



Appendix F

Radionuclides Measured by Gamma Spectroscopy (Gamma Scan)

E. J. Antonio

Gamma rays are a form of high energy electromagnetic radiation that originate from the nucleus of an atom. They have very short wavelengths and can easily penetrate all but the most dense materials. Gamma-emitting radionuclides may be natural in origin, result from Hanford Site operations, or be related to fallout from historic nuclear weapons testing.

Gamma rays can be detected and quantified by inorganic scintillators, which convert energy into visible light. Scintillators may include thallium-activated sodium iodide crystals (NaI[Tl]) or germanium semiconductor detectors and their associated electronics (gamma spectroscopy). A partial list of radionuclides whose activity is measurable using gamma spectroscopy is provided in Table F.1.

Table F.1. Radionuclides Measured by Gamma Spectroscopy

Radionuclide	Symbol	Principal Source
Beryllium-7 ^(a)	⁷ Be	Natural - cosmogenic
Sodium-22	²² Na	Fission product
Sodium-24	²⁴ Na	Fission product
Potassium-40 ^(a)	⁴⁰ K	Natural - primordial
Manganese-54	⁵⁴ Mn	Fission product
Cobalt-58	⁵⁸ Co	Fission product
Cobalt-60 ^(a)	⁶⁰ Co	Fission product
Iron-59	⁵⁹ Fe	Fission product
Zinc-65	⁶⁵ Zn	Fission product
Zirconium/niobium-95	⁹⁵ Zr/Nb	Activation product and fission product
Molybdenum-99	⁹⁹ Mo	Activation product and fission product
Ruthenium-103	¹⁰³ Ru	Activation product and fission product
Ruthenium-106 ^(a)	¹⁰⁶ Ru	Fission product
Antimony-125 ^(a)	¹²⁵ Sb	Activation product
Iodine-131	¹³¹ I	Fission product
Cesium-134 ^(a)	¹³⁴ Cs	Activation product
Cesium-137 ^(a)	¹³⁷ Cs	Fission product
Barium/lanthanum-140	¹⁴⁰ Ba/La	Fission product
Cerium-141	¹⁴¹ Ce	Activation product and fission product
Cerium/praseodymium-144	¹⁴⁴ Ce/Pr	Fission product
Europium-152 ^(a)	¹⁵² Eu	Activation product
Europium-154 ^(a)	¹⁵⁴ Eu	Activation product
Europium-155 ^(a)	¹⁵⁵ Eu	Activation product

(a) Routinely reported by contracting laboratory for Pacific Northwest National Laboratory environmental monitoring samples.

