 95 min

Proposed Launch Sites	Mahia Peninsula, New Zealand
Launch Vehicle Operator:	Rocket Lab
Mission Duration:	The operational lifetime of the hardware for each satellite is designed to be up to 10 years following deployment from the launch vehicle. The orbital lifetime for the satellites in the nominal mission scenario is expected to be between 3.356 and 3.691 years, as described in Section 6.
Launch / Deployment Profile:	**Launch** The Swarm satellites will be injected directly into the target orbit outlined in the table above. **Checkout** For up to 1 month following deployment into orbit, the Swarm satellites will remain in checkout phase. During this phase, ground operators will verify correct operation of the satellites and their payloads, and prepare the satellites for the operational phase. **Operations** The operational phase of the satellites begins following the successful deployment of the Swarm satellites from the launch vehicle and successful checkout. **Post-mission Disposal** Following the end of the operational phase, the satellites will remain on orbit in a non-transmitting mode while the orbit of the satellites passively decays until the satellites reenter the atmosphere and disintegrate. The satellites are nominally expected to reenter the atmosphere within 3.691 years following deployment from the launch vehicle, as detailed in Appendix B: Swarm Satellites Orbit Lifetime.
Selection of Orbit:	The selection of the chosen orbit was made due to available launch opportunities.
Potential Physical Interference with Other Orbiting Object:	As the satellites do not have any propulsion systems, their orbits will naturally decay following deployment from the launch vehicle. As detailed in Section 5, the probability of physical interference between the satellites and other space objects is sufficiently unlikely that the satellites comply with Requirement 4.5.

ODAR Section 2: Spacecraft Description

Physical Description:

Property	**Value**
Total Mass at Launch	4.037 kg (all satellites) [0.309 kg, 0.313 kg, 0.318 kg, 0.323 kg, 0.329 kg, 0.334 kg, 0.339 kg, 0.343 kg, 0.349 kg, 0.355 kg, 0.359 kg, 0.366 kg (individual satellite masses)]
Dry Mass at Launch	4.037 kg (all satellites) [0.309 kg, 0.313 kg, 0.318 kg, 0.323 kg, 0.329 kg, 0.334 kg, 0.339 kg, 0.343 kg, 0.349 kg, 0.355 kg, 0.359 kg, 0.366 kg (individual satellite masses)]
Form Factor	¼U satellite, Qty 12
COG	<X1,Y1,Z1> = <0, 12.5, 1.4> mm relative to geometric center (SPACEBEE-22) <X1,Y1,Z1> = <0, 13.2, 1.5> mm relative to geometric center (SPACEBEE-23) <X1,Y1,Z1> = <0, 13.8, 1.5> mm relative to geometric center (SPACEBEE-24) <X1,Y1,Z1> = <0, 15.0, 1.5> mm relative to geometric center (SPACEBEE-25) <X1,Y1,Z1> = <0, 15.5, 1.5> mm relative to geometric center (SPACEBEE-26) <X1,Y1,Z1> = <0, 16.0, 1.6> mm relative to geometric center (SPACEBEE-27) <X1,Y1,Z1> = <0, 17.0, 1.6> mm relative to geometric center (SPACEBEE-28) <X1,Y1,Z1> = <0, 17.4, 1.6> mm relative to geometric center (SPACEBEE-29) <X1,Y1,Z1> = <0, 17.9, 1.6> mm relative to geometric center (SPACEBEE-30) <X1,Y1,Z1> = <0, 18.6, 1.7> mm relative to geometric center (SPACEBEE-31)

	<X1,Y1,Z1> = <0, 19.0, 1.7> mm relative to geometric center (SPACEBEE-32) <X1,Y1,Z1> = <0, 19.4, 1.7> mm relative to geometric center (SPACEBEE-33)
Envelope (stowed)	113mm x 113mm x 26mm (each satellite)
Envelope (deployed)	113mm x 113mm x 26mm (each satellite) Deployed antennas are 1,142 mm tip to tip
Propulsion Systems	None
Fluid Systems	None
AOCS	Magnetorquer system for active stabilization, GPS navigation
Range Safety/ Pyrotechnic Devices	None
Electrical Generation	Solar cells
Electrical Storage	Rechargeable lithium-ion battery. Qty 1: 18650 cell.
Radioactive Materials	None

ODAR Section 3: Assessment of Debris Released During Normal Operations

Objects larger than 1mm expected to be released during orbit:	**None**
Rationale for release of each object:	N/A
Time of release of each object:	N/A
Release velocity of each object:	N/A
Expected orbital parameters of each object:	N/A
Calculated orbital lifetime of each object:	N/A

Assessment of spacecraft compliance with Requirements 4.3-1 and 4.3-2:	
4.3-1, Mission-Related Debris Passing Through LEO:	COMPLIANT

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

A DAS 2.1.1 log demonstrating the compliance to the above requirements is available in Appendix A – "DAS 2.1.1 Log".

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

Potential causes for spacecraft breakup (there is only one plausible causes for breakup of the satellites):

- Energy released from onboard Lithium-ion battery from the unlikely event of overcharging or shorts

Summary of failure modes and effects analysis of all credible failure modes which may lead to an accidental explosion:
The battery aboard the satellite is an 11 Whr Lithium-Ion battery, which represents the only credible failure mode during which stored energy is released. The main failure modes associated with Lithium Ion batteries result from overcharging, over-discharging, internal shorts, and external shorts.

