Lunar Exploration (3)
Lunar Missions planned (2A)

Author: Mr. Ryan Whitley
NASA, United States

Dr. Markus Landgraf
European Space Agency (ESA), The Netherlands
Mr. Naoki Sato
JAXA, Japan
Mr. Martin Picard
Canadian Space Agency, Canada
Mrs. Kandyce Goodliff
NASA LaRC, United States
Mr. Keith Stephenson
European Space Agency (ESA), The Netherlands
Mr. Shinichiro Narita
JAXA, Japan
Dr. Yves Gonthier
Canadian Space Agency, Canada
Dr. Aidan Cowley
ESA european space agency, Germany
Ms. Shahrzad Hosseini
Delft University of Technology (TU Delft), The Netherlands
Mr. Rogier Schonenborg
Schonenborg Space Engineering BV, The Netherlands

A GLOBAL EXPLORATION ROADMAP CONCEPT FOR HUMAN EXPLORATION OF THE MOON

Abstract

The International Space Exploration Coordination Group's (ISECG) Global Exploration Roadmap is a consensus vision that lays out a stepwise path to achieve a growing human presence in space extending from the International Space Station (ISS) in low Earth orbit to the Moon, Mars and beyond. The roadmap begins with "proving ground" activities in cislunar space and continues with a renewed presence on the lunar surface. Both exploration phases are designed to be stepping-stones on the path to Mars, maximizing technology development programs and expanding new capabilities.

As part of the two-pronged approach to extend human presence from ISS, the human lunar surface missions will be designed to build upon the proving ground activities that precede them. They will provide experience in planetary surface operations that cannot be obtained in cislunar space. Phase one of the proving ground culminates in the development of a Mars class evolvable deep space habitat (EDSH). Simultaneously, a sub-scale human lunar lander will be built as the first step in the overall human lunar lander development program. The initial use of this small-scale lander will be a demonstrator mission to land a tele-operated robotic rover and ascender. All aspects of the lander design, descender, rover and ascender will be designed to test and human rate systems for the full-scale lander.

To enable a five-mission limited campaign to grow the human footprint on the surface of the Moon, two new elements are required: a human lunar lander and a mobile surface habitat. The human lunar lander

will have been developed throughout the proving ground phase from the sub-scale demonstrator and will consist of a descender alongside a reusable ascent module. The reusable ascent module will be used for all five human lunar surface missions. Surface habitation, in the form of two small pressurized rovers, will enable 4 crew to spend up to 42 days on the lunar surface, including the lunar night. Operations conducted during the lunar day and the lunar night will utilize a minimum-energy régime supported by a radioisotope power system and secondary rechargeable system. After each 42-day mission the rovers will traverse autonomously, without crew, to the next landing site of interest, requiring one less launch for each subsequent mission. By taking advantage of the development of Mars-forward assets during the proving ground, a human lunar surface concept is proposed to maximize value for both lunar exploration and preparation for future deep space missions.