Jose Trevino

From: Karl Kensinger
Sent: Friday, April 13, 2012 4:19 PM
To: Jose Trevino
Cc: Walter Johnston
Subject: FW: summary of random reentry analyses for Falcon 9 upper stage

Attachments: Summary of Upper Stage Random Reentry Analyses for F9-003.pdf

Summary of Upper Stage Random ...

Jose,

Please include Mr. Den Herder's email and the attachment in File No. 0526-EX-ST-2011.

Thanks.

-----Original Message-----
From: David J. Den Herder [mailto:David.DenHerder@spacex.com]
Sent: Tuesday, April 03, 2012 7:37 PM
To: Karl Kensinger
Subject: summary of random reentry analyses for Falcon 9 upper stage

Hi Karl,
Per our telecon on Friday (and further to Tim’s letter) please find the reentry analysis summaries attached, in a format that should be fine for including in the public file (i.e. not ITAR controlled). There have now been two separate assessments of LV random reentry risk performed for this mission (the more recent by NASA, utilizing their proprietary “ORSAT” software), with detailed results provided to the FAA.
If you have any questions or additional follow-up, please let me know.
Thanks, and best regards,
Dave
(202) 649-2705

Summary of analysis performed by NASA (March 2012)

The Falcon 9 second stage reentry survivability assessment was performed by NASA using its Object Reentry Survival Analysis Tool (ORSAT), version 6.1. ORSAT is the only NASA-certified model for evaluating spacecraft and launch vehicle orbital stage component survivability following either a controlled or uncontrolled reentry. Each component is defined by its material type, shape, mass, dimensions, and complexity, e.g., whether or not it contains additional individual components, such as an electronics box. Detailed aero and thermal models are then applied to each component to determine if the heat of ablation for that component is reached during reentry. If the heat of ablation is not reach, the component in full or in part will reach the surface of the Earth and will represent a risk to people in the form of a debris casualty area (DCA). The DCA values for all surviving components are then summed to determine the total DCA for the reentering object. The total DCA is multiplied by the world population density for the appropriate orbital inclination and year to find the overall risk of human casualty. The calculated reentry risk was 2.83 per 10,000.

Summary of analysis performed by ACTA, Inc. (January 2012)

Using SpaceX provided information regarding the passivation of the stage 2 tank and definition of the stage 2 tank and Dragon trunk separation plane, ACTA developed the reentry thermal model that was used in the Coupled Aeroheating and Thermal Network Solver (CATNS) computer program. ACTA then used an initial reentry state provided by SpaceX that is representative of a gradual decay from low earth orbit suitable for generalized reentry demise computations. The Coupled Aeroheating and Thermal Network Solver (CATNS) simulates reentry trajectory, heating and demise calculations for each fragment debris class to estimate which fragments undergo aero-thermal demise and to catalog the fragment properties for those fragments that survive reentry. Estimating the dwell time of the stage 2 tank over small latitude bands and utilizing the global population library methodology used by the 45th Space Wing and the FAA, ACTA calculated the expected casualty area of the surviving fragments and expected casualty of the population centers. Summing up the cumulative casualty area over each population center and solving for Ec totals up to 12.5 in 10,000.