

PART III
APPENDIX C
RHA 3.54 - QUANTITIES¹ OF LICENSED MATERIAL
REQUIRING LABELING

Radionuclide	Quantity (μ Ci)
Hydrogen-3.....	1,000
Beryllium-7.....	1,000
Beryllium-10.....	1
Carbon-11.....	1,000
Carbon-14.....	1,000
Fluorine-18.....	1,000
Sodium-22.....	10
Sodium-24.....	100
Magnesium-28.....	100
Aluminum-26.....	10
Silicon-31.....	1,000
Silicon-32.....	1
Phosphorus-32.....	10
Phosphorus-33.....	100
Sulfur-35.....	100
Chlorine-36.....	10
Chlorine-38.....	1,000
Chlorine-39.....	1,000
Argon-39.....	1,000
Argon-41.....	1,000
Potassium-40.....	100
Potassium-42.....	1,000
Potassium-43.....	1,000
Potassium-44.....	1,000
Potassium-45.....	1,000
Calcium-41.....	100
Calcium-45.....	100
Calcium-47.....	100
Scandium-43.....	1,000
Scandium-44m.....	100
Scandium-44.....	100
Scandium-46.....	10
Scandium-47.....	100
Scandium-48.....	100
Scandium-49.....	1,000
Titanium-44.....	1
Titanium-45.....	1,000
Vanadium-47.....	1,000
Vanadium-48.....	100

Radionuclide	Quantity (μCi)
Vanadium-49.....	1,000
Chromium-48.....	1,000
Chromium-49.....	1,000
Chromium-51.....	100
Manganese-51.....	1,000
Manganese-52m.....	1,000
Manganese-52.....	100
Manganese-53.....	1,000
Manganese-54.....	100
Manganese-56.....	1,000
Iron-52.....	100
Iron-55.....	100
Iron-59.....	10
Iron-60.....	1
Cobalt-55.....	100
Cobalt-56.....	10
Cobalt-57.....	100
Cobalt-58m.....	1,000
Cobalt-58.....	100
Cobalt-60m.....	1,000
Cobalt-60.....	1
Cobalt-61.....	1,000
Cobalt-62m.....	1,000
Nickel-56.....	100
Nickel-57.....	100
Nickel-59.....	100
Nickel-63.....	100
Nickel-65.....	1,000
Nickel-66.....	10
Copper-60.....	1,000
Copper-61.....	1,000
Copper-64.....	1,000
Copper-67.....	1,000
Zinc-62.....	100
Zinc-63.....	1,000
Zinc-65.....	10
Zinc-69m.....	100
Zinc-69.....	1,000
Zinc-71m.....	1,000
Zinc-72.....	100
Gallium-65.....	1,000
Gallium-66.....	100
Gallium-67.....	1,000
Gallium-68.....	1,000
Gallium-70.....	1,000

Radionuclide	Quantity (μCi)
Gallium-72.....	100
Gallium-73.....	1,000
Germanium-66.....	1,000
Germanium-67.....	1,000
Germanium-68.....	10
Germanium-69.....	1,000
Germanium-71.....	1,000
Germanium-75.....	1,000
Germanium-77.....	1,000
Germanium-78.....	1,000
Arsenic-69.....	1,000
Arsenic-70.....	1,000
Arsenic-71.....	100
Arsenic-72.....	100
Arsenic-73.....	100
Arsenic-74.....	100
Arsenic-76.....	100
Arsenic-77.....	100
Arsenic-78.....	1,000
Selenium-70.....	1,000
Selenium-73m.....	1,000
Selenium-73.....	100
Selenium-75.....	100
Selenium-79.....	100
Selenium-81m.....	1,000
Selenium-81.....	1,000
Selenium-83.....	1,000
Bromine-74m.....	1,000
Bromine-74.....	1,000
Bromine-75.....	1,000
Bromine-76.....	100
Bromine-77.....	1,000
Bromine-80m.....	1,000
Bromine-80.....	1,000
Bromine-82.....	100
Bromine-83.....	1,000
Bromine-84.....	1,000
Krypton-74.....	1,000
Krypton-76.....	1,000
Krypton-77.....	1,000
Krypton-79.....	1,000
Krypton-81.....	1,000
Krypton-83m.....	1,000
Krypton-85m.....	1,000

