

From: Michael Miller

To: Nimesh Sangani

Date: November 17, 2020

Subject: Additional Information Request

Message:

1) Please provide a detailed explanation of the deployment process post-release from the launch tubes.

Answer: a detailed explanation has been added to the Mission Overview section of the revised ODAR, which has been submitted. Key points follow:

The 9 satellites, ThinSat-2A through ThinSat-2I, will be deployed from 2 Canisterized Satellite Dispensers (CSDs) mounted on the second stage of the launch vehicle. The spacecraft will deploy after the activation signal is initiated by the Cygnus vehicle, causing the CSD doors to open which will allow the spacecraft contained therein to exit, pushed gently out by the spring loaded push plate inside the CSD. Then these satellites will unfold accordion style, by force of the memory metal hinge connecting the folding panels to the satellites. The deployment switch on board each satellite, will enable the solar detector. About 10 seconds after the solar detector is activated by solar radiation, the power up sequence begins. See Schedule 1 in the ODAR for a step by step description of the deploy sequence.

2) Is the burn wire activating successfully solely a function of exposure to the space environment, or is there any electrical component?

3) Have these burn wires been used successfully in prior deployments?

4) Once the burn wire functions successfully and the spacecraft deploy, are the units locked into this "open position" in any mechanical way?

Answer to Questions 2, 3 and 4: There is no burn wire. When the CSD canister door is opened by a motor drive, the folded ThinSats inside are pushed out slowly by the spring loaded push plate inside the CSD. Then these satellites will unfold accordion style, by force of the memory metal hinge connecting the folding panels to the satellites

The statement about burn wire in the Mission Overview section of the ODAR was out of date; it is language describing an earlier design, that is not used. A corrected version of the ODAR has been submitted as an exhibit to the application.

Also re Question 4: the nitinol memory metal hinge that forces the folds to open up, is also relied on to hold them open. In addition, kapton material is attached to the hinges to absorb vibration and dampen oscillation. It is expected that any associated oscillations will dampen out in less than a minute after unfolding.

5) Please provide additional information on how deployment of the boom from ThinSat-2E will occur. Is there a chance this could interfere physically with another of the ThinSat-2 spacecraft (or the launch vehicle) and with sufficient force to damage it?

Answer: The extension of the boom will begin No Earlier Than 15 minutes after deployment of the satellite. Timer logic based on power up of the experiment, causes the Initiate Extend signal to energize a solenoid. The solenoid movement when energized, releases the drum on which the boom is coiled, so that the drum is free to rotate. The coiled spring force of the coiled boom, causes the drum to rotate, and the boom unwinds from the drum and extends to its full length of 0.8

meter.

Dispersion analysis by the launch vehicle operator, Northrup Grumman Innovation Systems, indicates that at the time of extension of the boom, the distance between ThinSat-2E and Antares, Cygnus and the other ThinSats, will be sufficient so that there is no concern about the boom touching any of these.