

Pantelis Michalopoulos
202 429 6494
pmichalo@steptoe.com
1330 Connecticut Avenue, NW
Washington, DC 20036-1795
202 429 3000 main
www.steptoe.com



Filed Electronically

July 20, 2018

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Re: PointView Tech, LLC, 0353-EX-CN-2018, Orbital Debris Mitigation

Dear Ms. Dortch:

Attached to this letter is an updated orbital debris assessment report (updating the report filed as Exhibit 2 to the narrative portion of the application in File No. 0353-EX-CN-2018) for PointView Tech, LLC's ("PointView's") proposed spacecraft.

As stated in the original report, a design to demise approach was taken for the Athena spacecraft. High heat of ablation materials (like titanium) were used only when absolutely required by the system manufacturers to guarantee launch survivability and in-orbit performance. This updated report reflects further refinement of the calculations based on additional, granular information obtained directly from equipment manufacturers. The prior report submitted by PointView already established that the proposed spacecraft would satisfy all orbital debris requirements set forth in the applicable NASA Technical Standard. This update reinforces that conclusion: only one component type is expected to survive re-entry, compared to three component types initially expected to do so. Correspondingly, the total debris area is 1.68 m² (from an initial estimate of 2.73 m²).

The attached updated version is submitted for the public record.

Sincerely,

Pantelis Michalopoulos
Counsel to PointView Tech, LLC

Athena De-orbit/Re-entry and Casualty Analysis

July 2018

DAS De-Orbit and Casualty Analysis

- ◆ DAS is a software program generated by NASA for orbital debris control and risk mitigation.
- ◆ Space programs and projects that use atmospheric reentry as a means of disposal for space structure need to limit the amount of debris that can survive reentry and pose a threat to people on the surface of the earth.
- ◆ The risk of human casualty is determined for objects returning to Earth's surface with a kinetic energy exceeding 15 Joules. The expected debris casualty area (DCA) is based on the quantity of each surviving object multiplied by its casualty area.
 - Each object's DCA is the debris field at earth's surface from one part of the satellite breaking up, but not fully immolating/sublimating during reentry. It is calculated based on the cross-sectional area of the remaining pieces, the dimensions of a person and the path angle of the velocity vector at impact.
- ◆ The casualty risk is the product of the total expected debris casualty area and the statistical population density based on the orbital inclination and the year of return.
 - The software program incorporate computations of world population densities up to the year 2050.
- ◆ In order to calculate the risk of human casualty, the arrangement of each element of the space structure needs to be defined to assess its reentry survival potential.
 - The spacecraft configuration and each of its units/items have to be defined in terms of body type, size, thermal mass, material etc. as input to the software.
 - The output gives the demise altitude, size of remaining item post reentry translated to debris casualty area, and the corresponding item kinetic energy.

DAS De-orbit (Re-Entry) Analysis

◆ DAS Simulation / Re-entry Analysis Result

- Most units/items have demise altitude around 46 to 78km. 2 items survived re-entry
- Total Debris Casualty Area (DCA) is 1.68 m²

