NASA'S INTERNATIONAL LUNAR NETWORK ANCHOR NODES AND ROBOTIC LUNAR LANDER PROJECT UPDATE. Barbara A. Cohen[1], Julie A. Bassler[1], Benjamin Ballard[2], D. Greg Chavers[1], Doug S. Eng[2], Monica S. Hammond, Larry A. Hill, Danny W. Harris[1], Todd A. Holloway[1], Sanae Kubota[2], Brian J. Morse[2], Brian D. Mulac[1], and Cheryl L. B. Reed[2]. [1]NASA Marshall Space Flight Center, Huntsville AL 35812 (Barbara.A.Cohen@nasa.gov); [2]The Johns Hopkins University Applied Physics Laboratory, Laurel MD 20723.

Introduction: NASA Marshall Space Flight Center and The Johns Hopkins University Applied Physics Laboratory have been conducting mission studies and performing risk reduction activities for NASA's robotic lunar lander flight projects. Additional mission studies have been conducted to support other objectives of the lunar science and exploration community and extensive risk reduction design and testing has been performed to advance the design of the lander system and reduce development risk for flight projects.

Mission Designs: Since 2008, the team has been supporting NASA's Science Mission Directorate designing small lunar robotic landers for diverse science missions. The primary emphasis has been to establish anchor nodes of the International Lunar Network (ILN), a network of lunar science stations envisioned to be emplaced by multiple nations. This network would consist of multiple landers carrying instruments to address the geophysical characteristics and evolution of the moon.

Based on the ILN studies, the team developed mission scenarios for two polar landers that share many common features: a Lunar Polar Rim mission rapid mission architecture for quickly demonstrating technology and landing on a polar rim, and a Lunar Polar Volatiles single point lander to study volatiles in a permanently shaded region.

Finally, the team worked with the Planetary Science Decadal Survey to develop a Lunar Polar Volatiles Explorer mission, consisting of a lander plus rover to study volatiles at multiple locations in a permanently shaded region. This mission uses a medium class lander and leverages from previous efforts on the Robotic Lunar Exploration Program 2 (RLEP-2) informed by new knowledge gained from the small lander class efforts.

Risk Reduction: During the pre-phase A studies for the ILN mission, lander subsystem technology risks were identified and prioritized based on technology readiness level (TRL) and commonality across multiple mission designs. The mass and power constraints of the lander system are key drivers for the risks. Risk mitigation activities to increase the TRL or reduce the development risk of key technologies were instigated, including high pressure propulsion system testing, structure and mechanism development and testing, long cycle time battery testing, thermal management system development and testing, and combined GN&C and avionics testing. The most visible elements of the risk reduction program are two free-flying autonomous lander test articles: a compressed air system with limited flight durations and a second version using hydrogen peroxide propellant to achieve significantly longer flight times and the ability to more fully exercise flight sensors and algorithms.

Uses for the Lunar Landers: For almost five years now, the MSFC/APL team has developed a flexible architecture of robotic lunar landers to envelop multiple mission scenarios. This architecture has both nuclear and solar array battery powered versions that interface to multiple launch vehicles depending on payload requirements, the number of landers desired, and available funding. The basic lander bus constitutes a transportation system that can be easily adapted to perform a number of different lunar science missions for NASA's SMD or lunar exploration missions for ESMD. The U.S. lunar science missions of the next decade, and their priority, will be determined by the in-progress Planetary Science Decadal Survey, and the lunar exploration missions are currently under study as defined by President Obama's new space policy and vision. For lunar robotic missions in general there is an intersection between science and exploration, and this robotic lander will satisfy requirements of the first of several surface missions envisioned to be implemented over the next five years. Combining missions in this way would constitute prudent use of NASA funds in an exciting partnership of two key Directorates (SMD and ESMD), and still provide the U.S. contribution to international ILN collaboration. Equally important, many of the robotic lander technologies to be demonstrated also have extended application to future robotic missions of other inner planet airless bodies, destinations of both SMD and ESMD.