Radionuclide	Quantity (μCi)
Krypton-85.....	1,000
Krypton-87.....	1,000
Krypton-88.....	1,000
Rubidium-79.....	1000
Rubidium-81m.....	1,000
Rubidium-81.....	1,000
Rubidium-82m.....	1,000
Rubidium-83.....	100
Rubidium-84.....	100
Rubidium-86.....	100
Rubidium-87.....	100
Rubidium-88.....	1,000
Rubidium-89.....	1,000
Strontium-80.....	100
Strontium-81.....	1,000
Strontium-83.....	100
Strontium-85m.....	1,000
Strontium-85.....	100
Strontium-87m.....	1,000
Strontium-89.....	10
Strontium-90.....	0.1
Strontium-91.....	100
Strontium-92.....	100
Yttrium-86m.....	1,000
Yttrium-86.....	100
Yttrium-87.....	100
Yttrium-88.....	10
Yttrium-90m.....	1,000
Yttrium-90.....	10
Yttrium-91m.....	1,000
Yttrium-91.....	10
Yttrium-92.....	100
Yttrium-93.....	100
Yttrium-94.....	1,000
Yttrium-95.....	1,000
Zirconium-86.....	100
Zirconium-88.....	10
Zirconium-89.....	100
Zirconium-93.....	1
Zirconium-95.....	10
Zirconium-97.....	100
Niobium-88.....	1,000
Niobium-89m(66 min)	1,000
Niobium-89 (122 min)	1,000
Niobium-90.....	100

Radionuclide	Quantity (μCi)
Niobium-93m.....	10
Niobium-94.....	1
Niobium-95m.....	100
Niobium-95.....	100
Niobium-96.....	100
Niobium-97.....	1,000
Niobium-98.....	1,000
Molybdenum-90.....	100
Molybdenum-93m.....	100
Molybdenum-93.....	10
Molybdenum-99.....	100
Molybdenum-101.....	1,000
Technetium-93m.....	1,000
Technetium-93.....	1,000
Technetium-94m.....	1,000
Technetium-94.....	1,000
Technetium-96m.....	1,000
Technetium-96.....	100
Technetium-97m.....	100
Technetium-97.....	1,000
Technetium-98.....	10
Technetium-99m.....	1,000
Technetium-99.....	100
Technetium-101.....	1,000
Technetium-104.....	1,000
Ruthenium-94.....	1,000
Ruthenium-97.....	1,000
Ruthenium-103.....	100
Ruthenium-105.....	1,000
Ruthenium-106.....	1
Rhodium-99m.....	1,000
Rhodium-99.....	100
Rhodium-100.....	100
Rhodium-101m.....	1,000
Rhodium-101.....	10
Rhodium-102m.....	10
Rhodium-102.....	10
Rhodium-103m.....	1,000
Rhodium-105.....	100
Rhodium-106m.....	1,000
Rhodium-107.....	1,000
Palladium-100.....	100
Palladium-101.....	1,000
Palladium-103.....	100
Palladium-107.....	10

Radionuclide	Quantity (μCi)
Palladium-109.....	100
Silver-102.....	1,000
Silver-103.....	1,000
Silver-104m.....	1,000
Silver-104.....	1,000
Silver-105.....	100
Silver-106m.....	100
Silver-106.....	1,000
Silver-108m.....	1
Silver-110m.....	10
Silver-111.....	100
Silver-112.....	100
Silver-115.....	1,000
Cadmium-104.....	1,000
Cadmium-107.....	1,000
Cadmium-109.....	1
Cadmium-113m.....	0.1
Cadmium-113.....	100
Cadmium-115m.....	10
Cadmium-115.....	100
Cadmium-117m.....	1,000
Cadmium-117.....	1,000
Indium-109.....	1,000
Indium-110m(69.1m).....	1,000
Indium-110(4.9h).....	1,000
Indium-111.....	100
Indium-112.....	1,000
Indium-113m.....	1,000
Indium-114m.....	10
Indium-115m.....	1,000
Indium-115.....	100
Indium-116m.....	1,000
Indium-117m.....	1,000
Indium-117.....	1,000
Indium-119m.....	1,000
Tin-110.....	100
Tin-111.....	1,000
Tin-113.....	100
Tin-117m.....	100
Tin-119m.....	100
Tin-121m.....	100
Tin-121.....	1,000
Tin-123m.....	1,000
Tin-123.....	10
Tin-125.....	10

