## Lunar CRater Observation and Sensing Satellite

### How LCROSS is Getting to the Moon

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The Lunar CRater Observational Sensing Satellite, also known as LCROSS, was developed for the purpose of exploring the Earth's moon in hope of finding water on the Moon. LCROSS is the secondary payload on the Lunar Reconnaissance Orbiter or LRO. According to the article, "LCROSS" on Lunarpedia, the "smaller secondary payload spacecraft will travel with the Lunar Reconnaissance Orbiter (LRO) satellite to the Moon on the same Atlas-Centaur EELV (Evolved Expendable Launch Vehicle) rocket. The LCROSS spacecraft will ultimately become independent once in the vicinity of the Moon", however, "on the way to the moon, the spacecraft's two main parts, the Shepherd Spacecraft (S-S/C) and the Centaur Upper Stage will remain coupled."

To insure the LCROSS spacecraft reaches the Moon and completes its mission the Northrop-Grumman Shepherd Spacecraft is designed to help guide the impact of the "LRO Centaur upper stage within 10km of a target," which in this case is inside a "permanently shadowed region at the North or South Pole of the Moon," according to NASA's official website (Day, "Spacecraft"). The highly specific configuration reduces the risk of it's own mission, as well as, the LRO mission through the use of flight avionics, propulsion, structures, adapters, and release systems in what is referred to as a "high-frequency structural configuration" (Day, "Spacecraft").

The Shepherd Spacecraft is a fairly elementary spacecraft that does not contain deployments or active mechanical elements, except for a separation band. The only technology required on the Shepherd Spacecraft is an "impact flash detection unit called a photometer." The payload contains two visible and four IR (Infrared) cameras, two NIR (near-Infrared) spectrometers and one development unit called a photometer. The structure of the spacecraft is a "single ESPA ring that functions as a multifunctional integrating element which supports the LRO adapter." The structural frame of the Shepherd Spacecraft is the ESPA ring, which has components mounted inside and around its exterior. A single cone mounted between the upper ESPA ring and the mounting "flange" of the LRO adapter, serves as the propulsion system, which uses hydrazine as a propellant (Day, "Spacecraft").

Built during the same time, the LCROSS flight avionics is a near "built-to-print copy" of the avionics designed for LRO. Flight software for the LCROSS mission has been developed over a series of "GSFC missions, including WMAP and EO-1." This software has a layered architecture, with the hardware layer at the core, surrounded by successive layers from the Operating System up to the application layer at the top of the hierarchy (Day, "Spacecraft").

The LCROSS mission also utilizes Mid IR cameras that document pre- and post- thermal impact images to determine the terrain. A total luminescent photometer will be used to observe possible impact flash, which is due to the "thermal heating and vaporization of the impactor and surface material." Depending on the shape of the light curve, certain initial conditions of the impact can be determined.

Works Cited:

Day, Brian. "Spacecraft and System Description." LCROSS. Sept. 2006. NASA. 19 Feb. 2009 <http://lcross.arc.nasa.gov/spacecraft.htm>;.

"LCROSS - Lunarpedia." Main Page - Lunarpedia. 12 Aug. 2008. 23 Feb. 2009 <http://www.lunarpedia.org/index.php?title=LCROSS>;.