Row Num	Name	Parent	Qty	Material	Body Type	Thermal Mass	Diameter/Width	Length	Height	Demise Alt	Total DCA	KE
1	Root Object		0	1							1.68	
2	panels	1	8	Aluminum (generic)	Box	3.75	0.57	0.57	0.02	71.7	0	0
3	Payload item 1	2	4	Titanium (6 Al-4 V)	Cylinder	0.287	0.08	0.03		0	1.68	242
4	M Wheel steel section	1	4	Stainless Steel (generic)	Cylinder	0.365	0.05	0.04		65.7	0	0
5	SC brackets and misc items	1	20	Aluminum (generic)	Box	0.45	0.1	0.15	0.1	75.9	0	0
6	Momentum wheels	1	4	Aluminum (generic)	Box	1.25	0.14	0.14	0.045	69.8	0	0
7	Star Tracker head electronics	1	2	Aluminum (generic)	Box	0.71	0.11	0.11	0.05	72.1	0	0
8	Star Tracker head cone	1	2	Aluminum (generic)	Cylinder	0.25	0.137	0.117		76.6	0	0
9	TTC antennas	1	2	Aluminum (generic)	Box	0.21	0.05	0.13	0.04	75.9	0	0
10	GPS antennas	1	2	Aluminum (generic)	Box	0.19	0.1	0.1	0.06	76.3	0	0
11	Gyros	1	2	Aluminum (generic)	Box	0.06	0.036	0.039	0.022	75.5	0	0
12	torque rods	1	3	Copper Alloy	Box	0.4	0.05	0.4	0.05	76.9	0	0
13	TTC Radio	1	1	Aluminum (generic)	Box	2.37	0.13	0.17	0.113	69.5	0	0
14	TTC Radio top filter box	1	1	Aluminum (generic)	Box	0.2	0.051	0.051	0.044	73.9	0	0
15	C&DH computer	1	1	Aluminum (generic)	Box	6.84	0.2	0.206	0.15	61	0	0
16	Battery	1	1	Aluminum (generic)	Box	7.15	0.184	0.2	0.112	57.7	0	0
17	Power Distribution	1	1	Aluminum (generic)	Box	4.78	0.173	0.22	0.084	63.2	0	0
18	Thermal MLI and hardware	1	12	Graphite Epoxy 1	Box	0.425	0.4	0.4	0.01	77.8	0	0
19	Magnetometer	1	2	Aluminum (generic)	Box	0.11	0.035	0.083	0.033	76.1	0	0
20	Payload item 2	1	2	Aluminum (generic)	Box	3.75	0.211	0.236	0.061	65.4	0	0
21	Payload item 3	1	1	Aluminum (generic)	Box	4.42	0.211	0.234	0.057	62.9	0	0
22	Payload item 4	1	1	Aluminum (generic)	Box	2.71	0.145	0.169	0.058	65.2	0	0
23	Payload item 5	1	1	Aluminum (generic)	Cylinder	2.61	0.5	0.2		75.7	0	0
24	Payload item 6	1	1	Aluminum (generic)	Box	7.03	0.18	0.235	0.15	62.9	0	0
25	Payload item 7	1	1	Aluminum (generic)	Box	14.93	0.255	0.3	0.18	54.2	0	0
26	Payload item 8	1	1	Aluminum (generic)	Box	5.17	0.206	0.251	0.095	64.3	0	0
27	Payload item 9	1	1	Aluminum (generic)	Box	1.16	0.15	0.15	0.05	71.1	0	0
28	Payload item 10	1	1	Aluminum (generic)	Cylinder	0.4	0.1	0.13		75.2	0	0
29	Harness (all wiring)	1	44	Copper Alloy	Cylinder	0.25	0.1	0.4		77.4	0	0
30	Payload bracket	1	4	Titanium (6 Al-4 V)	Cylinder	0.03	0.042	0.015		73.8	0	0
31	RW Ti bracket	1	4	Titanium (6 Al-4 V)	Box	0.14	0.032	0.032	0.032	67.4	0	0

Mass in kg, dimension in meter, area in square meters

Result in: Demise altitude (km), Total Debris Casualty Area in square meters, and kinetic energy in J.

DAS Casualty Analysis

- ◆ The next analysis is the Casualty Analysis
 - After the reentry data by knowing the total debris casualty area, one can run the DAS analysis for casualty probability
- ◆ Only Payload item 1 (4 items) will survive re-entry and resulted in casualty area
 - Total DCA is 1.68 square meters
- ◆ The Casualty Analysis result from DAS shows 1 in 51400 risk for human casualty
- ◆ This is in compliance to the requirement
 - DAS based on NASA requirement 4.7-1 in NASA-std-8719.14

Output						
Object	Compliance	Risk of Human	SubComponent	Demise	Total Debris	Kinetic
Name	Status	Casualty	Object	Altitude (km)	Casualty Area ...	Energy (J)
Athena	Compliant	1:51400			1.68	

Appendix 1

- ◆ DAS is a NASA software program based on NASA-STD-8719.14
 - Casualty risk requirement (section 4.7-1)

Requirement 4.7-1. Limit the risk of human casualty: The potential for human casualty is assumed for any object with an impacting kinetic energy in excess of 15 joules:

- a) For uncontrolled reentry, the risk of human casualty from surviving debris shall not exceed 0.0001 (1:10,000) ([Requirement 56626](#)).
- b) For controlled reentry, the selected trajectory shall ensure that no surviving debris impact with a kinetic energy greater than 15 joules is closer than 370 km from foreign landmasses, or is within 50 km from the continental U.S., territories of the U.S., and the permanent ice pack of Antarctica ([Requirement 56627](#)).
- c) For controlled reentries, the product of the probability of failure of the reentry burn (from Requirement 4.6-4.b) and the risk of human casualty assuming uncontrolled reentry shall not exceed 0.0001 (1:10,000) ([Requirement 56628](#)).