Radionuclide	Quantity (μCi)
Tin-126.....	10
Tin-127.....	1,000
Tin-128.....	1,000
Antimony-115.....	1,000
Antimony-116m.....	1,000
Antimony-116.....	1,000
Antimony-117.....	1,000
Antimony-118m.....	1,000
Antimony-119.....	1,000
Antimony-120(16min.)	1,000
Antimony-120(5.76d)	100
Antimony-122.....	100
Antimony-124m.....	1,000
Antimony-124.....	10
Antimony-125.....	100
Antimony-126m.....	1,000
Antimony-126.....	100
Antimony-127.....	100
Antimony-128(10.4min.)	1,000
Antimony-128(9.01h)	100
Antimony-129.....	100
Antimony-130.....	1,000
Antimony-131.....	1,000
Tellurium-116.....	1,000
Tellurium-121m.....	10
Tellurium-121.....	100
Tellurium-123m.....	10
Tellurium-123.....	100
Tellurium-125m.....	10
Tellurium-127m.....	10
Tellurium-127.....	1,000
Tellurium-129m.....	10
Tellurium-129.....	1,000
Tellurium-131m.....	10
Tellurium-131.....	100
Tellurium-132.....	10
Tellurium-133m.....	100
Tellurium-133.....	1,000
Tellurium-134.....	1,000
Iodine-120m.....	1,000
Iodine-120.....	100
Iodine-121.....	1,000
Iodine-123.....	100
Iodine-124.....	10

Radionuclide	Quantity (μCi)
Iodine-125.....	1
Iodine-126.....	1
Iodine-128.....	1,000
Iodine-129.....	1
Iodine-130.....	10
Iodine-131.....	1
Iodine-132m.....	100
Iodine-132.....	100
Iodine-133.....	10
Iodine-134.....	1,000
Iodine-135.....	100
Xenon-120.....	1,000
Xenon-121.....	1,000
Xenon-122.....	1,000
Xenon-123.....	1,000
Xenon-125.....	1,000
Xenon-127.....	1,000
Xenon-129m.....	1,000
Xenon-131m.....	1,000
Xenon-133m.....	1,000
Xenon-133.....	1,000
Xenon-135m.....	1,000
Xenon-135.....	1,000
Xenon-138.....	1,000
Cesium-125.....	1,000
Cesium-127.....	1,000
Cesium-129.....	1,000
Cesium-130.....	1,000
Cesium-131.....	1,000
Cesium-132.....	100
Cesium-134m.....	1,000
Cesium-134.....	10
Cesium-135m.....	1,000
Cesium-135.....	100
Cesium-136.....	10
Cesium-137.....	10
Cesium-138.....	1,000
Barium-126.....	1,000
Barium-128.....	100
Barium-131m.....	1,000
Barium-131.....	100
Barium-133m.....	100
Barium-133.....	100
Barium-135m.....	100
Barium-139.....	1,000

Radionuclide	Quantity (μCi)
Barium-140.....	100
Barium-141.....	1,000
Barium-142.....	1,000
Lanthanum-131.....	1,000
Lanthanum-132.....	100
Lanthanum-135.....	1,000
Lanthanum-137.....	10
Lanthanum-138.....	100
Lanthanum-140.....	100
Lanthanum-141.....	100
Lanthanum-142.....	1,000
Lanthanum-143.....	1,000
Cerium-134.....	100
Cerium-135.....	100
Cerium-137m.....	100
Cerium-137.....	1,000
Cerium-139.....	100
Cerium-141.....	100
Cerium-143.....	100
Cerium-144.....	1
Praseodymium-136.....	1,000
Praseodymium-137.....	1,000
Praseodymium-138m.....	1,000
Praseodymium-139.....	1,000
Praseodymium-142m.....	1,000
Praseodymium-142.....	100
Praseodymium-143.....	100
Praseodymium-144.....	1,000
Praseodymium-145.....	100
Praseodymium-147.....	1,000
Neodymium-136.....	1,000
Neodymium-138.....	100
Neodymium-139m.....	1,000
Neodymium-139.....	1,000
Neodymium-141.....	1,000
Neodymium-147.....	100
Neodymium-149.....	1,000
Neodymium-151.....	1,000
Promethium-141.....	1,000
Promethium-143.....	100
Promethium-144.....	10
Promethium-145.....	10
Promethium-146.....	1
Promethium-147.....	10
Promethium-148m.....	10

