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SPRITE

Orbital Debris Analysis Report – Rev.D

Approvers List

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Rev	Change Description	By
A	Initial Release	R. Heller
B	Updated Results	D.Chafetz
C	Final Formatting	B. Fleming
D	Revised with results from DAS 3.2.6	E. Bauch

0.1 Table of Contents

0.2 Reference Documents

Document Ref	Title
NASA-STD-8719.14C	Process for Limiting Orbital Debris
NASA-HDBK-8719.14	Handbook for Limiting Orbital Debris
NPR 8715.6B	NASA Procedural Requirements for Limiting Orbital Debris and Evaluating the Meteoroid and Orbital Debris Environments

0.3 Acronyms/Abbreviations

Acronym	Meaning
LASP	Laboratory for Atmospheric and Space Physics
TBD	To be determined
TBW	To be written

0.4 ODAR Self-Assessment

Orbital debris analysis was performed using Debris Analysis Software (DAS) version 3.2.6. Because SPRITE is a secondary payload and assessment of the launch vehicle falls under the purview of the primary payload, assessment of the launch vehicle is not performed here. Results of the SPRITE self-assessment are summarized below.

Requirement	Compliance	Comments
4.3-1a MRD 25-year limit		Not applicable
4.3-1b MRD <100 object x year limit		Not applicable
4.3-2 GEO MRD		Not applicable
4.4-1 <0.001 Explosion Risk		Not applicable
4.4-2 Passivate Energy Sources	Compliant	
4.4-3 Limit Intentional BU		Not applicable
4.4-4 Limit Intentional BU		Not applicable
4.5-1 <0.01 10cm Impact Risk	Compliant	
4.5-2 <0.01 Small MMOD Impacts		
4.6-1a-c LEO Disposal	Compliant	
4.6-2 Storage or Earth Escape		Not applicable
4.6-3 Long-term Reentry		Not applicable
4.6-4 Disposal Reliability		Not applicable
4.7-1 Reentry Risk	Compliant	
4.8-1 Special Classes		

1.0 Mission Overview

The Supernova Remnants and Proxies for ReIonization Testbed Experiment (SPRITE) mission is a far-ultraviolet spectrograph designed to observe galaxies and supernova remnants with a long slit, 100 – 175 nm low resolution spectrograph. It is a 12U in form-factor and carries an 18 x 16 cm collecting area telescope and microchannel plate detector. SPRITE will study ionizing radiation escape from redshift z > 0.2 galaxies, map large portions of the Magellanic Clouds, and search for ionized gas emission from the halos of local galaxies.

2.0 Spacecraft Description

SPRITE is an extended 12U CubeSat with outer dimensions of approximately 23x23x39 cm. An illustration of the spacecraft is provided in Figure 1. The body coordinate system aligns the body -Z axis with the telescope boresight. The body +Y is normal to the S-band antenna and opposite of the solar array normal. The body +X completes a right-handed body coordinate frame as depicted in the figure.

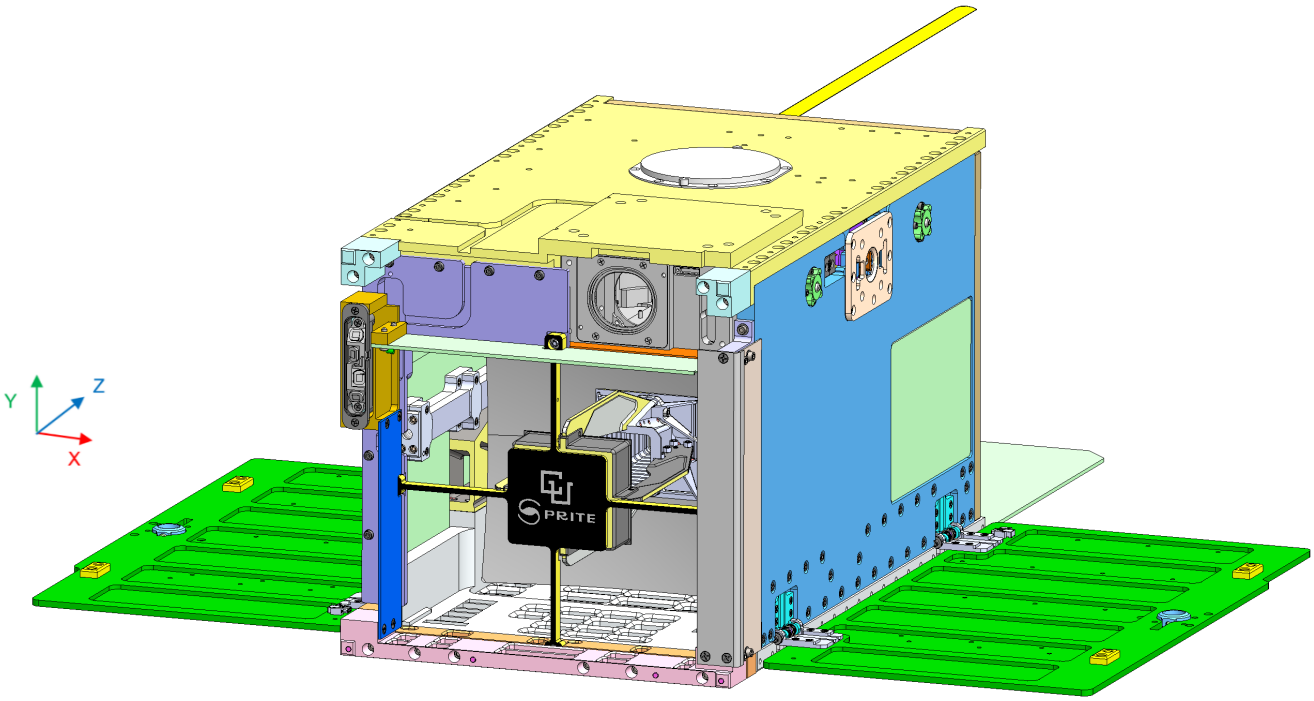

Figure 1 – SPRITE

SPRITE has three deployable solar arrays in addition to a single fixed array on the -Y face of the vehicle. The +X and -X deployable arrays have a 2x3U form factor, and the +Z deployable array is approximately 1.5x2U. All arrays comprise cells mounted to aluminum panels.

Total mass of the SPRITE spacecraft at launch is estimated at 19.5 kg. SPRITE has no propulsion subsystem or other expendable fluids, so the launch mass, dry mass, and end of mission (EOM) mass are the same.

Vehicle attitude determination and control is provided by a Blue Canyon Technologies (BCT) XACT-15 ADCS module. Vehicle attitude determination is performed by a single star tracker and inertial measurement unit (IMU) augmented by three external coarse sun sensors (CSS) mounted to the -Z, -X, and -Y faces of the vehicle. Three reaction wheels (RW) provide vehicle attitude control, and three torque rods provide continuous momentum desaturation of the RWs during operations. With the exception of the external CSSs, all components of the ADCS are contained within a 0.5U aluminum housing.

Aside from the kinetic energy stored in the RWs, the only energy storage devices on the spacecraft are two 77.8 Wh lithium-ion batteries (Space Inventor BAT-P3 modules). These will be passivated at the end of the mission (see Section 4.0)

There are no radioactive materials onboard.

3.0 Debris Released During Normal Operations

SPRITE will not release any debris during normal operations. NASA-STD-8719.14C Requirements 4.3-1 and 4.3-2 are therefore not applicable.

4.0 Intentional Breakups and Potential for Explosions

There are no credible failure modes that result in SPRITE breaking up or exploding prior to atmospheric reentry. Requirements 4.4-1 and 4.4-3 through 4.4-4 are not applicable.

As part of the required decommissioning in NASA-STD-8719.14C 4.4-2, upon the end of mission, a series of LS-9505M MilSpec latching relays will disconnect the SPRITE solar panels from the battery permanently, while a load resistor drains the remaining battery charge, satisfying the requirement for safe decommissioning.

5.0 Potential for On-Orbit Collisions

DAS calculates SPRITE’s probability for collision with large objects greater than 10 cm in diameter at 1.4529e-6 (the DAS logfile for this analysis is presented in Appendix D). SPRITE complies with 4.5-1.

