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

2015

Orbital Debris Assessment Report

LEMUR CUBESAT CONSTELLATION

PREPARED BY: SPIRE GLOBAL, INC

Summarized List of Compliance Status to Orbital Debris Requirements

For convenience, below is a summarized list of the compliance status to orbital debris requirements. Detailed explanations for each of these compliance statements are available in ODAR Sections 1 through 8.

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:	N/A
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
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 postmission disposal operations:	N/A
4.8-1, Collision Hazards of Space Tethers	N/A

ODAR Section 1: Program Management and Mission Overview

<table>
<tr><td>Program / Project Manager</td><td>Peter Platzer</td></tr>
<tr><td>Mission Description</td><td>The purpose of the LEMUR nanosatellite fleet is to provide high-revisit maritime domain monitoring data and GPS-Radio Occultation data. The mission consists of a set of 175 3U Cubesats satellites launched over the course of 2 years as secondary payloads on a series of many separate launch vehicles into various orbital planes, the result being a distributed constellation to improve average revisit time globally.</td></tr>
<tr><td>Foreign Government Involvement</td><td>None</td></tr>
<tr><td>Project Milestones:
Proposed Launch Date:
Proposed Launch Vehicles:
Proposed Launch Sites:
Launch Vehicle Operator:</td><td>LEMUR satellites will be launched typically 2 to 8 at a time; this will be dependent on the orbital characteristics, the launch vehicle reliability as well as schedule certainty. As a result of launching a small number of satellites at a time, Spire will have an extensive launch manifest in order to reach the full constellation of 175 satellites. Because of the nature of the secondary payload market, there is limited control over the future planning of the launches; launches will be booked as they become available, typically within a year of launch.

While the specific launches and schedule remain TBD, the bounding orbital characteristics of the constellation are known. All LEMUR satellites will be launched to an altitude of 650km or lower, with inclinations ranging from equatorial to polar sun-synchronous. Most secondary opportunities currently available to cubesats are to 500km SSO or 600km SSO orbits. Spire will also be interested in mid inclinations and equatorial orbits. The table below includes a set of the orbital planes that are desired from the constellation performance standpoint; these planes are also representative of the available launch opportunities for secondary cubesat payloads in the timeframe desired.

<table>
<tr><th>Number of Satellites</th><th>Altitude</th><th>Inclination</th></tr>
<tr><td>~60</td><td>500 km</td><td>~98 deg</td></tr>
<tr><td>~55</td><td>600 km</td><td>~98 deg</td></tr>
<tr><td>~40</td><td>500 km</td><td>~52 deg</td></tr>
<tr><td>~20</td><td>500km</td><td>~ 0-10 deg</td></tr>
<tr><td>Upper and Lower Limit</td><td>400km (ISS) – 650 km</td><td>51.6 deg – ~6 deg</td></tr>
</table>
</td></tr>
<tr><td>Mission Duration:</td><td>The operational lifetime of each satellite is estimated to be up to 2 years following</td></tr>
</table>

	deployment from the launch vehicle. The orbital lifetime for the constellation is nominally expected to be between 5-8 years, depending on the vehicle's orbit, as described in Section 6.
Launch / Deployment Profile:	**Launch** LEMUR satellites will be injected directly into the target orbits outlined in the table above. **Checkout** For up to 1 month following deployment into orbit, LEMUR satellites will remain in checkout phase. During this phase, ground operators will verify correct operation of the satellite and its payloads, and prepare it for the operational phase. **Operations** The operational phase of the satellite begins following the successful deployment of the satellite from the launch vehicle, and successful checkout. **Postmission Disposal** Following the end of the operational phase, the satellites will remain on orbit in a non-transmitting mode while the orbit of the satellite passively decays until the satellite reenters the atmosphere and disintegrates. The satellite is nominally expected to reenter the atmosphere 10 years following deployment from the launch vehicle.
Selection of Orbit:	The selection of orbits was made due to payload capability, available launch opportunities and orbital lifetime considerations.
Potential Physical Interference with Other Orbiting Object:	As the satellite does not have any propulsion systems, its orbit 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 satellite complies with Requirement 4.5.