Radionuclide	Quantity (μCi)
Promethium-148.....	10
Promethium-149.....	100
Promethium-150.....	1,000
Promethium-151.....	100
Samarium-141m.....	1,000
Samarium-141.....	1,000
Samarium-142.....	1,000
Samarium-145.....	100
Samarium-146.....	1
Samarium-147.....	100
Samarium-151.....	10
Samarium-153.....	100
Samarium-155.....	1,000
Samarium-156.....	1,000
Europium-145.....	100
Europium-146.....	100
Europium-147.....	100
Europium-148.....	10
Europium-149.....	100
Europium-150(12.62h)	100
Europium-150(34.2y)	1
Europium-152m.....	100
Europium-152.....	1
Europium-154.....	1
Europium-155.....	10
Europium-156.....	100
Europium-157.....	100
Europium-158.....	1,000
Gadolinium-145.....	1,000
Gadolinium-146.....	10
Gadolinium-147.....	100
Gadolinium-148.....	0.001
Gadolinium-149.....	100
Gadolinium-151.....	10
Gadolinium-152.....	100
Gadolinium-153.....	10
Gadolinium-159.....	100
Terbium-147.....	1,000
Terbium-149.....	100
Terbium-150.....	1,000
Terbium-151.....	100
Terbium-153.....	1,000
Terbium-154.....	100
Terbium-155.....	1,000
Terbium-156m(5.0h)	1,000

Radionuclide	Quantity (μCi)
Terbium-156m(24.4h)	1,000
Terbium-156	100
Terbium-157	10
Terbium-158	1
Terbium-160	10
Terbium-161	100
Dysprosium-155	1,000
Dysprosium-157	1,000
Dysprosium-159	100
Dysprosium-165	1,000
Dysprosium-166	100
Holmium-155	1,000
Holmium-157	1,000
Holmium-159	1,000
Holmium-161	1,000
Holmium-162m	1,000
Holmium-162	1,000
Holmium-164m	1,000
Holmium-164	1,000
Holmium-166m	1
Holmium-166	100
Holmium-167	1,000
Erbium-161	1,000
Erbium-165	1,000
Erbium-169	100
Erbium-171	100
Erbium-172	100
Thulium-162	1,000
Thulium-166	100
Thulium-167	100
Thulium-170	10
Thulium-171	10
Thulium-172	100
Thulium-173	100
Thulium-175	1,000
Ytterbium-162	1,000
Ytterbium-166	100
Ytterbium-167	1,000
Ytterbium-169	100
Ytterbium-175	100
Ytterbium-177	1,000
Ytterbium-178	1,000
Lutetium-169	100
Lutetium-170	100
Lutetium-171	100

Radionuclide	Quantity (μCi)
Lutetium-172.....	100
Lutetium-173.....	10
Lutetium-174m.....	10
Lutetium-174.....	10
Lutetium-176m.....	1,000
Lutetium-176.....	100
Lutetium-177m.....	10
Lutetium-177.....	100
Lutetium-178m.....	1,000
Lutetium-178.....	1,000
Lutetium-179.....	1,000
Hafnium-170.....	100
Hafnium-172.....	1
Hafnium-173.....	1,000
Hafnium-175.....	100
Hafnium-177m.....	1,000
Hafnium-178m.....	0.1
Hafnium-179m.....	10
Hafnium-180m.....	1,000
Hafnium-181.....	10
Hafnium-182m.....	1,000
Hafnium-182.....	0.1
Hafnium-183.....	1,000
Hafnium-184.....	100
Tantalum-172.....	1,000
Tantalum-173.....	1,000
Tantalum-174.....	1,000
Tantalum-175.....	1,000
Tantalum-176.....	100
Tantalum-177.....	1,000
Tantalum-178.....	1,000
Tantalum-179.....	100
Tantalum-180m.....	1,000
Tantalum-180.....	100
Tantalum-182m.....	1,000
Tantalum-182.....	10
Tantalum-183.....	100
Tantalum-184.....	100
Tantalum-185.....	1,000
Tantalum-186.....	1,000
Tungsten-176.....	1,000
Tungsten-177.....	1,000
Tungsten-178.....	1,000
Tungsten-179.....	1,000
Tungsten-181.....	1,000