Because SPRITE does not use propulsion to reach its disposal orbit, the probability of collision with small debris preventing SPRITE from complying with postmission disposal requirements is effectively zero. DAS shows SPRITE is compliant with 4.5-2.

6.0 Post mission Disposal Plans and Procedures

DAS 3.2.6 shows that SPRITE in the deployed configuration will reenter the atmosphere in mid-2029 after approximately 2.5 years from the end of the two-year mission. This orbit evolution for this scenario is shown in Figure 2. The average cross-sectional area is calculated using the expression $A_{average} = (A_{max} + A_1 + A_2)/2$ given in NASA-STD-8719.14C, where A_1 and A_2 are orthogonal to the maximum cross-section area A_{max}. In SPRITE's case, A_{max} is normal to the body Y axis, which has a total area of 0.25 m^2 with the solar arrays deployed. The remaining faces are 0.051 m^2 (body Z) and 0.089 m^2 (body X). Evaluating the expression from NASA-STD-8719.14C, $A_{average}$ is 0.19 m^2. Using total mass of 19.5 kg, the area-to-mass ratio is calculated at 0.01 m^2/kg.

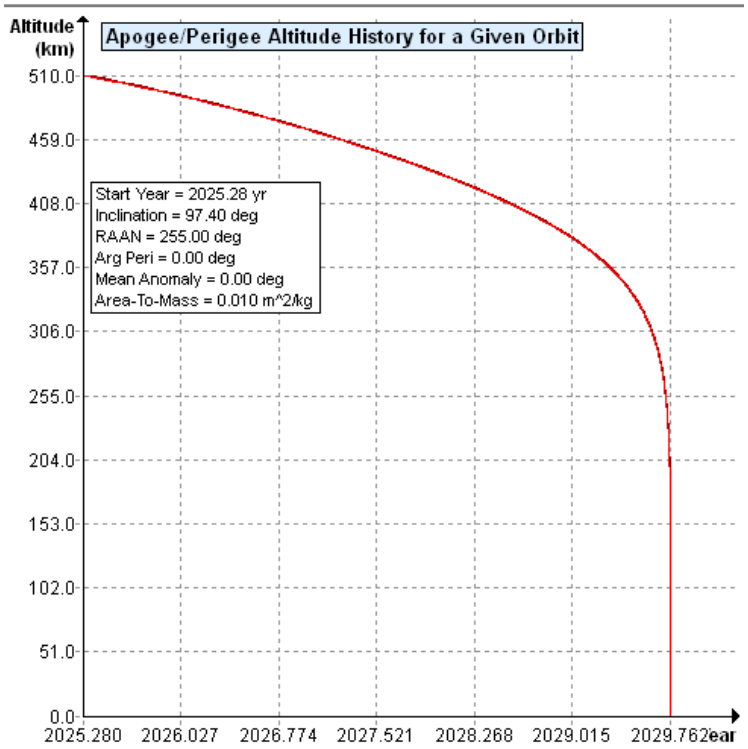

Figure 2 - SPRITE Deployed Configuration Orbit Evolution from 510 km.

In the event that the solar arrays fail to deploy, the mean area is reduced, which leads to a lower area-to-mass ratio. In this case, SPRITE will reenter in early 2034 - well inside the 25-year limit specified by 4.6-1. The area-to-mass ratio was calculated in the same fashion described above, but with A_{max} of 0.089 m^2 and orthogonal faces equal to 0.089 m^2 and 0.051 m^2. These values give an average area $A_{average}$ of 0.115 m^2 and area-to-mass ratio of 0.0059 m^2/kg. The SPRITE solar panel deployment mechanism has heritage on prior CubeSats with 100% deployment success rate.

In either event, SPRITE complies with requirement 4.6-1. Partial deployments are bounded by these scenarios and do not require separate analyses.

Requirements 4.6-2, 4.6-3, and 4.6-4 are not applicable.

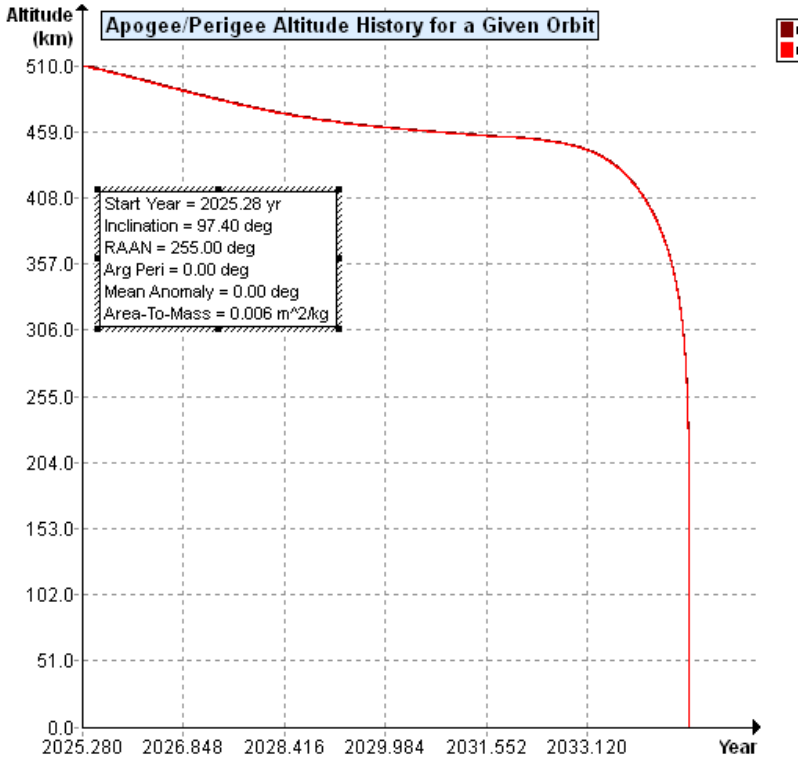

Figure 3 - SPRITE Orbit Evolution from 510 km if solar panels fail to deploy.

7.0 Reentry Hazards

The major components of SPRITE, simplified to match the geometric modeling of DAS, are presented in Appendix A.

DAS calculates the objects that will survive reentry. Components are listed with their corresponding impact areas and energy content.

Based on DAS 3.2.6 there is only 1 set of items on SPRITE that survive re-entry/do not demise. This is captured in the table below. Refer to Appendix B for all results.

SPRITE is therefore compliant with requirement 4.7-1.

No components re-enter with > 15J, which is compliant with FCC regulations.

SubComponent	Total Debris Casualty Area (m^2)	Kinetic Energy (J)
25	Detector Tungsten Shield	1.47

8.0 Special Classes of Space Missions

N/A

Appendix A - Component Sub-Items for Reentry Hazard Analysis

Table 1 contains the component properties imported to DAS for assessment against requirement 4.7-1.

The DAS logfile is attached in Appendix C which provides the outputs from DAS in raw format.

