Failure Analysis Results and Corrective Actions Implemented For the EMU 3011 Water in the Helmet Mishap

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During EVA (Extravehicular Activity) #23 aboard the ISS (International Space Station) on 07/16/2013 water entered the EMU (Extravehicular Mobility Unit) helmet resulting in the termination of the EVA (Extravehicular Activity) approximately 1-hour after it began. It was estimated that 1.5-L of water had migrated up the ventilation loop into the helmet, adversely impacting the astronauts hearing, vision and verbal communication. Subsequent on-board testing and ground-based TT&E (Test, Tear-down and Evaluation) of the affected EMU hardware components led to the determination that the proximate cause of the mishap was blockage of all water separator drum holes with a mixture of silica and silicates. The blockages caused a failure of the water separator function which resulted in EMU cooling water spilling into the ventilation loop, around the circulating fan, and ultimately pushing into the helmet. The root cause of the failure was determined to be ground-processing short-comings of the ALCLR (Airlock Cooling Loop Recovery) Ion Filter Beds which led to various levels of contaminants being introduced into the Filters before they left the ground. Those contaminants were thereafter introduced into the EMU hardware on-orbit during ALCLR scrubbing operations. This paper summarizes the failure analysis results along with identified process, hardware and operational corrective actions that were implemented as a result of findings from this investigation.

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