ODAR Section 2: Spacecraft Description

Physical Description:

Property	Value
Total Mass at Launch	4.5kg
Dry Mass at Launch	4.5kg
Form Factor	3U CubeSat
COG	<3cm radius from geometric center
Envelope (stowed)	100mm x 100mm x 340.5mm (excluding dynamic envelope)
Envelope (deployed)	1m x 1m x 300mm
Propulsion Systems	None
Fluid Systems	None
AOCS	Stabilization/pointing with 3x orthogonal reaction wheels, desaturation + coarse pointing with magnetorquers, GPS navigation
Range Safety / Pyrotechnic Devices	None
Electrical Generation	Triple-junction GaAs solar panels
Electrical Storage	Rechargeable lithium-polymer battery pack
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 2.0.2 log demonstrating the compliance to the above requirements is available in Appendix A – “DAS 2.0.2 Log”.

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

Potential causes for spacecraft breakup:

There are only two plausible causes for breakup of the satellites:

- energy released from onboard batteries, and
- mechanical failure of the reaction wheels

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

The batteries aboard the satellites are two 42Wh Lithium-Polymer batteries, and represent the only credible failure mode during which stored energy is released. The main failure modes associated with Lithium Polymer batteries result from overcharging, over-discharging, internal shorts, and external shorts.

The battery pack onboard LEMUR 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.

The only failure mode of the reaction wheel assemblies that could lead to creation of debris would be breakup of the wheels themselves due to mechanical failure while operating at a high angular rate. Risk mitigation strategies for breakups due to the reaction wheels include limiting the maximum rotational speed of the wheels, and containing them within a sealed compartment.

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

There is no planned breakup the satellites on-orbit.

List of components passivated at EOM:

At the end of mission, the only components that will require passivation are the reaction wheels. At the end of the mission, the reaction wheels will be de-spun to passivate.

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: There are no planned breakups of any of the satellites.	**COMPLIANT**
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 2.0.2 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 2.0.2 log demonstrating the compliance to the above requirements is available in Appendix A – “DAS 2.0.2 Log”.

ODAR Section 6: Assessment of Spacecraft Postmission 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 LEMUR 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.

Drag area from deployed antennas (2x 0.5m whip antennas, 3x 0.3m whip antennas) was neglected; as such, the effective area-to-mass calculated below is a conservative case.

Table 1 - Area-to-Mass Ratio of LEMUR-2 Satellites in Various Mission Scenarios

Scenario	Description	Effective Area-to-Mass (m2/kg)
Satellite Nonfunctional	▪ Solar arrays deploy only after 5 years ▪ Satellite tumbles randomly	0.0000 (yrs 1-5)[1] 0.0169 (yrs 5+)
Solar panel failure	▪ Solar panels fail to deploy ▪ Satellite maintains +Z axis nadir ▪ Position around Z axis as planned for mission operations	0.0130
Operational, nominal	▪ Solar panels deploy ▪ Satellite maintains +Z axis nadir ▪ Position around Z axis as planned for mission operations	0.0208
ADCS Nonfunctional	▪ Solar arrays deploy ▪ Satellite tumbles randomly	0.0169

[1] For the analysis, it was conservatively assumed that the satellite does not lose any altitude during the first 5 years (ie, an area of 0).

Table 2 shows the simulated orbital dwell time for a LEMUR satellite in each of the planned orbits of the constellation, in each of the identified mission scenarios. In all mission scenarios and orbits, the dwell time of the satellite was simulated using DAS 2.0.2 software to be less than 20 years.