Radionuclide	Quantity (μCi)
Tungsten-185.....	100
Tungsten-187.....	100
Tungsten-188.....	10
Rhenium-177.....	1,000
Rhenium-178.....	1,000
Rhenium-181.....	1,000
Rhenium-182(12.7h)	1,000
Rhenium-182(64.0h)	100
Rhenium-184m.....	10
Rhenium-184.....	100
Rhenium-186m.....	10
Rhenium-186.....	100
Rhenium-187.....	1,000
Rhenium-188m.....	1,000
Rhenium-188.....	100
Rhenium-189.....	100
Osmium-180.....	1,000
Osmium-181.....	1,000
Osmium-182.....	100
Osmium-185.....	100
Osmium-189m.....	1,000
Osmium-191m.....	1,000
Osmium-191.....	100
Osmium-193.....	100
Osmium-194.....	1
Iridium-182.....	1,000
Iridium-184.....	1,000
Iridium-185.....	1,000
Iridium-186.....	100
Iridium-187.....	1,000
Iridium-188.....	100
Iridium-189.....	100
Iridium-190m.....	1,000
Iridium-190.....	100
Iridium-192(73.8d)	1
Iridium-192m(1.4min)	10
Iridium-194m.....	10
Iridium-194.....	100
Iridium-195m.....	1,000
Iridium-195.....	1,000
Platinum-186.....	1,000
Platinum-188.....	100
Platinum-189.....	1,000
Platinum-191.....	100
Platinum-193m.....	100

Radionuclide	Quantity (μCi)
Platinum-193.....	1,000
Platinum-195m.....	100
Platinum-197m.....	1,000
Platinum-197.....	100
Platinum-199.....	1,000
Platinum-200.....	100
Gold-193.....	1,000
Gold-194.....	100
Gold-195.....	10
Gold-198m.....	100
Gold-198.....	100
Gold-199.....	100
Gold-200m.....	100
Gold-200.....	1,000
Gold-201.....	1,000
Mercury-193m.....	100
Mercury-193.....	1,00
Mercury-194.....	1
Mercury-195m.....	100
Mercury-195.....	1,000
Mercury-197m.....	100
Mercury-197.....	1,000
Mercury-199m.....	1,000
Mercury-203.....	100
Thallium-194m.....	1,000
Thallium-194.....	1,000
Thallium-195.....	1,000
Thallium-197.....	1,000
Thallium-198m.....	1,000
Thallium-198.....	1,000
Thallium-199.....	1,000
Thallium-200.....	1,000
Thallium-201.....	1,000
Thallium-202.....	100
Thallium-204.....	100
Lead-195m.....	1,000
Lead-198.....	1,000
Lead-199.....	1,000
Lead-200.....	100
Lead-201.....	1,000
Lead-202m.....	1,000
Lead-202.....	10
Lead-203.....	1,000
Lead-205.....	100
Lead-209.....	1,000

Radionuclide	Quantity (Φ Ci)
Lead-210.....	0.01
Lead-211.....	100
Lead-212.....	1
Lead-214.....	100
Bismuth-200.....	1,000
Bismuth-201.....	1,000
Bismuth-202.....	1,000
Bismuth-203.....	100
Bismuth-205.....	100
Bismuth-206.....	100
Bismuth-207.....	10
Bismuth-210m.....	0.1
Bismuth-210.....	1
Bismuth-212.....	10
Bismuth-213.....	10
Bismuth-214.....	100
Polonium-203.....	1,000
Polonium-205.....	1,000
Polonium-207.....	1,000
Polonium-210.....	0.1
Astatine-207.....	100
Astatine-211.....	10
Radon-220.....	1
Radon-222.....	1
Francium-222.....	100
Francium-223.....	100
Radium-223.....	0.1
Radium-224.....	0.1
Radium-225.....	0.1
Radium-226.....	0.1
Radium-227.....	1,000
Radium-228.....	0.1
Actinium-224.....	1
Actinium-225.....	0.01
Actinium-226.....	0.1
Actinium-227.....	0.001
Actinium-228.....	1
Thorium-226.....	10
Thorium-227.....	0.001
Thorium-228.....	0.001
Thorium-229.....	0.001
Thorium-230.....	0.001
Thorium-231.....	100
Thorium-232.....	100
Thorium-234.....	10

