AST&Science LLC
File No. 1059-EX-CN-2020
SUBMITTED UNDER REQUEST FOR CONFIDENTIAL TREATMENT

AST&Science LLC ("AST") submits this filing in response to recent questions from the International Bureau staff regarding the orbital debris analyses submitted with the application. This response updates prior orbital debris filings regarding the BlueWalker 3 ("BW3") spacecraft.

AST has taken every effort to meet and exceed NASA's standards, and to have the safest structure possible. This submission demonstrates that 97% of the BW3 will demise upon re-entry, specifically: 1) the LVA demises upon reentry; 2) the array demises upon reentry; 3) and the ControlSat, while it does not demise, meets and exceeds the NASA 1:10,000 requirement with more than a 100% margin. Moreover, the ControlSat represents just 3% of the area of the BW3 and will be built with standard space industry components. AST has done everything possible to design the safest and most responsible spacecraft.

TOPIC 1: Regarding the Launch Vehicle Adapter (LVA), we are providing information defining the material selection and updating the modeling conditions used in the NASA software to demonstrate that the LVA will demise upon re-entry. AST also has included information regarding the material used in the initial "conservative" assessment versus the revised assessment of the LVA.

RESPONSE: To understand how the LVA will de-orbit, we first start with a brief description of its function and design. The LVA is a framework structure used an adapter to interface the satellite with the launch vehicle fairing. [redacted]

Figure 1: a) (Top Left) Isometric view of the LVA interior in the stowed configuration. b) (Top Right) Isometric view of the LVA with the integrated satellite. c) (Bottom) Visual representation of LVA separation for satellite release.

Initially, the LVA was modeled in the NASA DAS with a conservative approach of assuming it was a solid aluminum cylinder. To more accurately model the deorbit configuration, AST reran the DAS by decomposing the LVA down into its primary constituents. Under this approach, the LVA is more-precisely modeled as

[1] *See* Tranchard, Pauline et al. "Modelling Behaviour of a Carbon Epoxy Composite Exposed to Fire: Part I-Characterisation of Thermophysical Properties." *Materials (Basel, Switzerland)* vol. 10,5 494. 4 May. 2017, doi:10.3390/ma10050494.

[redacted]

	"Initial" Configuration	"Current" Configuration
LVA Geometry	[redacted]	[redacted]
Dimensions	[redacted]	[redacted]
Thermal Mass	[redacted]	[redacted]
Material	[redacted]	[redacted]
Material Specific Heat	[redacted]	[redacted]
Heat of Fusion	[redacted]	[redacted]
Melt Temperature	[redacted]	[redacted]
Density	[redacted]	[redacted]

After taking this more refined approach as to how the LVA is modeled in the DAS, the software determines that the LVA is fully expected to demise upon re-entry. This means that only the satellite will contribute to the total casualty risk analysis.

TOPIC 2: Regarding the spacecraft, AST has taken a new look at the DAS inputs using a less conservative approach to see if the software still shows that it survives re-entry. As it does, AST clarifies and explains its design decisions and the limitations of materials used in the spacecraft (not the LVA) to optimize demise, as well as whether other materials were available that have better burn rates.

RESPONSE: Before addressing any changes to the DAS modeling of the spacecraft and optimized material selection, AST provides a brief description of the satellite and configuration that underlies the modeling approach. The satellite has two major systems, the ControlSat and the phased array. The ControlSat is more of a traditional satellite that interfaces with the phased array. The phased array is the primary payload used to execute the mission. The ControlSat is centrally located and interfaced with the phased array as seen in Figure 2.

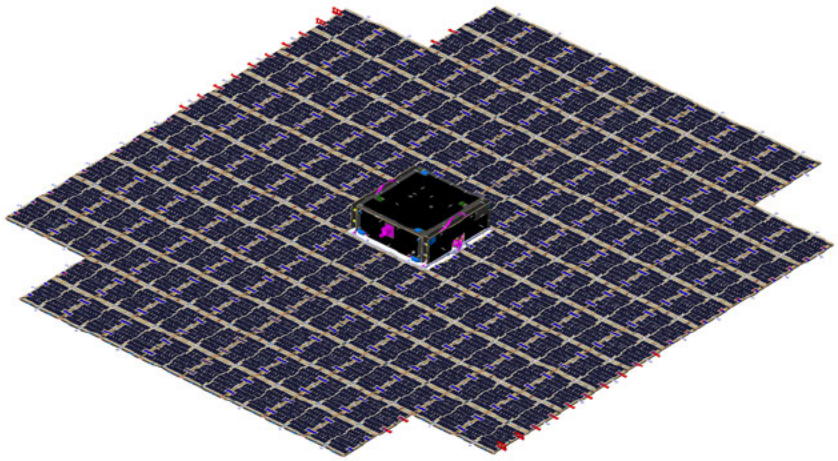


Figure 2: BlueWalker 3 satellite. The ControlSat is located central to the phased array.

