PHOENIX Lander : Utilization of the Deep Space Gateway for Accelerated Lunar Settlement Infrastructure Establishment.. M.Thangavelu[1] and Isabella Rodriguez[2], [1]Conductor, ASTE527 Graduate Space Concepts Studio Department of Astronautical Engineering, Viterbi School of Engineering, University of Southern California, mthangav@usc.edu, Graduate Student[2], Department of Astronautical Engineering, USC

**Abstract:** Commerce, driven by innovation and economics, is rapidly changing the space industry paradigm as we know it, and the new private space companies are the prominent players taking advantage of reusable space systems. Salient system features for a small mission-specific reusable lander called Phoenix: Orbital Reusable Planetary Lander is proposed.

The small Phoenix lander is conceived for a very specific mission. It is designed to carry a crew of two from the Deep Space Gateway in low lunar orbit to the lunar surface and back. The Phoenix mission is to resolve robotic system anomalies using crew, during the teleoperated phase of buildup that is supervised from the orbiting DSG. EVA suited crew will depart the DSG on the Phoenix lander that is berthed on it, and arrive at the construction site, resolve the anomaly and head back to DSG in short order. Mission duration is dictated by EVA suit service limitations and is not expected to last more than 10 hours at most, including the 30 minute round trip time for lunar descent, ascent and DSG rendezvous and dock.

The Phoenix concept is achievable within the next 5 years by utilizing commercial lander technology being pursued now. This architecture explores the concept of a planetary lander that is single stage and fully reusable. It is designed to be light and reusable in space using DSG/Orion compatible systems This architecture will also propose orbital locations for the Deep Space Gateway, compare current lander concepts, and propose alternative re-fueling options. The Phoenix lander has the potential to change how humans imagine space travel and routine and on-demand access to extraterrestrial surfaces form orbiting spacecraft. The Phoenix concept aims to drastically reduce the costs of extraterrestrial settlement buildup and operations. Lunar buildup will be so much smoother with crew supervision capability from the orbiting DSG, and this will vastly help lunar global exploration in the future.

Furthermore, the Phoenix architecture is also applicable for future Mars expeditions. Recent developments in the private space industry and NASA's plans to seek out a commercial lander solution fits in nicely with the Phoenix concept. The Phoenix Reusable Lander is a stepping stone to make settlements beyond Earth a real possibility at a quick and affordable pace.

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