National Aeronautics and
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Reply to Attn of: VA-H1

June 10, 2019

TO: Scott Higginbotham, LSP Mission Manager, NASA/KSC/VA-C

FROM: Yusef Johnson, a.i. solutions/KSC/AIS2

SUBJECT: Updates to Orbital Debris Analysis Performed for the SORTIE CubeSat Manifested on the ELaNa-25 Mission

This memorandum serves as an update to analysis data regarding the SORTIE CubeSat, which was previously supplied as part of the ELaNa-23 Orbital Debris Analysis Report (ODAR), dated 8/23/2017 and a follow on Memorandum regarding 'Analysis of Updated Mass Properties of the SORTIE CubeSat' dated 5/17/2018. The SORTIE CubeSat is now manifested on the ELaNa-25 mission, slated for NG-12 with a target launch date of 10/19/19, and also had design mass property and component changes which warranted performance of a new orbital debris analysis.

SORTIE was originally analyzed to a 408 by 400 km orbit as part of the ELaNA-23 mission assessment. A new SORTIE orbital debris analysis was performed at the ELaNa-25 orbit of 426 by 407 km.

The mass of the spacecraft increased from 7.94 kg to ~9.59 kg, which leads to a change in the area-to-mass ratio. The area-to-mass ratio changed to 0.019 m^2/kg, which yields an orbital lifetime of 1.28 years. This new orbital lifetime yielded a collision probability of 0.0000. SORTIE is compliant with Requirement 4.5-1 (Limiting Debris Generated by Collisions with Large Objects) and Requirement 4.6-1 (Orbital Lifetime Less than 25 Years).

The SORTIE CubeSat also has some updates to its component list, which is shown in Appendix A. Although analysis using the Debris Analysis Software (DAS) still shows that SORTIE has components that survive to the ground, none of these components have a kinetic energy greater than 15 joules.

SORTIE High Melting Temperature Material Analysis

CubeSat	Name	Material	Total Mass (g)	Demise Alt (km)	Kinetic Energy (J)
SORTIE	Antennae	Steel AISI 410	25	0	0
SORTIE	Separation Switches	Steel AISI 410	37.2	0	1
SORTIE	Fasteners	Steel AISI 316	99.75	0	0

Therefore, SORTIE is still compliant with Requirement 4.7-1.

SORTIE has no capability of plans or end-of-mission disposal, so therefore Requirement 4.5-2 is not applicable. SORTIE will passively re-enter. The original ODAR serves as the EOMP (End of Mission Plan).

In summary, SORTIE is still in compliance with all requirements of NASA of NASA-STD-8719.14 Rev B.

Appendix A. SORTIE Component List

Item Number	Name	Qty	Material	Body Type	Total Mass (g)	Diameter / Width (mm)	Length (mm)	Height (mm)	High Temp	Melting Temp (F°)	Survivability
1	SORTIE	-	-	-	9594	-	-	-	-	-	-
2	CubeSat Structure	1	Aluminum 6061	Hollow Box	4132	239.2	366	113.4	No	-	Demise
3	Antennae	1	Steel 410	whip	25	12.7	165	0.3	No	2700˚	0 km
4	Antennae Structure	1	Delrin 150	Hollow Box	60	38.6	68	43.2	No	-	Demise
5	6U Solar Panel	1	Aluminum honeycomb structure	Plate	202	200	309.9	12	No	-	Demise
6	3U Solar Panel	2	Polyimide w/ Kapton; GaAs Solar Cell	Plate	300	88	309.5	5.5	No	-	Demise
7	Sep Switches	6	aluminum 6061 : stainless steel 316	Box	37.2	18	27.8	10.3	No	2450˚	0 km
8	Payload mIVM	1	Copper Alloy ;Aluminum 6061: FR-4	Box	810	97.23	94.183	63.42	No	-	Demise
9	Payload uPLP	1	Copper Alloy ;Aluminum 6061: FR-4	Box	215	86.4	100	16.5	No	-	Demise
10	GPS Antenna	1	PCB FR-4; Aluminum 6061	Plate	16	45.2	N/A	7.2	No	-	Demise
11	Batteries	8	Lithium-Ion	Cylinder	372	18.2	N/A	65	No	-	Demise
12	Battery housing	1	Aluminum 6061; Ultem; PCB FR-4	Box	188	100	100	48.4	No	-	Demise
13	ADCS Components	1	Aluminum 6061; PCB FR-4	Box	1030	100	100	70	No	-	Demise
14	Power Distribution Boards	4	PCB FR-4	Plate	430	90.2	95.9	3.175	No	-	Demise
15	C&DH Boards	3	PCB FR-4	Plate	300	76.2	83.9	3.175	No	-	Demise
16	Radio	1	Aluminum 6061; PCB FR-4	Box	92	68.6	76.1	21.6	No	-	Demise
17	Ballast Mass 1	1	Aluminum 6061	Box	151.7	35	65	25	No	-	Demise
18	Ballast Mass 2	1	Aluminum 6061	Box	306.7	50.8	112	20	No	-	Demise
19	Ballast Mass 3	1	Aluminum 6061	Box	403.4	50	60	50	No	-	Demise
20	Fasteners* (#2, #4)	285	18-8 Stainless Steel	-	99.75	6.16	8.92	6.16	No	2500˚	0 km

21	Standoffs*	34	Aluminum	-	27.2	4.76	4.76	13.5	No	-	Demise
22	Cabling*	330	Teflon insulated Copper alloy	Cylinder	396	0.51	304.8	N/A	No	-	Demise