Given the drastic difference in the two systems, each was modeled as separate payloads under a single DAS mission. Starting with the ControlSat, AST has modeled it as an exterior box of Gallium Arsenide to represent the outer most solar panel layer that covers it. Within that "parent" object, AST modeled an aluminum box representative of the ControlSat structure plus mounting panels representative of each of the subsystems contained within. From there, each of the major subsystems were included in the DAS as "child" objects nested within the ControlSat structure. This can be seen visually below in Figure 3. The full list of objects with material selection, mass, and dimensions can be seen in the attached DAS Activity Logs.

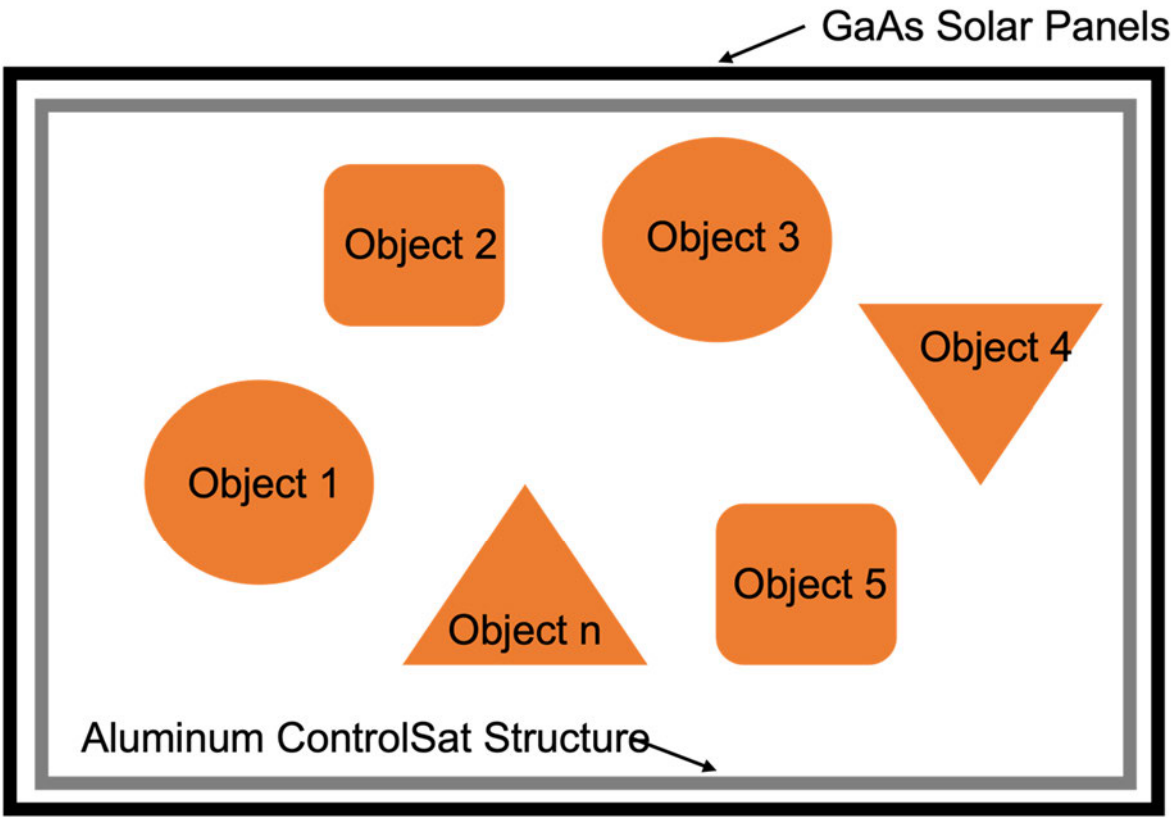


Figure 3: Visual representation of the ControlSat as modeled in DAS.

