

## Chapter DHS 157

## APPENDIX F

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**Quantities of Licensed Material Requiring Labeling  
(in Atomic Order)**

**Note:** To convert microcuries to kBq, multiply the microcurie value by 37.

| <b>Radionuclide</b> | <b>Microcuries</b> | <b>Radionuclide</b> | <b>Microcuries</b> |
|---------------------|--------------------|---------------------|--------------------|
| Hydrogen-3.....     | 1,000              | Chromium-49.....    | 1,000              |
| Beryllium-7.....    | 1,000              | Chromium-51.....    | 1,000              |
| Beryllium-10.....   | 1                  | Manganese-51.....   | 1,000              |
| Carbon-11.....      | 1,000              | Manganese-52m.....  | 1,000              |
| Carbon-14.....      | 100                | Manganese-52.....   | 100                |
| Fluorine-18.....    | 1,000              | Manganese-53.....   | 1,000              |
| Sodium-22.....      | 10                 | Manganese-54.....   | 100                |
| Sodium-24.....      | 100                | Manganese-56.....   | 1,000              |
| Magnesium-28.....   | 100                | Iron-52.....        | 100                |
| Aluminum-26.....    | 10                 | Iron-55.....        | 100                |
| Silicon-31.....     | 1,000              | Iron-59.....        | 10                 |
| Silicon-32.....     | 1                  | Iron-60.....        | 1                  |
| Phosphorus-32.....  | 10                 | Cobalt-55.....      | 100                |
| Phosphorus-33.....  | 100                | Cobalt-56.....      | 10                 |
| Sulfur-35.....      | 100                | Cobalt-57.....      | 100                |
| Chlorine-36.....    | 10                 | Cobalt-58m.....     | 1,000              |
| Chlorine-38.....    | 1,000              | Cobalt-58.....      | 100                |
| Chlorine-39.....    | 1,000              | Cobalt-60m.....     | 1,000              |
| Argon-39.....       | 1,000              | Cobalt-60.....      | 1                  |
| Argon-41.....       | 1,000              | Cobalt-61.....      | 1,000              |
| Potassium-40.....   | 100                | Cobalt-62m.....     | 1,000              |
| Potassium-42.....   | 1,000              | Nickel-56.....      | 100                |
| Potassium-43.....   | 1,000              | Nickel-57.....      | 100                |
| Potassium-44.....   | 1,000              | Nickel-59.....      | 100                |
| Potassium-45.....   | 1,000              | Nickel-63.....      | 100                |
| Calcium-41.....     | 100                | Nickel-65.....      | 1,000              |
| Calcium-45.....     | 100                | Nickel-66.....      | 10                 |
| Calcium-47.....     | 100                | Copper-60.....      | 1,000              |
| Scandium-43.....    | 1,000              | Copper-61.....      | 1,000              |
| Scandium-44m.....   | 100                | Copper-64.....      | 1,000              |
| Scandium-44.....    | 100                | Copper-67.....      | 1,000              |
| Scandium-46.....    | 10                 | Zinc-62.....        | 100                |
| Scandium-47.....    | 100                | Zinc-63.....        | 1,000              |
| Scandium-48.....    | 100                | Zinc-65.....        | 10                 |
| Scandium-49.....    | 1,000              | Zinc-69m.....       | 100                |
| Titanium-44.....    | 1                  | Zinc-69.....        | 1,000              |
| Titanium-45.....    | 1,000              | Zinc-71m.....       | 1,000              |
| Vanadium-47.....    | 1,000              | Zinc-72.....        | 100                |
| Vanadium-48.....    | 100                | Gallium-65.....     | 1,000              |
| Vanadium-49.....    | 1,000              | Gallium-66.....     | 100                |
| Chromium-48.....    | 1,000              | Gallium-67.....     | 1,000              |