Table 1 - SPRITE Component Sub-Item Import File Contents

Row Num	Name	Parent	Qty	Material	Body Type	Thermal Mass	Diameter/Width	Length	Height
1	Root Object	0	1	Aluminum 6061-T6	Box	19.5	0.226	0.39	0.226
2	Plus X Panel	1	1	Aluminum 6061-T6	Box	1.2155	0.2033	0.3379	0.01
3	Minus X Panel	1	1	Aluminum 6061-T6	Box	1.1124	0.2033	0.3399	0.01
4	Plus Z Baffle	1	1	Aluminum 6061-T6	Box	0.045	0.055	0.119	0.005
5	Plus Z Panel	1	1	Aluminum 6061-T6	Flat Plate	0.0897	0.094	0.094	0.0038
6	Minus Z Panel	1	1	Aluminum 6061-T6	Flat Plate	0.7456	0.2263	0.2263	0.0054
7	Plus Y Panel	1	1	Aluminum 6061-T6	Flat Plate	2.7473	0.2263	0.3149	0.0142
8	ADCS Housing	7	2	Aluminum 6061-T6	Box	0.253	0.1	0.1	0.05
9	ADCS - Reaction Wheel Case	8	3	Aluminum 6061-T6	Box	0.017	0.041	0.041	0.017
10	ADCS - Reaction Wheel Magnets	9	24	Iron	Box	0.0008	0.0064	0.011	0.0019
11	ADCS Reaction Wheel	9	3	Stainless Steel (generic)	Cylinder	0.022	0.013	0.041	
12	S Band Radio	7	1	Aluminum 6061-T6	Box	0.18	0.0896	0.0953	0.0144
13	UHF Radio	7	1	Aluminum 6061-T6	Box	0.1735	0.057	0.083	0.018
14	Detector Electronics Box	7	1	Aluminum 6061-T6	Box	0.7701	0.0889	0.1219	0.0684
15	CTIM	7	1	Aluminum 6061-T6	Box	0.0194	0.0279	0.0626	0.0044
16	Electronics Bus	7	1	Aluminum 6061-T6	Box	0.56	0.0924	0.0924	0.0712
17	Battery	7	2	Aluminum 6061-T6	Box	0.456	0.0911	0.094	0.0412
18	Grating Mount	7	1	Aluminum 6061-T6	Box	0.1611	0.0737	0.0885	0.0579
19	Grating	7	1	Zerodur	Box	0.0197	0.028	0.032	0.0101
20	Bathtub	7	1	Aluminum 6061-T6	Box	0.0845	0.061	0.1026	0.0173
21	Cylindrical Flat Fold Mirror (M3)	7	1	Zerodur	Box	0.1156	0.04	0.0714	0.016
22	Slit Jaw	7	1	Aluminum 6061-T6	Box	0.0132	0.0186	0.034	0.0163
23	Detector Housing	7	1	Aluminum 6061-T6	Box	0.78045	0.1105	0.13775	0.086
24	Detector Pump	7	3	Steel AISI 316	Cylinder	0.25	0.033	0.0473	
25	Detector Tungsten Shield	7	16	Tungsten	Flat Plate	0.0339	0.0743	0.0945	0.00025016
26	Detector	7	1	Zerodur	Box	0.0101	0.02	0.04	0.005
27	Minus Y Panel	1	1	Aluminum 6061-T6	Box	1.1262	0.2263	0.3149	0.01
28	HVPS	27	1	Aluminum 6061-T6	Box	0.5652	0.083	0.11	0.04
29	Detector Subassembly	27	1	Aluminum 6061-T6	Box	2.233	0.1126	0.13375	0.0985
30	Top Wire Tree	27	1	Aluminum 6061-T6	Box	0.4402	0.0956	0.1651	0.065
31	DRM	27	1	Stainless Steel (generic)	Box	0.209	0.045	0.0545	0.034
32	Deployable Solar Arrays 3x2	1	2	Fiberglass	Box	0.4438	0.2048	0.3364	0.0035
33	Deployable Solar Arrays 2x2	1	1	Fiberglass	Flat Plate	0.2307	0.1628	0.22	0.00350002
34	PAM Plus X	1	3	Aluminum 6061-T6	Box	0.0918	0.048	0.048	0.0153
35	PAM Minus X	1	3	Aluminum 6061-T6	Box	0.0918	0.048	0.048	0.0153
36	PAM -Z	1	3	Aluminum 6061-T6	Box	0.0918	0.048	0.048	0.0153
37	Torque Rod Housing	36	3	Aluminum 6061-T6	Cylinder	0.0017	0.0122	0.035	
38	Torque Rod Winding	37	3	Copper Alloy	Cylinder	0.0183	0.012	0.033	
39	Torque Rod Core	37	3	Iron	Cylinder	0.0196	0.0094	0.0381	
40	ADCS Star Tracker Housing	36	1	Aluminum 6061-T6	Box	0.052	0.052	0.053	0.048
41	S Band Antenna	1	1	Aluminum 6061-T6	Flat Plate	0.14	0.098	0.2213	0.00238469
42	Light Tube	1	1	Aluminum 6061-T6	Box	0.0932	0.031	0.17535	0.014
43	Primary Mirror (M1)	1	1	Zerodur	Box	1.8953	0.16	0.18	0.0275
44	Secondary Mirror (M2)	1	1	Zerodur	Box	0.1007	0.057	0.061	0.01145
45	Secondary Reflector Spider	1	4	Invar	Flat Plate	0.04268	0.02242	0.1363	0.00173499
46	Front Thermal Router	1	1	Aluminum 6061-T6	Flat Plate	0.0288	0.0529	0.0569	0.00353457
47	Panel Tensioner	1	3	Titanium (6 Al-4 V)	Flat Plate	0.007	0.0252	0.0252	0.00248432
48	DRM Shear Offload	1	1	Titanium (6 Al-4 V)	Flat Plate	0.0017	0.0157	0.0157	0.00155439
49	Pump System Manifold Tubes	1	4	Stainless Steel (generic)	Cylinder	0.0196	0.0064	0.0773	
50	Pump System Manifold Clamps	1	3	Stainless Steel (generic)	Box	0.02255	0.02135	0.0303	0.015
51	Pump System Manifold X	1	1	Stainless Steel (generic)	Flat Plate	0.0909	0.0484	0.0484	0.00497483
52	Pump System Manifold L	1	1	Stainless Steel (generic)	Cylinder	0.0525	0.0142	0.0665	
53	Minus X Flexure Bottom	1	1	Titanium (6 Al-4 V)	Box	0.0329	0.0193	0.07925	0.0051
54	Minus X Flexure Sides	1	2	Titanium (6 Al-4 V)	Flat Plate	0.0283	0.025	0.0789	0.00323355
55	Minus X Flexure Top	1	2	Titanium (6 Al-4 V)	Box	0.0632	0.0246	0.03	0.0193
56	Plus X Flexure Body Top	1	1	Titanium (6 Al-4 V)	Box	0.028	0.0127	0.0823	0.0066
57	Plus X Flexure Body Sides	1	2	Titanium (6 Al-4 V)	Box	0.0179	0.0127	0.048	0.0066
58	Plus X Flexure Lightweighting	1	1	Titanium (6 Al-4 V)	Box	0.0171	0.0252	0.0402	0.0038
59	Plus X Flexure Arm	1	1	Titanium (6 Al-4 V)	Box	0.0243	0.0127	0.0651	0.0076
60	Plus X Flexure Feet	1	2	Titanium (6 Al-4 V)	Box	0.042	0.0178	0.0358	0.015
61	Fastener	1	1	Steel A-286	Cylinder	0.00074	0.0046	0.0117	
62	Washer	1	1	Stainless Steel (generic)	Flat Plate	0.00034	0.0079	0.0079	0.00069844
63	UHF Antenna Housing	1	1	Teflon	Box	0.026	0.0396	0.0935	0.033
64	UHF Antenna	1	1	Stainless Steel (generic)	Flat Plate	0.005	0.0124	0.508	0.00010176
65	UHF Antenna Hardware	1	1	Steel AISI 304	Flat Plate	0.00092	0.0124	0.0165	0.00056919
66	PAM Shear Mech 2	1	3	Stainless Steel (generic)	Flat Plate	0.056	0.0488	0.0635	0.00231686

Appendix B - Component Sub-Items Results for Reentry Hazard Analysis

2 contains the component results from DAS for assessment against requirement 4.7-1.

