**Advancing the Global Exploration
Strategy
Human Exploration of the Moon**

Summary of Scenario Discussions at International
Space Exploration Coordination Group
Yokohama, Japan
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1.0 Introduction

In *The Global Exploration Strategy: The Framework For Cooperation,* fourteen international space agencies[1] expressed their common interest in "creating a common language of exploration" to "enhance mutual understanding among partners and to identify areas for potential cooperation." It was in this spirit that in July 2008 the members of the International Space Exploration Coordination Group (ISECG) agreed to collectively explore ideas and plans for human exploration of the Moon.[2] From the latter half of 2008 through early 2009 interested agencies[3] participated in a series of Lunar Architecture Workshops to begin the process of discussing human exploration of the Moon in the international community.

Workshop participants have begun to study the means by which lunar exploration objectives can be met, examining the many kinds of spacecraft and other systems that can be developed over time to enable human exploration of the moon. These systems are often referred to as architecture elements, and the members of the ISECG that participated in the workshops have considered how the innovative utilization of these elements can provide the necessary functions for lunar exploration – including habitation and life support, transportation, and scientific investigation. A critical aspect of the successful functioning of these elements, if they are to be provided by multiple international space agencies, is the interfaces that enable the necessary level of interoperability. Participants have begun to formulate recommendations regarding these interfaces, highlighting the importance of standards, which can promote robustness across a global exploration architecture.

This multilateral lunar architecture study is planned to continue through mid-2010, with a goal of developing a reference lunar surface architecture which may be used to inform subsequent decision milestones of individual agencies.

2.0 The Lunar Architecture Workshops

Three Lunar Architecture Workshops, open to all ISECG members, were conducted between September 2008 and February 2009.[4] During the workshops, participating agencies reviewed their respective lunar

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[1] In alphabetical order: ASI (Italy), BNSC (United Kingdom), CNES (France), CNSA (China), CSA (Canada), CSIRO (Australia), DLR (Germany), ESA (European Space Agency), ISRO (India), JAXA (Japan), KARI (Republic of Korea), NASA (United States of America), NSAU (Ukraine), Roscosmos (Russia). "Space Agencies" refers to government organizations responsible for space activities.
[2] The ISECG held its second meeting in Montreal, Canada, on July 9-10, 2008.
[3] ISECG members that participated in at least one workshop include ASI, BNSC, CNES, CSA, DLR, ESA, JAXA, KARI, NASA, and Roscosmos (Russia)
[4] The first workshop was September 17-18, in Bremen, Germany. The second workshop was October 29 – 30 in Cocoa Beach, Florida, USA. The third workshop was February 3-5 in Houston, Texas, USA.

exploration objectives and, where applicable, the status of ongoing or completed lunar exploration studies. The workshops gave participants the opportunity to share plans, look for common themes and objectives and begin the multilateral process of examining coordinated lunar exploration. Together, the group identified common objectives for exploration of the Moon, such as science of and from the Moon, preparation for human Mars exploration, and engaging the public through the course of lunar exploration. The group also considered International Space Station lessons learned, opportunities for private industry, as well as other strategic considerations which may impact a lunar exploration architecture.

Through the course of the workshops, participants considered how to best satisfy the lunar exploration objectives of the international community, ultimately identifying three distinct scenarios worthy of more detailed analysis: polar outpost missions, sortie missions, and extended-stay missions. These scenarios are explained further below, and provide the framework for the continued development and analysis of the international exploration of the Moon. The participants will conduct this analysis through additional workshops planned between now and mid-2010.

3.0 Lunar Exploration Scenarios

Workshop participants examined architectures associated with three major types of lunar exploration scenarios: establishment of a polar outpost, sortie, and extended-stay missions. Each scenario requires at a minimum the provision of crew and cargo transportation, communications from the Moon to Earth, and support for extravehicular activity. Participants discussed the key parameters of potential architecture element in order to understand how they may be utilized in each scenario.

3.1 Polar Lunar Outpost Scenario

A human lunar outpost at one of the poles can be described as the build up of capabilities and elements that enable the opportunity for continuous presence of astronauts on the Moon, with individual stays of up to 180 days. It is envisioned that a completed outpost can be accomplished with a relatively small number of missions. An outpost can begin satisfying science, public outreach and other objectives during its construction phase and upon completion. A major attribute of a lunar outpost is to allow the international community to develop the systems and capabilities with sufficient reliability to consider undertaking an international mission to Mars.

3.2 Lunar Sortie Mission Scenario

A lunar sortie mission can be described as one or more short duration flights to any location on the moon. These missions will satisfy a range of science objectives as well as public engagement and others. The main characteristic of this type of mission is that the crew lives out of the NASA Altair lander (or another human lunar lander) and can conduct up to seven days worth of scientific or other activities with the resources brought with them. Pre-deployment of resources is not necessarily precluded in this scenario.

3.3 Extended-Stay Mission Scenario

Workshop participants recognized that significant enhancement of sortie mission scenarios can be achieved if elements in addition to a human lunar lander are in-place on the lunar surface. The participants characterized an extended-stay scenario by the pre-deployment of elements that may extend the sortie mission crew time, provide additional capability for crew habitation, science or demonstration of capabilities and technologies necessary for human missions to Mars.