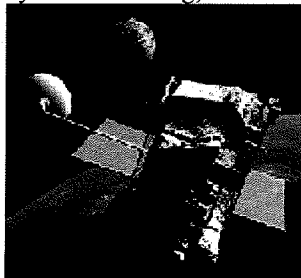




By Frank Moring, Jr./Aviation Week & Space Technology



NASA plans to blast the permanently dark floor of the moon's Shackleton Crater with two heavy impactors early in 2009 to test the theory that ancient water ice lies buried there.

The impactors - a 2,000-kilogram (4,409-pound) spent upper stage and a 534-kilogram (1,177-pound) Shepherding Spacecraft - will piggyback on the Lunar Reconnaissance Orbiter (LRO) mission NASA intends to launch on an Atlas V or Delta IV in October 2008.

Engineers at NASA's Ames Research Center expect the spent stage to kick a plume of material from the crater bottom 30-35 miles above the lunar surface. The Shepherding Spacecraft will fly through the plume, using its infrared sensors to look down into the crater and through the plume against the cold background of space for water signatures.

At the same time, ground telescopes and perhaps instruments on the LRO, Indian, Chinese and Japanese lunar orbiters and the Hubble Space Telescope also will analyze the plume and impact crater. If they find ice, it will have a huge impact on future exploration architecture.

"The guess is it's going to be tied up in some mud or dirt or something," Associate Administrator for Exploration Systems Scott Horowitz said of the potential water during a press briefing in Washington April 10. "So you're going to have to have some process. But if you could just distill the water out, of course you could drink it. It's all an integrated problem. [For example], what's your power source? Are you going to use solar-based power? Well then you're not going to have fuel cells" that generate water.

If the plume and the expected "exoatmosphere" of fine debris circling the Moon after the impact doesn't contain water, it may mean only that the impactor missed a deposit. Butler Hine, deputy program manager for NASA's Robotic Lunar Exploration Program (RLEP) at Ames, said ice might exist in clumps that lie outside the primary impact crater, which should be about a third the size of a football field. For that reason, the Shepherding Spacecraft itself also will smash into the Shackleton Crater floor about 15 minutes after the spent upper stage, giving scientists two ground-truth data points to evaluate.

LCROSS

Dubbed the Lunar Crater Observation and Sensing Satellite (LCROSS), the mission was picked from among 19 proposals to use an extra 1,000 kilograms (2,204 pounds) of payload capacity the LRO mission gained when NASA decided to switch it from a Delta II launch vehicle to an Evolved Expendable Launch Vehicle (EELV). Horowitz said the heavy fuel load that will be required to keep the LRO at its planned 50-kilometer (31-mile) orbit raised stability problems on the smaller Delta II.

Overall the LRO mission will cost about \$600 million. Of that amount, NASA will spend about \$73 million on the LCROSS spacecraft, which were designed to make maximum use of existing hardware to meet the tight schedule. For example, the Shepherding Spacecraft will use the same avionics as the LRO, while the spacecraft structure will be a standard payload interface fitted with the necessary power, navigation, guidance and propulsion systems. Northrop Grumman is teamed with Ames on both the avionics package and the overall spacecraft integration.

As outlined by Daniel Andrews, LCROSS project manager at Ames, the Shepherding Spacecraft and spent stage will make two full orbits of Earth after sending LRO on its way to orbit the Moon, arriving at the impact point in the South Pole crater after about 90 days. In addition to infrared cameras and spectrometers, it also will carry visible-light cameras that should be able to deliver an image of the developing plume every two seconds with the communications bandwidth available, and perhaps more once the design margins are better understood.

Earlier lunar orbiters - NASA's Lunar Prospector and the Pentagon's Clementine testbed, which used the Moon to test missile defense hardware - have returned strong signatures of hydrogen from the permanently shaded regions at the bottoms of craters at both lunar poles. But just what form the hydrogen takes remains in dispute, and the objective of the LCROSS mission is to obtain ground truth to guide future exploration planning, Horowitz said.

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