Landsat 9 Micrometeoroid and Orbital Debris Mission Success Approach

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ABSTRACT

Landsat 9* (L9) is the successor mission to Landsat 8 (L8) previously known as Landsat Data Continuity Mission (LDCM). Both missions are large unmanned remote sensing satellites operating in sun-synchronous polar orbits. As opposed to L8/LDCM, systems engineers for L9 incorporated Micrometeoroid/Orbital Debris (MMOD) protection for small object collisions as part of the L9’s mission success criteria. In other words, the NASA Process for Limiting Orbital Debris (NASA-STD-8719.14A) only calls for analyses of the protection of disposal-critical hardware, but L9 opted to also assess and provide small particle penetration protections for all observatory components including instruments that are not part of the spacecraft components needed for controlled reentry.

Systems engineers at Goddard developed a design process to protect against MMOD during the life of Low Earth Orbit (LEO) observatories, and in particular the Landsat 9 Mission. Simply stated, this design process enhanced the effectiveness of existing Multi-Layer Insulation (MLI) to provide the needed protection.

The end goal of the design process was to establish a necessary blanket areal density for a given electronics box or instrument wall thickness and a separation between the outer MLI blanket and the structure underneath. The trade space was presented as a set of design curves for different combinations of blanket density, box wall thickness, and separation distance between MLI and structure.

An advantage of this process was that it is largely independent of MMOD flux data on a surface-by-surface basis. Ultimately, cost savings should result from incorporating small object penetration protection early in the design cycle, rather than adding spot shielding blankets later as needed to meet an overall penetration risk standard (the more traditional approach). The approach and implementation to the L9 Observatory design will be addressed in this paper.

*L9 is a joint mission being formulated, implemented, and operated by the National Aeronautics and Space Administration (NASA) and the Department of the Interior’s (DOI) United States Geological Survey (USGS).