ANALYTIC SHIELDING OPTIMIZATION TO REDUCE CREW EXPOSURE TO IONIZING RADIATION INSIDE SPACE VEHICLES. Razvan Gaza[1], Tim P. Cooper[1], Arthur Hanzo[1], Hesham Hussein[1], Kandy S. Jarvis[1], Ryan Kimble[1], Kerry T. Lee[2], Chirag Patel[1], Brandon D. Reddell[1], Nicholas Stoffle[2], E. Neal Zapp[2], and Tad D. Shelfer[1]

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A sustainable lunar architecture provides capabilities for leveraging out-of-service components for alternate uses. Discarded architecture elements may be used to provide ionizing radiation shielding to crew habitats in case of a Solar Particle Event. The specific location relative to the vehicle where the additional shielding mass is placed, as corroborated with particularities of the vehicle design, has a large influence on protection gain. This effect is caused by the exponential-like decrease of radiation exposure with shielding mass thickness. Consequently, the most benefit from a given amount of shielding mass is obtained by preferentially supplementing thinly shielded regions of the vehicle exposed to the radiation environment.

A novel analytic technique to derive an optimal shielding configuration was developed by Lockheed Martin during Design Analysis Cycle 3 (DAC-3) of the Orion Crew Exploration Vehicle (CEV). [1] Based on a detailed Computer Aided Design (CAD) model of the vehicle including a specific crew positioning scenario, a set of under-shielded vehicle regions can be identified as candidates for shielding augmentation. Analytic tools are available to allow visualization of an idealized supplemental shielding distribution in the CAD environment, which in turn is used as a reference for deriving a realistic shielding configuration from available vehicle components.

While the analysis referenced in this communication applies particularly to the Orion vehicle, the general method can be applied to a large range of space exploration vehicles, including but not limited to lunar and Mars architecture components. In addition, the method can be immediately applied for optimization of radiation shielding provided to sensitive electronic components.

References:

[1] Lockheed Martin, DRD CEV-T-045001 “Project Orion: CEV Space Radiation Analysis and Certification Report”, NASA Deliverable (2009)