# Exhibit B – Honeybee-00 Orbital Debris Assessment Report (ODAR)

This report is presented as compliance with NASA-STD-8719.14 Revision C

DAS Software Version: v 3.2.6

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This document conforms to the format prescribed in NASA-STD-8719.14b Appendix A.1. The document accurately compiles the information and analyses with regards to sections 1 through 7. Section 8 applies to tether missions and is not included here. Sections 9 through 14 apply to launch vehicle ODAR and hence are not included here. The document does not contain any proprietary, confidential, ITAR or export-controlled information.

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**ODAR Section 1: Program Management and Mission Overview**

**A. Project Manager:**

Eiji Yafuso

**B. Foreign government or space agency participation:**

No foreign government or space agency participation is anticipated.

**C. Schedule of upcoming mission milestones:**

Launch: Anticipated SpaceX Transporter or other rideshare launch no earlier than October 1, 2025.

**D. Mission Overview:**

This ODAR applies to the Honeybee-00 satellite. Honeybee-00 is a remote sensing satellite demonstrating technical capability to capture images in V-NIR and SWIR spectrums. Honeybee-00 satellite will be launched to a nominal altitude of 500 km.

This ODAR applies to the 'Honeybee-00' satellite. 'Honeybee-00' is a technology demonstration spacecraft custom-built according to Pixxel's needs.

The mission objectives are as follows:

- Demonstrate the capability of low power, low-weight, miniaturized hyperspectral camera with V-NIR and SWIR imaging capability in-orbit.
- Assess the longevity and durability of the low-power hyperspectral camera in-orbit.
- Provide commercial Earth Exploration data services.

The satellite bus uses reaction wheels, magnetic torque coils, magnetometers, sun sensors, and gyroscopes to enable precision 3-axis pointing.

Honeybee-00 is scheduled to launch aboard a Space X Transporter mission to 500 km +/- 20 km. At this altitude Honeybee-00 will station keep in SSO for five years. After 5 years, Honeybee-00 will perform a post mission disposal maneuver via its electric propulsion system, lowering the spacecraft's perigee and apogee to ~350 km. This deorbit maneuver will be paused as the vehicle passes the ISS and resumed thereafter. After this maneuver the spacecraft will deorbit in less than six months.

**E. Launch Vehicle and Launch Site:**

Honeybee-00 is expected to launch on a SpaceX Falcon 9, from the Cape Canaveral Space Force Station, Florida, U.S.A.

**F. Proposed Launch Date and Mission Duration:**

Current launch is expected to be no earlier than October 1, 2025. Mission duration is notionally 5 years.

**G. Launch and deployment profile:**

*(including all parking, transfer, and operational orbits with apogee, perigee, and inclination)*

The Honeybee-00 spacecraft will be deployed into a Sun-synchronous Low Earth orbit.

The Honeybee-00 spacecraft will deploy solar panels once released from the Falcon-9 upper stage. The spacecraft is expected to be deployed notionally into an orbit with the following orbital parameters:

- Expected Orbital Altitude : 500 +/-20 km
- Eccentricity : ~ 0.00 km
- Inclination : 97.5° ± 1.0°
- LTAN / LTDN: To be defined by SpaceX Transporter-X, expected 10:30am +/- 10 mins.

The expected profile will be to deploy and station-keep for 5 years, then passively deorbit (i.e. station keeping will cease such that passive decay begins while the satellite is at an orbit altitude between 500-480 km). This passive deorbit will allow for less than five-year

post mission cessation deorbit of the spacecraft. The figure below provides the time for deorbit from 500 km.

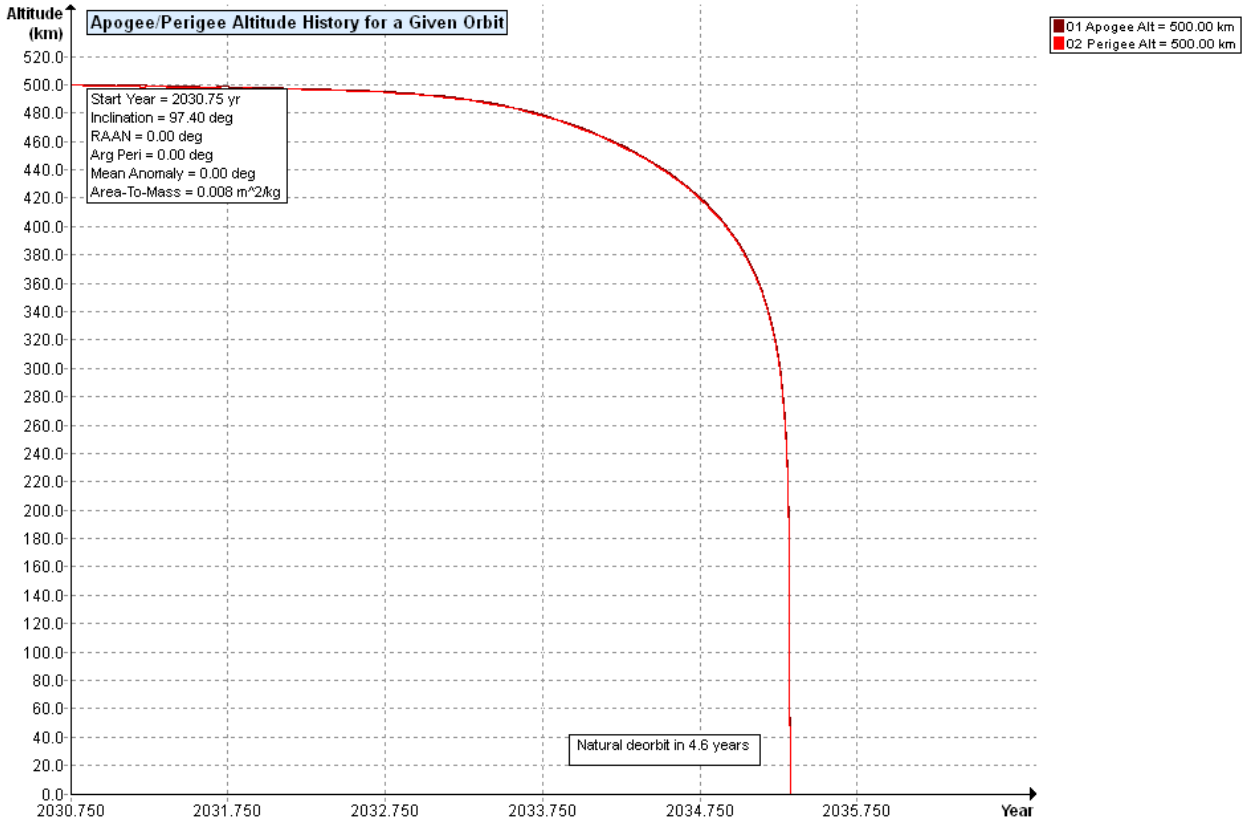



*Figure 1: Orbital Decay form 500 km post mission cessation.*

To speed this process up, Pixxel may, at its discretion, elect to perform a post-mission disposal maneuver (from ~500 km circular to approximately 350 km circular). This maneuver will be ceased once the satellite is in proximity of the ISS and then restart once past the ISS altitude 'box.'

In the unexpected event that the spacecraft fails in orbit, and does not station keep, the spacecraft will go through natural orbital decay and deorbit in less than 5.26 years at the worst-case altitude of 520 km, as shown below in Figure 2.