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

		Orbital Lifetime (Years)				
Description	**Effective Area-to-Mass (m2/kg)**	**600 km Sun-Synchronous**	**500 km Sun-Synchronous**	**500 km Mid Inclination**	**Upper Bound**	**Lower Bound**
		600km x 600km, 98 deg	500km x 500km, 98 deg	500km x 500km, ~52 deg	650km x 650km, 6 deg	400km x 400km, ~52 deg
Satellite Nonfunctional	**0.0074**	**19.8**	**7.1**	**7.2**	**23.8**[2]	**1.0**
Solar panels failure	0.0130	11.1	6.1	6.1	23.2	0.5
ADCS Nonfunctional	0.0169	9.0	5.0	5.7	18.8	0.3
Operational, Nominal	**0.0208**	**8.3**	**5.6**	**5.2**	**17.3**	**0.4**

Identification of Systems Required for Postmission Disposal: None

Plan for Spacecraft Maneuvers required for Postmission 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**

[2] No decay in first 5 years, after that deployment of antenna and solar panel due to decay of nylon filament with an effective area/mass of 0.0169 m2/kg

4.6-3, Disposal for space structures between LEO and GEO:	**N/A**
4.6-4, Reliability of postmission 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 (g)	Shape	Size (mm)
Solar Panels (long)	Glass, GaAs, FR4 PCB	6	150	Flat Plate	100 x 300
GPS Antenna (large)	Aluminum	1	450	Box	300 x 80 x 8
GPS Antenna (small)	Aluminum	1	50	Box	50 x 50 x 17
Subsystem PCBs	FR4 PCB	12	80	Flat Plate	90 x 90
Primary Structure	Aluminum	1	560	Box	100 x 100 x 300
Optical Camera	Aluminum, FR4 PCB, Glass	1	350	Cylinder	30 x 100
Reaction wheel assembly + enclosure	Aluminum, copper, FR4 PCB	1	600	Box	100 x 100 x 56
Battery pack	Li-Polymer	2	470	Box	80 x 60 x 40

Summary of objects expected to survive an uncontrolled reentry (using DAS 2.0.2 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 2.0.2 log demonstrating the compliance to Requirement 4.7-1 is available in Appendix A – “DAS 2.0.2 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 postmission disposal: N/A

Probability of tether colliding with large space objects: N/A

Probability of tether being severed during mission or after postmission 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**

Appendix A: DAS 2.0.2 Log

Below is the log of the DAS 2.0.2 simulation performed to demonstrate compliance to the above requirements.

```
04 22 2015; 22:49:55PM     DAS Application Started
04 22 2015; 22:49:57PM     Opened Project C:\Program Files (x86)\NASA\DAS
2.0\project\
04 22 2015; 22:50:57PM     Opened Project
C:\Users\nanosatisfi\Downloads\ODAR-2015-04-22\ODAR\
04 22 2015; 22:51:47PM     Science and Engineering - Orbit Lifetime/Dwell
Time

**INPUT**

      Start Year = 2015.500000 (yr)
      Perigee Altitude = 500.000000 (km)
      Apogee Altitude = 500.000000 (km)
      Inclination = 51.600000 (deg)
      RAAN = 0.000000 (deg)
      Argument of Perigee = 0.000000 (deg)
      Area-To-Mass Ratio = 0.007400 (m^2/kg)

**OUTPUT**

      Orbital Lifetime from Startyr = 7.178645 (yr)
      Time Spent in LEO during Lifetime  = 7.178645 (yr)
      Last year of Propagation = 2022 (yr)
      Returned Error Message: Object reentered
04 22 2015; 22:52:41PM     Science and Engineering - Orbit Lifetime/Dwell
Time

**INPUT**

      Start Year = 2015.500000 (yr)
      Perigee Altitude = 500.000000 (km)
      Apogee Altitude = 500.000000 (km)
      Inclination = 51.600000 (deg)
      RAAN = 0.000000 (deg)
      Argument of Perigee = 0.000000 (deg)
      Area-To-Mass Ratio = 0.013000 (m^2/kg)

**OUTPUT**

      Orbital Lifetime from Startyr = 6.121834 (yr)
      Time Spent in LEO during Lifetime  = 6.121834 (yr)
      Last year of Propagation = 2021 (yr)
      Returned Error Message: Object reentered
04 22 2015; 22:52:51PM     Science and Engineering - Orbit Lifetime/Dwell
Time
```