The battery onboard Swarm satellites complies with all controls / process requirements identified in JSC-20793 Section 5.4.3 to mitigate chance of any accidental venting / explosion caused by the above failure modes.

Detailed Plan for any designed spacecraft breakup, including explosions and intentional collisions:
There is no planned breakup of the satellites on-orbit.

List of components passivated at EOM:
At end of mission, all radio transmissions and beacons will be disabled. Spacecraft transmissions are only initiated by ground command and self terminate. All RF transmissions from the satellite can be disabled via command from the ground.

Rationale for all items required to be passivated that cannot be due to design:
N/A

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

There are no planned breakups of any of the satellites.	
4.4-4, Limiting the short-term risk to other space systems from planned breakups There are no planned breakups of any of the satellites.	**COMPLIANT**

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

Probability for Collision with Objects >10cm:
The probability of a collision of any of the satellites with an orbiting object larger than 10cm in diameter was sufficiently small that the simulation performed using DAS 2.1.1 software returned a probability value of 0.

Assessment of spacecraft compliance with Requirement 4.5-1 and 4.5-2:	
4.5-1, Probability of Collision with Large Objects:	**COMPLIANT**
4.5-2, Probability of Damage from Small Objects:	**COMPLIANT**

A DAS 2.1.1 log demonstrating the compliance to the above requirements is available in Appendix A – “DAS 2.1.1 Log”.

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

Description of Disposal Option Selected:
Following its deployment, the satellite’s orbit will naturally decay until it reenters the atmosphere. Table 1 describes the mission scenarios for which lifetime analysis of Swarm satellites was considered, and the effective area-to-mass ratio of the satellite in each scenario. The ratio was calculated using the external dimensions of the satellite and deployed arrays. The satellites will be deployed from the P-POD with a spring and will separate from one another with separation springs in the feet.

Drag area from deployed antennas (4 antennas, 521 mm long turnstile antennas) was neglected; as such, the effective area-to-mass calculated below is a conservative case.

Table 1 - Area-to-Mass Ratio of Swarm Satellites in Various Mission Scenarios

Scenario	**Description**	**Effective Area-to-Mass (m^2/kg)**
Operational, Nominal	● Satellite maintains +Z axis nadir ● Satellite maintains position around Z axis as planned for mission operations	0.00950 (for 0.309 kg satellite) 0.00939 (for 0.313 kg satellite) 0.00924 (for 0.318 kg satellite) 0.00910 (for 0.323 kg satellite) 0.00893 (for 0.329 kg satellite) 0.00880 (for 0.334 kg satellite) 0.00867 (for 0.339 kg satellite) 0.00857 (for 0.343 kg satellite) 0.00842 (for 0.349 kg satellite) 0.00828 (for 0.355 kg satellite) 0.00818 (for 0.359 kg satellite) 0.00803 (for 0.366 kg satellite)
ADCS Nonfunctional	● Satellite tumbles randomly	0.0254 (for 0.309 kg satellite) 0.0251 (for 0.313 kg satellite) 0.0247 (for 0.318 kg satellite) 0.0243 (for 0.323 kg satellite) 0.0239 (for 0.329 kg satellite) 0.0235 (for 0.334 kg satellite) 0.0232 (for 0.339 kg satellite) 0.0229 (for 0.343 kg satellite) 0.0225 (for 0.349 kg satellite) 0.0221 (for 0.355 kg satellite) 0.0219 (for 0.359 kg satellite) 0.0215 (for 0.366 kg satellite)

Table 2 shows the simulated orbital dwell time for a Swarm satellite for the range of possible orbits, in each of the identified mission scenarios. In all mission scenarios, the dwell time of the satellite was simulated using DAS 2.1.1 software to be less than 4 years.

Table 2 – Orbit Dwell Time for Swarm Satellite in Each Planned Orbit and Mission Scenario

		Orbital Lifetime (years)
Cases		**Nominal or ADCS Nonfunctional**
Launch		**December 2019 Rocket Lab (12 x 1/4U Satellites)**
Orbit		**505 km x 505 km (97.4 deg)**
Scenario	**Effective Area-to-Mass (m^2/kg)**	
Operational, Nominal (for 0.309 kg satellite)	0.0095	3.356
ADCS Nonfunctional	0.0254	2.179

(for 0.309 kg satellite)		
Operational, Nominal (for 0.313 kg satellite)	0.00939	3.379
ADCS Nonfunctional (for 0.313 kg satellite)	0.0251	2.190
Operational, Nominal (for 0.318 kg satellite)	0.00924	3.411
ADCS Nonfunctional (for 0.318 kg satellite)	0.0247	2.201
Operational, Nominal (for 0.323 kg satellite)	0.00910	3.439
ADCS Nonfunctional (for 0.323 kg satellite)	0.0243	2.218
Operational, Nominal (for 0.329 kg satellite)	0.00893	3.472
ADCS Nonfunctional (for 0.329 kg satellite)	0.0239	2.229
Operational, Nominal (for 0.334 kg satellite)	0.00880	3.504
ADCS Nonfunctional (for 0.334 kg satellite)	0.0235	2.245
Operational, Nominal (for 0.339 kg satellite)	0.00867	3.532
ADCS Nonfunctional (for 0.339 kg satellite)	0.0232	2.256
Operational, Nominal (for 0.343 kg satellite)	0.00857	3.554
ADCS Nonfunctional (for 0.343 kg satellite)	0.0229	2.995
Operational, Nominal (for 0.349 kg satellite)	0.00842	3.592
ADCS Nonfunctional (for 0.349 kg satellite)	0.0225	2.283
Operational, Nominal (for 0.355 kg satellite)	0.00828	3.625
ADCS Nonfunctional (for 0.355 kg satellite)	0.0221	2.300