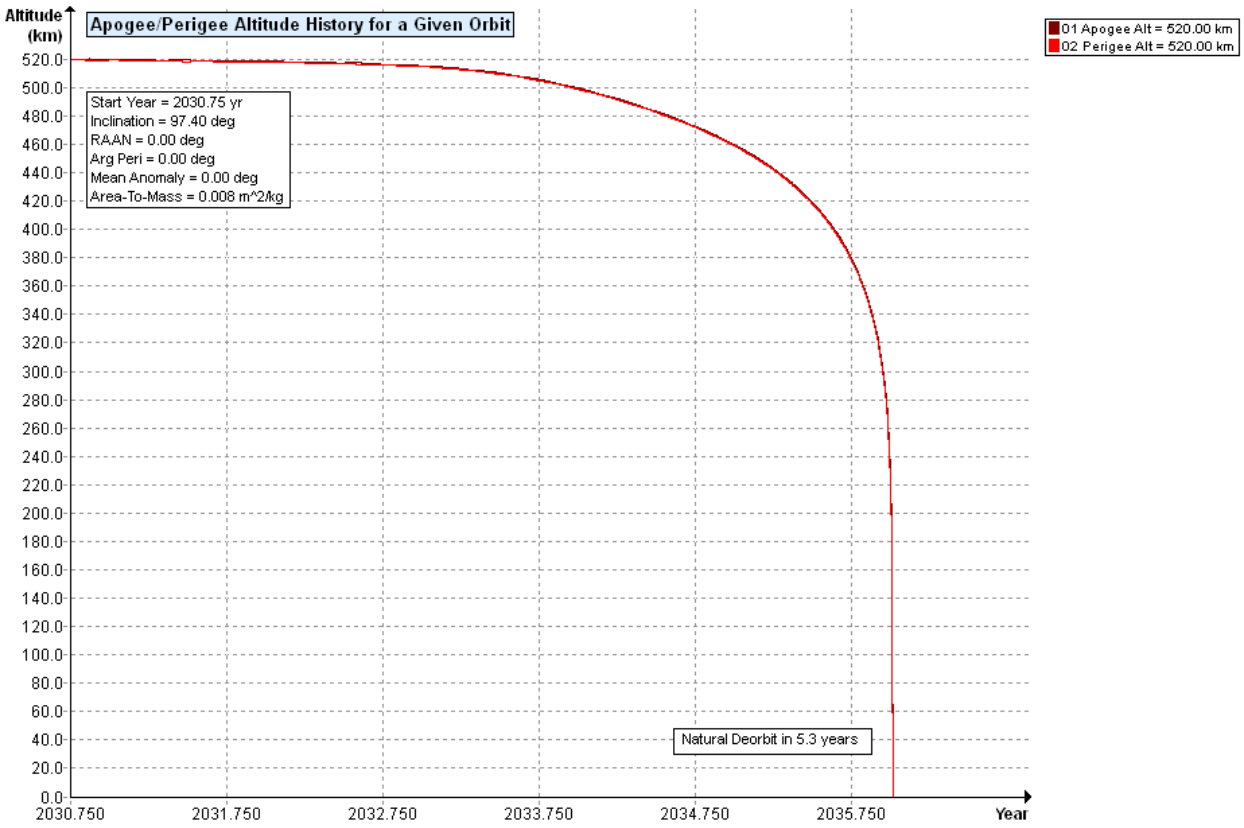



*Figure 2: Natural altitude decay from 520 km worst case deployment with arrays deployed.*[1]

**H. Reason for selection of operational orbit(s):**

Since the Honeybee-00 mission is an Earth observation mission, a LEO orbit was chosen to have better image quality. The SSO is chosen to ensure consistency among images as well as to help satisfy the stringent power requirements of a typical smallsat mission.

**I. Identification of any interaction or potential physical interference with other operational spacecraft:**

No such interaction is planned.

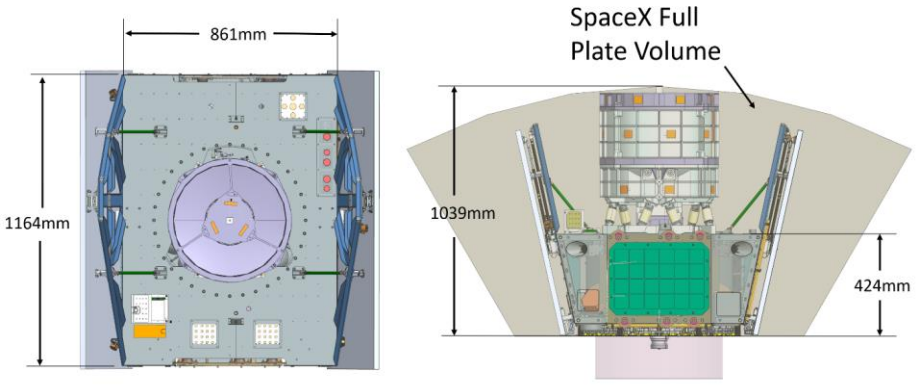
[1] T*he start year is* incorrectly *identified as 2030 due to an error in DAS causing inverted graphs with 2025 start date. This start date does not constitute a significant difference.*

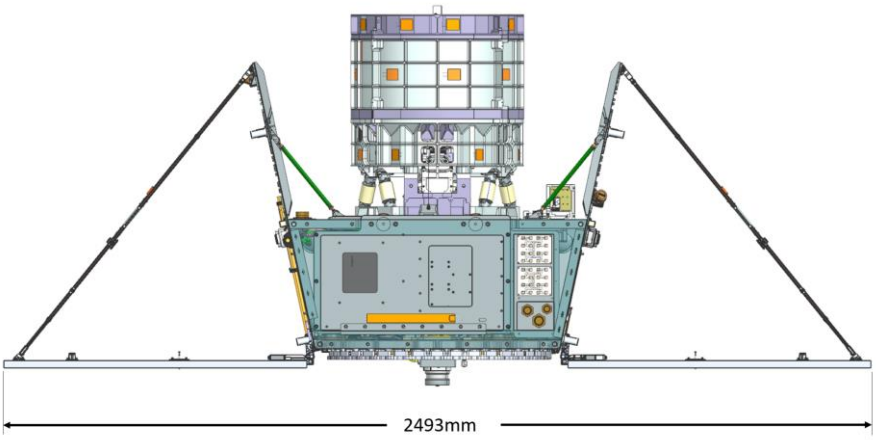
**ODAR Section 2: Spacecraft Description**

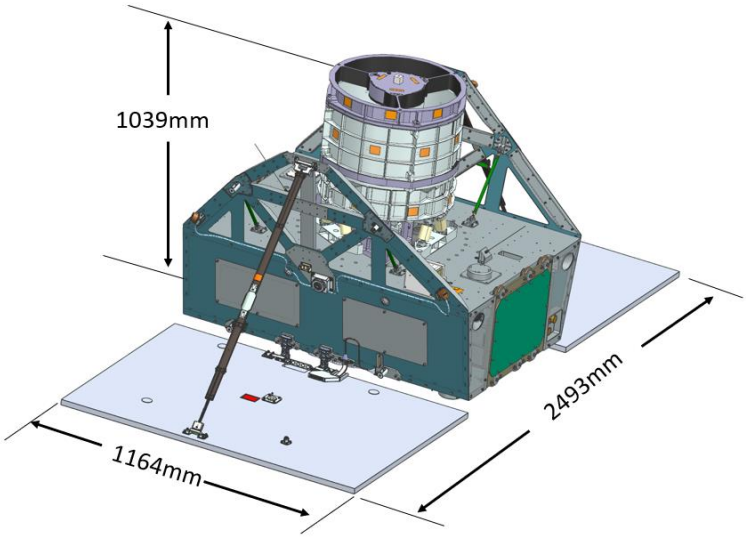
## A. Physical description of the spacecraft:

The Honeybee-00 spacecraft is a custom-sized microsatellite. The satellite bus is an aluminum alloy-based structure which measures ~1200 mm x 2500 mm x 1050 mm. The structure consists of four side panels, a top deck and a bottom deck. The panels and the decks have ridges as supporting structures. The bus holds external components such as the camera and 2 deployable solar panels. In the stowed position the satellite bounding box measures ~1200 mm x 1000 mm x 1050 mm. The satellite has an expected mass of 190 ± 10 kg. The satellite bus holds multiple internal components mounted on to the panels via M3, M4 and M5 screws. The satellite houses a xenon fueled electric propulsion system. The solar panels are deployed using a low shock hold down release mechanism that deploys the panels about 2 minutes after the spacecraft is ejected from the launch vehicle.

## B. Detailed illustration of the entire spacecraft:






**C. Total spacecraft mass at launch, including all propellants and fluids:**

202.073 kg

**D. Dry mass of spacecraft at launch, excluding solid rocket motor propellants:**

195.61 kg

**E. Description of all propulsion systems:**

The Honeybee-00 satellite consists of an electrical propulsion system - 'ASTRA Spacecraft Engine (ASE)'. The ASE thruster is a Hall effect thruster using 6.45 kg of xenon as its fuel

source. The xenon is pressurized in storage containers. The ASE thruster system produces up to 24mN of thrust using 400W of power.

**F. Identification, including mass and pressure, of all fluids (liquids and gases) planned to be on board and a description of the fluid loading plan or strategies, excluding fluids in sealed heat pipes:**

None.

**G. Description of all fluid systems, including size, type, and qualifications of fluid containers such as propellant and pressurization tanks, including pressurized batteries:**

High Pressure Xenon System:

- The propulsion system includes 6.45 kg/8.8-l of xenon stored in 8 (1.1 l) pressure vessels at a MEOP 1,080 psi of pressure. These containers meet DOT container standards. The pressure vessels can be vented prior to deorbiting to remove this energy from the system.

Batteries:

- The batteries are standard commercial-off-the-shelf ("COTS"), unpressurized lithium-ion battery cells.