Appendix 2

- ◆ DAS is a NASA software program based on NASA-STD-8719.14
 - Casualty risk based on inclination

The population density data (shown on Figure E-1) comes from an assessment conducted at Johnson Space Center in 2002 of world-wide population projection databases.

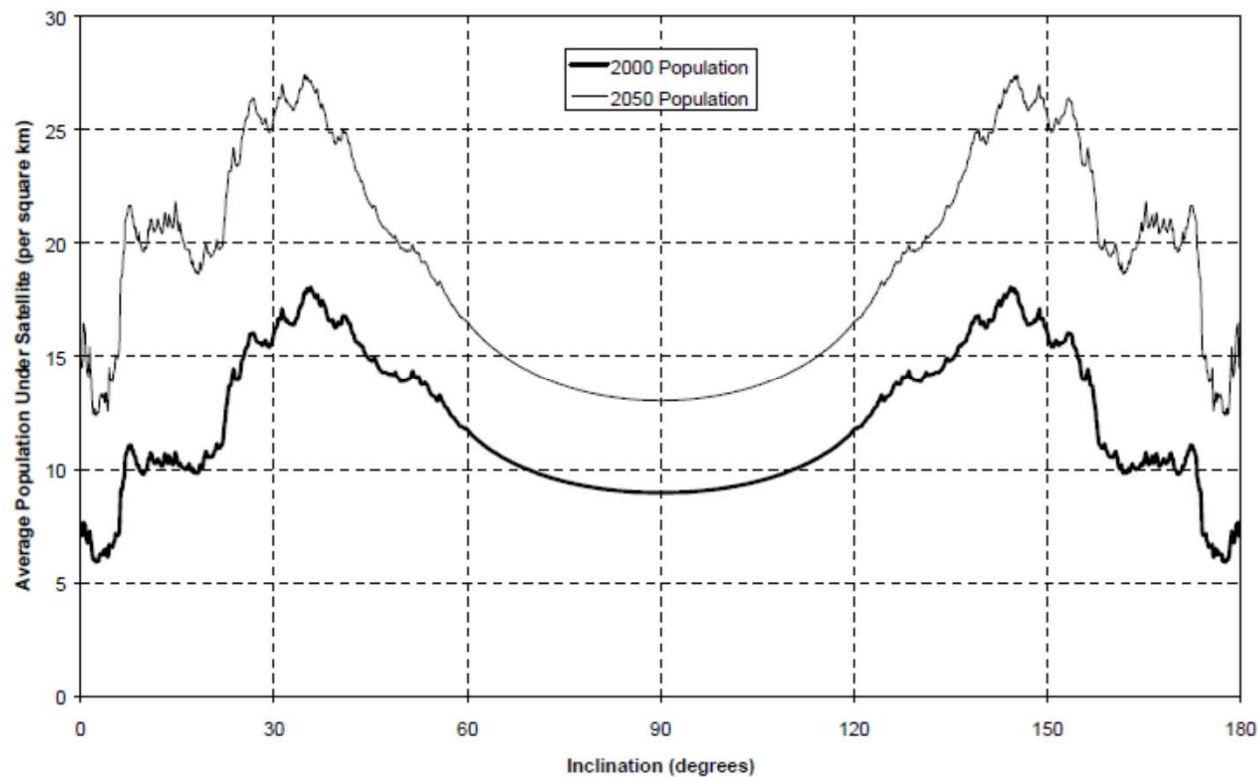


Figure E-1. Average Population Density as a Function of Orbital Inclination

Appendix 3 – DAS 2.0.2 Log

06 13 2018; 14:15:37PM DAS Application Started

06 13 2018; 14:15:42PM Opened Project C:\Frankie\DAS 2.0\project\Athena\6-2018 run\

