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# Application of the Oak Ridge Isotope Generation Code and the Defense Land Fallout Interpretive Code to National Technical Nuclear Forensics

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This project provided a robust fallout planning tool for the National Technical Nuclear Forensics interagency ground sample collection team. They needed a fast running, portable mission planning tool to allow them to respond to emerging improvised nuclear device (IND) post-detonation situations. ORNL has developed new graphical user interfaces for two existing codes, ORIGEN and DELFIC. The Oak Ridge Isotope Generation (ORIGEN) code is a validated, radionuclide production and decay code that predicts the fallout source term inventory after the detonation of an IND. This includes the number of atoms, mass, and/or activity of each fission product, actinide, and activation product. The ORIGEN Fallout Analysis Tool also provides the list of photon energies and intensities associated with the fallout isotope inventory at any time during its decay. With the use of updated dose conversion factors and predicted activity concentrations, the inventory can be transformed into an external dose rate. The Defense Land Fallout Interpretive Code (DELFIC) is a validated, physics-based, research reference, fallout prediction code. It has been implemented into a Fallout Planning Tool and is used to predict the expected isotope concentrations of fallout, particle sizes, fractionation ratios, dose rates, and integrated doses over the planned collection routes—information vital to ensure quality samples for nuclear forensic analysis while predicting dose to the sample collectors. DELFIC contains a particle activity module that models the radiochemical fractionation of the condensing elements to predict the activity size distribution for a given scenario. DELFIC's cloud rise module produces a definition of the stabilized cloud that accounts for particle settling and advection during cloud rise, which causes a physical fractionation of the particles. This 3D spatial size distribution along with the activity size distribution provides the most detailed physics-based characterization of the fallout source term phenomenology available in an operational fallout model. *This work was funded by the Office of Nonproliferation and Verification Research and Development (NA-22) and the Office of National Technical Nuclear Forensics (NA-45) within the U.S. Department of Energy's National Nuclear Security Administration.

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