In summary, the limiting object for re-entry demise is the aluminum structure of the ControlSat. In this case, all the child objects contained within the ControlSat return with the ControlSat structure after the solar panel exterior has burned up upon re-entry. As was presented in the original filings, this poses a total debris casualty area of 2.67 m^2 and total kinetic energy of 154.5 kJ. This results in a total casualty risk of 1:21,600. AST considered and investigated other materials for the ControlSat structure. The major physical limitation is the ability of the satellite to withstand launch loads. For this reason, aluminum was selected (over stainless steel) for its higher specific heat and lower melting temperature while also still providing mechanical viability to withstand launch loads. The outer solar panel layer is necessary to achieve the power positive requirement of the satellite and to maintain complete control of the satellite through all phases of operation. Because of this, the outer most layer, which demises on re-entry, is a necessity for control and operation of the spacecraft. This includes, but is not limited to, operation of the propulsion for debris mitigation

maneuvers. It is important to note that AST's analysis demonstrates compliance to the 1:10,000 requirement, with a total casualty risk of 1:21,600.

The second system analyzed in the DAS is the phased array. This was modeled as a large, flat plate of aluminum. The phased array is composed of several Micron elements. These Microns contain a [redacted] electronics, [redacted] - [redacted]), antenna elements, the mechanical structure, [redacted] and [redacted] between the Micron elements to initiate the deployment. After the most recent design cycle of the deployment system, AST made a material change in the DAS regarding the [redacted] and [redacted] input. Below is the "initial/current" comparison between the two configurations and materials.

Object	"Initial" Material	"Current" Material
[redacted]	Aluminum 6061	[redacted]
[redacted]	Aluminum 6061	[redacted]
[redacted]	Aluminum 6061	[redacted]
[redacted]	Aluminum 6061	[redacted]
[redacted]	Graphite Epoxy	[redacted]

The material change was elected to improve structural stability while also reducing mass and increasing the probability of demise upon re-entry. After this change, the only surviving objects from the phased array are the [redacted] that make up the phased array. The total debris casualty area from the surviving [redacted] is 33.48 m^2 with an impact kinetic energy of 12.65 J. Since these do not exceed 15 J, they do not contribute to the total casualty risk assessment. The [redacted] were initially modeled in the DAS with iron [redacted] AST discussed the material with the supplier due to their experience with material selection for space applications and the flight heritage behind their product. The material used [redacted]®, which is a nickel-iron allow. [redacted] offers a lower melt temperature than iron [redacted] K versus 1812 K), while still maintaining operational capabilities. This was the only available material option that could improve the probability of demise while still providing operational capabilities. The [redacted] and help to stabilize the array during maneuvers such as drag compensation and collision avoidance.

In summary, the only contribution to the total casualty risk assessment for the spacecraft is the ControlSat, and results in a casualty risk assessment of 1:21,600. An overview of the surviving entities, impact area, impact kinetic energy, and total casualty risk can be seen below.

Object	*Quantity*	*Modeled Material*	*Debris Casualty Area (m^2)*	*Kinetic Energy (J)*
ControlSat	1	[redacted]	2.67	147,993
Micron [redacted]	[redacted]	[redacted]	33.5	12.7
Total Debris Casualty Area (m2)				***2.67***
Total Causality Risk				***1:21,600***

TOPIC 3: The Commission has asked for updated information regarding the large object collision risk using a conservative configuration of the full platform area. AST quantifies this collision risk, assuming the planform area of the spacecraft versus the cross-sectional area that AST will use during the entire BW3 mission.

RESPONSE: To evaluate the collision risk from the planform area, AST changed the final area-to-mass ratio of the satellite used in the NASA DAS software. With a total mass of [redacted] kg, a final area-to-mass ratio of [redacted] m^2/kg was used such that the resulting surface area is [redacted] m^2, representing the platform area of the satellite. The ControlSat area-to-mass ratio is [redacted] m^2/kg with a mass of [redacted]. This results in a surface area of [redacted] m^2. The resulting probability of collision with large objects is shown below. This data can also be seen in the attached activity log. The total probability of collision is $6.82(10^{-5})$ which satisfies the 0.001 probability requirement

Object	*Final Area-To-Mass Ratio*	*Final Mass*	*Active Station Keeping*	*P_c with Large Objects*
ControlSat	[redacted]	[redacted]	Yes	$4.6(10^{-6})$
Phased Array	[redacted]	[redacted]	Yes	$6.36(10^{-5})$
Total P_c				***$6.82(10^{-5})$***

TOPIC 4: The Commission has asked for the NASA DAS software activity logs used in the new orbit re-entry analysis and collision probability analysis.

