

HUMAN EXPLORATION OF THE MOON AND MARS SYMPOSIUM (A5)  
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TECHNOLOGY DEVELOPMENT FOR HUMAN EXPLORATION OF MARS

**Abstract**

Current plans call for the first human missions to Mars to be launched around 2030. The recently completed "Mars Design Reference Mission 5.0" study defines a conceptual mission architecture and identifies enabling technologies. NASA is beginning long-range development on key technologies needed for these missions because it will take many years for them to reach maturity. The ISS and the lunar outpost will be used as test beds for these technologies to reduce risk and prepare for human exploration of Mars.

NASA's Exploration Technology Development Program is maturing technologies and demonstrating operational scenarios for lunar exploration that are extensible to future human missions to Mars. These include fission surface power systems; entry, descent, and landing systems for large payloads; liquid oxygen-liquid methane propulsion systems; cryogenic fluid management; closed-loop life support; small pressurized rovers for surface mobility; in-situ resource utilization; radiation shielding; and optical communications. Advanced technologies will enable more affordable and sustainable Mars exploration.