Lunar Reconnaissance Orbiter (LRO) Thermal Design Drivers and Current Thermal Design Concept

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Abstract

Numerous missions for both robotic and human exploration of the moon are presently being proposed and planned. The Lunar Reconnaissance Orbiter (LRO) is the first step in the Robotic Lunar Exploration Program, which is scheduled for a 2008 launch atop a Delta II rocket. LRO's objective is to conduct science investigations that will prepare for and support future human exploration of the moon. A suite of six onboard instruments will characterize the lunar radiation environment, provide high resolution topographical and temperature mapping of the surface, assess the resources available at the Polar Regions including water in the form of ice, and determine mineralogical and elemental composition of the moon's surface.

This presentation focuses solely on the thermal design drivers of the orbiter and provides a status on the current philosophy behind the initial thermal design concept for the spacecraft and its suite of science instruments. The LRO program is currently a Phase A/B project signifying that a PDR level design has not yet been completed. However, significant progress has been made towards addressing the impacts of the harsh lunar environment on the orbiter thermal control system.

LRO is challenging from a thermal design perspective for numerous reasons. First of all, an atypical harsh lunar environment imposes severe transient infrared radiation (IR) loading on the spacecraft and instruments which necessitates the use of zenith facing radiators that flip through the sun. Second, the implementation of any thermal control hardware must be minimized since the mission is mass critical (due to the high fuel-to-dry-mass ratio required for lunar orbit insertion and a low science orbit). Third, the number of onboard instruments that must be integrated onto the spacecraft is extraordinarily high, especially when considering the aggressive 3-year schedule. Finally, there is a lack of precedence for low lunar orbit missions from which to draw past design experience.

The current spacecraft design is a modular concept comprising separate modules for the

avionics and propulsion subsystems, and includes a thermally isolated instrument deck that
is mounted to the avionics module which serves both as an optical bench and a radiator. The
spacecraft and instrument thermal models are developed in Thermal Synthesizer System (TSS)
and SINDA/FLUINT 4.7.