RESPONSE: Please see attached document "BW3 ActivityLog".

10 08 2021; 16:11:04PM Activity Log Started
10 08 2021; 16:11:05PM Opened Project
[redacted]
10 08 2021; 16:11:15PM Processing Requirement 4.3-1:   Return Status : Passed

==========
Project Data
==========
        Objects Passing Through LEO = True
        Number of Objects = 2

INPUT
        Quantity = 4
        [redacted]
        Perigee Altitude = 400.000000 (km)
        Apogee Altitude = 400.000000 (km)
        Inclination = 53.000000 (deg)
        RAAN = -1.000000 (deg)
        Argument of Perigee = -1.000000 (deg)
        Mean Anomaly = -1.000000 (deg)
        Released Year = 2022.300000 (yr)

OUTPUT
        Perigee Altitude = -6378.136000 (km)
        Apogee Altitude = -6378.136000 (km)
        Inclination = 0.000000 (deg)
        Lifetime = 0.097603 (yr)
        Object Reentered within 25 years of Release = True
        Object-Time = 0.328542 (obj-yrs)
        Total Object-Time = 0.492813 (obj-yrs)
        Status = Pass
         Returned Error Message - Normal Processing

==========

INPUT
        Quantity = 2
        [redacted]
        Perigee Altitude = 400.000000 (km)
        Apogee Altitude = 400.000000 (km)
        Inclination = 53.000000 (deg)
        RAAN = -1.000000 (deg)
        Argument of Perigee = -1.000000 (deg)
        Mean Anomaly = -1.000000 (deg)
        Released Year = 2022.300000 (yr)

OUTPUT
        Perigee Altitude = -6378.136000 (km)
        Apogee Altitude = -6378.136000 (km)
        Inclination = 0.000000 (deg)

```
        Lifetime = 0.097603 (yr)
        Object Reentered within 25 years of Release = True
        Object-Time = 0.164271 (obj-yrs)
        Total Object-Time = 0.492813 (obj-yrs)
        Status = Pass
         Returned Error Message - Normal Processing

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

=============== End of Requirement 4.3-1 ===============
10 08 2021; 16:11:18PM  Processing Requirement 4.3-2: Return Status : Passed

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

=============== End of Requirement 4.3-2 ===============
10 08 2021; 16:14:32PM  Processing Requirement 4.5-1:   Return Status :  Passed

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

**INPUT**

        Space Structure Name = ControlSat
        Space Structure Type = Payload
        Perigee Altitude = 400.000 (km)
        Apogee Altitude = 400.000 (km)
        Inclination = 53.000 (deg)
        RAAN = 0.000 (deg)
        Argument of Perigee = 0.000 (deg)
        Mean Anomaly = 0.000 (deg)
        [redacted]
        Start Year = 2022.300 (yr)
        [redacted]
        Duration = 2.000 (yr)
        Station-Kept = True
        Abandoned = True

**OUTPUT**

        Collision Probability = 4.6002E-06
        Returned Message: Normal Processing
        Date Range Message: Normal Date Range
        Status = Pass

==============
```

INPUT

Space Structure Name = Phased Array [redacted]
Space Structure Type = Payload
Perigee Altitude = 400.000 (km)
Apogee Altitude = 400.000 (km)
Inclination = 53.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
[redacted]
Start Year = 2022.300 (yr)
[redacted]
Duration = 2.000 (yr)
Station-Kept = True
Abandoned = True

OUTPUT

Collision Probability = 6.3646E-05
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

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

10 08 2021; 16:14:36PM Project Data Saved To File
10 08 2021; 16:18:41PM Requirement 4.5-2: Compliant

==========
Spacecraft = ControlSat
Critical Surface = Propellant Tank
==========

INPUT

Apogee Altitude = 400.000 (km)
Perigee Altitude = 400.000 (km)
Orbital Inclination = 53.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
[redacted]
Station Kept = Yes
Start Year = 2022.300 (yr)

Duration = 2.000 (yr)
Orientation = Fixed Oriented
[redacted]
CS Pressurized = Yes
[redacted]

OUTPUT

Probability of Penetration = 6.7145E-06 (6.7145E-06)
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range

==========
Spacecraft = ControlSat
Critical Surface = Avionics
==========

INPUT

Apogee Altitude = 400.000 (km)
Perigee Altitude = 400.000 (km)
Orbital Inclination = 53.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
[redacted]
Station Kept = Yes
Start Year = 2022.300 (yr)
Duration = 2.000 (yr)
Orientation = Fixed Oriented
[redacted]
CS Pressurized = No
[redacted]