**H. Description of all active and/or passive attitude control systems with an indication of the normal attitude of the spacecraft with respect to the velocity vector:**

The guidance, navigation, and control (GNC) subsystem has a sensor suite consisting of star trackers, IMU (containing gyros and accelerometers), GPS receiver, three-axis magnetometer, and sun sensors. The actuator suite consists of chemical thrusters, reaction wheels, and magnetorquers. The GNC subsystem has several operational modes that enable the spacecraft to perform its mission:

- A detumbling mode is used to reduce angular rates below a threshold after launch vehicle separation or after a hardware failure in the GNC subsystem. The magnetometer

is used to sense the orientation of the Earth's magnetic field and the magnetorquers are used to generate torques opposing the rotation of the spacecraft.

- A pointing mode is used to orient the spacecraft in either the velocity, anti-velocity, nadir, ground tracking, or inertially fixed directions. This mode is used for orbit maneuvers, proximity operations, ground communication, and payload activities.
- A safe mode is used to maximize solar power generation while also allowing communications with the ground network. Safe mode is entered either by ground command or autonomously by the flight software when it detects a low battery state of charge. During this mode, the spacecraft will maintain its solar panels pointing toward the sun and will also track selected ground stations when they come within line of sight.

During normal operations, the reaction wheels provide redundant 3-axis attitude control while the magnetorquers are used to maintain wheel speeds below their maximum limits. The nominal spacecraft orientation has the solar panels in the zenith direction (+R for radial), the launch vehicle separation ring in the velocity direction (+T for tangential), and the propulsion system thrusting in the anti-velocity direction (-T).

**I. Description of any range safety or other pyrotechnic devices:**

Space vehicle separation will be accomplished using a debris-free low-shock release system as designed by approved integrators for our launch. The deployer is a debris-free deployment mechanism.

Two split-spool Hold Down and Release Mechanisms (HDRMs) are used for the deployment mechanism for the solar panel. The HDRMs are non-pyrotechnic burn wires, and no debris will be released.

**J. Description of the electrical generation and storage system:**

The spacecraft contains a 24-cell lithium-ion battery with three strings of eight cells each, for a voltage range of 26-33V and capacity of 60 A-hr. Each string is packaged individually with 8 cells held in an aluminum bracket. The LG 18650-MJ1 cells are not pressure vessels.

**K. Identification of any other sources of stored energy not noted above:**

The reaction wheels can store kinetic energy but will be disconnected from power prior to deorbit.

**L. Identification of any radioactive materials onboard or made a positive statement that there are no radioactive materials onboard:**

No radioactive material is onboard the Honeybee-00 spacecraft.

**M. Spacecraft operating in low-Earth orbit will be presumed trackable if each individual spacecraft is 10 cm or larger in its smallest dimension, excluding deployable components:**

The spacecraft will be in low-Earth orbit and has a smallest dimension measuring much greater than 10 cm. Thus, it is trackable.

**N. How the operator plans to identify the spacecraft following deployment and whether spacecraft tracking will be active or passive:**

Spacecraft tracking will be passive and active. Prior to deployment an initial ephemeris is produced by the launch service that will be used to schedule a contact time window with the ground station. The spacecraft will also use a beacon for a brief period after deployment. The accuracy of the ephemeris will depend on the launch vehicle's performance, delays, and deployment times. A more accurate ephemeris will be made available shortly after deployment. After deployment when the satellite establishes contact with the nearest available contracted ground station, active satellite tracking will be employed to enhance and maintain satellite ephemeris data. The collected data will be used to identify the spacecraft from two-line element sets once they become available by the 18th Space Control Squadron.

**O. Whether, prior to deployment, the spacecraft will be registered with the 18th Space Control Squadron or successor entity:**

Prior to deployment, the spacecraft will be registered with the 18th Space Control Squadron via their Satellite Registration Form and Space Situational Awareness (SSA) Sharing Agreement.

**P. The extent to which the spacecraft operator plans to share information regarding initial deployment, ephemeris, and/or planned maneuvers with the 18th Space Control Squadron or successor entity, other entities that engage in space situational awareness or space traffic management functions, and/or other operators:**

Pixxel will provide the 18th Space Control Squadron information regarding initial deployment, owner/operator (O/O) ephemeris, and planned maneuvers. This is intended to provide better space situational awareness and improve the accuracy of conjunction analysis (CA). The higher accuracy O/O ephemeris will improve the quality of the CA and reduce the frequency of Conjunction Data Messages (CDMs). Pixxel will share ephemeris with other operators.

**Q. Planned Proximity Operations:**

There are no planned proximity operations.

**ODAR Section 3: Assessment of Spacecraft Debris Released during Normal Operations**

**A. Identification of any object (>1 mm) expected to be released from the spacecraft any time after launch, including object dimensions, mass, and material:**

Pixxel has assessed the potential for any amount of debris to be released into the space environment under normal satellite operations and has taken all possible spacecraft hardware design and operational planning measures to minimize the possibility of any such orbital debris. There are no planned intentional releases of objects from the Honeybee-00 spacecraft during any mission phase, including deployment, operations, and disposal. The Honeybee-00 spacecraft design does not incorporate any shrouds or covers to be removed upon deployment, and no shrapnel will be generated as a result of the deployment of the

science antennas or solar array. Honeybee-00 spacecraft will utilize a 24” separation system that uses non-explosive actuators and retains all the separation hardware.

**B. Rationale/necessity for release of each object:**

N/A

**C. Time of release of each object, relative to launch time:**

N/A

**D. Release velocity of each object with respect to spacecraft:**

N/A

**E. Expected orbital parameters (apogee, perigee, and inclination) of each object after release:**

N/A

**F. Calculated orbital lifetime of each object, including time spent in Low Earth Orbit (LEO):**

N/A

**G. Assessment of spacecraft compliance with Requirements 4.3-1 and 4.3-2:**

**Requirement 4.3-1. Debris passing through LEO:** For missions leaving debris in orbits passing though LEO, released debris with diameters of 1 mm or larger shall satisfy both Requirement 4.3-1a and Requirement 4.3-1b:

*A. All debris released during the deployment, operation, and disposal phases shall be limited to a maximum orbital lifetime of 25 years from date of release.*

*B. The total object-time product shall be no larger than 100 object-years per mission. The object-time product is the sum of all debris of the total time spent below 2000 km altitude during the orbital lifetime of each object*

- **Compliance Statement:** COMPLIANT. There are no intentional releases.

**Requirement 4.3-2. Debris passing near GEO:** For missions leaving debris in orbits with the potential of traversing GEO (GEO altitude +/- 200 km and +/- 15 degrees latitude), released debris with diameters of 5 cm or greater shall be left in orbits which will ensure that within 25 years after release the apogee will no longer exceed GEO – 200 km.

- **Compliance Statement:** COMPLIANT. Not Applicable.

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

### A. Potential causes of spacecraft breakup during deployment and mission operations

A spacecraft breakup would only occur from a critical electric propulsion system failure, based on the spacecraft architecture. This is mitigated by the following design characteristics:

- Use of DOT certified containers for high pressure fluids.
- Redundant inhibits the propulsion system operation. These inhibits exist in software, power, and hardware such that operation of the propulsion system is safe and minimizes the likelihood of critical failure leading to spacecraft breakup.

### B. Summary of failure modes and effects analyses of all credible failure modes which may lead to an accidental explosion.

The electric propulsion system holds ~6.45 kg of xenon at 1080 psi (8x identical tanks, each with a volume of 1.1 L and designed MEOP of 4000 psi). Three valves separate the thruster with an additional isolation valve separating cathode from propellant supply to prevent propellant leakage and prevent uncommanded thrusting. Five interfaces are mated using VCR or AN fittings. All other interfaces between pressurized volumes are welded. The fill and drain valve for the system contain 2 inhibitors against leakage.

- Flammability — There are no known flammability concerns for xenon.
- Material Compatibility — material compatibility with all ‘wetted’ materials does not pose a hazard with xenon.

**C. Propulsion Hazard Assessment Summary:**

Propulsion System: The risk of an explosion within the propulsion system is extremely low. Standard spacecraft design practices inducing MEOP 2.5x lower than burst pressures protect the system from explosion. Xenon is also non-hypergolic and non-flammable, therefore, any inadvertent fuel leaks or evacuation of the propellant lines would not result in an explosion.

Battery Power System: The battery safety systems are discussed in the assessment of spacecraft compliance with ODAR requirement 4.4-1, which describes the combined faults required for the mutually exclusive failures that lead to battery venting. The batteries are COTS batteries equipped with safety vent features that release excessive pressure build-up, precluding explosions.

**D. Plan for any designed spacecraft breakup:**

There are no planned breakups.

**E. List of components which shall be passivated at EOM including method of passivation and amount which cannot be passivated:**

Propulsion System: Residual propellant will be expended via EOM burns to reduce the orbit altitude as much as possible, as discussed above in Section 1.G. The propulsion system will be operated in the axial thrust mode until the tank pressure drops below ~105 psi. The thrust will cease effectively, at this time. However, we plan to keep the isolation and thruster valves open for several hours, in order to completely vent the propulsion hardware. This ‘vacuum decontamination’ is very effective in removing any residual traces of xenon and pressure from the system.

