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Author: Prof. Sarag Saikia
Purdue University, United States

Dr. Buzz Aldrin
Buzz Aldrin Enterprises, LLC, United States
Dr. Andrew Aldrin
Florida Institute of Technology, United States
Prof. James Longuski
Purdue University, United States

DESIGN OF A 50-PERSON BASE FOR PIONEERING HUMAN ACTIVITIES LEADING TO PERMANENCE ON MARS

Abstract

We propose a pioneering international base to support 50 explorers as the first step toward sustainable human presence on Mars via a gradual buildup of capabilities. Mars is the next tangible frontier for expanding human expansion beyond Earth and a goal for pioneering space. NASA and industry are developing the capabilities needed to send humans to an asteroid by 2025 and Mars within the 2030s—goals outlined in the NASA Authorization Act of 2010 as well as in the 2010 US National Space Policy. In October 2015, NASA released a plan outlining the next steps for the Journey to Mars. Recently SpaceX's Elon Musk outlined a plan to establish a Mars colony of up to 80,000 people with a per person trip cost of less than USD 0.5 M. Musk provides no further detailed plan as to how the SpaceX's colony will be established and operated.

In this paper, we envisage that initial exploration of Mars will start off as a scientific exploration and engineering base analogous to the United States' Amundsen–Scott South Pole Station in Antarctica. The scientific base will serve as a proving ground for pioneering activities for further expansion leading to a permanent colony on the Red Planet.

We present different mission architectures and implementation approaches, detailed construction strategy, civil engineering needs, design and build up of the 50-person base, and operations plans for the base for 20 to 30 years. During the operations period, the pioneering Martians will identify capabilities and resources and devise a plan to establishing a sustainable human presence on Mars. The pioneers—with the help of the in-space and surface systems and equipment—will develop and refine such capabilities as preparation of landing sites; production of water, oxygen, rocket propellant from in situ resources; production of a variety of food sources; production of in situ materials for construction of habitats, and manufacturing of other useful hardware. These pioneering activities will be carried out on the surface of Mars to a level where they can be relied upon without "routine" support and supplies from Earth—a major step towards a sustainable civilization on Mars.