INPUT

Start Year = 2015.500000 (yr)
Perigee Altitude = 500.000000 (km)
Apogee Altitude = 500.000000 (km)
Inclination = 51.600000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.016900 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 5.700205 (yr)
Time Spent in LEO during Lifetime = 5.700205 (yr)
Last year of Propagation = 2021 (yr)
Returned Error Message: Object reentered
04 22 2015; 22:53:02PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2015.500000 (yr)
Perigee Altitude = 500.000000 (km)
Apogee Altitude = 500.000000 (km)
Inclination = 51.600000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.020800 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 5.212868 (yr)
Time Spent in LEO during Lifetime = 5.212868 (yr)
Last year of Propagation = 2020 (yr)
Returned Error Message: Object reentered
04 22 2015; 22:53:24PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2015.500000 (yr)
Perigee Altitude = 600.000000 (km)
Apogee Altitude = 600.000000 (km)
Inclination = 98.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.020800 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 8.268309 (yr)

Time Spent in LEO during Lifetime = 8.268309 (yr)
Last year of Propagation = 2023 (yr)
Returned Error Message: Object reentered
04 22 2015; 22:53:38PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2015.500000 (yr)
Perigee Altitude = 600.000000 (km)
Apogee Altitude = 600.000000 (km)
Inclination = 98.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.016900 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 8.974675 (yr)
Time Spent in LEO during Lifetime = 8.974675 (yr)
Last year of Propagation = 2024 (yr)
Returned Error Message: Object reentered
04 22 2015; 22:53:46PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2015.500000 (yr)
Perigee Altitude = 600.000000 (km)
Apogee Altitude = 600.000000 (km)
Inclination = 98.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.013000 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 11.082820 (yr)
Time Spent in LEO during Lifetime = 11.082820 (yr)
Last year of Propagation = 2026 (yr)
Returned Error Message: Object reentered
04 22 2015; 22:53:57PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2015.500000 (yr)
Perigee Altitude = 600.000000 (km)
Apogee Altitude = 600.000000 (km)
Inclination = 98.000000 (deg)
RAAN = 0.000000 (deg)

```
      Argument of Perigee = 0.000000 (deg)
      Area-To-Mass Ratio = 0.007400 (m^2/kg)

**OUTPUT**

      Orbital Lifetime from Startyr = 19.805613 (yr)
      Time Spent in LEO during Lifetime  = 19.805613 (yr)
      Last year of Propagation = 2035 (yr)
      Returned Error Message: Object reentered
04 22 2015; 22:55:47PM     Mission Editor Changes Applied
04 22 2015; 22:56:24PM     Mission Editor Changes Applied
04 22 2015; 22:56:28PM     Project Data Saved To File
04 22 2015; 22:56:48PM     Processing Requirement 4.3-1:    Return Status :
Not Run

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

=============== End of Requirement 4.3-1 ===============
04 22 2015; 22:56:51PM     Processing Requirement 4.3-2: Return Status :
Passed

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

=============== End of Requirement 4.3-2 ===============
04 22 2015; 22:56:53PM     Requirement 4.4-3:  Compliant

=============== End of Requirement 4.4-3 ===============
04 22 2015; 22:57:01PM     Processing Requirement 4.5-1:    Return Status :
Passed

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

**INPUT**

      Space Structure Name = Lemur2_650Equatorial
      Space Structure Type = Payload
      Perigee Altitude = 650.000000 (km)
      Apogee Altitude = 650.000000 (km)
      Inclination = 6.000000 (deg)
      RAAN = 0.000000 (deg)
      Argument of Perigee = 0.000000 (deg)
      Mean Anomaly = 0.000000 (deg)
      Final Area-To-Mass Ratio = 0.020800 (m^2/kg)
      Start Year = 2015.500000 (yr)
      Initial Mass = 4.500000 (kg)
```

Final Mass = 4.500000 (kg)
Duration = 17.300000 (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

==========

INPUT

Space Structure Name = Lemur2_600SSO
Space Structure Type = Payload
Perigee Altitude = 600.000000 (km)
Apogee Altitude = 600.000000 (km)
Inclination = 97.800000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.020800 (m^2/kg)
Start Year = 2015.500000 (yr)
Initial Mass = 4.500000 (kg)
Final Mass = 4.500000 (kg)
Duration = 8.300000 (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