OUTPUT

Probability of Penetration = 2.7269E-10 (2.7269E-10)
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range

==========
Spacecraft = ControlSat

Critical Surface = [redacted]
==========

INPUT

Apogee Altitude = 400.000 (km)
Perigee Altitude = 400.000 (km)
Orbital Inclination = 53.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
[redacted]
Station Kept = Yes
Start Year = 2022.300 (yr)
Duration = 2.000 (yr)
Orientation = Fixed Oriented
[redacted]
CS Pressurized = No

OUTPUT

Probability of Penetration = 1.5317E-05 (1.5317E-05)
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range

==========
Spacecraft = ControlSat
Critical Surface = [redacted]
==========

INPUT

Apogee Altitude = 400.000 (km)
Perigee Altitude = 400.000 (km)
Orbital Inclination = 53.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
[redacted]
Station Kept = Yes
Start Year = 2022.300 (yr)
Duration = 2.000 (yr)
Orientation = Fixed Oriented
[redacted]

[redacted]
CS Pressurized = No
[redacted]

OUTPUT

Probability of Penetration = 2.3476E-09 (2.3476E-09)
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range

==========
Spacecraft = ControlSat
Critical Surface = [redacted]
==========

INPUT

Apogee Altitude = 400.000 (km)
Perigee Altitude = 400.000 (km)
Orbital Inclination = 53.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
[redacted]
Station Kept = Yes
Start Year = 2022.300 (yr)
Duration = 2.000 (yr)
Orientation = Fixed Oriented
[redacted]
CS Pressurized = No
[redacted]

OUTPUT

Probability of Penetration = 1.0006E-07 (1.0006E-07)
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range

==========
Spacecraft = ControlSat
Critical Surface = [redacted]
==========

INPUT

Apogee Altitude = 400.000 (km)
Perigee Altitude = 400.000 (km)
Orbital Inclination = 53.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
[redacted]
Station Kept = Yes
Start Year = 2022.300 (yr)
Duration = 2.000 (yr)
Orientation = Fixed Oriented
[redacted]
CS Pressurized = No
[redacted]

OUTPUT

Probability of Penetration = 4.9741E-10 (4.9741E-10)
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range

==========
Spacecraft = Phased Array [redacted]
Critical Surface = Micron [redacted]
==========

INPUT

Apogee Altitude = 400.000 (km)
Perigee Altitude = 400.000 (km)
Orbital Inclination = 53.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
[redacted]
Station Kept = Yes
Start Year = 2022.300 (yr)
Duration = 2.000 (yr)
Orientation = Random Tumbling
[redacted]

[redacted]
CS Pressurized = No
[redacted]

OUTPUT

Probability of Penetration = 9.1989E-05 (9.1994E-05)
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range

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

10 08 2021; 16:18:42PM Processing Requirement 4.6 Return Status : Passed

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

INPUT

Space Structure Name = ControlSat
Space Structure Type = Payload

Perigee Altitude = 400.000000 (km)
Apogee Altitude = 400.000000 (km)
Inclination = 53.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
[redacted]
Start Year = 2022.300000 (yr)
[redacted]
Duration = 2.000000 (yr)
Station Kept = True
Abandoned = True
PMD Perigee Altitude = 400.000000 (km)
PMD Apogee Altitude = 400.000000 (km)
PMD Inclination = 53.000000 (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 = Passes LEO reentry orbit criteria.

Released Year = 2024 (yr)

Requirement = 61
Compliance Status = Pass

==========

INPUT

Space Structure Name = Phased Array [redacted]
Space Structure Type = Payload

Perigee Altitude = 400.000000 (km)
Apogee Altitude = 400.000000 (km)
Inclination = 53.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
[redacted]
Start Year = 2022.300000 (yr)
[redacted]
Duration = 2.000000 (yr)
Station Kept = True
Abandoned = True
PMD Perigee Altitude = 400.000000 (km)
PMD Apogee Altitude = 400.000000 (km)
PMD Inclination = 53.000000 (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 = Passes LEO reentry orbit criteria.