06 13 2018; 14:34:20PM Science and Engineering - Re-Entry Survivability Analysis

*****INPUT****

Item Number = 1

name = Root Object
quantity = 1
parent = 0
materialID = 5
type = Box
Aero Mass = 134.000000
Thermal Mass = 134.000000
Diameter/Width = 0.575000
Length = 0.875000
Height = 0.574000

name = panels
quantity = 8
parent = 1
materialID = 5
type = Box
Aero Mass = 3.893500
Thermal Mass = 3.750000
Diameter/Width = 0.570000
Length = 0.570000
Height = 0.020000

name = Payload item 1
quantity = 4
parent = 2
materialID = 65
type = Cylinder
Aero Mass = 0.287000
Thermal Mass = 0.287000
Diameter/Width = 0.080000
Length = 0.030000

name = M Wheel steel section
quantity = 4
parent = 1
materialID = 54
type = Cylinder
Aero Mass = 0.365000
Thermal Mass = 0.365000
Diameter/Width = 0.050000
Length = 0.040000

name = SC brackets and misc items
quantity = 20
parent = 1
materialID = 5
type = Box
Aero Mass = 0.450000
Thermal Mass = 0.450000
Diameter/Width = 0.100000
Length = 0.150000
Height = 0.100000

name = Momentum wheels
quantity = 4
parent = 1
materialID = 5
type = Box
Aero Mass = 1.250000
Thermal Mass = 1.250000
Diameter/Width = 0.140000
Length = 0.140000

Height = 0.045000

name = Star Tracker head electronics
quantity = 2
parent = 1
materialID = 5
type = Box
Aero Mass = 0.710000
Thermal Mass = 0.710000
Diameter/Width = 0.110000
Length = 0.110000
Height = 0.050000

name = Star Tracker head cone
quantity = 2
parent = 1
materialID = 5
type = Cylinder
Aero Mass = 0.250000
Thermal Mass = 0.250000
Diameter/Width = 0.137000
Length = 0.117000

name = TTC antennas
quantity = 2
parent = 1
materialID = 5
type = Box
Aero Mass = 0.210000
Thermal Mass = 0.210000
Diameter/Width = 0.050000
Length = 0.130000
Height = 0.040000

name = GPS antennas
quantity = 2
parent = 1
materialID = 5
type = Box
Aero Mass = 0.190000
Thermal Mass = 0.190000
Diameter/Width = 0.100000
Length = 0.100000
Height = 0.060000

name = Gyros
quantity = 2
parent = 1
materialID = 5
type = Box
Aero Mass = 0.060000
Thermal Mass = 0.060000
Diameter/Width = 0.036000
Length = 0.039000
Height = 0.022000

name = torque rods
quantity = 3
parent = 1
materialID = 19
type = Box
Aero Mass = 0.400000
Thermal Mass = 0.400000
Diameter/Width = 0.050000
Length = 0.400000
Height = 0.050000

name = TTC Radio
quantity = 1
parent = 1
materialID = 5
type = Box

Aero Mass = 2.370000
Thermal Mass = 2.370000
Diameter/Width = 0.130000
Length = 0.170000
Height = 0.113000

name = TTC Radio top filter box
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 0.200000
Thermal Mass = 0.200000
Diameter/Width = 0.051000
Length = 0.051000
Height = 0.044000

name = CDH computer
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 6.840000
Thermal Mass = 6.840000
Diameter/Width = 0.200000
Length = 0.206000
Height = 0.150000

name = Battery
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 7.150000
Thermal Mass = 7.150000
Diameter/Width = 0.184000
Length = 0.200000
Height = 0.112000

name = Power Distribution
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 4.780000
Thermal Mass = 4.780000
Diameter/Width = 0.173000
Length = 0.220000
Height = 0.084000

name = Thermal MLI and hardware
quantity = 12
parent = 1
materialID = 27
type = Box
Aero Mass = 0.425000
Thermal Mass = 0.425000
Diameter/Width = 0.400000
Length = 0.400000
Height = 0.010000

name = Magnetometer
quantity = 2
parent = 1
materialID = 5
type = Box
Aero Mass = 0.110000
Thermal Mass = 0.110000
Diameter/Width = 0.035000
Length = 0.083000
Height = 0.033000

name = Payload item 2
quantity = 2
parent = 1
materialID = 5
type = Box
Aero Mass = 3.750000
Thermal Mass = 3.750000
Diameter/Width = 0.211000
Length = 0.236000
Height = 0.061000