Reaction Wheels: Reaction wheels will be spun down and the spacecraft will be controlled via torque rods.

Batteries: Batteries will not be passivated due to the low risk and low impact of a cell or cells rupturing and the extremely short lifetime at EOM.

**F. Rationale for Non-Passivation:**

In the unlikely event that a battery cell ruptures, the small size, mass, and potential energy of these batteries is such that debris from the battery rupture would be contained within the vessel due to the lack of penetration energy. Furthermore, by not passivating the batteries, the Honeybee-00 spacecraft can still be commanded in the event that a conjunction warning is received during the final months on orbit.

**G. Assessment of Spacecraft Compliance with Requirements 4.4-1 through 4.4-4**

**Requirement 4.4-1:** Limiting the risk to other space systems from accidental explosions during deployment and mission operations while in orbit about Earth or the Moon.

- *For each spacecraft and launch vehicle orbital stage employed for a mission, the program or project shall demonstrate, via failure mode and effects analyses or equivalent analyses, that the integrated probability of explosion for all credible failure modes of each spacecraft and launch vehicle is less than 0.001 (excluding small particle impacts) (Requirement 56449).*

**Battery explosion:**

- **Effect:** All failure modes below might result in battery explosion with the possibility of orbital debris generation. However, in the unlikely event that a battery cell does explosively rupture, the small size, mass, and potential energy of these small batteries, coupled with the multiple enclosures surrounding the batteries, will ensure debris from the battery rupture should be contained within the spacecraft due to the lack of penetration energy.
- **Probability:** Extremely Low. It is believed to be less than 0.01% given that multiple independent (not common mode) faults must occur for each failure mode to cause the ultimate effect (explosion). The Honeybee-00 spacecraft uses Samsung INR18650-MJ1 battery cells which have extensive flight heritage. Each battery cell has over-voltage and over-current protection. Battery testing includes Lot Sampling Testing, Acceptance Testing, and Final Checkout after Assembling the satellite.

- **Failure Mode 1:** Internal cell short circuit
  - **Mitigation:** Qualification and acceptance shock, vibration, thermal cycling, and vacuum tests followed by maximum system rate-limited charge and discharge will prove that no internal short circuit sensitivity exists.
  - **Combined faults required for realized failure:** Environmental testing and functional charge/discharge tests must both be ineffective in discovery of the failure mode.
- **Failure Mode 2:** Internal thermal rise due to high load discharge rate
  - **Mitigation**: Battery cells were UL/UN tested in lab for high load discharge rates by short circuiting the terminal to determine the feasibility of an out-of-control thermal rise in the cell.
  - **Combined faults required for realized failure**: Spacecraft thermal design must be incorrect and external over-current detection and disconnect function must fail to enable this failure mode.
- **Failure Mode 3:** Excessive discharge rate or short-circuit due to external device failure or terminal contact with conductors not at battery voltage levels (due to abrasion or inadequate proximity separation)
  - **Mitigation:** This failure mode is negated by:
    - Qualification tested short circuit protection on each external circuit;
    - Design of battery packs and insulators such that no contact with nearby board traces is possible without being caused by some other mechanical failure; and
    - Obviation of such other mechanical failures by proto-qualification and acceptance of environmental tests (shock, vibration, thermal cycling, and thermal-vacuum tests).
  - **Combined faults required for realized failure:** An external load must fail/short-circuit and external over-current detection and disconnect function must all occur to enable this failure mode.
- **Failure Mode 4:** Inoperable vents
  - **Mitigation:** Battery venting is not inhibited by the battery holder design or the spacecraft design. The battery can vent gases to the external environment.

- **Combined faults required for realized failure:** The cell manufacturer and the satellite integrator must fail to install proper venting.

- **Failure Mode 5:** Crushing
  - **Mitigation:** Failure mode prevented by design. No moving parts appear near the battery assembly. Battery cells are UL/UN tested for crush and impact.
  - **Combined faults required for realized failure:** A catastrophic failure must occur in an external system and the failure must cause a collision sufficient to crush the batteries leading to an internal short circuit and the satellite must be in a naturally sustained orbit at the time the crushing occurs.
- **Failure Mode 6:** Low level current leakage or short-circuit through battery pack case or due to moisture-based degradation of insulators.
  - **Mitigation:** These modes are negated by a) battery holder/case design made of non-conductive plastic and b) operation in a vacuum such that no moisture can affect insulators.
  - **Combined faults required for realized failure:** Abrasion or piercing failure of circuit board coating or wire insulators and dislocation of battery packs and failure of battery terminal insulators and failure to detect such failure modes in environmental tests must occur for this failure mode.
- **Failure Mode 7:** Excess battery cell temperature due to orbital environment and high discharge combined
  - **Mitigation:** The spacecraft thermal design will negate this possibility. Thermal rise has been analyzed in combination with space environment temperatures showing that the batteries do not exceed normal allowable operating temperatures under a variety of modeled cases, including worst case orbital scenarios. Analysis shows these temperatures to be well below temperatures of concern for explosions. Battery cells are UL/UN thermal tested without fire or explosion.
  - **Combined faults required for realized failure:** Incorrect thermal analysis and thermal design and mission simulations in thermal-vacuum chamber testing and over-current monitoring and control must all fail for this failure mode to occur.

**Requirement 4.4-2:** Design for passivation after completion of mission operations while in orbit about Earth or the Moon:

- *Design of all spacecraft and launch vehicle orbital stages shall include the ability to deplete all onboard sources of stored energy and disconnect all energy generation sources when they are no longer required for mission operations or post-mission disposal or control to a level which cannot cause an explosion or deflagration large enough to release orbital debris or break up the spacecraft (Requirement 56450).*
- **Compliance statement:** See above list of components to be passivated at EOM.

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

- **Compliance statement:** This requirement is not applicable. There are no planned breakups.

**Requirement 4.4-4:** Limiting the short-term risk to other space systems from planned breakups

- **Compliance statement:** This requirement is not applicable. There are no planned breakups.

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

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

- *For each spacecraft and launch vehicle orbital stage in or passing through LEO, the program or project shall demonstrate that, during the orbital lifetime of each spacecraft and orbital stage, the probability of accidental collision with space objects larger than 10 cm in diameter is less than 0.001 (Requirement 56506).*
- **Compliance statement:** Large object impact and debris generation probability: 4.6803E-05.

**Detailed description and assessment of efficacy of any planned debris avoidance capability intended to help in meeting requirement 4.5-1**

There is no significant risk of collision based on Honeybee-00's orbital parameters, capable electrical propulsion system.

The propulsion system generates ~54 mN of axial thrust. 40 minutes of burns per orbit for three orbits at 500 km (station keeping orbit) would change the perigee of the spacecraft by 1.2 km from 500 to 498.8 km. Burning continuously for two orbits will allow the spacecraft to build a 25 km separation distance. The spacecraft's power system supports such operation.

Typically, a 5-km separation distance provides a sufficiently low probability of collision (PC). In this example, an in-track separation of 25 km was selected to exceed the screening volume listed in table 3 of the "Space Flight Safety Handbook for Satellite Operators" from the 18th SDS. Of course, in cases where the time to execute the first burn is less than 48 hours prior to the time of closest approach (TCA), a longer burn or a series of burns can be executed to achieve an adequately low PC.

Pixxel will register the Honeybee-00 satellite with the US Space Force's 18th Space Defense Squadron, which provides active monitoring. Pixxel will attempt to contact and work with any entity that owns a spacecraft, which has the potential to collide with the Honeybee-00 satellite, to avoid collision.

**If at any time during the spacecraft's mission or de-orbit phase the spacecraft will operate in or transit through the orbits used by any planned or inhabitable spacecraft, including the International Space Station, describe the design and operational strategies, such as coordination, that will be used to minimize the risk of collision and avoid posing any operational constraints to the spacecraft**

During the de-orbit phase, if an optional PMD is pursued, the Honeybee-00 spacecraft will transfer from an altitude greater than that of the ISS and other inhabitable spacecraft

to an altitude below that of the ISS and other inhabitable spacecraft; thus, this phase may transit through an orbit used by the ISS or another spacecraft. As discussed herein, the deorbit maneuver will be paused as the vehicle passes through the ISS orbit and resumed thereafter. The delta-V for the deorbit burn to below 300 km circular orbit from 515 km (safely below the ISS and other inhabitable spacecraft) is 121.44 m/s (around 1/3 of the total delta V capacity on board). Therefore, under nominal operating conditions, the Honeybee-00 spacecraft will be actively deorbited, maintaining a circular orbit, until it is safely below the operational orbits of the ISS and other inhabitable spacecraft.