Operational, Nominal (for 0.359 kg satellite)	0.00818	3.647
ADCS Nonfunctional (for 0.359 kg satellite)	0.0219	2.305
Operational, Nominal (for 0.366 kg satellite)	0.00803	3.691
ADCS Nonfunctional (for 0.366 kg satellite)	0.0215	2.322

Identification of Systems Required for Post-mission Disposal: None

Plan for Spacecraft Maneuvers required for Post-mission Disposal: N/A

Calculation of final Area-to-Mass Ratio if Atmospheric Reentry Not Selected: N/A

Assessment of Spacecraft Compliance with Requirements 4.6-1 through 4.6-4:	
4.6-1, Disposal for space structures passing through LEO All of the satellites will reenter the atmosphere within 25 years of mission completion and 30 years of launch.	**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**

ODAR Section 7: Assessment of Spacecraft Reentry Hazards

Detailed description of spacecraft components by size, mass, material, shape, and original location on the space vehicle:
A system-level mass breakdown and primary materials list included in the generic satellite bus is available in the table below:

Subsystem	Materials	Quantity	Mass (grams)	Shape	Size (mm)
Solar Panels	Copper, Glass	2	1	Box	79 x 50 x 0.3

Main Board PCB	FR4	2	28.0	Box	98 x 98 x 1.6
Primary Structure	Al 6061	1	202.5 (for 0.309 kg satellite) 206.5 (for 0.313 kg satellite) 211.5 (for 0.318 kg satellite) 216.5 (for 0.323 kg satellite) 222.5 (for 0.329 kg satellite) 227.5 (for 0.334 kg satellite) 232.5 (for 0.339 kg satellite) 236.5 (for 0.343 kg satellite) 242.5 (for 0.349 kg satellite) 248.5 (for 0.355 kg satellite)	Box	113 x 113 x 26

			252.5 (for 0.359 kg satellite) 259.5 (for 0.366 kg satellite)		
Battery	Li-Ion	1	48.5	Cylinder	18 (r) x 67 (l)

Summary of objects expected to survive an uncontrolled reentry (using DAS 2.1.1 software): None
Calculation of probability of human casualty for expected reentry year and inclination: 0%

Assessment of spacecraft compliance with Requirement 4.7-1:	
4.7-1, Casualty Risk from Reentry Debris:	**COMPLIANT**

A DAS 2.1.1 log demonstrating the compliance to Requirement 4.7-1 is available in Appendix A – "DAS 2.1.1 Log".

ODAR Section 7A: Assessment of Spacecraft Hazardous Materials

Summary of Hazardous Materials Contained on Spacecraft: None

ODAR Section 8: Assessment for Tether Missions

Type of tether: N/A
Description of tether system: N/A
Determination of minimum size of object that will cause the tether to be severed: N/A
Tether mission plan, including duration and post-mission disposal: N/A
Probability of tether colliding with large space objects: N/A
Probability of tether being severed during mission or after post-mission disposal: N/A
Maximum orbital lifetime of a severed tether fragment: N/A

Assessment of compliance with Requirement 4.8-1:	
4.8-1, Collision Hazards of Space Tethers:	**N/A**

ODAR Section 9: Orbital Tracking Methodology

The satellite is a ¼U CubeSat in size (11.3 cm x 11.3 cm x 2.6 cm). Further, the satellites have an onboard GPS receiver, and the GPS location of the satellites is transmitted on command from the ground. We will have the ability to silence all RF transmissions of the satellites by command from the ground. Our GPS data, and computed TLEs, will be provided to CSpOC and to satellite operators that wish to receive the live telemetry. The GPS device will provide telemetry throughout the hardware lifetime of the satellites, which exceeds the anticipated orbital lifetime of the satellites.

Additional information regarding orbital tracking for Swarm's ¼U satellites is included in Exhibit D: Trackability Analysis and Exhibit E: LeoLabs Report.