name = Payload item 3
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 4.420000
Thermal Mass = 4.420000
Diameter/Width = 0.211000
Length = 0.234000
Height = 0.057000

name = Payload item 4
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 2.710000
Thermal Mass = 2.710000
Diameter/Width = 0.145000
Length = 0.169000
Height = 0.058000

name = Payload item 5
quantity = 1
parent = 1
materialID = 5
type = Cylinder
Aero Mass = 2.610000
Thermal Mass = 2.610000
Diameter/Width = 0.500000
Length = 0.200000

name = Payload item 6
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 7.030000
Thermal Mass = 7.030000
Diameter/Width = 0.180000
Length = 0.235000
Height = 0.150000

name = Payload item 7
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 14.930000
Thermal Mass = 14.930000
Diameter/Width = 0.255000
Length = 0.300000
Height = 0.180000

name = Payload item 8
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 5.170000
Thermal Mass = 5.170000

Diameter/Width = 0.206000
Length = 0.251000
Height = 0.095000

name = Payload item 9
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 1.160000
Thermal Mass = 1.160000
Diameter/Width = 0.150000
Length = 0.150000
Height = 0.050000

name = Payload item 10
quantity = 1
parent = 1
materialID = 5
type = Cylinder
Aero Mass = 0.400000
Thermal Mass = 0.400000
Diameter/Width = 0.100000
Length = 0.130000

name = Harness (all wiring)
quantity = 44
parent = 1
materialID = 19
type = Cylinder
Aero Mass = 0.250000
Thermal Mass = 0.250000
Diameter/Width = 0.100000
Length = 0.400000

name = Payload bracket
quantity = 4
parent = 1
materialID = 65
type = Cylinder
Aero Mass = 0.030000
Thermal Mass = 0.030000
Diameter/Width = 0.042000
Length = 0.015000

name = RW Ti bracket
quantity = 4
parent = 1
materialID = 65
type = Box
Aero Mass = 0.140000
Thermal Mass = 0.140000
Diameter/Width = 0.032000
Length = 0.032000
Height = 0.032000

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

name = Root Object
Demise Altitude = 77.998129
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

name = panels
Demise Altitude = 71.676160
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

name = Payload item 1

```
Demise Altitude = 0.000000
Debris Casualty Area = 1.684751
Impact Kinetic Energy = 241.946350

*****
name = M Wheel steel section
Demise Altitude = 65.701097
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*****
name = SC brackets and misc items
Demise Altitude = 75.926847
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*****
name = Momentum wheels
Demise Altitude = 69.827355
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*****
name = Star Tracker head electronics
Demise Altitude = 72.098496
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*****
name = Star Tracker head cone
Demise Altitude = 76.561293
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*****
name = TTC antennas
Demise Altitude = 75.912847
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*****
name = GPS antennas
Demise Altitude = 76.331191
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*****
name = Gyros
Demise Altitude = 75.495894
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*****
name = torque rods
Demise Altitude = 76.937582
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*****
name = TTC Radio
Demise Altitude = 69.526738
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*****
name = TTC Radio top filter box
Demise Altitude = 73.876777
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*****
name = CDH computer
```

Demise Altitude = 61.044710
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

name = Battery
Demise Altitude = 57.731788
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

name = Power Distribution
Demise Altitude = 63.249640
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

name = Thermal MLI and hardware
Demise Altitude = 77.838097
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

name = Magnetometer
Demise Altitude = 76.052340
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

name = Payload item 2
Demise Altitude = 65.358769
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

name = Payload item 3
Demise Altitude = 62.929280
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

name = Payload item 4
Demise Altitude = 65.231171
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

name = Payload item 5
Demise Altitude = 75.698715
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

name = Payload item 6
Demise Altitude = 62.852343
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

name = Payload item 7
Demise Altitude = 54.167065
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

name = Payload item 8
Demise Altitude = 64.288780
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

name = Payload item 9

Demise Altitude = 71.110097
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

name = Payload item 10
Demise Altitude = 75.220504
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

name = Harness (all wiring)
Demise Altitude = 77.366058
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

name = Payload bracket
Demise Altitude = 73.760019
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

name = RW Ti bracket
Demise Altitude = 67.383089
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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