Table 2 - SPRITE Component Sub-Item Results

Row Num	Name	Demise Alt	Total DCA	KE
1	Root Object		0	
2	Plus X Panel	76.8	0	0
3	Minus X Panel	76.9	0	0
4	Plus Z Baffle	77.7	0	0
5	Plus Z Panel	77.5	0	0
6	Minus Z Panel	76.9	0	0
7	Plus Y Panel	75.3	0	0
8	ADCS Housing	74.6	0	0
9	ADCS - Reaction Wheel Case	74.4	0	0
10	ADCS - Reaction Wheel Magnets	73.6	0	0
11	ADCS Reaction Wheel	71.7	0	0
12	S Band Radio	74.5	0	0
13	UHF Radio	74.3	0	0
14	Detector Electronics Box	73.7	0	0
15	CTIM	75	0	0
16	Electronics Bus	73.8	0	0
17	Battery	73.8	0	0
18	Grating Mount	74.8	0	0
19	Grating	73.2	0	0
20	Bathtub	74.9	0	0
21	Cylindrical Flat Fold Mirror (M3)	71.1	0	0
22	Slit Jaw	75	0	0
23	Detector Housing	74	0	0
24	Detector Pump	65.8	0	0
25	Detector Tungsten Shield	0	6.42	1.47
26	Detector	74	0	0
27	Minus Y Panel	76.9	0	0
28	HVPS	75.2	0	0
29	Detector Subassembly	73.4	0	0
30	Top Wire Tree	76.2	0	0
31	DRM	71.7	0	0
32	Deployable Solar Arrays 3x2	76.7	0	0
33	Deployable Solar Arrays 2x2	76.9	0	0
34	PAM Plus X	76.9	0	0
35	PAM Minus X	76.9	0	0
36	PAM -Z	76.9	0	0
37	Torque Rod Housing	76.9	0	0
38	Torque Rod Winding	75.3	0	0
39	Torque Rod Core	72.6	0	0
40	ADCS Star Tracker Housing	76.6	0	0
41	S Band Antenna	77.7	0	0
42	Light Tube	77.5	0	0
43	Primary Mirror (M1)	59.9	0	0
44	Secondary Mirror (M2)	73.5	0	0
45	Secondary Reflector Spider	76.2	0	0
46	Front Thermal Router	77.6	0	0
47	Panel Tensioner	74.6	0	0
48	DRM Shear Offload	76.2	0	0
49	Pump System Manifold Tubes	75.8	0	0
50	Pump System Manifold Clamps	76	0	0

51	Pump System Manifold X	73	0	0
52	Pump System Manifold L	74.1	0	0
53	Minus X Flexure Bottom	73.2	0	0
54	Minus X Flexure Sides	71.4	0	0
55	Minus X Flexure Top	70.1	0	0
56	Plus X Flexure Body Top	74.1	0	0
57	Plus X Flexure Body Sides	74.3	0	0
58	Plus X Flexure Lightweighting	74.1	0	0
59	Plus X Flexure Arm	74	0	0
60	Plus X Flexure Feet	72.3	0	0
61	Fastener	77.4	0	0
62	Washer	77.5	0	0
63	UHF Antenna Housing	77.9	0	0
64	UHF Antenna	77.9	0	0
65	UHF Antenna Hardware	77.3	0	0
66	PAM Shear Mech 2	75.5	0	0

Appendix C - DAS Logfile

Appendix C contains the activity logfile from the DAS analysis showing components and parent relations

10 16 2024; 13:27:11PM Activity Log Started
10 16 2024; 13:35:20PM Project Data Saved To File
10 17 2024; 10:12:17AM Activity Log Started
10 17 2024; 10:12:17AM Opened Project C:\Users\evba6506\Documents\Projects\SPRITE\
10 17 2024; 10:13:18AM Science and Engineering - Re-Entry Survivability Analysis

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

name = Root Object
quantity = 1
parent = 0
materialID = 8
type = Box
Aero Mass = 19.500000
Thermal Mass = 19.500000
Diameter/Width = 0.226000
Length = 0.390000
Height = 0.226000

name = Plus X Panel
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 1.215500
Thermal Mass = 1.215500
Diameter/Width = 0.203300
Length = 0.337900
Height = 0.010000

name = Minus X Panel
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 1.112400
Thermal Mass = 1.112400
Diameter/Width = 0.203300
Length = 0.339900
Height = 0.010000

name = Plus Z Baffle
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.045000
Thermal Mass = 0.045000
Diameter/Width = 0.055000
Length = 0.119000

Height = 0.005000

name = Plus Z Panel
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.089700
Thermal Mass = 0.089700
Diameter/Width = 0.094000
Length = 0.094000

name = Minus Z Panel
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.745600
Thermal Mass = 0.745600
Diameter/Width = 0.226300
Length = 0.226300

name = Plus Y Panel
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 8.481550
Thermal Mass = 2.747300
Diameter/Width = 0.226300
Length = 0.314900

name = ADCS Housing
quantity = 2
parent = 7
materialID = 8
type = Box
Aero Mass = 0.321100
Thermal Mass = 0.253000
Diameter/Width = 0.100000
Length = 0.100000
Height = 0.050000

name = ADCS - Reaction Wheel Case
quantity = 3
parent = 8
materialID = 8
type = Box
Aero Mass = 0.045400
Thermal Mass = 0.017000
Diameter/Width = 0.041000
Length = 0.041000
Height = 0.017000

name = ADCS - Reaction Wheel Magnets
quantity = 24

parent = 9
materialID = 38
type = Box
Aero Mass = 0.000800
Thermal Mass = 0.000800
Diameter/Width = 0.006400
Length = 0.011000
Height = 0.001900

name = ADCS Reaction Wheel
quantity = 3
parent = 9
materialID = 54
type = Cylinder
Aero Mass = 0.022000
Thermal Mass = 0.022000
Diameter/Width = 0.013000
Length = 0.041000

name = S Band Radio
quantity = 1
parent = 7
materialID = 8
type = Box
Aero Mass = 0.180000
Thermal Mass = 0.180000
Diameter/Width = 0.089600
Length = 0.095300
Height = 0.014400

name = UHF Radio
quantity = 1
parent = 7
materialID = 8
type = Box
Aero Mass = 0.173500
Thermal Mass = 0.173500
Diameter/Width = 0.057000
Length = 0.083000
Height = 0.018000

name = Detector Electronics Box
quantity = 1
parent = 7
materialID = 8
type = Box
Aero Mass = 0.770100
Thermal Mass = 0.770100
Diameter/Width = 0.088900
Length = 0.121900
Height = 0.068400

name = CTIM
quantity = 1
parent = 7
materialID = 8

type = Box
Aero Mass = 0.019400
Thermal Mass = 0.019400
Diameter/Width = 0.027900
Length = 0.062600
Height = 0.004400

name = Electronics Bus
quantity = 1
parent = 7
materialID = 8
type = Box
Aero Mass = 0.560000
Thermal Mass = 0.560000
Diameter/Width = 0.092400
Length = 0.092400
Height = 0.071200

name = Battery
quantity = 2
parent = 7
materialID = 8
type = Box
Aero Mass = 0.456000
Thermal Mass = 0.456000
Diameter/Width = 0.091100
Length = 0.094000
Height = 0.041200

name = Grating Mount
quantity = 1
parent = 7
materialID = 8
type = Box
Aero Mass = 0.161100
Thermal Mass = 0.161100
Diameter/Width = 0.073700
Length = 0.088500
Height = 0.057900

name = Grating
quantity = 1
parent = 7
materialID = 71
type = Box
Aero Mass = 0.019700
Thermal Mass = 0.019700
Diameter/Width = 0.028000
Length = 0.032000
Height = 0.010100

name = Bathtub
quantity = 1
parent = 7
materialID = 8
type = Box

Aero Mass = 0.084500
Thermal Mass = 0.084500
Diameter/Width = 0.061000
Length = 0.102600
Height = 0.017300

name = Cylindrical Flat Fold Mirror (M3)
quantity = 1
parent = 7
materialID = 71
type = Box
Aero Mass = 0.115600
Thermal Mass = 0.115600
Diameter/Width = 0.040000
Length = 0.071400
Height = 0.016000

name = Slit Jaw
quantity = 1
parent = 7
materialID = 8
type = Box
Aero Mass = 0.013200
Thermal Mass = 0.013200
Diameter/Width = 0.018600
Length = 0.034000
Height = 0.016300

name = Detector Housing
quantity = 1
parent = 7
materialID = 8
type = Box
Aero Mass = 0.780450
Thermal Mass = 0.780450
Diameter/Width = 0.110500
Length = 0.137750
Height = 0.086000

name = Detector Pump
quantity = 3
parent = 7
materialID = 59
type = Cylinder
Aero Mass = 0.250000
Thermal Mass = 0.250000
Diameter/Width = 0.033000
Length = 0.047300

name = Detector Tungsten Shield
quantity = 16
parent = 7
materialID = 67
type = Flat Plate
Aero Mass = 0.033900
Thermal Mass = 0.033900