Appendix A: DAS 2.1.1 Log

08 29 2019; 17:27:05PM Activity Log Started
08 29 2019; 17:35:32PM Mission Editor Changes Applied
08 29 2019; 17:35:49PM Processing Requirement 4.3-1: Return Status : Not Run

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

========== End of Requirement 4.3-1 ==========
08 29 2019; 17:35:55PM Processing Requirement 4.3-2: Return Status : Passed

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

========== End of Requirement 4.3-2 ==========
08 29 2019; 17:35:57PM Requirement 4.4-3: Compliant

========== End of Requirement 4.4-3 ==========
08 29 2019; 18:37:05PM Processing Requirement 4.5-1: Return Status : Passed

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

INPUT

Space Structure Name = SPACEBEE-22

Space Structure Type = Payload
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.009500 (m^2/kg)
Start Year = 2019.900000 (yr)
Initial Mass = 0.309000 (kg)
Final Mass = 0.309000 (kg)
Duration = 3.400000 (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 = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = SPACEBEE-23
Space Structure Type = Payload
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.009390 (m^2/kg)
Start Year = 2019.900000 (yr)
Initial Mass = 0.313000 (kg)
Final Mass = 0.313000 (kg)
Duration = 3.400000 (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 = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = SPACEBEE-24
Space Structure Type = Payload
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.009240 (m^2/kg)
Start Year = 2019.900000 (yr)
Initial Mass = 0.318000 (kg)
Final Mass = 0.318000 (kg)
Duration = 3.400000 (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 = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = SPACEBEE-25
Space Structure Type = Payload
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.009100 (m^2/kg)
Start Year = 2019.900000 (yr)
Initial Mass = 0.323000 (kg)
Final Mass = 0.323000 (kg)
Duration = 3.400000 (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 = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = SPACEBEE-26
Space Structure Type = Payload
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.008930 (m^2/kg)
Start Year = 2019.900000 (yr)

Initial Mass = 0.329000 (kg)
Final Mass = 0.329000 (kg)
Duration = 3.500000 (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 = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = SPACEBEE-27
Space Structure Type = Payload
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.008800 (m^2/kg)
Start Year = 2019.900000 (yr)
Initial Mass = 0.334000 (kg)
Final Mass = 0.334000 (kg)
Duration = 3.500000 (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 = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = SPACEBEE-28
Space Structure Type = Payload
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.008670 (m^2/kg)
Start Year = 2019.900000 (yr)
Initial Mass = 0.339000 (kg)
Final Mass = 0.339000 (kg)
Duration = 3.500000 (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 = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = SPACEBEE-29
Space Structure Type = Payload
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)

RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.008570 (m^2/kg)
Start Year = 2019.900000 (yr)
Initial Mass = 0.343000 (kg)
Final Mass = 0.343000 (kg)
Duration = 3.600000 (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 = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = SPACEBEE-30
Space Structure Type = Payload
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.008420 (m^2/kg)
Start Year = 2019.900000 (yr)
Initial Mass = 0.349000 (kg)
Final Mass = 0.349000 (kg)
Duration = 3.600000 (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 = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = SPACEBEE-31
Space Structure Type = Payload
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.008280 (m^2/kg)
Start Year = 2019.900000 (yr)
Initial Mass = 0.355000 (kg)
Final Mass = 0.355000 (kg)
Duration = 3.600000 (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 = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = SPACEBEE-32
Space Structure Type = Payload
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.008180 (m^2/kg)
Start Year = 2019.900000 (yr)
Initial Mass = 0.359000 (kg)
Final Mass = 0.359000 (kg)
Duration = 3.600000 (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 = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = SPACEBEE-33
Space Structure Type = Payload
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.008030 (m^2/kg)
Start Year = 2019.900000 (yr)
Initial Mass = 0.366000 (kg)
Final Mass = 0.366000 (kg)
Duration = 3.700000 (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 = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

========== End of Requirement 4.5-1 ==========
08 29 2019; 21:59:11PM Requirement 4.5-2: Compliant
08 29 2019; 21:59:13PM Processing Requirement 4.6 Return Status : Passed

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

INPUT

Space Structure Name = SPACEBEE-22
Space Structure Type = Payload

Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Area-To-Mass Ratio = 0.009500 (m^2/kg)
Start Year = 2019.900000 (yr)
Initial Mass = 0.309000 (kg)
Final Mass = 0.309000 (kg)
Duration = 3.400000 (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

Suggested Perigee Altitude = 505.000000 (km)
Suggested Apogee Altitude = 505.000000 (km)
Returned Error Message = Reentry during mission (no PMD req.).

Released Year = 2023 (yr)
Requirement = 61
Compliance Status = Pass

==========

INPUT

Space Structure Name = SPACEBEE-23
Space Structure Type = Payload

Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Area-To-Mass Ratio = 0.009390 (m^2/kg)
Start Year = 2019.900000 (yr)
Initial Mass = 0.313000 (kg)
Final Mass = 0.313000 (kg)
Duration = 3.400000 (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

Suggested Perigee Altitude = 505.000000 (km)
Suggested Apogee Altitude = 505.000000 (km)
Returned Error Message = Reentry during mission (no PMD req.).

Released Year = 2023 (yr)

Requirement = 61
Compliance Status = Pass

==========

INPUT

Space Structure Name = SPACEBEE-24
Space Structure Type = Payload

Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Area-To-Mass Ratio = 0.009240 (m^2/kg)
Start Year = 2019.900000 (yr)
Initial Mass = 0.318000 (kg)
Final Mass = 0.318000 (kg)
Duration = 3.400000 (yr)
Station Kept = False
Abandoned = True
PMD Perigee Altitude = 220.874825 (km)
PMD Apogee Altitude = 220.874825 (km)
PMD Inclination = 97.256646 (deg)
PMD RAAN = 148.675640 (deg)
PMD Argument of Perigee = 312.351277 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Suggested Perigee Altitude = 220.874825 (km)
Suggested Apogee Altitude = 220.874825 (km)
Returned Error Message = Passes LEO reentry orbit criteria.

