Paper ID: 81319
oral

27th IAA SYMPOSIUM ON HUMAN EXPLORATION OF THE SOLAR SYSTEM (A5)
Human Exploration of Mars (2)

Author: Dr. Robert Zubrin
The Mars Society, United States

TECHNOLOGICAL REQUIREMENTS FOR SETTLING MARS

Abstract

While, in generic terms, current technology is sufficient to support the development of hardware capable of enabling human exploration missions to the Red Planet, important advances are needed to enable settlement. Critical advances to enable settlement include food production, artificial intelligence, energy generation, and mineral extraction technology.

Importation of food to support a Mars city is impossible, and the conventionally accepted option of growing food in greenhouses appears to be impractical. At the same yield per hectare as Iowa cornfields, it would take 5000 hectares of greenhouses to feed a Mars city of 100,000 people. Providing 200 W/m2 of supplementary lighting would require 10 Gigawatts of power. The problem is that the efficiency of photosynthesis converting light energy to food energy at the level of the cornfield it is 0.2

Mars cities will need power on a much larger scale that proposed space nuclear reactors, and will need to sharply reduce their uranium consumption. Breeder reactors, preferably able to use both thorium and uranium as fuel are needed, with simplified internal design allowing them to be made on Mars.

Fusion power could be very attractive for Mars, since deuterium is five times more common than it is on Earth. But creating lithium blankets to breed tritium to for D-T reactors could be extremely difficult. Mars fusion reactors would therefore need to be able to operate on the catalyzed D-D cycle. As such reactors would be much more economical than those requiring lithium blankets, they could well help make fusion economically competitive on Earth as well.

Mars cities will face a severe labor shortage. Robots are complex machines requiring a global industrial base to produce. In contrast, people can be produced by any healthy couple. Unfortunately, people tend to have very narrow skill sets. AI technology that would vastly expand the skill sets of the small resident population is needed.

Another key area is extraction of elements from low quality mineral ores. Lacking global transport, Martain cities will need to obtain useful materials from low quality ores lying within practical ground transport distances. Such technologies are also essential for mining precious metals from asteroids, a key prop of future Martian economy.