==========

INPUT

Space Structure Name = Lemur2_500km52deg
Space Structure Type = Payload
Perigee Altitude = 500.000000 (km)
Apogee Altitude = 500.000000 (km)
Inclination = 51.600000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.020800 (m^2/kg)
Start Year = 2015.500000 (yr)
Initial Mass = 4.500000 (kg)
Final Mass = 4.500000 (kg)
Duration = 5.200000 (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 ==========
04 22 2015; 22:57:09PM Requirement 4.5-2: Compliant
04 22 2015; 22:57:12PM Processing Requirement 4.6 Return Status : Passed

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

INPUT

Space Structure Name = Lemur2_650Equatorial
Space Structure Type = Payload

Perigee Altitude = 650.000000 (km)

```
      Apogee Altitude = 650.000000 (km)
      Inclination = 6.000000 (deg)
      RAAN = 0.000000 (deg)
      Argument of Perigee = 0.000000 (deg)
      Mean Anomaly = 0.000000 (deg)
      Area-To-Mass Ratio = 0.020800 (m^2/kg)
      Start Year = 2015.500000 (yr)
      Initial Mass = 4.500000 (kg)
      Final Mass = 4.500000 (kg)
      Duration = 17.300000 (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 = 650.000000 (km)
      Suggested Apogee Altitude = 650.000000 (km)
      Returned Error Message = Reentry during mission (no PMD req.).

      Released Year = 2032 (yr)
      Requirement = 61
      Compliance Status = Pass

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

**INPUT**

      Space Structure Name = Lemur2_600SSO
      Space Structure Type = Payload

      Perigee Altitude = 600.000000 (km)
      Apogee Altitude = 600.000000 (km)
      Inclination = 97.800000 (deg)
      RAAN = 0.000000 (deg)
      Argument of Perigee = 0.000000 (deg)
      Mean Anomaly = 0.000000 (deg)
      Area-To-Mass Ratio = 0.020800 (m^2/kg)
      Start Year = 2015.500000 (yr)
      Initial Mass = 4.500000 (kg)
      Final Mass = 4.500000 (kg)
      Duration = 8.300000 (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 = 600.000000 (km)
Suggested Apogee Altitude = 600.000000 (km)
Returned Error Message = Reentry during mission (no PMD req.).

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

==========

INPUT

Space Structure Name = Lemur2_500km52deg
Space Structure Type = Payload

Perigee Altitude = 500.000000 (km)
Apogee Altitude = 500.000000 (km)
Inclination = 51.600000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Area-To-Mass Ratio = 0.020800 (m^2/kg)
Start Year = 2015.500000 (yr)
Initial Mass = 4.500000 (kg)
Final Mass = 4.500000 (kg)
Duration = 5.200000 (yr)
Station Kept = False
Abandoned = True
PMD Perigee Altitude = 248.048791 (km)
PMD Apogee Altitude = 256.789865 (km)
PMD Inclination = 51.571325 (deg)
PMD RAAN = 7.848664 (deg)
PMD Argument of Perigee = 74.605471 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Suggested Perigee Altitude = 248.048791 (km)
Suggested Apogee Altitude = 256.789865 (km)
Returned Error Message = Passes LEO reentry orbit criteria.

Released Year = 2020 (yr)
Requirement = 61

```
      Compliance Status = Pass


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

=============== End of Requirement 4.6 ===============
04 22 2015; 22:58:19PM     *********Processing Requirement 4.7-1
      Return Status :  Passed

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

name = Lemur2_650Equatorial
quantity = 1
parent = 0
materialID = 5
type = Box
Aero Mass = 4.500000
Thermal Mass = 4.500000
Diameter/Width = 0.100000
Length = 0.340000
Height = 0.100000

name = Structure_tray
quantity = 2
parent = 1
materialID = 9
type = Box
Aero Mass = 0.200000
Thermal Mass = 0.200000
Diameter/Width = 0.100000
Length = 0.340000
Height = 0.005000

name = Structure_ribs
quantity = 10
parent = 1
materialID = 9
type = Box
Aero Mass = 0.010000
Thermal Mass = 0.010000
Diameter/Width = 0.012000
Length = 0.083000
Height = 0.006000

name = Structure_mountingplates
quantity = 5
parent = 1
materialID = 9
type = Flat Plate
Aero Mass = 0.100000
```