*Table 1: delta-V Budget for Mission*

| | ***Delta-V (m/s)*** | ***Prop Mass (kg)*** | ***% of Total*** |
|---|---|---|---|
| *Orbit Raising* | *13.83* | *0.21* | *3.71%* |
| *Station Keeping* | *166.02* | *2.56* | *45.24%* |
| *Collision Avoidance* | *5* | *0.08* | *1.34%* |
| *Deorbit* | *121.44* | *1.85* | *32.72%* |
| *Margin* | *61.25* | *0.96* | *16.98%* |
| ***TOTAL*** | ***367.54*** | ***5.65*** | ***100.00%*** |

**Certify that upon receipt of a space situational awareness conjunction warning, the operator will review and take all possible steps to assess the collision risk, and will mitigate the collision risk if necessary**

Upon receipt of an actionable Conjunction Data Message (CDM) from the 18th, Pixxel certifies that it will attempt to contact the operator of any active spacecraft involved in such a warning, share ephemeris data and other appropriate operational information with any such operator, and modify the spacecraft's attitude, orbit, and/or operations to avoid a collision. If the operator of the other spacecraft does not have maneuvering capabilities, Pixxel will upload a special ephemeris including potential collision avoidance maneuvers (CAMs) via the Application Programming Interface (API) to the 18th Space Defense Squadron to avoid a collision. High-risk events will be mitigated to at least one and a half orders of magnitude below the collision probability mitigated action threshold of 1E-4. As

shown above, burning continuously for two orbits 48 hours prior to TCA results in greater than 25 km of in-track offset between a pair of orbiting objects. The example reflects a small fraction of the available control authority for the Honeybee-00 spacecraft.

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

- *For each spacecraft, the program or project shall demonstrate that, during the mission of the spacecraft, the probability of accidental collision with orbital debris and meteoroids sufficient to prevent compliance with the applicable post-mission disposal requirements is less than 0.01 (Requirement 56507).*
- **Compliance Statement:** The spacecraft does not need to conduct a PMD maneuver to meet deorbit requirements, and accordingly, this requirement is not applicable.

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

**A. Description of spacecraft disposal option selected:**

Consistent with NASA-STD 8719.4C, Honeybee-00 will be disposed of via atmospheric reentry through natural decay. Pixxel may elect to accelerate this via a PMD maneuver. The operational altitude in LEO lends to natural forces that will quickly lead to atmospheric reentry once the operations, including station-keeping with maneuvers, are ceased.

**B. Post-mission Disposal Maneuver Plan:**

To accelerate reentry, Honeybee-00 may perform, at Pixxel's discretion, a PMD maneuver via a series of apogee and perigee burns in the anti-velocity direction to lower the satellite to a disposal orbit of approximately 350 x 350 km. In the case that Honeybee-00 reaches 350 km and has not expended all of its fuel, the remaining fuel will be used to lower the spacecraft further to accelerate the deorbit. Valves will then be left open to allow any final xenon to be expelled. This PMD maneuver is ~42 m/s of dV, which is well within the dV budget of this mission which contains 411 m/s dV.

**C. Honeybee-00 nominal deployed configuration area-to-mass ratio calculation:**

- Spacecraft mass: 200.0/197 kg (wet/dry mass)
- Cross-sectional area: 2.12 $m^2$ (average)
- Area-to-mass ratio: 0.0106/0.01985 $m^2$/kg (initial/final)

**D. Honeybee-00 undeployed, DOA configuration area-to-mass ratio calculation:**

- Spacecraft mass: 200.0 kg (mass unchanged in DOA scenario)
- Cross-sectional area: 01.598 $m^2$ (average)
- Area-to-mass ratio: 0.007992/0.008282 $m^2$/kg (initial/final match as no propellant expended)

**E. Assessment of spacecraft compliance with ODAR requirements 4.6-1 to 4.6-4**

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

- **Compliance statement:** The Honeybee-00 satellite reentry is COMPLIANT. As discussed above, the spacecraft will deorbit less than five years after cessation of operations.

**Requirement 4.6-2:** Disposal for space structure near GEO

- **Compliance statement**: Not applicable

**Requirement 4.6-3:** Disposal for space structures between LEO and GEO

- **Compliance statement**: Not applicable

**Requirement 4.6-4:** Reliability of post-mission disposal operations

- **Compliance statement**: N/A. An EOM maneuver is not required.

## ODAR Section 7: Assessment of Spacecraft Re-entry Hazards

### A. Summary of objects expected to survive uncontrolled reentry

For Honeybee-00 spacecraft, only the tank carbon wraps are expected to survive uncontrolled reentry with an impact energy of greater than 15J (specifically 37.79 J). See activity log below.

Carbon Overwrapped Pressure Vessel (COPV) tanks were selected for this mission after a comprehensive trade was completed. Based on the tank performance values such as operating pressure and mass paired with size, DOT rating, availability, and price the baseline COPV tanks were chosen These tanks have an aluminum liner paired with a thin layer of carbon/glass/resin composite overwrap. Other tank options considered were disqualified due to significant lead times (14-18+ months) and prohibitive cost (8-10x).

The tanks selected are commercially available and mass-produced driving supply chain reliability. These COPV tanks have substantial flight heritage, being flown in SpaceX Falcon 9 rockets and NASA's ISS missions. These tanks are comprised of 0.63 kg of aluminum and 0.31 kg of composite carbon glass/resin wrap, meaning the majority of the tank would burn up prior reentry, leaving only a small portion of the composite to remain. We have confidence in the heritage of COPV tanks to meet our needs while not sacrificing our mission window with the shortened lead times.

### B. Compliance Assessment for Requirement 4.7-1:

Limit the risk of human casualty.

**Requirement 4.7-1(a):**

- *The potential for human casualty is assumed for any object with an impacting kinetic energy in excess of 15 joules. For uncontrolled reentry, the risk of human casualty from surviving debris shall not exceed 0.0001 (1:10,000) (Requirement 56626).*
- **Compliance statement:** The calculated risk of human casualty is 1:18,300.

## ODAR Section 8: Assessment of Special Classes of Space Missions

Not Applicable to this Mission, No RPOD activities planned.

**DAS v 3.2.6 Output**

01 29 2025; 12:17:41PM Activity Log Started

01 29 2025; 12:17:49PM Project Files copied from C:\Users\NilsHeidenreich\AppData\Local\NASA\DAS3.2.6\

01 29 2025; 12:17:49PM Project Data Saved To File

01 29 2025; 12:20:26PM Activity Log Started

01 29 2025; 12:20:26PM Opened Project C:\Users\NilsHeidenreich\Desktop\DAS As Run (1.29)\

01 29 2025; 12:20:50PM Processing Requirement 4.6 Return Status : Passed

==========

Project Data

==========

**INPUT**

Space Structure Name = SN2

Space Structure Type = Payload

Perigee Altitude = 520.000000 (km)

Apogee Altitude = 520.000000 (km)

Inclination = 97.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Mean Anomaly = 0.000000 (deg)

Area-To-Mass Ratio = 0.008172 (m^2/kg)

Start Year = 2025.751000 (yr)

Initial Mass = 202.073000 (kg)

Final Mass = 195.610000 (kg)

Duration = 5.000000 (yr)

Station Kept = True

Abandoned = True

PMD Perigee Altitude = 520.000000 (km)

PMD Apogee Altitude = 520.000000 (km)

PMD Inclination = 97.000000 (deg)

PMD RAAN = 0.000000 (deg)

PMD Argument of Perigee = 0.000000 (deg)

PMD Mean Anomaly = 0.000000 (deg)

Long-Term Reentry = False

**OUTPUT**

Suggested Perigee Altitude = 520.000000 (km)

Suggested Apogee Altitude = 520.000000 (km)

Returned Error Message = Passes LEO reentry orbit criteria.

