

Life support Challenges for Human Space Exploration (10)  
Life Support Technologies and Systems (1)

Author: Mr. Robert Bagdigian

NASA, United States, robert.m.bagdigian@nasa.gov

Ms. Robyn Carrasquillo

NASA, United States, robyn.l.carrasquillo@nasa.gov

Mr. Jordan Metcalf

NASA, United States, jordan.l.metcalf@nasa.gov

Ms. Laurie Peterson

NASA, United States, laurie.j.peterson@nasa.gov

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA) ENVIRONMENTAL  
CONTROL AND LIFE SUPPORT (ECLS) CAPABILITY ROADMAP DEVELOPMENT FOR  
EXPLORATION

**Abstract**

NASA is considering a number of future human space exploration mission concepts . Although detailed requirements and vehicle architectures remain mostly undefined, near-term technology investment decisions need to be guided by the anticipated capabilities needed to enable or enhance the mission concepts. This paper describes a roadmap that NASA has formulated to guide the development of Environmental Control and Life Support Systems (ECLSS) capabilities required to enhance the long-term operation of the International Space Station (ISS) and enable beyond-Low Earth Orbit (LEO) human exploration missions. Three generic mission types were defined to serve as a basis for developing a prioritized list of needed capabilities and technologies. Those are 1) a short duration micro gravity mission; 2) a long duration transit microgravity mission; and 3) a long duration surface exploration mission. To organize the effort, ECLSS was categorized into three major functional groups (atmosphere, water, and solid waste management) with each broken down into sub-functions. The ability of existing, flight-proven state-of-the-art (SOA) technologies to meet the functional needs of each of the three mission types was then assessed. When SOA capabilities were deemed to fall short of meeting the needs, those “gaps” were prioritized in terms of whether or not the corresponding capabilities enable or enhance each of the mission types. The resulting list of enabling and enhancing capability gaps can be used to guide future ECLSS development. A strategy to fulfill those needs over time was then developed in the form of a roadmap. Through execution of this roadmap, the hardware and technologies needed to enable and enhance exploration may be developed in a manner that synergistically benefits the ISS operational capability, supports Multi-Purpose Crew Vehicle (MPCV) development, and sustains long-term technology investments for longer duration missions. This paper summarizes NASA’s ECLSS capability roadmap development process, findings, and recommendations.