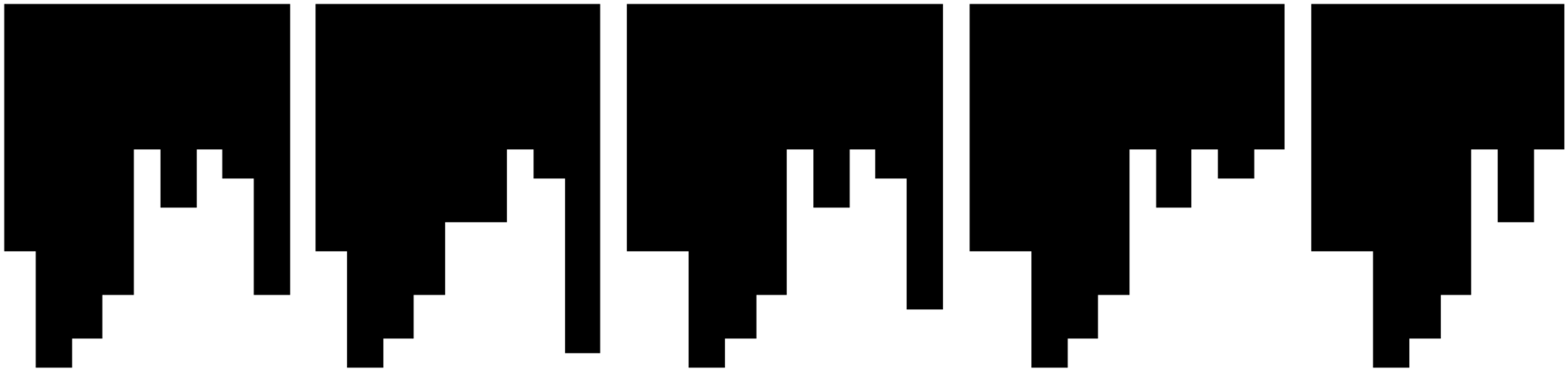
Released Year = 2024 (yr)
Requirement = 61
Compliance Status = Pass

==========

========== End of Requirement 4.6 ==========
10 08 2021; 16:19:00PM *********Processing Requirement 4.7-1
Return Status : Passed

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

[redacted]



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

name = ControlSat
Demise Altitude = 77.992874
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = ControlSat Structure[redacted]
Demise Altitude = 0.000000
Debris Casualty Area = 2.667737
Impact Kinetic Energy = 154547.828125

****
[redacted]
Demise Altitude = 0.000000
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
[redacted]
Demise Altitude = 0.000000

Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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[redacted]
Demise Altitude = 0.000000
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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Demise Altitude = 0.000000
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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Debris Casualty Area = 0.000000
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Debris Casualty Area = 0.000000
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Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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[redacted]
Demise Altitude = 0.000000
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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[redacted]
Demise Altitude = 0.000000
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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[redacted]
Demise Altitude = 0.000000
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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Demise Altitude = 0.000000
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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Debris Casualty Area = 0.000000
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Debris Casualty Area = 0.000000
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Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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[redacted]
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Impact Kinetic Energy = 0.000000

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Impact Kinetic Energy = 0.000000

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Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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Demise Altitude = 0.000000
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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[redacted]
Demise Altitude = 0.000000
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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[redacted]
Demise Altitude = 0.000000
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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[redacted]
Demise Altitude = 0.000000
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
[redacted]
Demise Altitude = 0.000000
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

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

name = Phased Array [redacted]

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

name = Phased Array [redacted]
Demise Altitude = 77.990089
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
[redacted]
Demise Altitude = 75.562752
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
[redacted]
Demise Altitude = 76.588097
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
[redacted]
Demise Altitude = 76.416061
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
[redacted]
Demise Altitude = 0.000000
Debris Casualty Area = 33.478802
Impact Kinetic Energy = 12.651192

****
[redacted]
Demise Altitude = 66.942238
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
[redacted]
Demise Altitude = 77.247917
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
[redacted]
Demise Altitude = 76.724319
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
[redacted]
Demise Altitude = 77.603447
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
[redacted]
Demise Altitude = 77.585381
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
[redacted]
Demise Altitude = 77.077644
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

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

name = LVA Panel - Debris
[redacted]

[redacted]

[redacted]

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

name = LVA Panel - Debris
Demise Altitude = 77.990463
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
[redacted]
Demise Altitude = 69.240021
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

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

name = LVA Base - Debris
[redacted]

[redacted]

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

name = LVA Base - Debris
Demise Altitude = 77.987495
Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

****

[redacted]

Demise Altitude = 67.354805
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

========== End of Requirement 4.7-1 ==========
10 08 2021; 16:19:00PM Project Data Saved To File
10 08 2021; 16:19:17PM Project Data Saved To File