



NASA SBIR 2016 Phase I Solicitation

H6.03 Spacecraft Autonomy and Space Mission Automation for Consumables

Lead Center: ARC

Participating Center(s): JPL, JSC

Future human spaceflight missions will place crew's at large distances and light-time delays from Earth, requiring novel capabilities for crews and ground to manage spacecraft consumables and renewables such as power, water, propellant and life support systems to prevent Loss of Mission (LOM) or Loss of Crew (LOC). This capability is necessary to reconfigure spacecraft, or replan missions, in response to events such as leaks or failures leading to unexpected expenditure of consumables coupled with lack of communications. If crews in the spacecraft must manage, plan and operate much of the mission themselves, NASA must migrate operations functionality from the flight control room to the vehicle for use by the crew. Migrating flight controller tools and procedures to the crew on-board the spacecraft would, even if technically possible, overburden the crew. Enabling these same monitoring, tracking, and management capabilities on-board the spacecraft for a small crew to use will require significant automation and decision support software. Required capabilities to enable future human spaceflight to distant destinations include:

- Enable on-board crew management of vehicle consumables that are currently flight controller responsibilities.
- Increase the onboard capability to detect and respond to unexpected consumables-management related events and faults without dependence on ground.
- Reduce up-front and recurring software costs to produce flight-critical software.
- Provide more efficient and cost effective ground based operations through automation of consumables management processes, and up-front and recurring mission operations software costs.

Necessary capabilities include:

- Peer-to-peer mission operations planning.
- Mixed initiative planning systems.
- Elicitation of mission planning constraints and preferences.
- Planning system software integration.
- Space Vehicle System Automation.
- Autonomous rendezvous and docking software.
- Integrated discrete and continuous control software.
- Long-duration high-reliability autonomous system.
- Power aware computing.
- Power Systems Autonomous Control.
- Vehicle Systems Automation.
- Crew Situational Awareness of Vehicle Automation.
- Contingency Management.

The emphasis of proposed efforts should focus primarily on software systems, but emphasize hardware and operating systems the proposed software will run on (e.g., processors, sensors), and proposals must demonstrate understanding of the consumables and dependent spacecraft systems that the software is intended to manage.

Proposals may reference existing fault management techniques, but this subtopic does not solicit development of fault management capability; proposers interested in developing these capabilities are referred to the relevant H6 topic area (H6.04). While Verification, Validation and Requirements of autonomous systems is also an important area, this subtopic does not solicit development of these technologies, proposers interested in developing these capabilities are referred to the relevant H6 topic area (H6.02).

Proposals must demonstrate mission operations cost reduction by use of standards, open source software, crew workload reduction, and/or decrease of software integration costs.

Proposals must demonstrate autonomy software cost reduction by use of standards, demonstration of capability especially on long-duration missions, system integration, and/or open source software.