Diameter/Width = 0.074300
Length = 0.094500

name = Detector
quantity = 1
parent = 7
materialID = 71
type = Box
Aero Mass = 0.010100
Thermal Mass = 0.010100
Diameter/Width = 0.020000
Length = 0.040000
Height = 0.005000

name = Minus Y Panel
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 4.573600
Thermal Mass = 1.126200
Diameter/Width = 0.226300
Length = 0.314900
Height = 0.010000

name = HVPS
quantity = 1
parent = 27
materialID = 8
type = Box
Aero Mass = 0.565200
Thermal Mass = 0.565200
Diameter/Width = 0.083000
Length = 0.110000
Height = 0.040000

name = Detector Subassembly
quantity = 1
parent = 27
materialID = 8
type = Box
Aero Mass = 2.233000
Thermal Mass = 2.233000
Diameter/Width = 0.112600
Length = 0.133750
Height = 0.098500

name = Top Wire Tree
quantity = 1
parent = 27
materialID = 8
type = Box
Aero Mass = 0.440200
Thermal Mass = 0.440200
Diameter/Width = 0.095600
Length = 0.165100

Height = 0.065000

name = DRM
quantity = 1
parent = 27
materialID = 54
type = Box
Aero Mass = 0.209000
Thermal Mass = 0.209000
Diameter/Width = 0.045000
Length = 0.054500
Height = 0.034000

name = Deployable Solar Arrays 3x2
quantity = 2
parent = 1
materialID = 23
type = Box
Aero Mass = 0.443800
Thermal Mass = 0.443800
Diameter/Width = 0.204800
Length = 0.336400
Height = 0.003500

name = Deployable Solar Arrays 2x2
quantity = 1
parent = 1
materialID = 23
type = Flat Plate
Aero Mass = 0.230700
Thermal Mass = 0.230700
Diameter/Width = 0.162800
Length = 0.220000

name = PAM Plus X
quantity = 3
parent = 1
materialID = 8
type = Box
Aero Mass = 0.091800
Thermal Mass = 0.091800
Diameter/Width = 0.048000
Length = 0.048000
Height = 0.015300

name = PAM Minus X
quantity = 3
parent = 1
materialID = 8
type = Box
Aero Mass = 0.091800
Thermal Mass = 0.091800
Diameter/Width = 0.048000
Length = 0.048000
Height = 0.015300

name = PAM -Z
quantity = 3
parent = 1
materialID = 8
type = Box
Aero Mass = 0.148733
Thermal Mass = 0.091800
Diameter/Width = 0.048000
Length = 0.048000
Height = 0.015300

name = Torque Rod Housing
quantity = 3
parent = 36
materialID = 8
type = Cylinder
Aero Mass = 0.039600
Thermal Mass = 0.001700
Diameter/Width = 0.012200
Length = 0.035000

name = Torque Rod Winding
quantity = 3
parent = 37
materialID = 19
type = Cylinder
Aero Mass = 0.018300
Thermal Mass = 0.018300
Diameter/Width = 0.012000
Length = 0.033000

name = Torque Rod Core
quantity = 3
parent = 37
materialID = 38
type = Cylinder
Aero Mass = 0.019600
Thermal Mass = 0.019600
Diameter/Width = 0.009400
Length = 0.038100

name = ADCS Star Tracker Housing
quantity = 1
parent = 36
materialID = 8
type = Box
Aero Mass = 0.052000
Thermal Mass = 0.052000
Diameter/Width = 0.052000
Length = 0.053000
Height = 0.048000

name = S Band Antenna
quantity = 1
parent = 1
materialID = 8

type = Flat Plate
Aero Mass = 0.140000
Thermal Mass = 0.140000
Diameter/Width = 0.098000
Length = 0.221300

name = Light Tube
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.093200
Thermal Mass = 0.093200
Diameter/Width = 0.031000
Length = 0.175350
Height = 0.014000

name = Primary Mirror (M1)
quantity = 1
parent = 1
materialID = 71
type = Box
Aero Mass = 1.895300
Thermal Mass = 1.895300
Diameter/Width = 0.160000
Length = 0.180000
Height = 0.027500

name = Secondary Mirror (M2)
quantity = 1
parent = 1
materialID = 71
type = Box
Aero Mass = 0.100700
Thermal Mass = 0.100700
Diameter/Width = 0.057000
Length = 0.061000
Height = 0.011450

name = Secondary Reflector Spider
quantity = 4
parent = 1
materialID = 72
type = Flat Plate
Aero Mass = 0.042680
Thermal Mass = 0.042680
Diameter/Width = 0.022420
Length = 0.136300

name = Front Thermal Router
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.028800
Thermal Mass = 0.028800

Diameter/Width = 0.052900
Length = 0.056900

name = Panel Tensioner
quantity = 3
parent = 1
materialID = 65
type = Flat Plate
Aero Mass = 0.007000
Thermal Mass = 0.007000
Diameter/Width = 0.025200
Length = 0.025200

name = DRM Shear Offload
quantity = 1
parent = 1
materialID = 65
type = Flat Plate
Aero Mass = 0.001700
Thermal Mass = 0.001700
Diameter/Width = 0.015700
Length = 0.015700

name = Pump System Manifold Tubes
quantity = 4
parent = 1
materialID = 54
type = Cylinder
Aero Mass = 0.019600
Thermal Mass = 0.019600
Diameter/Width = 0.006400
Length = 0.077300

name = Pump System Manifold Clamps
quantity = 3
parent = 1
materialID = 54
type = Box
Aero Mass = 0.022550
Thermal Mass = 0.022550
Diameter/Width = 0.021350
Length = 0.030300
Height = 0.015000

name = Pump System Manifold X
quantity = 1
parent = 1
materialID = 54
type = Flat Plate
Aero Mass = 0.090900
Thermal Mass = 0.090900
Diameter/Width = 0.048400
Length = 0.048400

name = Pump System Manifold L
quantity = 1

parent = 1
materialID = 54
type = Cylinder
Aero Mass = 0.052500
Thermal Mass = 0.052500
Diameter/Width = 0.014200
Length = 0.066500

name = Minus X Flexure Bottom
quantity = 1
parent = 1
materialID = 65
type = Box
Aero Mass = 0.032900
Thermal Mass = 0.032900
Diameter/Width = 0.019300
Length = 0.079250
Height = 0.005100

name = Minus X Flexure Sides
quantity = 2
parent = 1
materialID = 65
type = Flat Plate
Aero Mass = 0.028300
Thermal Mass = 0.028300
Diameter/Width = 0.025000
Length = 0.078900

name = Minus X Flexure Top
quantity = 2
parent = 1
materialID = 65
type = Box
Aero Mass = 0.063200
Thermal Mass = 0.063200
Diameter/Width = 0.024600
Length = 0.030000
Height = 0.019300

name = Plus X Flexure Body Top
quantity = 1
parent = 1
materialID = 65
type = Box
Aero Mass = 0.028000
Thermal Mass = 0.028000
Diameter/Width = 0.012700
Length = 0.082300
Height = 0.006600

name = Plus X Flexure Body Sides
quantity = 2
parent = 1
materialID = 65
type = Box

Aero Mass = 0.017900
Thermal Mass = 0.017900
Diameter/Width = 0.012700
Length = 0.048000
Height = 0.006600

name = Plus X Flexure Lightweighting
quantity = 1
parent = 1
materialID = 65
type = Box
Aero Mass = 0.017100
Thermal Mass = 0.017100
Diameter/Width = 0.025200
Length = 0.040200
Height = 0.003800

name = Plus X Flexure Arm
quantity = 1
parent = 1
materialID = 65
type = Box
Aero Mass = 0.024300
Thermal Mass = 0.024300
Diameter/Width = 0.012700
Length = 0.065100
Height = 0.007600

name = Plus X Flexure Feet
quantity = 2
parent = 1
materialID = 65
type = Box
Aero Mass = 0.042000
Thermal Mass = 0.042000
Diameter/Width = 0.017800
Length = 0.035800
Height = 0.015000

name = Fastener
quantity = 1
parent = 1
materialID = 57
type = Cylinder
Aero Mass = 0.000740
Thermal Mass = 0.000740
Diameter/Width = 0.004600
Length = 0.011700

name = Washer
quantity = 1
parent = 1
materialID = 54
type = Flat Plate
Aero Mass = 0.000340
Thermal Mass = 0.000340

