LANLCellular-Level Dosimetric Characterization of Ionizing Radiation *via* Monte Carlo N-Particle (MCNP6) Simulation

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With the increased risk of accidental and purposeful release of radiation, the use of radiation in cancer therapy, and increased space missions, the need to understand, address and respond to the impact of radiation exposure on human health is more urgent than ever. Accidental releases of radiation from power plants such as in the Chernobyl incident and in the Fukushima Daiichi disaster has demonstrated a need to identify health effects over a potentially large population or area. Prediction of consequences of exposure and the assignment of degrees of urgency to a large number of human patients at once is a key need for our nation. A critical component of the response, both in treatment of individual patients and in interaction with the community, is an accurate determination of the quantitative relationship between exposure levels (dose) and corresponding health risks.

When groups of individuals are exposed to radiation, there is an urgent need to understand the extent of exposure and magnitude of damage. This determination is severely limited by the inability to measure dose received by individuals in various exposure scenarios and the current animal-based experimental radiation exposure platforms, which are inadequate for the prediction of human physiological responses and, consequently, dose-effect correlations. Thus, a fundamental effort based on strong science is critical to dispel uncertainties associated with radiation exposure.

The particle radiation transport code, which stands for Monte Carlo N-Particle, is a general-purpose three-dimensional simulation tool that can transport 37 different particle types for has been applied to study such varied problems as criticality, shielding, dosimetry, and detector response. It enables complete, relatively easy-to-use depletion calculations in a single Monte Carlo code. The enhancements of MCNP6 described here help provide a powerful capability as well as dictate a path forward for future developments to improve the usefulness of the technology.

Los Alamos National Laboratory is uniquely positioned to address fundamental gaps in our current understanding on the impact of radiation exposure on human health and therefore inform triage efforts. Such knowledge is paramount to the preparedness against unintentional releases.