Released Year = 2023 (yr)
Requirement = 61
Compliance Status = Pass

==========

INPUT

Space Structure Name = SPACEBEE-25
Space Structure Type = Payload

Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Area-To-Mass Ratio = 0.009100 (m^2/kg)
Start Year = 2019.900000 (yr)
Initial Mass = 0.323000 (kg)
Final Mass = 0.323000 (kg)
Duration = 3.400000 (yr)
Station Kept = False
Abandoned = True
PMD Perigee Altitude = 279.403512 (km)
PMD Apogee Altitude = 279.403512 (km)
PMD Inclination = 97.265324 (deg)
PMD RAAN = 147.666657 (deg)
PMD Argument of Perigee = 313.279530 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Suggested Perigee Altitude = 279.403512 (km)
Suggested Apogee Altitude = 279.403512 (km)
Returned Error Message = Passes LEO reentry orbit criteria.

Released Year = 2023 (yr)
Requirement = 61
Compliance Status = Pass

==========

INPUT

Space Structure Name = SPACEBEE-26
Space Structure Type = Payload

Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Area-To-Mass Ratio = 0.008930 (m^2/kg)
Start Year = 2019.900000 (yr)
Initial Mass = 0.329000 (kg)
Final Mass = 0.329000 (kg)

Duration = 3.500000 (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 = 505.000000 (km)
Suggested Apogee Altitude = 505.000000 (km)
Returned Error Message = Reentry during mission (no PMD req.).

Released Year = 2023 (yr)
Requirement = 61
Compliance Status = Pass

==========

INPUT

Space Structure Name = SPACEBEE-27
Space Structure Type = Payload

Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Area-To-Mass Ratio = 0.008800 (m^2/kg)
Start Year = 2019.900000 (yr)
Initial Mass = 0.334000 (kg)
Final Mass = 0.334000 (kg)
Duration = 3.500000 (yr)
Station Kept = False
Abandoned = True
PMD Perigee Altitude = 180.123178 (km)
PMD Apogee Altitude = 180.123178 (km)
PMD Inclination = 97.247126 (deg)
PMD RAAN = 185.264108 (deg)
PMD Argument of Perigee = 308.347032 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Suggested Perigee Altitude = 180.123178 (km)
Suggested Apogee Altitude = 180.123178 (km)
Returned Error Message = Passes LEO reentry orbit criteria.

Released Year = 2023 (yr)
Requirement = 61
Compliance Status = Pass

==========

INPUT

Space Structure Name = SPACEBEE-28
Space Structure Type = Payload

Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Area-To-Mass Ratio = 0.008670 (m^2/kg)
Start Year = 2019.900000 (yr)
Initial Mass = 0.339000 (kg)
Final Mass = 0.339000 (kg)
Duration = 3.500000 (yr)
Station Kept = False
Abandoned = True
PMD Perigee Altitude = 268.262245 (km)
PMD Apogee Altitude = 268.262245 (km)
PMD Inclination = 97.260196 (deg)
PMD RAAN = 184.137288 (deg)
PMD Argument of Perigee = 310.578022 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Suggested Perigee Altitude = 268.262245 (km)
Suggested Apogee Altitude = 268.262245 (km)
Returned Error Message = Passes LEO reentry orbit criteria.

Released Year = 2023 (yr)
Requirement = 61
Compliance Status = Pass

==========

INPUT

Space Structure Name = SPACEBEE-29
Space Structure Type = Payload

Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Area-To-Mass Ratio = 0.008570 (m^2/kg)
Start Year = 2019.900000 (yr)
Initial Mass = 0.343000 (kg)
Final Mass = 0.343000 (kg)
Duration = 3.600000 (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 = 505.000000 (km)
Suggested Apogee Altitude = 505.000000 (km)
Returned Error Message = Reentry during mission (no PMD req.).

Released Year = 2023 (yr)
Requirement = 61
Compliance Status = Pass

==========

INPUT

Space Structure Name = SPACEBEE-30
Space Structure Type = Payload

Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)

RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Area-To-Mass Ratio = 0.008420 (m^2/kg)
Start Year = 2019.900000 (yr)
Initial Mass = 0.349000 (kg)
Final Mass = 0.349000 (kg)
Duration = 3.600000 (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 = 505.000000 (km)
Suggested Apogee Altitude = 505.000000 (km)
Returned Error Message = Reentry during mission (no PMD req.).

Released Year = 2023 (yr)
Requirement = 61
Compliance Status = Pass

==========

INPUT

Space Structure Name = SPACEBEE-31
Space Structure Type = Payload

Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Area-To-Mass Ratio = 0.008280 (m^2/kg)
Start Year = 2019.900000 (yr)
Initial Mass = 0.355000 (kg)
Final Mass = 0.355000 (kg)
Duration = 3.600000 (yr)
Station Kept = False
Abandoned = True

PMD Perigee Altitude = 253.815161 (km)
PMD Apogee Altitude = 253.815161 (km)
PMD Inclination = 97.256669 (deg)
PMD RAAN = 220.683035 (deg)
PMD Argument of Perigee = 312.180433 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Suggested Perigee Altitude = 253.815161 (km)
Suggested Apogee Altitude = 253.815161 (km)
Returned Error Message = Passes LEO reentry orbit criteria.

