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Proposed Paper - Abstract

Author: Kevin Lange/Jacobs Technology (kevin.e.lange@nasa.gov or kevin.lange@jacobs.com)

Title: Scaling Impacts in Life Support Architecture and Technology Selection

For long-duration space missions outside of Earth orbit, reliability considerations will drive higher levels of redundancy and/or on-board spares for life support equipment. Component scaling will be a critical element in minimizing overall launch mass while maintaining an acceptable level of system reliability. Building on an earlier reliability study (AIAA 2012-3491), this paper considers the impact of alternative scaling approaches, including the design of technology assemblies and their individual components to maximum, nominal, survival, or other fractional requirements. The optimal level of life support system closure is evaluated for deep-space missions of varying duration using equivalent system mass (ESM) as the comparative basis. Reliability impacts are included in ESM by estimating the number of component spares required to meet a target system reliability. Common cause failures are included in the analysis. ISS and ISS-derived life support technologies are considered along with selected alternatives. This study focusses on minimizing launch mass, which may be enabling for deep-space missions.