```
Thermal Mass = 0.100000
Diameter/Width = 0.080000
Length = 0.100000

name = PCB
quantity = 15
parent = 1
materialID = 23
type = Flat Plate
Aero Mass = 0.080000
Thermal Mass = 0.080000
Diameter/Width = 0.080000
Length = 0.080000

name = Lenses
quantity = 2
parent = 1
materialID = 9
type = Cylinder
Aero Mass = 0.200000
Thermal Mass = 0.200000
Diameter/Width = 0.030000
Length = 0.120000

name = Reaction Wheels
quantity = 3
parent = 1
materialID = 67
type = Cylinder
Aero Mass = 0.120000
Thermal Mass = 0.120000
Diameter/Width = 0.030000
Length = 0.020000

name = solar_panels
quantity = 6
parent = 1
materialID = 23
type = Flat Plate
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.083000
Length = 0.324000

name = solar_cells
quantity = 61
parent = 1
materialID = 24
type = Flat Plate
Aero Mass = 0.015000
Thermal Mass = 0.015000
```

```
Diameter/Width = 0.040000
Length = 0.080000

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

name = Lemur2_650Equatorial
Demise Altitude = 77.996621
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Structure_tray
Demise Altitude = 76.444527
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Structure_ribs
Demise Altitude = 77.121871
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Structure_mountingplates
Demise Altitude = 75.443886
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PCB
Demise Altitude = 76.127535
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Lenses
Demise Altitude = 72.843566
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Reaction Wheels
Demise Altitude = 0.000000
Debris Casualty Area = 1.169982
Impact Kinetic Energy = 202.520203

************************************
name = solar_panels
Demise Altitude = 77.271605
Debris Casualty Area = 0.000000
```

```
Impact Kinetic Energy = 0.000000

************************************
name = solar_cells
Demise Altitude = 77.747871
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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

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

name = Lemur2_600SSO
quantity = 1
parent = 0
materialID = 9
type = Box
Aero Mass = 4.500000
Thermal Mass = 4.500000
Diameter/Width = 0.100000
Length = 0.340000
Height = 0.100000

name = Lemur2_600SSO
quantity = 1
parent = 1
materialID = 9
type = Box
Aero Mass = 4.500000
Thermal Mass = 4.500000
Diameter/Width = 0.100000
Length = 0.340000
Height = 0.100000

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

name = Lemur2_600SSO
Demise Altitude = 77.998722
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Lemur2_600SSO
Demise Altitude = 66.439011
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
```

```
************************************

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

name = Lemur2_500km52deg
quantity = 1
parent = 0
materialID = 9
type = Box
Aero Mass = 4.500000
Thermal Mass = 4.500000
Diameter/Width = 0.100000
Length = 0.340000
Height = 0.100000

name = Lemur2_500km52deg
quantity = 1
parent = 1
materialID = 9
type = Box
Aero Mass = 4.500000
Thermal Mass = 4.500000
Diameter/Width = 0.100000
Length = 0.340000
Height = 0.100000

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

name = Lemur2_500km52deg
Demise Altitude = 77.993738
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Lemur2_500km52deg
Demise Altitude = 65.304866
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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

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

11 23 2015; 18:34:55PM DAS Application Started
11 23 2015; 18:34:56PM Opened Project C:\Users\jspark\Desktop\Lemur-2\ODAR\
11 23 2015; 18:35:04PM Processing Requirement 4.3-1:  Return Status :  Not Run
====================
No Project Data Available
```

