APPENDIX T

List of Some Major Uses of Radioisotopes in the United States

A radioisotope is an unstable isotope of an element that decays or disintegrates spontaneously, thereby emitting radiation. Approximately 5,000 natural and artificial radioisotopes have been identified. Radioisotopes come from three sources: from nature, such as radon in the air or radium in the soil; from machine-produced nuclear interactions in devices, such as linear accelerators and cyclotrons; or from nuclear reactors.

The licensing and regulation of radioisotopes in the United States are shared by the NRC, the U.S. Environmental Protection Agency (EPA), and many State governments. The EPA is also responsible for, among other things, setting air emission and drinking water standards for radionuclides. The States regulate radioactive substances that occur naturally or are produced by machines, such as linear accelerators or cyclotrons. The Food and Drug Administration (FDA) regulates the manufacture and use of linear accelerators; the States regulate their operation.

Americium-241
Used in many smoke detectors for homes and businesses; to measure levels of toxic lead in dried paint samples; to ensure uniform thickness in rolling processes like steel and paper production; and to help determine where oil wells should be drilled.

Cadmium-109
Used to analyze metal alloys for checking stock, scrap sorting.

Calcium-47
Important aid to biomedical researchers studying the cellular functions and bone formation in mammals.

Californium-252
Used to inspect airline luggage for hidden explosives, to gauge the moisture content of soil in the road construction and building industries, and to measure the moisture of materials stored in soils.

Carbon-14
Major research tool. Helps ensure potential new drugs are metabolized without forming harmful byproducts. Used in biological research, agriculture, pollution control, and archeology.

Cesium-137
Used to measure correct patient dosages of radioactive pharmaceuticals; to measure and control the liquid flow in oil pipelines; to tell researchers whether oil wells are plugged by sand; and to ensure the right fill level for packages of food, drugs, and other products. (The products in these packages do not become radioactive.)

Chromium-51
Used in research in red blood cell survival studies.

Cobalt-57
Used as a tracer to diagnose pernicious anemia.

Cobalt-60
Used to sterilize surgical instruments and to improve the safety and reliability of industrial fuel oil burners. Used in cancer treatment, food irradiation, gauges, and radiography.

Curium-244
Used in mining to analyze material excavated from pits and slurries from drilling operations.

Fluorine-18
Used for positron emission imaging in medical diagnosis.

Gallium-68
Used for positron emission imaging in medical diagnosis.

Iodine-123
Widely used to diagnose thyroid disorders and other metabolic disorders including brain function.

Iodine-125
Major diagnostic tool used in clinical tests and to diagnose thyroid disorders. Also used in biomedical research.

Iodine-129
Used to check some radioactivity counters at in vitro diagnostic testing laboratories.

Iodine-131
Used to treat thyroid disorders.

Iridium-192
Used to test the integrity of pipeline welds, boilers, and aircraft parts and in brachytherapy/tumor irradiation.

Iron-55
Used to analyze electroplating solutions and to detect the presence of sulphur in the air. Used in metabolism research.

Krypton-85
Used in indicator lights in appliances such as clothes washers and dryers, stereos, and coffee makers; to gauge the thickness of thin plastics and sheet metal, rubber, textiles, and paper; and to measure dust and pollutant levels.

Lutecium-177
Used as part of radiopharmaceuticals for treatment of cancer.

Nickel-63
Used to detect explosives, in voltage regulators and current surge protectors in electronic devices, and in electron capture detectors for gas chromatographs.

Phosphorus-32
Used in molecular biology and genetics research.

Phosphorus-33
Used in molecular biology and genetics research.

Plutonium-238
Has powered more than 20 NASA spacecraft since 1972. (The most common radioisotopes of plutonium are Pu-238, Pu-239, and Pu-240.)

Polonium-210
Reduces the static charge in production of photographic film and other materials.

Promethium-147
Used in electric blanket thermostats and to gauge the thickness of thin plastics, thin sheet metal, rubber, textiles, and paper.

Radium-226
Makes lighting rods more effective. (The most common isotopes of radium are Ra-226 and Ra-228. Radium-226 is part of the uranium decay series. Radium-228 and Ra-224 are part of the thorium decay series. All isotopes of radium are radioactive. Radium decays to produce radon gas.)

Selenium-75
Used in protein studies in life science research.

Sodium-24
Used to locate leaks in industrial pipe lines and in oil well studies.

Strontium-85
Used to study bone formation and metabolism.

Strontium-90
Used in survey meters by schools, the military, and emergency management authorities. Also used in cigarette manufacturing sensors and medical treatment.

Sulphur-35
Used in genetics and molecular biology research.

Technetium-99m
The most widely used radioactive pharmaceutical for diagnostic studies in nuclear medicine. Different chemical forms are used for brain, bone, liver, spleen, and kidney imaging and also for blood flow studies.

Thallium-201
Used in nuclear medicine for nuclear cardiology and tumor detection.

Thallium-204
Used to measure dust and pollutant levels on filter paper and to gauge the thickness of plastics, sheet metal, rubber, textiles, and paper.

Thorium-229
Helps fluorescent lights last longer.

Thorium-232
As thoriated tungsten, used in electric arc welding rods in construction, aircraft, petrochemical, and food processing equipment industries.

Thorium-230
Provides coloring and fluorescence in colored glazes and glassware.

Tritium
Major tool for biomedical research. Used for life science and drug metabolism studies to ensure the safety of potential new drugs; for luminous exit signs; for luminous dials, gauges, and wrist watches; to produce luminous paint; and for geological prospecting and hydrology.

Uranium-235
Fuel for nuclear power plants and naval nuclear propulsion systems; previously used to produce fluorescent glassware, a variety of colored glazes, and wall tiles.

Xenon-133
Used in nuclear medicine for lung ventilation and blood flow studies.

Yttrium-90
Used as microsphere brachytherapy for treatment of liver cancers.

Source: NUREG/BR-0217, Revision 1, "The Regulation and Use of Radioisotopes in Today's World," April 2000.For more information visit the following web pages:
EPA at https://www.epa.gov/radiation/radionuclides
FDA at https://www.fda.gov radiation-emitting-products
National Nuclear Data Center at https://www.nndc.bnl.gov/