Released Year = 2036 (yr)

Requirement = 61

Compliance Status = Pass

==========

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

01 29 2025; 12:21:07PM Science and Engineering - Apogee/Perigee History for a Given Orbit

**INPUT**

Perigee Altitude = 520.000000 (km)

Apogee Altitude = 520.000000 (km)

Inclination = 97.406500 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Mean Anomaly = 0.000000 (deg)

Area-To-Mass Ratio = 0.008172 (m^2/kg)

Start Year = 2030.800000 (yr)

Integration Time = 7.000000 (yr)

**OUTPUT**

Plot

01 29 2025; 12:21:19PM Processing Requirement 4.3-1: Return Status : Not Run

==========

No Project Data Available

==========

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

01 29 2025; 12:21:22PM Processing Requirement 4.3-2: Return Status : Passed

==========

No Project Data Available

==========

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

01 29 2025; 13:27:27PM Processing Requirement 4.5-1: Return Status : Passed

==========

Run Data

==========

**INPUT**

Space Structure Name = SN2

Space Structure Type = Payload

Perigee Altitude = 520.000 (km)

Apogee Altitude = 520.000 (km)

Inclination = 97.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0082 (m^2/kg)

Start Year = 2025.751 (yr)

Initial Mass = 202.073 (kg)

Final Mass = 195.610 (kg)

Duration = 5.000 (yr)

Station-Kept = True

Abandoned = True

Long-Term Reentry = False

**OUTPUT**

Collision Probability = 4.6803E-05

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==========

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

01 29 2025; 13:27:31PM Project Data Saved To File

01 29 2025; 13:27:36PM Requirement 4.5-2: Compliant

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

01 29 2025; 13:27:38PM *********Processing Requirement 4.7-1

Return Status : Passed

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

Item Number = 1

name = SN2

quantity = 1

parent = 0

materialID = 8

type = Box

Aero Mass = 195.610001

Thermal Mass = 195.610001

Diameter/Width = 0.750000

Length = 1.000000

Height = 0.750000

name = Battery

quantity = 1

parent = 1

materialID = 8

type = Box

Aero Mass = 14.380000

Thermal Mass = 14.380000

Diameter/Width = 0.303000
Length = 0.417000
Height = 0.132000

name = Solar Array panel
quantity = 2
parent = 1
materialID = 8
type = Box
Aero Mass = 7.200000
Thermal Mass = 3.600000
Diameter/Width = 0.871000
Length = 1.136000
Height = 0.020000

name = Solar Array AL structure
quantity = 2
parent = 3
materialID = 8
type = Box
Aero Mass = 3.350000
Thermal Mass = 3.350000
Diameter/Width = 1.000000
Length = 1.000000
Height = 0.020000

name = Solar Array Cell and CIC
quantity = 2
parent = 3
materialID = 27
type = Box

Aero Mass = 0.250000
Thermal Mass = 0.250000
Diameter/Width = 0.871000
Length = 1.136000
Height = 0.000300

name = PX Panel
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 69.140000
Thermal Mass = 5.580000
Diameter/Width = 0.854000
Length = 1.120000

name = Center Cylinder
quantity = 1
parent = 6
materialID = 8
type = Cylinder
Aero Mass = 8.320000
Thermal Mass = 8.320000
Diameter/Width = 0.325000
Length = 0.600000

name = Bottle Mounts
quantity = 4
parent = 6
materialID = 8
type = Box

Aero Mass = 0.730000
Thermal Mass = 0.730000
Diameter/Width = 0.254000
Length = 0.284480
Height = 0.043180

name = RWA Bracket
quantity = 4
parent = 6
materialID = 8
type = Box
Aero Mass = 0.360000
Thermal Mass = 0.360000
Diameter/Width = 0.136000
Length = 0.182000
Height = 0.095000

name = Avionics Tray
quantity = 1
parent = 6
materialID = 8
type = Flat Plate
Aero Mass = 6.000000
Thermal Mass = 6.000000
Diameter/Width = 0.350000
Length = 0.527000

name = Reaction Wheels
quantity = 4
parent = 6
materialID = 8

type = Box
Aero Mass = 1.450000
Thermal Mass = 1.450000
Diameter/Width = 0.146000
Length = 0.154000
Height = 0.045000

name = Torque Rods
quantity = 3
parent = 6
materialID = 8
type = Cylinder
Aero Mass = 0.540000
Thermal Mass = 0.540000
Diameter/Width = 0.050000
Length = 0.430000

name = Star Tracker
quantity = 2
parent = 6
materialID = 8
type = Box
Aero Mass = 0.270000
Thermal Mass = 0.270000
Diameter/Width = 0.050000
Length = 0.095000
Height = 0.044000

name = GNSS Receiver
quantity = 1
parent = 6

materialID = 8

type = Box

Aero Mass = 0.280000

Thermal Mass = 0.280000

Diameter/Width = 0.056000

Length = 0.094000

Height = 0.026000

name = GNSS L-Band Antenna

quantity = 1

parent = 6

materialID = 8

type = Box

Aero Mass = 0.080000

Thermal Mass = 0.080000

Diameter/Width = 0.052832

Length = 0.052832

Height = 0.017526

name = Redundant X-Band Transmitter

quantity = 1

parent = 6

materialID = 8

type = Box

Aero Mass = 0.280000

Thermal Mass = 0.280000

Diameter/Width = 0.090000

Length = 0.095000

Height = 0.013000

name = X-Band Antenna

quantity = 2

parent = 6

materialID = 8

type = Flat Plate

Aero Mass = 0.010000

Thermal Mass = 0.010000

Diameter/Width = 0.082600

Length = 0.098000

name = Redundant S-Band Transceiver

quantity = 1

parent = 6

materialID = 8

type = Box

Aero Mass = 0.190000

Thermal Mass = 0.190000

Diameter/Width = 0.089000

Length = 0.094000

Height = 0.018500

name = Redundant UHF Transceiver

quantity = 1

parent = 6

materialID = 8

type = Box

Aero Mass = 0.100000

Thermal Mass = 0.100000

Diameter/Width = 0.089000

Length = 0.095000

Height = 0.011000

name = Ethernet Switch
quantity = 1
parent = 6
materialID = 8
type = Box
Aero Mass = 2.500000
Thermal Mass = 2.500000
Diameter/Width = 0.180000
Length = 0.230000
Height = 0.040000

name = PDU
quantity = 1
parent = 6
materialID = 8
type = Box
Aero Mass = 2.540000
Thermal Mass = 2.540000
Diameter/Width = 0.210820
Length = 0.228600
Height = 0.048260

name = Flight Computer
quantity = 1
parent = 6
materialID = 8
type = Box
Aero Mass = 0.770000
Thermal Mass = 0.770000
Diameter/Width = 0.114000
Length = 0.114000

Height = 0.050000

name = Harness/Connectors
quantity = 1
parent = 6
materialID = 54
type = Cylinder
Aero Mass = 14.030000
Thermal Mass = 14.030000
Diameter/Width = 0.050000
Length = 3.000000

name = Heaters
quantity = 8
parent = 6
materialID = 8
type = Flat Plate
Aero Mass = 0.030000
Thermal Mass = 0.030000
Diameter/Width = 0.100000
Length = 0.100000

name = UHF Hybrid Coupler
quantity = 1
parent = 6
materialID = 8
type = Box
Aero Mass = 3.060000
Thermal Mass = 0.060000
Diameter/Width = 0.100000
Length = 0.100000

Height = 0.100000

name = S-Band Radio PCB
quantity = 2
parent = 25
materialID = 8
type = Box
Aero Mass = 1.500000
Thermal Mass = 1.500000
Diameter/Width = 0.114000
Length = 0.114000
Height = 0.050000

name = COMM Carrier Board
quantity = 1
parent = 6
materialID = 8
type = Flat Plate
Aero Mass = 0.150000
Thermal Mass = 0.150000
Diameter/Width = 0.100000
Length = 0.100000

name = Magnetometer
quantity = 1
parent = 6
materialID = 8
type = Box
Aero Mass = 0.080000
Thermal Mass = 0.080000
Diameter/Width = 0.100000

Length = 0.100000
Height = 0.050000

name = IMU
quantity = 1
parent = 6
materialID = 8
type = Box
Aero Mass = 0.060000
Thermal Mass = 0.060000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

name = Solar Array HDRM Bracket
quantity = 2
parent = 6
materialID = 8
type = Box
Aero Mass = 0.250000
Thermal Mass = 0.250000
Diameter/Width = 0.100000
Length = 0.100000
Height = 0.100000

name = Solare Array mount brackets
quantity = 2
parent = 6
materialID = 8
type = Box
Aero Mass = 0.340000

Thermal Mass = 0.340000
Diameter/Width = 0.100000
Length = 0.100000
Height = 0.100000

name = S-band antenna bracket
quantity = 1
parent = 6
materialID = 8
type = Flat Plate
Aero Mass = 0.140000
Thermal Mass = 0.140000
Diameter/Width = 0.100000
Length = 0.100000

name = L-band antenna bracket
quantity = 1
parent = 6
materialID = 8
type = Flat Plate
Aero Mass = 0.390000
Thermal Mass = 0.390000
Diameter/Width = 0.100000
Length = 0.100000

name = Cylindrical Tank - AL
quantity = 8
parent = 6
materialID = 8
type = Cylinder
Aero Mass = 0.630000

Thermal Mass = 0.630000
Diameter/Width = 0.104000
Length = 0.250000

name = Cylindrical Tank - Carbon
quantity = 8
parent = 6
materialID = 16
type = Cylinder
Aero Mass = 0.310000
Thermal Mass = 0.310000
Diameter/Width = 0.104000
Length = 0.250000

name = USX radio
quantity = 1
parent = 6
materialID = 8
type = Box
Aero Mass = 2.010000
Thermal Mass = 2.010000
Diameter/Width = 0.150000
Length = 0.250000
Height = 0.100000

name = APU
quantity = 1
parent = 6
materialID = 8
type = Box
Aero Mass = 0.610000

