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Next-Generation Evaporative Cooling Systems for the Advanced Extravehicular Mobility Unit Portable Life Support System

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The development of the Advanced Extravehicular Mobility Unit (AEMU) Portable Life Support System (PLSS) is currently underway at NASA Johnson Space Center. The AEMU PLSS features two new evaporative cooling systems, the Reduced Volume Prototype Spacesuit Water Membrane Evaporator (RVP SWME), and the Auxiliary Cooling Loop (ACL). The RVP SWME is the third generation of hollow fiber SWME hardware, and like its predecessors, RVP SWME provides nominal crewmember and electronics cooling by flowing water through porous hollow fibers. Water vapor escapes through the hollow fiber pores, thereby cooling the liquid water that remains inside of the fibers. This cooled water is then recirculated to remove heat from the crewmember and PLSS electronics. Major design improvements, including a 36% reduction in volume, reduced weight, and more flight like backpressure valve, facilitate the packaging of RVP SWME in the AEMU PLSS envelope. In addition to the RVP SWME, the Auxiliary Cooling Loop (ACL), was developed for contingency crewmember cooling. The ACL is a completely redundant, independent cooling system that consists of a small evaporative cooler--the Mini Membrane Evaporator (Mini-ME), independent pump, independent feedwater assembly and independent Liquid Cooling Garment (LCG). The Mini-ME utilizes the same hollow fiber technology featured in the RVP SWME, but is only 25% of the size of RVP SWME, providing only the necessary crewmember cooling in a contingency situation. The ACL provides a number of benefits when compared with the current EMU PLSS contingency cooling technology; contingency crewmember cooling can be provided for a longer period of time, more contingency situations can be accounted for, no reliance on a Secondary Oxygen Vessel (SOV) for contingency cooling--thereby allowing a SOV reduction in size and pressure, and the ACL can be recharged—allowing the AEMU PLSS to be reused, even after a contingency event. The development of these evaporative cooling systems will contribute to a more robust and comprehensive AEMU PLSS.