Released Year = 2023 (yr)
Requirement = 61
Compliance Status = Pass

==========

INPUT

Space Structure Name = SPACEBEE-32
Space Structure Type = Payload

Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Area-To-Mass Ratio = 0.008180 (m^2/kg)
Start Year = 2019.900000 (yr)
Initial Mass = 0.359000 (kg)
Final Mass = 0.359000 (kg)
Duration = 3.600000 (yr)
Station Kept = False
Abandoned = True
PMD Perigee Altitude = 286.890463 (km)
PMD Apogee Altitude = 286.890463 (km)
PMD Inclination = 97.261571 (deg)
PMD RAAN = 219.870325 (deg)
PMD Argument of Perigee = 312.817576 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Suggested Perigee Altitude = 286.890463 (km)

Suggested Apogee Altitude = 286.890463 (km)
Returned Error Message = Passes LEO reentry orbit criteria.

Released Year = 2023 (yr)
Requirement = 61
Compliance Status = Pass

==========

INPUT

Space Structure Name = SPACEBEE-33
Space Structure Type = Payload

Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Area-To-Mass Ratio = 0.008030 (m^2/kg)
Start Year = 2019.900000 (yr)
Initial Mass = 0.366000 (kg)
Final Mass = 0.366000 (kg)
Duration = 3.700000 (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 = 505.000000 (km)
Suggested Apogee Altitude = 505.000000 (km)
Returned Error Message = Reentry during mission (no PMD req.).

Released Year = 2023 (yr)
Requirement = 61
Compliance Status = Pass

==========

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

08 30 2019; 09:07:08AM *********Processing Requirement 4.7-1
Return Status : Passed

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

name = SPACEBEE-22
quantity = 1
parent = 0
materialID = 5
type = Box
Aero Mass = 0.309000
Thermal Mass = 0.309000
Diameter/Width = 0.113000
Length = 0.113000
Height = 0.026000

name = Solar Panels
quantity = 2
parent = 1
materialID = 24
type = Box
Aero Mass = 0.000100
Thermal Mass = 0.000100
Diameter/Width = 0.050000
Length = 0.079000
Height = 0.000300

name = Main Board PCB
quantity = 2
parent = 1
materialID = 23
type = Box
Aero Mass = 0.028000
Thermal Mass = 0.028000
Diameter/Width = 0.098000
Length = 0.098000
Height = 0.001600

name = Battery Pack
quantity = 1
parent = 1
materialID = 5
type = Cylinder
Aero Mass = 0.048500
Thermal Mass = 0.048500
Diameter/Width = 0.039000

Length = 0.067000

name = Primary Structure
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 0.202500
Thermal Mass = 0.202500
Diameter/Width = 0.113000
Length = 0.113000
Height = 0.026000

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

name = SPACEBEE-22
Demise Altitude = 77.989304
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Solar Panels
Demise Altitude = 77.989304
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Main Board PCB
Demise Altitude = 77.035713
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Battery Pack
Demise Altitude = 74.306442
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Primary Structure
Demise Altitude = 71.629730
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 2

name = SPACEBEE-23
quantity = 1
parent = 0
materialID = 5
type = Box
Aero Mass = 0.313000
Thermal Mass = 0.313000
Diameter/Width = 0.113000
Length = 0.113000
Height = 0.026000

name = S
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 0.313000
Thermal Mass = 0.313000
Diameter/Width = 0.113000
Length = 0.113000
Height = 0.026000

**********OUTPUT****
Item Number = 2

name = SPACEBEE-23
Demise Altitude = 77.993286
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = S
Demise Altitude = 68.730080
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 3

name = SPACEBEE-24
quantity = 1
parent = 0

materialID = 5
type = Box
Aero Mass = 0.318000
Thermal Mass = 0.318000
Diameter/Width = 0.113000
Length = 0.113000
Height = 0.026000

name = S
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 0.318000
Thermal Mass = 0.318000
Diameter/Width = 0.113000
Length = 0.113000
Height = 0.026000

**********OUTPUT****
Item Number = 3

name = SPACEBEE-24
Demise Altitude = 77.998337
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = S
Demise Altitude = 68.699608
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 4

name = SPACEBEE-25
quantity = 1
parent = 0
materialID = 5
type = Box
Aero Mass = 0.323000
Thermal Mass = 0.323000
Diameter/Width = 0.113000
Length = 0.113000

Height = 0.026000

name = S
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 0.323000
Thermal Mass = 0.323000
Diameter/Width = 0.113000
Length = 0.113000
Height = 0.026000

**********OUTPUT****
Item Number = 4

name = SPACEBEE-25
Demise Altitude = 77.996437
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = S
Demise Altitude = 68.659767
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 5

name = SPACEBEE-26
quantity = 1
parent = 0
materialID = 5
type = Box
Aero Mass = 0.329000
Thermal Mass = 0.329000
Diameter/Width = 0.113000
Length = 0.113000
Height = 0.026000

name = S
quantity = 1
parent = 1
materialID = 5

type = Box
Aero Mass = 0.329000
Thermal Mass = 0.329000
Diameter/Width = 0.113000
Length = 0.113000
Height = 0.026000