Diameter/Width = 0.007900
Length = 0.007900

name = UHF Antenna Housing
quantity = 1
parent = 1
materialID = 64
type = Box
Aero Mass = 0.026000
Thermal Mass = 0.026000
Diameter/Width = 0.039600
Length = 0.093500
Height = 0.033000

name = UHF Antenna
quantity = 1
parent = 1
materialID = 54
type = Flat Plate
Aero Mass = 0.005000
Thermal Mass = 0.005000
Diameter/Width = 0.012400
Length = 0.508000

name = UHF Antenna Hardware
quantity = 1
parent = 1
materialID = 58
type = Flat Plate
Aero Mass = 0.000920
Thermal Mass = 0.000920
Diameter/Width = 0.012400
Length = 0.016500

name = PAM Shear Mech 2
quantity = 3
parent = 1
materialID = 54
type = Flat Plate
Aero Mass = 0.056000
Thermal Mass = 0.056000
Diameter/Width = 0.048800
Length = 0.063500

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

name = Root Object
Demise Altitude = 77.999729
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Plus X Panel
Demise Altitude = 76.793924
Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

****

name = Minus X Panel
Demise Altitude = 76.902080
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Plus Z Baffle
Demise Altitude = 77.739714
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Plus Z Panel
Demise Altitude = 77.493558
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Minus Z Panel
Demise Altitude = 76.897025
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Plus Y Panel
Demise Altitude = 75.289264
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = ADCS Housing
Demise Altitude = 74.581918
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = ADCS - Reaction Wheel Case
Demise Altitude = 74.362426
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = ADCS - Reaction Wheel Magnets
Demise Altitude = 73.586954
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = ADCS Reaction Wheel
Demise Altitude = 71.668093
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = S Band Radio
Demise Altitude = 74.503681
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = UHF Radio
Demise Altitude = 74.312429
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Detector Electronics Box
Demise Altitude = 73.690774
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = CTIM
Demise Altitude = 75.004728
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Electronics Bus
Demise Altitude = 73.839048
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Battery
Demise Altitude = 73.797533
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Grating Mount
Demise Altitude = 74.781725
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Grating
Demise Altitude = 73.219556
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Bathtub
Demise Altitude = 74.900315
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Cylindrical Flat Fold Mirror (M3)

Demise Altitude = 71.062343
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Slit Jaw
Demise Altitude = 75.023559
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Detector Housing
Demise Altitude = 74.033334
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Detector Pump
Demise Altitude = 65.778213
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Detector Tungsten Shield
Demise Altitude = 0.000000
Debris Casualty Area = 6.415827
Impact Kinetic Energy = 1.467168

****

name = Detector
Demise Altitude = 74.041982
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Minus Y Panel
Demise Altitude = 76.922914
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = HVPS
Demise Altitude = 75.174247
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Detector Subassembly
Demise Altitude = 73.414451
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Top Wire Tree
Demise Altitude = 76.159676
Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

****

name = DRM
Demise Altitude = 71.703289
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Deployable Solar Arrays 3x2
Demise Altitude = 76.731839
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Deployable Solar Arrays 2x2
Demise Altitude = 76.889783
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = PAM Plus X
Demise Altitude = 76.927019
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = PAM Minus X
Demise Altitude = 76.927019
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = PAM -Z
Demise Altitude = 76.942212
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Torque Rod Housing
Demise Altitude = 76.870552
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Torque Rod Winding
Demise Altitude = 75.251523
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Torque Rod Core
Demise Altitude = 72.594946
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = ADCS Star Tracker Housing
Demise Altitude = 76.608191
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = S Band Antenna
Demise Altitude = 77.654889
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Light Tube
Demise Altitude = 77.515243
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Primary Mirror (M1)
Demise Altitude = 59.859996
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Secondary Mirror (M2)
Demise Altitude = 73.512886
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Secondary Reflector Spider
Demise Altitude = 76.202333
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Front Thermal Router
Demise Altitude = 77.619627
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Panel Tensioner
Demise Altitude = 74.572664
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = DRM Shear Offload
Demise Altitude = 76.227989
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Pump System Manifold Tubes

Demise Altitude = 75.761489
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Pump System Manifold Clamps
Demise Altitude = 76.029164
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Pump System Manifold X
Demise Altitude = 73.010450
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Pump System Manifold L
Demise Altitude = 74.084133
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Minus X Flexure Bottom
Demise Altitude = 73.204640
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Minus X Flexure Sides
Demise Altitude = 71.445244
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Minus X Flexure Top
Demise Altitude = 70.119126
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Plus X Flexure Body Top
Demise Altitude = 74.086290
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Plus X Flexure Body Sides
Demise Altitude = 74.279740
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Plus X Flexure Lightweighting
Demise Altitude = 74.051645
Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

****

name = Plus X Flexure Arm
Demise Altitude = 73.992822
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Plus X Flexure Feet
Demise Altitude = 72.277516
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Fastener
Demise Altitude = 77.425240
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Washer
Demise Altitude = 77.537732
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = UHF Antenna Housing
Demise Altitude = 77.869770
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = UHF Antenna
Demise Altitude = 77.929741
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = UHF Antenna Hardware
Demise Altitude = 77.342875
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = PAM Shear Mech 2
Demise Altitude = 75.470695
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

========== End of Re-Entry Survivability Analysis ==========
10 17 2024; 10:13:43AM Science and Engineering - Re-Entry Survivability Analysis

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

name = Root Object
quantity = 1
parent = 0
materialID = 8
type = Box
Aero Mass = 19.500000
Thermal Mass = 19.500000
Diameter/Width = 0.226000
Length = 0.390000
Height = 0.226000

name = Plus X Panel
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 1.215500
Thermal Mass = 1.215500
Diameter/Width = 0.203300
Length = 0.337900
Height = 0.010000

name = Minus X Panel
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 1.112400
Thermal Mass = 1.112400
Diameter/Width = 0.203300
Length = 0.339900
Height = 0.010000

name = Plus Z Baffle
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 0.045000
Thermal Mass = 0.045000
Diameter/Width = 0.055000
Length = 0.119000
Height = 0.005000

name = Plus Z Panel
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.089700
Thermal Mass = 0.089700
Diameter/Width = 0.094000
Length = 0.094000

name = Minus Z Panel
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.745600
Thermal Mass = 0.745600
Diameter/Width = 0.226300
Length = 0.226300

name = Plus Y Panel
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 8.481550
Thermal Mass = 2.747300
Diameter/Width = 0.226300
Length = 0.314900

name = ADCS Housing
quantity = 2
parent = 7
materialID = 8
type = Box
Aero Mass = 0.321100
Thermal Mass = 0.253000
Diameter/Width = 0.100000
Length = 0.100000
Height = 0.050000

name = ADCS - Reaction Wheel Case
quantity = 3
parent = 8
materialID = 8
type = Box
Aero Mass = 0.045400
Thermal Mass = 0.017000
Diameter/Width = 0.041000
Length = 0.041000
Height = 0.017000

name = ADCS - Reaction Wheel Magnets
quantity = 24
parent = 9
materialID = 38
type = Box
Aero Mass = 0.000800
Thermal Mass = 0.000800
Diameter/Width = 0.006400
Length = 0.011000
Height = 0.001900

name = ADCS Reaction Wheel
quantity = 3

parent = 9
materialID = 54
type = Cylinder
Aero Mass = 0.022000
Thermal Mass = 0.022000
Diameter/Width = 0.013000
Length = 0.041000

name = S Band Radio
quantity = 1
parent = 7
materialID = 8
type = Box
Aero Mass = 0.180000
Thermal Mass = 0.180000
Diameter/Width = 0.089600
Length = 0.095300
Height = 0.014400

name = UHF Radio
quantity = 1
parent = 7
materialID = 8
type = Box
Aero Mass = 0.173500
Thermal Mass = 0.173500
Diameter/Width = 0.057000
Length = 0.083000
Height = 0.018000

name = Detector Electronics Box
quantity = 1
parent = 7
materialID = 8
type = Box
Aero Mass = 0.770100
Thermal Mass = 0.770100
Diameter/Width = 0.088900
Length = 0.121900
Height = 0.068400

name = CTIM
quantity = 1
parent = 7
materialID = 8
type = Box
Aero Mass = 0.019400
Thermal Mass = 0.019400
Diameter/Width = 0.027900
Length = 0.062600
Height = 0.004400

name = Electronics Bus
quantity = 1
parent = 7
materialID = 8

type = Box
Aero Mass = 0.560000
Thermal Mass = 0.560000
Diameter/Width = 0.092400
Length = 0.092400
Height = 0.071200

name = Battery
quantity = 2
parent = 7
materialID = 8
type = Box
Aero Mass = 0.456000
Thermal Mass = 0.456000
Diameter/Width = 0.091100
Length = 0.094000
Height = 0.041200

name = Grating Mount
quantity = 1
parent = 7
materialID = 8
type = Box
Aero Mass = 0.161100
Thermal Mass = 0.161100
Diameter/Width = 0.073700
Length = 0.088500
Height = 0.057900

name = Grating
quantity = 1
parent = 7
materialID = 71
type = Box
Aero Mass = 0.019700
Thermal Mass = 0.019700
Diameter/Width = 0.028000
Length = 0.032000
Height = 0.010100

name = Bathtub
quantity = 1
parent = 7
materialID = 8
type = Box
Aero Mass = 0.084500
Thermal Mass = 0.084500
Diameter/Width = 0.061000
Length = 0.102600
Height = 0.017300

name = Cylindrical Flat Fold Mirror (M3)
quantity = 1
parent = 7
materialID = 71
type = Box

