



Living on the Moon: Inflatable Habitat Research

When NASA astronauts explore the moon starting in 2020, they'll stay for about a week to start out and then gradually lengthen their visits as an outpost takes shape. At first, they'll take everything they need in their lunar landers, but longer stays will require more support than one lander can deliver.

For that reason, engineers are starting to develop concepts for habitation modules that provide necessary protection and support in a package that's as light and compact as possible. That's because for every pound of cargo that lands on the moon, NASA will need to launch 125 pounds from Earth to cover fuel, engines and systems that ensure a safe journey. In addition, habitats will need to be as easy to construct or assemble as possible because the astronauts will be working in spacesuits.



One option being studied is the use of inflatable structures.

NASA, the National Science Foundation (NSF), and ILC Dover of Frederica, Del., have joined forces in a NASA-sponsored Innovative Partnership Program to investigate inflatable structures technology as possible long-term habitats for future astronaut teams.

The Objective

The overall objective of this joint project is to design, construct, and test a proof-of-concept inflatable structure, focusing on how easy it is to deploy and how durable it is in an extremely harsh environment – Antarctica.

The test inflatable habitat will be used as an integral part of McMurdo Station, the National Science Foundation's logistics hub in Antarctica. It has been designed and built to match the size and volume of current NSF habitats used in Antarctica, 16 feet wide by 24 feet long for a total of 384 square feet. The half-cylinder shaped structure will have a maximum headroom of 8 feet at the center of its curved ceiling.

The structure consists of a tubular inflatable structure, an insulation blanket, guy wires, power and lighting systems, a pressurizing system, heaters, a protective floor and sensors to monitor the structure and environment. It can be set up, taken down and redeployed multiple times – it takes four people fewer than four hours to set it up.

The habitat will be used from January 2008 through February 2009. During this period, specially placed sensors will record data on how the habitat is used and how it stands up to the harsh conditions in Antarctica.

The Partnership

This partnership came about because NASA and the NSF are tasked to send human crews into harsh environments for scientific

and exploration purposes, while providing the infrastructure that allows them to operate in a safe, productive manner. In addition, ILC Dover has extensive experience with inflatable structures and space-rated systems. Both NASA and the NSF must provide this infrastructure at the end of a very long logistical pipeline, making low mass, efficient packing and high durability top priorities.

NASA's current long-term habitation capability is represented by the space shuttle crew compartment and the space station pressurized modules. Both are capable and robust, but not designed to meet the anticipated needs of lunar or Mars exploration.



NASA hopes to gain experience with packing and transporting such habitats, setting them up on location, using them in harsh environments, monitoring their performance remotely and dealing with lunar dust – represented in this case by Antarctic snow and dust.

The NSF also is interested in lighter, easier-to-assemble habitats. It currently uses a 50-year-old design known as a Jamesway, that is comparably bulky and complex. Modern variations on the Jamesway, although lighter, are still rigid and difficult to ship, with limited insulation.

During the test of the new inflatable habitat, the NSF will study improvements in packing, transportation and set up, as well as power consumption and damage tolerance for this newest variation of a time-tested concept.

This test inflatable structure has its origins in recent work carried out by several NASA centers, with all three partners helping develop the proof-of-concept test article. ILC Dover will construct the primary pressure vessel and portions of the interior outfitting; NASA will develop the data system that will monitor and transmit performance data during the deployment phase, and the NSF will transport the entire system to the Antarctic, set it up in a suitable location and test its robustness. The NSF also will provide on-site monitoring and support while it is being deployed and used in the test. All three organizations will share the performance data generated during the test.

The inflatable habitat research could lead to potential solutions to issues NASA and the NSF face in reaching their exploration and scientific goals.

Constellation Program

The nation's next major human space flight program is NASA's Constellation Program, which is currently developing spacecraft and launch systems for a new generation of explorers that will go to the moon, Mars, and beyond. Initial flights of the new Orion spacecraft will be to the space station in low-Earth orbit and by 2020 will support the development of an outpost on the moon. Early lunar missions will be about a week long, but eventually stays on the lunar surface are expected to last about six months, similar in length to current space station missions.

NASA and Antarctica

Exploration of the lunar and Martian surfaces and space poses great challenges to humans. One of the challenges is the extreme environments that astronauts will encounter. To simulate these environments, NASA engineers and scientists use comparable locations – the desert and ocean – on Earth to prepare for upcoming exploration missions. In addition to preparing for the future, NASA scientists use Antarctica, another of Earth's extreme environments, to study the past.

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FS-2007-11-016-JSC

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Rev date: 11/21/07