14TH IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Novel Concepts and Technologies to Enable Future Building Blocks in Space Exploration and Development (3)

Author: Ms. Vinita Marwaha Madill
Space Generation Advisory Council (SGAC), United Kingdom

EVA SUIT DESIGN AND OPERATIONAL RECOMMENDATIONS NECESSARY FOR ESA'S LUNAR EXPLORATION GOALS

Abstract

Essential technology design considerations for extravehicular activity (EVA) will be required for long-duration human exploration. The implications for a long-term extended duration exploration mission will bring unique challenges to the crew, without room for complacency during EVA operations. An evaluation of crew communications will be discussed, including the need for crew autonomy during mission planning and troubleshooting. There will be a need to reset expectations of hardware and system longevity for long-term missions, removing the assumption of consistent system behaviour. Potential failure scenarios are in need of being evaluated in detail ahead of time, depicted through the example of a recent high visibility close call during EVA. The fine line between maximising crew productivity during a long-range mission and adopting a safety conscious posture should be realised. The importance of on-board training and procedural changes are highlighted, particularly taking International Space Station (ISS) hardware and crew training lessons learned into account.

An increased capability and flexibility in the use of EVA suits, will be required, providing the ability to withstand the deep-space and lunar environments. Issues investigated in relation to EVA suit design include lunar dust. The high degree of abrasion Apollo astronauts' spacesuits experienced whilst conducting lunar EVA emphasised the need for a solution. Exposure to fine-grained particles of lunar dust is additionally indicated to cause numerous health problems for the astronauts. An evaluation of these issues along with recommendations discussed for future crew exploration environments will be presented. Hardware lessons learned during ISS operations including suit operation, part lifetime and wear in a microgravity environment should be incorporated into future suit design. These factors must be taken into account during the design process of an EVA suit for use on the lunar surface along with dust mitigation technologies.

Analyses from this review are presented in the context of future exploration mission reference architectures, including ESA's lunar exploration goals, such as the "Moon Village" initiative, and the International Space Exploration Coordination Group (ISECG) Global Exploration Roadmap (2013). Based on the aforementioned review, recommendations for EVA training, suit design and operational procedures are suggested. Extensions of original designs and recommendations based on my conclusions and successive independent analysis will be presented.