APPENDIX AA

List of Some Major Uses of Radioisotopes in the United States

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 by-products. 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

lodine-123

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

lodine-125

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

lodine-129

Used to check some radioactivity counters in vitro diagnostic testing laboratories.

lodine-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, and 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 thermo-stats...and to gauge the thickness of thin plastics, thin sheet metal, rubber, textile, 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: <u>NUREG/BR-0217 Rev. 1</u> APRIL 2000, The Regulation and Use of Radioisotopes in Today's World 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/

1		PERIODIC TABLE OF ELEMENTS												2			
н		·												Ho			
Hvdrogen		L L C Heiur												Helium			
3	4											5	6	7	8	9	10
11	Bo											R	C	N	0	F	No
Lithium	Beryllium										Boron	Carbon	Nitrogen	Oxygen	Fluorine	Neon	
11	12	Radioactive elements have no stable isotopes									13	14	15	16	17	18	
Na	Ma	radioactive cientents nave no stable isotopes.										Δι	Si	P	S	CL	Δr
Sodium	Magnesium											Aluminium	Silicon	Phosphorus	Sulfur	Chlorine	Argon
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
ĸ	Ca	Sc	Ті	V	Cr	Mn	F۵	Co	Ni	Cu	Zn	Ga	Go	Δς	Sa	Br	Kr
Potassium	Calcium	Scandium	Titanium	₩ Vanadium	Chromium	Manganese	Iron	Cobalt	Nickel		Zinc	Gallium	Germanium	Arsenic	Selenium	Bromine	Krypton
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Rh	Sr		7r	Nh	Mo	To	Ru	Rh	Pd	Δα	Cd	In	Sn	Sh	То		Xo
Rubidium	Strontium	Yttrium	Zirconium	Niobium	Molybdenum	Technetium	Ruthenium	Rhodium	Palladium	Silver	Cadmium	Indium		Antimony	Tellurium	lodine	Xenon
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
Ce	Ba	*	Нf	Тэ	1/1/	Ro	Oc	Ir	Dt	Διι	Ha	т	Dh	Bi	Po	Δt	Bn
Caesium	Barium	Lanthanum	Hafnium	Tantalum	VV Tungsten	Rhenium	Osmium	Iridium	Platinum	Gold	Mercury	Thallium	Lead	Bismuth	Polonium	Astatine	Radon
87	88	89	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	FI	Мс	Lv	Ts	Og
Francium	Radium	Actinium	Rutherfordium	Dubnium	Seaborgium	Bohrium	Hassium	Meitnerium	Darmstadtium	Roentgenium	Copernicium	Nihonium	Flerovium	Moscovium	Livermorium	Tennessine	Oganesson

*	58	59	60	61	62	63	64	65	66	67	68	69	70	71
	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
	Cerium	Praseodymium	Neodymium	Promethium	Samarium	Europium	Gadolinium	Terbium	Dysprosium	Holmium	Erbium	Thulium	Ytterbium	Lutetium
**	90	91	92	93	94	95	96	97	98	99	100	101	102	103
	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
	Thorium	Protactinium	Uranium	Neptunium	Plutonium	Americium	Curium	Berkelium	Californium	Einsteinium	Fermium	Mendelevium	Nobelium	Lawrencium