Radionuclide	Quantity (μCi)
Thorium-natural.....	100
Protactinium-227.....	10
Protactinium-228.....	1
Protactinium-230.....	0.1
Protactinium-231.....	0.001
Protactinium-232.....	1
Protactinium-233.....	100
Protactinium-234.....	100
Uranium-230.....	0.01
Uranium-231.....	100
Uranium-232.....	0.001
Uranium-233.....	0.001
Uranium-234.....	0.001
Uranium-235.....	0.001
Uranium-236.....	0.001
Uranium-237.....	100
Uranium-238.....	100
Uranium-239.....	1,000
Uranium-240.....	100
Uranium-natural.....	100
Neptunium-232.....	100
Neptunium-233.....	1,000
Neptunium-234.....	100
Neptunium-235.....	100
Neptunium-236($1.15 \times 10^5 \text{y}$).....	0.001
Neptunium-236(22.5h).....	1
Neptunium-237.....	1.001
Neptunium-238.....	10
Neptunium-239.....	100
Neptunium-240.....	1,000
Plutonium-234.....	10
Plutonium-235.....	1,000
Plutonium-236.....	0.001
Plutonium-237.....	100
Plutonium-238.....	0.001
Plutonium-239.....	0.001
Plutonium-240.....	0.001
Plutonium-241.....	0.01
Plutonium-242.....	0.001
Plutonium-243.....	1,000
Plutonium-244.....	0.001
Plutonium-245.....	100
Americium-237.....	1,000
Americium-238.....	100
Americium-239.....	1,000

Radionuclide	Quantity (μCi)
Americium-240.....	100
Americium-241.....	0.001
Americium-242m.....	0.001
Americium-242.....	10
Americium-243.....	0.001
Americium-244m.....	100
Americium-244.....	10
Americium-245.....	1,000
Americium-246m.....	1,000
Americium-246.....	1,000
Curium-238.....	100
Curium-240.....	0.1
Curium-241.....	1
Curium-242.....	0.01
Curium-243.....	0.001
Curium-244.....	0.001
Curium-245.....	0.001
Curium-246.....	0.001
Curium-247.....	0.001
Curium-248.....	0.001
Curium-249.....	1,000
Berkelium-245.....	100
Berkelium-246.....	100
Berkelium-247.....	0.001
Berkelium-249.....	0.1
Berkelium-250.....	10
Californium-244.....	100
Californium-246.....	1
Californium-248.....	0.01
Californium-249.....	0.001
Californium-250.....	0.001
Californium-251.....	0.001
Californium-252.....	0.001
Californium-253.....	0.1
Californium-254.....	0.001
Any alpha emitting radionuclide not listed above or mixtures of alpha emitters of unknown composition.....	0.001
Einsteinium-250.....	100
Einsteinium-251.....	100
Einsteinium-253.....	0.1
Einsteinium-254m.....	1
Einsteinium-254.....	0.01

Radionuclide	Quantity (μCi)
Fermium-252.....	1
Fermium-253.....	1
Fermium-254.....	10
Fermium-255.....	1
Fermium-257.....	0.01
Mendelevium-257.....	10
Mendelevium-258.....	0.01
Any radionuclide other than alpha emitting radionuclides not listed above, or mixtures of beta emitters of unknown composition.....	0.01

¹ The quantities listed above were derived by taking 1/10th of the most restrictive ALI listed in table 1, columns 1 and 2, of appendix B, RHA 3.53 of this part, rounding to the nearest factor of 10, and arbitrarily constraining the values listed between 0.001 and 1,000 μCi .

Values of 100 ΦCi have been assigned for radionuclides having a radioactive half-life in excess of 10^9 years (except rhenium, 1000 μCi) to take into account their low specific activity.

Note: For purposes of RHA 3.22.5, RHA 3.25.1, and RHA 3.44.1 where there is involved a combination of radionuclides in known amounts, the limit for the combination should be derived as follows: determine, for each radionuclide in the combination, the ratio between the quantity present in the combination and the limit otherwise established for the specific radionuclide when not in combination. The sum of such ratios for all radionuclides in the combination may not exceed "1" (i.e., "unity").