Thermal Mass = 0.610000
Diameter/Width = 0.114000
Length = 0.114000
Height = 0.050000

name = Harness interface box
quantity = 1
parent = 6
materialID = 8
type = Box
Aero Mass = 0.690000
Thermal Mass = 0.690000
Diameter/Width = 0.114000
Length = 0.114000
Height = 0.050000

name = NX Panel
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 5.670000
Thermal Mass = 5.670000
Diameter/Width = 0.854000
Length = 1.120000

name = PY Panel
quantity = 1
parent = 1
materialID = 8
type = Flat Plate

Aero Mass = 0.360000
Thermal Mass = 0.360000
Diameter/Width = 0.352000
Length = 1.120000

name = NY Panel
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.470000
Thermal Mass = 0.470000
Diameter/Width = 0.352000
Length = 1.120000

name = PZ Panel
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 14.100000
Thermal Mass = 14.100000
Diameter/Width = 0.352000
Length = 0.854000

name = NZ Panel
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 13.360000

Thermal Mass = 9.740000
Diameter/Width = 0.352000
Length = 0.854000

name = EP Power Processing Unit
quantity = 1
parent = 43
materialID = 8
type = Box
Aero Mass = 2.150000
Thermal Mass = 2.150000
Diameter/Width = 0.391000
Length = 0.570000
Height = 0.171000

name = EP Feed System Module
quantity = 1
parent = 43
materialID = 8
type = Box
Aero Mass = 1.330000
Thermal Mass = 1.330000
Diameter/Width = 0.155000
Length = 0.166000
Height = 0.090000

name = Lines
quantity = 1
parent = 43
materialID = 54
type = Cylinder

Aero Mass = 0.140000
Thermal Mass = 0.140000
Diameter/Width = 0.003000
Length = 3.000000

name = Sun Sensor Mount
quantity = 3
parent = 1
materialID = 8
type = Box
Aero Mass = 0.060000
Thermal Mass = 0.060000
Diameter/Width = 0.040000
Length = 0.052000
Height = 0.022000

name = Star Tracker Closeout Baffle and Bracket
quantity = 2
parent = 1
materialID = 50
type = Cylinder
Aero Mass = 1.700000
Thermal Mass = 1.700000
Diameter/Width = 0.100000
Length = 0.200000

name = Multi-Layer Insulation Blankets
quantity = 1
parent = 1
materialID = 8
type = Flat Plate

Aero Mass = 3.450000
Thermal Mass = 3.450000
Diameter/Width = 1.000000
Length = 1.000000

name = S-Band Antenna
quantity = 2
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.130000
Thermal Mass = 0.130000
Diameter/Width = 0.098000
Length = 0.098000

name = Separation System - Fly Away
quantity = 1
parent = 1
materialID = 8
type = Cylinder
Aero Mass = 3.550000
Thermal Mass = 3.550000
Diameter/Width = 0.150000
Length = 0.150000

name = Temperature sensors
quantity = 12
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.020000

Thermal Mass = 0.020000
Diameter/Width = 0.100000
Length = 0.100000

name = UHF Antenna
quantity = 2
parent = 1
materialID = 54
type = Cylinder
Aero Mass = 0.060000
Thermal Mass = 0.060000
Diameter/Width = 0.050000
Length = 0.100000

name = Thermal Tape
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.150000
Thermal Mass = 0.150000
Diameter/Width = 0.100000
Length = 0.100000

name = Strut body
quantity = 4
parent = 1
materialID = 8
type = Cylinder
Aero Mass = 0.130000
Thermal Mass = 0.130000

Diameter/Width = 0.050000
Length = 0.100000

name = Payload plate
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.210000
Thermal Mass = 0.210000
Diameter/Width = 0.200000
Length = 0.200000

name = Fastener Shipset
quantity = 100
parent = 1
materialID = 54
type = Cylinder
Aero Mass = 0.030000
Thermal Mass = 0.030000
Diameter/Width = 0.050000
Length = 0.050000

name = EP Thruster
quantity = 1
parent = 1
materialID = 8
type = Cylinder
Aero Mass = 1.180000
Thermal Mass = 1.180000
Diameter/Width = 0.115000

Length = 0.120000

name = EP FDV Adapter ASSEM
quantity = 1
parent = 1
materialID = 8
type = Cylinder
Aero Mass = 0.200000
Thermal Mass = 0.200000
Diameter/Width = 0.057000
Length = 0.114000

name = Primary mirror
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 8.600000
Thermal Mass = 8.600000
Diameter/Width = 0.480000
Length = 0.480000

name = Offner Mirror
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 1.300000
Thermal Mass = 1.300000
Diameter/Width = 0.170000
Length = 0.280000

name = Secondary Mirror
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.800000
Thermal Mass = 0.800000
Diameter/Width = 0.200000
Length = 0.200000

name = Image Processing Computer Enclosure
quantity = 2
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.800000
Thermal Mass = 0.800000
Diameter/Width = 0.115000
Length = 0.150000

name = Boresight Refernce Cube
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.030000
Thermal Mass = 0.030000
Diameter/Width = 0.025000
Length = 0.025000
Height = 0.025000

name = Spider/Secondary Mirror Assembly
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 3.500000
Thermal Mass = 3.500000
Diameter/Width = 0.500000
Length = 0.500000

name = Scan Tube
quantity = 1
parent = 1
materialID = 8
type = Cylinder
Aero Mass = 3.700000
Thermal Mass = 3.700000
Diameter/Width = 0.500000
Length = 0.500000

name = Optical Bench/Primary Mirror/Lens Cell Assembly
quantity = 1
parent = 1
materialID = 8
type = Cylinder
Aero Mass = 11.600000
Thermal Mass = 11.600000
Diameter/Width = 0.500000
Length = 0.500000

name = Optical Bench/Primary Mirror/Lens Cell Assembly2
quantity = 1
parent = 1
materialID = 9
type = Cylinder
Aero Mass = 0.600000
Thermal Mass = 0.600000
Diameter/Width = 0.110000
Length = 0.275000

name = Optical Bench/Primary Mirror/Lens Cell Assembly3
quantity = 1
parent = 1
materialID = 8
type = Cylinder
Aero Mass = 0.400000
Thermal Mass = 0.400000
Diameter/Width = 0.150000
Length = 0.150000

name = Optical Bench/Primary Mirror/Lens Cell Assembly4
quantity = 1
parent = 1
materialID = 8
type = Cylinder
Aero Mass = 0.250000
Thermal Mass = 0.250000
Diameter/Width = 0.070000
Length = 0.070000

name = Bipod Strut Assembly

quantity = 6
parent = 1
materialID = 23
type = Cylinder
Aero Mass = 0.040000
Thermal Mass = 0.040000
Diameter/Width = 0.050000
Length = 0.055000

name = Bipod Strut Assembly2
quantity = 6
parent = 1
materialID = 66
type = Cylinder
Aero Mass = 0.250000
Thermal Mass = 0.250000
Diameter/Width = 0.050000
Length = 0.055000

name = Spectrometer/Camera Assembly
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 11.000000
Thermal Mass = 11.000000
Diameter/Width = 0.256000
Length = 0.305000
Height = 0.190000

name = Bipod Foot

quantity = 3

parent = 1

materialID = 8

type = Box

Aero Mass = 0.700000

Thermal Mass = 0.700000

Diameter/Width = 0.070000

Length = 0.280000

Height = 0.035000

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

Item Number = 1

name = SN2

Demise Altitude = 77.995216

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Battery

Demise Altitude = 73.435809

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Solar Array panel

Demise Altitude = 77.585415

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Solar Array AL structure
Demise Altitude = 77.087539
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

**********

name = Solar Array Cell and CIC
Demise Altitude = 77.550765
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

**********

name = PX Panel
Demise Altitude = 77.352495
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

**********

name = Center Cylinder
Demise Altitude = 75.404964
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

**********

name = Bottle Mounts
Demise Altitude = 76.855149
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

**********

name = RWA Bracket

Demise Altitude = 77.015163

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Avionics Tray

Demise Altitude = 75.039095

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Reaction Wheels

Demise Altitude = 75.313344

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Torque Rods

Demise Altitude = 76.640945

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Star Tracker

Demise Altitude = 76.520018

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = GNSS Receiver

Demise Altitude = 76.310568

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = GNSS L-Band Antenna

Demise Altitude = 76.758069

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Redundant X-Band Transmitter

Demise Altitude = 76.348383

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = X-Band Antenna

Demise Altitude = 77.328167

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Redundant S-Band Transceiver

