

IAF HUMAN SPACEFLIGHT SYMPOSIUM (B3)  
Advanced Systems, Technologies, and Innovations for Human Spaceflight (7)

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AN OVERVIEW OF JAXA ECLSS RESEARCH AND DEVELOPMENT FOR FUTURE  
EXPLORATION MISSIONS

**Abstract**

The Environmental Control and Life Support System (ECLSS) used on the International Space Station (ISS) is an essential technology to provide a habitable environment for crews. The current ISS ECLSS includes several subsystems for air and water management, most of which require crew maintenance and resupply from the earth. For future human space exploration of the Moon, Mars and beyond, ECLSS should have higher reliability and recovery rate with less resource utilization. Japan Aerospace Exploration Agency (JAXA) has been developing a closed-loop ECLSS to attain higher reliability, resiliency, a lower maintenance time and lower resupply needs, lower volume, mass, power and cooling requirements compared to the current ISS ECLSS architecture. Our system consists of three parts: an air revitalization system, a water recovery system, and a waste management system. In the air revitalization system, for instance, Trace Contaminant Control System (TCCS) removes chemical contaminants from cabin air and Carbon Dioxide Removal System (CDRS) collects CO<sub>2</sub> discharged by crew metabolism using CO<sub>2</sub> adsorbent, which are a “core” ECLSS necessary for crew exploration. In addition, Oxygen Generation System produces O<sub>2</sub> by water electrolysis with H<sub>2</sub> byproduct, which is used in CO<sub>2</sub> Reduction System to convert into methane and water through Sabatier reaction. The methane decomposition system breaks down the methane into carbon and H<sub>2</sub>, which is essential to the closed system’s H<sub>2</sub>/mass balance. These are categorized as a “regenerative” ECLSS which are not always required for short-duration missions but essential for deep space human exploration to reduce the amount of resupply from the earth. The lunar orbital platform, “Gateway” is a next generation space station that will enable an innovative human, scientific, and commercial exploration of deep space. In the initial phase, two to four crew members will be supported for approximately 30 days. JAXA is contributing to the program providing the core ECLSS mentioned above for one of the habitation modules, the International Habitation module (I-HAB). In the future, moreover, the duration of stay will be extended to 100 days and more. The regenerative ECLSS such as Oxygen Generation System and Water Recovery System will not be installed in the initial phase

of the Gateway but will be promising in the upcoming stages for longer and deeper human exploration. JAXA has been working on the development of the closed-loop ECLSS for future exploration missions. The overview of our ECLSS RD will be presented here.