Predictive Fallout Composition Modeling: Improvements and Applications of the Defense Land Fallout Interpretive Code[1]

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Abstract

This paper outlines several improvements to the Particle Activity Module (PAM) of the Defense Land Fallout Interpretive Code (DELFIC). A brief description of the fallout process is given, including the formation of the nuclear cloud, cooling and condensation of fallout material, and ground deposition and decay of fallout particles. The modeling of each phase of the fallout process is discussed within DELFIC to demonstrate the capabilities and limitations with the code for modeling and simulation. Expansion of the DELFIC isotopic library to include actinides and light elements is shown. Several key features of the new library are demonstrated, including compliance with ENDF/B-VII standards, augmentation of "hardwired" entrained soil and actinide decay calculations with exact Bateman calculations, and full physical and chemical fractionation of all material inventories. Improvements to the radionuclide source term are demonstrated, including the ability to specify heterogeneous fission types and the ability to import source terms from irradiation calculations using the Oak Ridge Isotope Generation (ORIGEN) code. Additionally, the exposure, kerma, and effective dose conversion factors are revised. Finally, the application of DELFIC for consequence management planning and forensic analysis is presented. For consequence management, DELFIC is shown to provide disaster recovery teams with simulations of real-time events, including the location, composition, time of arrival, activity rates, and dose rates of fallout, accounting for site-specific atmospheric effects. The results from DELFIC are also demonstrated for use by nuclear forensics teams to plan collection routes (including the determination of optimal collection locations), estimate dose rates to workers, and anticipate the composition of material at collection sites. These capabilities give mission planners the ability to maximize their effectiveness in the field while minimizing risk to their workers.

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