```
====================
============== End of Requirement 4.3-1 ==============
11 23 2015; 18:36:25PM Mission Editor Changes Applied
11 23 2015; 18:36:47PM Processing Requirement 4.3-1:  Return Status :  Not Run
====================
No Project Data Available
====================
============== End of Requirement 4.3-1 ==============
11 23 2015; 18:36:51PM Processing Requirement 4.3-2: Return Status : Passed
====================
No Project Data Available
====================
============== End of Requirement 4.3-2 ==============
11 23 2015; 18:36:53PM Requirement 4.4-3:  Compliant
============== End of Requirement 4.4-3 ==============
11 23 2015; 18:36:57PM Processing Requirement 4.5-1:  Return Status :  Passed
==============
Run Data
==============
**INPUT**
        Space Structure Name = Lemur2_500kmSSO
        Space Structure Type = Payload
        Perigee Altitude = 500.000000 (km)
        Apogee Altitude = 500.000000 (km)
        Inclination = 98.000000 (deg)
        RAAN = 0.000000 (deg)
        Argument of Perigee = 0.000000 (deg)
        Mean Anomaly = 0.000000 (deg)
        Final Area-To-Mass Ratio = 0.013000 (m^2/kg)
        Start Year = 2015.500000 (yr)
        Initial Mass = 4.500000 (kg)
        Final Mass = 4.500000 (kg)
        Duration = 7.100000 (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 = Lemur2_400km51deg
        Space Structure Type = Payload
        Perigee Altitude = 400.000000 (km)
        Apogee Altitude = 400.000000 (km)
        Inclination = 51.600000 (deg)
        RAAN = 0.000000 (deg)
        Argument of Perigee = 0.000000 (deg)
        Mean Anomaly = 0.000000 (deg)
        Final Area-To-Mass Ratio = 0.013000 (m^2/kg)
```

```
        Start Year = 2015.500000 (yr)
        Initial Mass = 4.500000 (kg)
        Final Mass = 4.500000 (kg)
        Duration = 1.000000 (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**
        Collision Probability = 0.000000
        Returned Error Message: Normal Processing
        Date Range Error Message: Normal Date Range
        Status = Pass
==============
=============== End of Requirement 4.5-1 ===============
11 23 2015; 18:37:04PM Requirement 4.5-2:  Compliant
11 23 2015; 18:37:06PM Processing Requirement 4.6    Return Status :  Passed
==============
Project Data
==============
**INPUT**
        Space Structure Name = Lemur2_500kmSSO
        Space Structure Type = Payload
        Perigee Altitude = 500.000000 (km)
        Apogee Altitude = 500.000000 (km)
        Inclination = 98.000000 (deg)
        RAAN = 0.000000 (deg)
        Argument of Perigee = 0.000000 (deg)
        Mean Anomaly = 0.000000 (deg)
        Area-To-Mass Ratio = 0.013000 (m^2/kg)
        Start Year = 2015.500000 (yr)
        Initial Mass = 4.500000 (kg)
        Final Mass = 4.500000 (kg)
        Duration = 7.100000 (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 = 500.000000 (km)
        Suggested Apogee Altitude = 500.000000 (km)
        Returned Error Message = Reentry during mission (no PMD req.).
        Released Year = 2021 (yr)
        Requirement = 61
        Compliance Status = Pass
==============
**INPUT**
        Space Structure Name = Lemur2_400km51deg
        Space Structure Type = Payload
```

```
        Perigee Altitude = 400.000000 (km)
        Apogee Altitude = 400.000000 (km)
        Inclination = 51.600000 (deg)
        RAAN = 0.000000 (deg)
        Argument of Perigee = 0.000000 (deg)
        Mean Anomaly = 0.000000 (deg)
        Area-To-Mass Ratio = 0.013000 (m^2/kg)
        Start Year = 2015.500000 (yr)
        Initial Mass = 4.500000 (kg)
        Final Mass = 4.500000 (kg)
        Duration = 1.000000 (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 = 400.000000 (km)
        Suggested Apogee Altitude = 400.000000 (km)
        Returned Error Message = Reentry during mission (no PMD req.).
        Released Year = 2016 (yr)
        Requirement = 61
        Compliance Status = Pass
==============
=============== End of Requirement 4.6 ===============
```