**********OUTPUT****
Item Number = 5

name = SPACEBEE-26
Demise Altitude = 77.993042
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = S
Demise Altitude = 68.610321
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 6

name = SPACEBEE-27
quantity = 1
parent = 0
materialID = 5
type = Box
Aero Mass = 0.334000
Thermal Mass = 0.334000
Diameter/Width = 0.113000
Length = 0.113000
Height = 0.026000

name = S
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 0.334000
Thermal Mass = 0.334000
Diameter/Width = 0.113000
Length = 0.113000
Height = 0.026000

**********OUTPUT****
Item Number = 6

name = SPACEBEE-27
Demise Altitude = 77.997009
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = S
Demise Altitude = 68.578346
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 7

name = SPACEBEE-28
quantity = 1
parent = 0
materialID = 5
type = Box
Aero Mass = 0.339000
Thermal Mass = 0.339000
Diameter/Width = 0.113000
Length = 0.113000
Height = 0.026000

name = S
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 0.339000
Thermal Mass = 0.339000
Diameter/Width = 0.113000
Length = 0.113000
Height = 0.026000

**********OUTPUT****
Item Number = 7

name = SPACEBEE-28
Demise Altitude = 77.995171

Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = S
Demise Altitude = 68.523537
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 8

name = SPACEBEE-29
quantity = 1
parent = 0
materialID = 5
type = Box
Aero Mass = 0.343000
Thermal Mass = 0.343000
Diameter/Width = 0.113000
Length = 0.113000
Height = 0.026000

name = S
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 0.343000
Thermal Mass = 0.343000
Diameter/Width = 0.113000
Length = 0.113000
Height = 0.026000

**********OUTPUT****
Item Number = 8

name = SPACEBEE-29
Demise Altitude = 77.992821
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = S
Demise Altitude = 68.490311

Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 9

name = SPACEBEE-30
quantity = 1
parent = 0
materialID = 5
type = Box
Aero Mass = 0.349000
Thermal Mass = 0.349000
Diameter/Width = 0.113000
Length = 0.113000
Height = 0.026000

name = S
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 0.349000
Thermal Mass = 0.349000
Diameter/Width = 0.113000
Length = 0.113000
Height = 0.026000

**********OUTPUT****
Item Number = 9

name = SPACEBEE-30
Demise Altitude = 77.997276
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = S
Demise Altitude = 68.466194
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

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

Item Number = 10

name = SPACEBEE-31
quantity = 1
parent = 0
materialID = 5
type = Box
Aero Mass = 0.355000
Thermal Mass = 0.355000
Diameter/Width = 0.113000
Length = 0.113000
Height = 0.026000

name = S
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 0.355000
Thermal Mass = 0.355000
Diameter/Width = 0.113000
Length = 0.113000
Height = 0.026000

**********OUTPUT****
Item Number = 10

name = SPACEBEE-31
Demise Altitude = 77.989998
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = S
Demise Altitude = 68.411026
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 11

name = SPACEBEE-32
quantity = 1
parent = 0
materialID = 5

type = Box
Aero Mass = 0.359000
Thermal Mass = 0.359000
Diameter/Width = 0.113000
Length = 0.113000
Height = 0.026000

name = S
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 0.359000
Thermal Mass = 0.359000
Diameter/Width = 0.113000
Length = 0.113000
Height = 0.026000

**********OUTPUT****
Item Number = 11

name = SPACEBEE-32
Demise Altitude = 77.990913
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = S
Demise Altitude = 68.382164
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 12

name = SPACEBEE-33
quantity = 1
parent = 0
materialID = 5
type = Box
Aero Mass = 0.366000
Thermal Mass = 0.366000
Diameter/Width = 0.113000
Length = 0.113000
Height = 0.026000

name = S
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 0.366000
Thermal Mass = 0.366000
Diameter/Width = 0.113000
Length = 0.113000
Height = 0.026000

**********OUTPUT****
Item Number = 12

name = SPACEBEE-33
Demise Altitude = 77.993713
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = S
Demise Altitude = 68.333229
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