Aero Mass = 0.115600
Thermal Mass = 0.115600
Diameter/Width = 0.040000
Length = 0.071400
Height = 0.016000

name = Slit Jaw
quantity = 1
parent = 7
materialID = 8
type = Box
Aero Mass = 0.013200
Thermal Mass = 0.013200
Diameter/Width = 0.018600
Length = 0.034000
Height = 0.016300

name = Detector Housing
quantity = 1
parent = 7
materialID = 8
type = Box
Aero Mass = 0.780450
Thermal Mass = 0.780450
Diameter/Width = 0.110500
Length = 0.137750
Height = 0.086000

name = Detector Pump
quantity = 3
parent = 7
materialID = 59
type = Cylinder
Aero Mass = 0.250000
Thermal Mass = 0.250000
Diameter/Width = 0.033000
Length = 0.047300

name = Detector Tungsten Shield
quantity = 16
parent = 7
materialID = 67
type = Flat Plate
Aero Mass = 0.033900
Thermal Mass = 0.033900
Diameter/Width = 0.074300
Length = 0.094500

name = Detector
quantity = 1
parent = 7
materialID = 71
type = Box
Aero Mass = 0.010100
Thermal Mass = 0.010100
Diameter/Width = 0.020000

Length = 0.040000
Height = 0.005000

name = Minus Y Panel
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 4.573600
Thermal Mass = 1.126200
Diameter/Width = 0.226300
Length = 0.314900
Height = 0.010000

name = HVPS
quantity = 1
parent = 27
materialID = 8
type = Box
Aero Mass = 0.565200
Thermal Mass = 0.565200
Diameter/Width = 0.083000
Length = 0.110000
Height = 0.040000

name = Detector Subassembly
quantity = 1
parent = 27
materialID = 8
type = Box
Aero Mass = 2.233000
Thermal Mass = 2.233000
Diameter/Width = 0.112600
Length = 0.133750
Height = 0.098500

name = Top Wire Tree
quantity = 1
parent = 27
materialID = 8
type = Box
Aero Mass = 0.440200
Thermal Mass = 0.440200
Diameter/Width = 0.095600
Length = 0.165100
Height = 0.065000

name = DRM
quantity = 1
parent = 27
materialID = 54
type = Box
Aero Mass = 0.209000
Thermal Mass = 0.209000
Diameter/Width = 0.045000
Length = 0.054500

Height = 0.034000

name = Deployable Solar Arrays 3x2
quantity = 2
parent = 1
materialID = 23
type = Box
Aero Mass = 0.443800
Thermal Mass = 0.443800
Diameter/Width = 0.204800
Length = 0.336400
Height = 0.003500

name = Deployable Solar Arrays 2x2
quantity = 1
parent = 1
materialID = 23
type = Flat Plate
Aero Mass = 0.230700
Thermal Mass = 0.230700
Diameter/Width = 0.162800
Length = 0.220000

name = PAM Plus X
quantity = 3
parent = 1
materialID = 8
type = Box
Aero Mass = 0.091800
Thermal Mass = 0.091800
Diameter/Width = 0.048000
Length = 0.048000
Height = 0.015300

name = PAM Minus X
quantity = 3
parent = 1
materialID = 8
type = Box
Aero Mass = 0.091800
Thermal Mass = 0.091800
Diameter/Width = 0.048000
Length = 0.048000
Height = 0.015300

name = PAM -Z
quantity = 3
parent = 1
materialID = 8
type = Box
Aero Mass = 0.148733
Thermal Mass = 0.091800
Diameter/Width = 0.048000
Length = 0.048000
Height = 0.015300

name = Torque Rod Housing
quantity = 3
parent = 36
materialID = 8
type = Cylinder
Aero Mass = 0.039600
Thermal Mass = 0.001700
Diameter/Width = 0.012200
Length = 0.035000

name = Torque Rod Winding
quantity = 3
parent = 37
materialID = 19
type = Cylinder
Aero Mass = 0.018300
Thermal Mass = 0.018300
Diameter/Width = 0.012000
Length = 0.033000

name = Torque Rod Core
quantity = 3
parent = 37
materialID = 38
type = Cylinder
Aero Mass = 0.019600
Thermal Mass = 0.019600
Diameter/Width = 0.009400
Length = 0.038100

name = ADCS Star Tracker Housing
quantity = 1
parent = 36
materialID = 8
type = Box
Aero Mass = 0.052000
Thermal Mass = 0.052000
Diameter/Width = 0.052000
Length = 0.053000
Height = 0.048000

name = S Band Antenna
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.140000
Thermal Mass = 0.140000
Diameter/Width = 0.098000
Length = 0.221300

name = Light Tube
quantity = 1
parent = 1
materialID = 8
type = Box

Aero Mass = 0.093200
Thermal Mass = 0.093200
Diameter/Width = 0.031000
Length = 0.175350
Height = 0.014000

name = Primary Mirror (M1)
quantity = 1
parent = 1
materialID = 71
type = Box
Aero Mass = 1.895300
Thermal Mass = 1.895300
Diameter/Width = 0.160000
Length = 0.180000
Height = 0.027500

name = Secondary Mirror (M2)
quantity = 1
parent = 1
materialID = 71
type = Box
Aero Mass = 0.100700
Thermal Mass = 0.100700
Diameter/Width = 0.057000
Length = 0.061000
Height = 0.011450

name = Secondary Reflector Spider
quantity = 4
parent = 1
materialID = 72
type = Flat Plate
Aero Mass = 0.042680
Thermal Mass = 0.042680
Diameter/Width = 0.022420
Length = 0.136300

name = Front Thermal Router
quantity = 1
parent = 1
materialID = 8
type = Flat Plate
Aero Mass = 0.028800
Thermal Mass = 0.028800
Diameter/Width = 0.052900
Length = 0.056900

name = Panel Tensioner
quantity = 3
parent = 1
materialID = 65
type = Flat Plate
Aero Mass = 0.007000
Thermal Mass = 0.007000
Diameter/Width = 0.025200