Demise Altitude = 76.699913

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Redundant UHF Transceiver

Demise Altitude = 76.980540

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Ethernet Switch

Demise Altitude = 75.030556

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = PDU

Demise Altitude = 75.186131

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Flight Computer

Demise Altitude = 75.859846

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Harness/Connectors

Demise Altitude = 68.990946

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Heaters

Demise Altitude = 77.239100

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = UHF Hybrid Coupler

Demise Altitude = 77.260742

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = S-Band Radio PCB

Demise Altitude = 74.425686

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = COMM Carrier Board

Demise Altitude = 76.776908

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Magnetometer

Demise Altitude = 77.170438

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = IMU

Demise Altitude = 77.049213

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Solar Array HDRM Bracket

Demise Altitude = 76.945414

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Solare Array mount brackets

Demise Altitude = 76.793705

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = S-band antenna bracket

Demise Altitude = 76.812089

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = L-band antenna bracket

Demise Altitude = 75.866465

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Cylindrical Tank - AL

Demise Altitude = 76.552837

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Cylindrical Tank - Carbon

Demise Altitude = 0.000000

Debris Casualty Area = 4.220819

Impact Kinetic Energy = 37.794211

**********

name = USX radio

Demise Altitude = 75.989241

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = APU

Demise Altitude = 76.166899

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Harness interface box

Demise Altitude = 76.014040

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = NX Panel

Demise Altitude = 77.271664

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = PY Panel

Demise Altitude = 77.952735

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = NY Panel

Demise Altitude = 77.923440

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = PZ Panel

Demise Altitude = 74.372446

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = NZ Panel

Demise Altitude = 75.526221

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = EP Power Processing Unit

Demise Altitude = 75.020955

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = EP Feed System Module

Demise Altitude = 74.084152

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Lines

Demise Altitude = 75.002497

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Sun Sensor Mount

Demise Altitude = 77.514638

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Star Tracker Closeout Baffle and Bracket

Demise Altitude = 74.428452

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Multi-Layer Insulation Blankets

Demise Altitude = 77.532146

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = S-Band Antenna

Demise Altitude = 77.470678

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Separation System - Fly Away

Demise Altitude = 73.382195

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Temperature sensors

Demise Altitude = 77.918162

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = UHF Antenna

Demise Altitude = 76.916510

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Thermal Tape

Demise Altitude = 77.408228

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Strut body

Demise Altitude = 77.367885

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Payload plate

Demise Altitude = 77.713725

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Fastener Shipset

Demise Altitude = 77.135837

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = EP Thruster

Demise Altitude = 75.626877

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = EP FDV Adapter ASSEM

Demise Altitude = 77.213183

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Primary mirror

Demise Altitude = 74.831144

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Offner Mirror

Demise Altitude = 76.635859

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Secondary Mirror

Demise Altitude = 76.925578

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Image Processing Computer Enclosure

Demise Altitude = 76.109764

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Boresight Refernce Cube

Demise Altitude = 77.474983

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Spider/Secondary Mirror Assembly

Demise Altitude = 76.760926

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Scan Tube

Demise Altitude = 77.354404

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Optical Bench/Primary Mirror/Lens Cell Assembly

Demise Altitude = 76.081167

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Optical Bench/Primary Mirror/Lens Cell Assembly2

Demise Altitude = 76.355679

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Optical Bench/Primary Mirror/Lens Cell Assembly3

Demise Altitude = 77.431871

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Optical Bench/Primary Mirror/Lens Cell Assembly4

Demise Altitude = 76.834944

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Bipod Strut Assembly

Demise Altitude = 77.227571

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Bipod Strut Assembly2

Demise Altitude = 69.820306

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Spectrometer/Camera Assembly

Demise Altitude = 73.928774

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

name = Bipod Foot

Demise Altitude = 77.061849

Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

**********

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

01 29 2025; 13:27:38PM Project Data Saved To File

01 29 2025; 13:46:06PM Activity Log Started

01 29 2025; 13:46:06PM Opened Project C:\Users\NilsHeidenreich\Desktop\DAS As Run (1.29)\

01 29 2025; 13:46:34PM Project Data Saved To File

01 29 2025; 13:47:36PM Mission Editor Changes Applied

01 29 2025; 13:47:36PM Project Data Saved To File

01 29 2025; 13:47:36PM Project Data Saved To File

01 29 2025; 13:48:11PM Science and Engineering - Apogee/Perigee History for a Given Orbit

**INPUT**

Perigee Altitude = 520.000000 (km)

Apogee Altitude = 520.000000 (km)

Inclination = 97.400000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Mean Anomaly = 0.000000 (deg)

Area-To-Mass Ratio = 0.008172 (m^2/kg)

Start Year = 2030.800000 (yr)

Integration Time = 7.000000 (yr)

**OUTPUT**

Plot

01 29 2025; 13:49:13PM Science and Engineering - Apogee/Perigee History for a Given Orbit

**INPUT**

Perigee Altitude = 520.000000 (km)

Apogee Altitude = 520.000000 (km)

Inclination = 97.400000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Mean Anomaly = 0.000000 (deg)

Area-To-Mass Ratio = 0.008172 (m^2/kg)

Start Year = 2030.800000 (yr)

Integration Time = 7.000000 (yr)

**OUTPUT**

Plot

01 29 2025; 13:49:55PM Science and Engineering - Apogee/Perigee History for a Given Orbit

**INPUT**

Perigee Altitude = 520.000000 (km)

Apogee Altitude = 520.000000 (km)

Inclination = 97.400000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Mean Anomaly = 0.000000 (deg)

Area-To-Mass Ratio = 0.008172 (m^2/kg)

Start Year = 2030.750000 (yr)

Integration Time = 7.000000 (yr)

**OUTPUT**

Plot

01 29 2025; 13:50:28PM Science and Engineering - Apogee/Perigee History for a Given Orbit

**INPUT**

Perigee Altitude = 500.000000 (km)

Apogee Altitude = 500.000000 (km)

Inclination = 97.400000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Mean Anomaly = 0.000000 (deg)

Area-To-Mass Ratio = 0.008172 (m^2/kg)

Start Year = 2030.750000 (yr)

Integration Time = 7.000000 (yr)

**OUTPUT**

Plot

01 29 2025; 13:50:45PM Science and Engineering - Apogee/Perigee History for a Given Orbit

**INPUT**

Perigee Altitude = 520.000000 (km)

Apogee Altitude = 520.000000 (km)

Inclination = 97.400000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Mean Anomaly = 0.000000 (deg)

Area-To-Mass Ratio = 0.008172 (m^2/kg)

Start Year = 2030.750000 (yr)

Integration Time = 7.000000 (yr)

**OUTPUT**

Plot

01 29 2025; 13:56:40PM Science and Engineering - Apogee/Perigee History for a Given Orbit

**INPUT**

Perigee Altitude = 500.000000 (km)
Apogee Altitude = 500.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Area-To-Mass Ratio = 0.008172 (m^2/kg)
Start Year = 2030.750000 (yr)
Integration Time = 7.000000 (yr)

**OUTPUT**

Plot

01 29 2025; 14:00:37PM Science and Engineering - Apogee/Perigee History for a Given Orbit

**INPUT**

Perigee Altitude = 480.000000 (km)
Apogee Altitude = 480.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Area-To-Mass Ratio = 0.008172 (m^2/kg)
Start Year = 2030.750000 (yr)

Integration Time = 7.000000 (yr)

**OUTPUT**

Plot

01 29 2025; 14:03:11PM Science and Engineering - Apogee/Perigee History for a Given Orbit

**INPUT**

Perigee Altitude = 520.000000 (km)
Apogee Altitude = 520.000000 (km)
Inclination = 97.400000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Area-To-Mass Ratio = 0.008172 (m^2/kg)
Start Year = 2030.750000 (yr)
Integration Time = 7.000000 (yr)

**OUTPUT**

Plot

01 29 2025; 14:04:07PM Mission Editor Changes Applied

01 29 2025; 14:04:07PM Project Data Saved To File

01 29 2025; 14:04:07PM Project Data Saved To File

01 29 2025; 14:06:41PM Processing Requirement 4.3-1: Return Status : Not Run

==========

No Project Data Available

==========

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

01 29 2025; 14:06:44PM Processing Requirement 4.3-2: Return Status : Passed

==========

No Project Data Available

==========

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

01 29 2025; 14:14:11PM Processing Requirement 4.5-1: Return Status : Passed

==========

Run Data

==========

**INPUT**

Space Structure Name = SN2

Space Structure Type = Payload

Perigee Altitude = 520.000 (km)

Apogee Altitude = 520.000 (km)

Inclination = 97.400 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0082 (m^2/kg)

Start Year = 2025.750 (yr)

Initial Mass = 202.073 (kg)

Final Mass = 195.610 (kg)

Duration = 5.000 (yr)

Station-Kept = True

Abandoned = True

Long-Term Reentry = False

**OUTPUT**

Collision Probability = 4.7253E-05

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==========

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

01 29 2025; 14:14:13PM Project Data Saved To File

01 29 2025; 14:14:18PM Requirement 4.5-2: Compliant

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

01 29 2025; 14:14:23PM Processing Requirement 4.6 Return Status : Passed