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

Appendix B: Swarm Satellites Orbit Lifetime

08 29 2019; 17:09:10PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2019.900000 (yr)
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.009500 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 3.356605 (yr)
Time Spent in LEO during Lifetime = 3.356605 (yr)
Last year of Propagation = 2023 (yr)
Returned Error Message: Object reentered
08 29 2019; 17:09:31PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2019.900000 (yr)
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.025400 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 2.179329 (yr)
Time Spent in LEO during Lifetime = 2.179329 (yr)
Last year of Propagation = 2022 (yr)
Returned Error Message: Object reentered
08 29 2019; 17:09:40PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2019.900000 (yr)
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.009390 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 3.378508 (yr)
Time Spent in LEO during Lifetime = 3.378508 (yr)
Last year of Propagation = 2023 (yr)
Returned Error Message: Object reentered
08 29 2019; 17:09:47PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2019.900000 (yr)
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.025100 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 2.190281 (yr)
Time Spent in LEO during Lifetime = 2.190281 (yr)
Last year of Propagation = 2022 (yr)
Returned Error Message: Object reentered
08 29 2019; 17:09:58PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2019.900000 (yr)
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.009240 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 3.411362 (yr)
Time Spent in LEO during Lifetime = 3.411362 (yr)
Last year of Propagation = 2023 (yr)
Returned Error Message: Object reentered
08 29 2019; 17:10:06PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2019.900000 (yr)
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.024700 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 2.201232 (yr)
Time Spent in LEO during Lifetime = 2.201232 (yr)
Last year of Propagation = 2022 (yr)
Returned Error Message: Object reentered
08 29 2019; 17:10:15PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2019.900000 (yr)
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.009100 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 3.438741 (yr)
Time Spent in LEO during Lifetime = 3.438741 (yr)
Last year of Propagation = 2023 (yr)
Returned Error Message: Object reentered
08 29 2019; 17:10:26PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2019.900000 (yr)
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.024300 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 2.217659 (yr)
Time Spent in LEO during Lifetime = 2.217659 (yr)
Last year of Propagation = 2022 (yr)
Returned Error Message: Object reentered
08 29 2019; 17:10:41PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2019.900000 (yr)
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)

Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.008930 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 3.471595 (yr)
Time Spent in LEO during Lifetime = 3.471595 (yr)
Last year of Propagation = 2023 (yr)
Returned Error Message: Object reentered
08 29 2019; 17:10:49PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2019.900000 (yr)
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.023900 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 2.228611 (yr)
Time Spent in LEO during Lifetime = 2.228611 (yr)
Last year of Propagation = 2022 (yr)
Returned Error Message: Object reentered
08 29 2019; 17:10:55PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2019.900000 (yr)
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.008800 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 3.504449 (yr)
Time Spent in LEO during Lifetime = 3.504449 (yr)
Last year of Propagation = 2023 (yr)
Returned Error Message: Object reentered

08 29 2019; 17:11:03PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2019.900000 (yr)
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.023500 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 2.245038 (yr)
Time Spent in LEO during Lifetime = 2.245038 (yr)
Last year of Propagation = 2022 (yr)
Returned Error Message: Object reentered

08 29 2019; 17:14:28PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2019.900000 (yr)
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.008670 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 3.531828 (yr)
Time Spent in LEO during Lifetime = 3.531828 (yr)
Last year of Propagation = 2023 (yr)
Returned Error Message: Object reentered

08 29 2019; 17:14:38PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2019.900000 (yr)
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.023200 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 2.255989 (yr)
Time Spent in LEO during Lifetime = 2.255989 (yr)
Last year of Propagation = 2022 (yr)
Returned Error Message: Object reentered
08 29 2019; 17:14:46PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2019.900000 (yr)
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.008570 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 3.553730 (yr)
Time Spent in LEO during Lifetime = 3.553730 (yr)
Last year of Propagation = 2023 (yr)
Returned Error Message: Object reentered
08 29 2019; 17:14:54PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2019.900000 (yr)
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.011900 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 2.995209 (yr)
Time Spent in LEO during Lifetime = 2.995209 (yr)
Last year of Propagation = 2022 (yr)
Returned Error Message: Object reentered
08 29 2019; 17:15:01PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2019.900000 (yr)
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.008420 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 3.592060 (yr)
Time Spent in LEO during Lifetime = 3.592060 (yr)
Last year of Propagation = 2023 (yr)
Returned Error Message: Object reentered
08 29 2019; 17:15:11PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2019.900000 (yr)
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.022500 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 2.283368 (yr)
Time Spent in LEO during Lifetime = 2.283368 (yr)
Last year of Propagation = 2022 (yr)
Returned Error Message: Object reentered
08 29 2019; 17:15:33PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2019.900000 (yr)
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.008280 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 3.624914 (yr)

Time Spent in LEO during Lifetime = 3.624914 (yr)
Last year of Propagation = 2023 (yr)
Returned Error Message: Object reentered
08 29 2019; 17:15:55PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2019.900000 (yr)
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.022100 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 2.299795 (yr)
Time Spent in LEO during Lifetime = 2.299795 (yr)
Last year of Propagation = 2022 (yr)
Returned Error Message: Object reentered
08 29 2019; 17:16:04PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2019.900000 (yr)
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.008180 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 3.646817 (yr)
Time Spent in LEO during Lifetime = 3.646817 (yr)
Last year of Propagation = 2023 (yr)
Returned Error Message: Object reentered
08 29 2019; 17:16:13PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2019.900000 (yr)
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)

RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.021900 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 2.305270 (yr)
Time Spent in LEO during Lifetime = 2.305270 (yr)
Last year of Propagation = 2022 (yr)
Returned Error Message: Object reentered
08 29 2019; 17:16:24PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2019.900000 (yr)
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.008030 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 3.690623 (yr)
Time Spent in LEO during Lifetime = 3.690623 (yr)
Last year of Propagation = 2023 (yr)
Returned Error Message: Object reentered
08 29 2019; 17:16:36PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2019.900000 (yr)
Perigee Altitude = 505.000000 (km)
Apogee Altitude = 505.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.021500 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 2.321697 (yr)
Time Spent in LEO during Lifetime = 2.321697 (yr)
Last year of Propagation = 2022 (yr)
Returned Error Message: Object reentered