Length = 0.025200

name = DRM Shear Offload
quantity = 1
parent = 1
materialID = 65
type = Flat Plate
Aero Mass = 0.001700
Thermal Mass = 0.001700
Diameter/Width = 0.015700
Length = 0.015700

name = Pump System Manifold Tubes
quantity = 4
parent = 1
materialID = 54
type = Cylinder
Aero Mass = 0.019600
Thermal Mass = 0.019600
Diameter/Width = 0.006400
Length = 0.077300

name = Pump System Manifold Clamps
quantity = 3
parent = 1
materialID = 54
type = Box
Aero Mass = 0.022550
Thermal Mass = 0.022550
Diameter/Width = 0.021350
Length = 0.030300
Height = 0.015000

name = Pump System Manifold X
quantity = 1
parent = 1
materialID = 54
type = Flat Plate
Aero Mass = 0.090900
Thermal Mass = 0.090900
Diameter/Width = 0.048400
Length = 0.048400

name = Pump System Manifold L
quantity = 1
parent = 1
materialID = 54
type = Cylinder
Aero Mass = 0.052500
Thermal Mass = 0.052500
Diameter/Width = 0.014200
Length = 0.066500

name = Minus X Flexure Bottom
quantity = 1
parent = 1

materialID = 65
type = Box
Aero Mass = 0.032900
Thermal Mass = 0.032900
Diameter/Width = 0.019300
Length = 0.079250
Height = 0.005100

name = Minus X Flexure Sides
quantity = 2
parent = 1
materialID = 65
type = Flat Plate
Aero Mass = 0.028300
Thermal Mass = 0.028300
Diameter/Width = 0.025000
Length = 0.078900

name = Minus X Flexure Top
quantity = 2
parent = 1
materialID = 65
type = Box
Aero Mass = 0.063200
Thermal Mass = 0.063200
Diameter/Width = 0.024600
Length = 0.030000
Height = 0.019300

name = Plus X Flexure Body Top
quantity = 1
parent = 1
materialID = 65
type = Box
Aero Mass = 0.028000
Thermal Mass = 0.028000
Diameter/Width = 0.012700
Length = 0.082300
Height = 0.006600

name = Plus X Flexure Body Sides
quantity = 2
parent = 1
materialID = 65
type = Box
Aero Mass = 0.017900
Thermal Mass = 0.017900
Diameter/Width = 0.012700
Length = 0.048000
Height = 0.006600

name = Plus X Flexure Lightweighting
quantity = 1
parent = 1
materialID = 65
type = Box

Aero Mass = 0.017100
Thermal Mass = 0.017100
Diameter/Width = 0.025200
Length = 0.040200
Height = 0.003800

name = Plus X Flexure Arm
quantity = 1
parent = 1
materialID = 65
type = Box
Aero Mass = 0.024300
Thermal Mass = 0.024300
Diameter/Width = 0.012700
Length = 0.065100
Height = 0.007600

name = Plus X Flexure Feet
quantity = 2
parent = 1
materialID = 65
type = Box
Aero Mass = 0.042000
Thermal Mass = 0.042000
Diameter/Width = 0.017800
Length = 0.035800
Height = 0.015000

name = Fastener
quantity = 1
parent = 1
materialID = 57
type = Cylinder
Aero Mass = 0.000740
Thermal Mass = 0.000740
Diameter/Width = 0.004600
Length = 0.011700

name = Washer
quantity = 1
parent = 1
materialID = 54
type = Flat Plate
Aero Mass = 0.000340
Thermal Mass = 0.000340
Diameter/Width = 0.007900
Length = 0.007900

name = UHF Antenna Housing
quantity = 1
parent = 1
materialID = 64
type = Box
Aero Mass = 0.026000
Thermal Mass = 0.026000
Diameter/Width = 0.039600

Length = 0.093500
Height = 0.033000

name = UHF Antenna
quantity = 1
parent = 1
materialID = 54
type = Flat Plate
Aero Mass = 0.005000
Thermal Mass = 0.005000
Diameter/Width = 0.012400
Length = 0.508000

name = UHF Antenna Hardware
quantity = 1
parent = 1
materialID = 58
type = Flat Plate
Aero Mass = 0.000920
Thermal Mass = 0.000920
Diameter/Width = 0.012400
Length = 0.016500

name = PAM Shear Mech 2
quantity = 3
parent = 1
materialID = 54
type = Flat Plate
Aero Mass = 0.056000
Thermal Mass = 0.056000
Diameter/Width = 0.048800
Length = 0.063500

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

name = Root Object
Demise Altitude = 77.999729
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Plus X Panel
Demise Altitude = 76.793924
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Minus X Panel
Demise Altitude = 76.902080
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Plus Z Baffle
Demise Altitude = 77.739714

Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Plus Z Panel
Demise Altitude = 77.493558
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Minus Z Panel
Demise Altitude = 76.897025
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Plus Y Panel
Demise Altitude = 75.289264
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = ADCS Housing
Demise Altitude = 74.581918
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = ADCS - Reaction Wheel Case
Demise Altitude = 74.362426
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = ADCS - Reaction Wheel Magnets
Demise Altitude = 73.586954
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = ADCS Reaction Wheel
Demise Altitude = 71.668093
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = S Band Radio
Demise Altitude = 74.503681
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = UHF Radio
Demise Altitude = 74.312429
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Detector Electronics Box
Demise Altitude = 73.690774
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = CTIM
Demise Altitude = 75.004728
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Electronics Bus
Demise Altitude = 73.839048
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Battery
Demise Altitude = 73.797533
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Grating Mount
Demise Altitude = 74.781725
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Grating
Demise Altitude = 73.219556
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Bathtub
Demise Altitude = 74.900315
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Cylindrical Flat Fold Mirror (M3)
Demise Altitude = 71.062343
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Slit Jaw
Demise Altitude = 75.023559
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Detector Housing
Demise Altitude = 74.033334
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Detector Pump
Demise Altitude = 65.778213
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Detector Tungsten Shield
Demise Altitude = 0.000000
Debris Casualty Area = 6.415827
Impact Kinetic Energy = 1.467168

****

name = Detector
Demise Altitude = 74.041982
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Minus Y Panel
Demise Altitude = 76.922914
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = HVPS
Demise Altitude = 75.174247
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Detector Subassembly
Demise Altitude = 73.414451
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Top Wire Tree
Demise Altitude = 76.159676
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = DRM
Demise Altitude = 71.703289
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Deployable Solar Arrays 3x2
Demise Altitude = 76.731839

Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Deployable Solar Arrays 2x2
Demise Altitude = 76.889783
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = PAM Plus X
Demise Altitude = 76.927019
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = PAM Minus X
Demise Altitude = 76.927019
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = PAM -Z
Demise Altitude = 76.942212
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Torque Rod Housing
Demise Altitude = 76.870552
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Torque Rod Winding
Demise Altitude = 75.251523
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Torque Rod Core
Demise Altitude = 72.594946
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = ADCS Star Tracker Housing
Demise Altitude = 76.608191
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = S Band Antenna
Demise Altitude = 77.654889
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Light Tube
Demise Altitude = 77.515243
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Primary Mirror (M1)
Demise Altitude = 59.859996
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Secondary Mirror (M2)
Demise Altitude = 73.512886
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Secondary Reflector Spider
Demise Altitude = 76.202333
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Front Thermal Router
Demise Altitude = 77.619627
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Panel Tensioner
Demise Altitude = 74.572664
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = DRM Shear Offload
Demise Altitude = 76.227989
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Pump System Manifold Tubes
Demise Altitude = 75.761489
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Pump System Manifold Clamps
Demise Altitude = 76.029164
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Pump System Manifold X
Demise Altitude = 73.010450
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Pump System Manifold L
Demise Altitude = 74.084133
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Minus X Flexure Bottom
Demise Altitude = 73.204640
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Minus X Flexure Sides
Demise Altitude = 71.445244
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Minus X Flexure Top
Demise Altitude = 70.119126
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Plus X Flexure Body Top
Demise Altitude = 74.086290
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Plus X Flexure Body Sides
Demise Altitude = 74.279740
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Plus X Flexure Lightweighting
Demise Altitude = 74.051645
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Plus X Flexure Arm
Demise Altitude = 73.992822
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Plus X Flexure Feet
Demise Altitude = 72.277516

Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Fastener
Demise Altitude = 77.425240
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Washer
Demise Altitude = 77.537732
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = UHF Antenna Housing
Demise Altitude = 77.869770
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = UHF Antenna
Demise Altitude = 77.929741
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = UHF Antenna Hardware
Demise Altitude = 77.342875
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = PAM Shear Mech 2
Demise Altitude = 75.470695
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

========== End of Re-Entry Survivability Analysis ==========

Appendix D - DAS Collision Logfile

Appendix D contains the collision risk logfile from the DAS analysis

10 16 2024; 13:22:04PM Activity Log Started
10 16 2024; 13:26:57PM Processing Requirement 4.5-1: Return Status : Passed

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

INPUT

Space Structure Name = SPRITE
Space Structure Type = Payload
Perigee Altitude = 510.000 (km)
Apogee Altitude = 510.000 (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 = 0.0100 (m^2/kg)
Start Year = 2025.280 (yr)
Initial Mass = 19.500 (kg)
Final Mass = 19.500 (kg)
Duration = 6.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 1.4529E-06
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

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