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Radiation Fields, Effects and Risks in Human Space Missions (5)

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EVOLVING RADIOLOGICAL PROTECTION GUIDELINES FOR EXPLORATION-CLASS MISSIONS

Abstract

International Space Station (ISS) partner nations have agreed on short term dose limits, but have yet to come to a consensus on career constraints. These differences have been accommodated in mission planning to-date, by ensuring the forecasted dose for an upcoming mission complies with each crew member's respective career limit. Missions beyond low earth orbit (BLEO) will make this more challenging to accomplish, since there is a higher probability that any long-duration mission will result in non-compliance.

Canadian Nuclear Laboratories (CNL) investigating how to build upon existing Canadian Space Agency (CSA) radiological protection measures in preparation for exploration-class missions. The CSA career effective dose limit of 1 Sv for ISS missions is based on recommendations from the International Commission on Radiological Protection publication 60 (ICRP-60). We will discuss how the ICRP-60 Commission arrived at this career limit for terrestrial exposure scenarios, as well as how this limit applies to LEO and BLEO missions and the quantification of radiation-induced cancers.

A multitude of other space flight injuries and illnesses have been documented, which includes bone loss, muscle loss, vision deterioration, cardiovascular risk, and anxiety. CNL sees benefit to evaluating these health risks and radiological hazards on a common scale. The National Aeronautics and Space Administration's (NASA) Integrated Medical Model (IMM), performs a similar analysis for medical conditions experienced during ISS missions. It employs a Crew Health Index (CHI) derived from the Quality Adjusted Life Year (QALY) in its optimization algorithm. One QALY translates to one year of perfect health. A similar metric used in public health studies is the Disability Adjusted Life Year (DALY) which is equivalent to one year of healthy life lost. Both values aim to capture the impacts of illness or injury on quality of life and life expectancy. We will discuss how incorporating deterministic and stochastic radiological health risks into CHI, QALY and/or DALY may improve the communication of health hazards with astronauts.