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Evaluating the Irradiation and Processing History of Potential Radiological Device Materials

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Cobalt-60 and iridium-192 sources are both generated in nuclear reactors through the irradiation of stable target materials. However, variation in: neutron energy, flux and irradiation time; target material characteristics and purity; the activation cross sections of the desired reactions; decay and daughter progeny in-growth; and any post irradiation processing, can play a key part in determining the isotopic and chemical composition of the material produced. These isotopic ratios, together with those of any activated elemental impurities, therefore have the potential to provide information relating towards not only the material's production date, but also the source's production route, irradiation history and original elemental and isotopic composition.

Preliminary studies evaluating the effects of neutron spectra on radionuclide production using computational modeling have indicated a number of potential signatures. These signatures show significant variability depending on the reactor conditions employed, but need to be validated using materials of known production history prior to further utilisation. Chemical dissolution, separation and purification methods are therefore being developed for both source types to enable the isolation and detection of the isotopes of interest. Details of the techniques being used will be provided, and the various issues that source size, target purity and manufacturing conditions have on signature development and identification will be discussed.

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