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|                   |       |                           |       |
|-------------------|-------|---------------------------|-------|
| Gallium-68.....   | 1,000 | Rubidium-82m.....         | 1,000 |
| Gallium-70.....   | 1,000 | Rubidium-83.....          | 100   |
| Gallium-72.....   | 100   | Rubidium-84.....          | 100   |
| Gallium-73.....   | 1,000 | Rubidium-86.....          | 100   |
| Germanium-66..... | 1,000 | Rubidium-87.....          | 100   |
| Germanium-67..... | 1,000 | Rubidium-88.....          | 1,000 |
| Germanium-68..... | 10    | Rubidium-89.....          | 1,000 |
| Germanium-69..... | 1,000 | Strontium-80.....         | 100   |
| Germanium-71..... | 1,000 | Strontium-81.....         | 1,000 |
| Germanium-75..... | 1,000 | Strontium-83.....         | 100   |
| Germanium-77..... | 1,000 | Strontium-85m.....        | 1,000 |
| Germanium-78..... | 1,000 | Strontium-85.....         | 100   |
| Arsenic-69.....   | 1,000 | Strontium-87m.....        | 1,000 |
| Arsenic-70.....   | 1,000 | Strontium-89.....         | 10    |
| Arsenic-71.....   | 100   | Strontium-90.....         | 0.1   |
| Arsenic-72.....   | 100   | Strontium-91.....         | 100   |
| Arsenic-73.....   | 100   | Strontium-92.....         | 100   |
| Arsenic-74.....   | 100   | Yttrium-86m.....          | 1,000 |
| Arsenic-76.....   | 100   | Yttrium-86.....           | 100   |
| Arsenic-77.....   | 100   | Yttrium-87.....           | 100   |
| Arsenic-78.....   | 1,000 | Yttrium-88.....           | 10    |
| Selenium-70.....  | 1,000 | Yttrium-90m.....          | 1,000 |
| Selenium-73m..... | 1,000 | Yttrium-90.....           | 10    |
| Selenium-73.....  | 100   | Yttrium-91m.....          | 1,000 |
| Selenium-75.....  | 100   | Yttrium-91.....           | 10    |
| Selenium-79.....  | 100   | Yttrium-92.....           | 100   |
| Selenium-81m..... | 1,000 | Yttrium-93.....           | 100   |
| Selenium-81.....  | 1,000 | Yttrium-94.....           | 1,000 |
| Selenium-83.....  | 1,000 | Yttrium-95.....           | 1,000 |
| Bromine-74m.....  | 1,000 | Zirconium-86.....         | 100   |
| Bromine-74.....   | 1,000 | Zirconium-88.....         | 10    |
| Bromine-75.....   | 1,000 | Zirconium-89.....         | 100   |
| Bromine-76.....   | 100   | Zirconium-93.....         | 1     |
| Bromine-77.....   | 1,000 | Zirconium-95.....         | 10    |
| Bromine-80m.....  | 1,000 | Zirconium-97.....         | 100   |
| Bromine-80.....   | 1,000 | Niobium-88.....           | 1,000 |
| Bromine-82.....   | 100   | Niobium-89m (66 min)..... | 1,000 |
| Bromine-83.....   | 1,000 | Niobium-89 (122 min)..... | 1,000 |
| Bromine-84.....   | 1,000 | Niobium-90.....           | 100   |
| Krypton-74.....   | 1,000 | Niobium-93m.....          | 10    |
| Krypton-76.....   | 1,000 | Niobium-94.....           | 1     |
| Krypton-77.....   | 1,000 | Niobium-95m.....          | 100   |
| Krypton-79.....   | 1,000 | Niobium-95.....           | 100   |
| Krypton-81.....   | 1,000 | Niobium-96.....           | 100   |
| Krypton-83m.....  | 1,000 | Niobium-97.....           | 1,000 |
| Krypton-85m.....  | 1,000 | Niobium-98.....           | 1,000 |
| Krypton-85.....   | 1,000 | Molybdenum-90.....        | 100   |
| Krypton-87.....   | 1,000 | Molybdenum-93m.....       | 100   |
| Krypton-88.....   | 1,000 | Molybdenum-93.....        | 10    |
| Rubidium-79.....  | 1,000 | Molybdenum-99.....        | 100   |
| Rubidium-81m..... | 1,000 | Molybdenum-101.....       | 1,000 |
| Rubidium-81.....  | 1,000 | Technetium-93m.....       | 1,000 |

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|                     |       |                              |       |
|---------------------|-------|------------------------------|-------|
| Technetium-93.....  | 1,000 | Cadmium-117m.....            | 1,000 |
| Technetium-94m..... | 1,000 | Cadmium-117.....             | 1,000 |
| Technetium-94.....  | 1,000 | Indium-109.....              | 1,000 |
| Technetium-96m..... | 1,000 | Indium-110 (69.1 min).....   | 1,000 |
| Technetium-96.....  | 100   | Indium-110 (4.9 h).....      | 1,000 |
| Technetium-97m..... | 100   | Indium-111.....              | 100   |
| Technetium-97.....  | 1,000 | Indium-112.....              | 1,000 |
| Technetium-98.....  | 10    | Indium-113m.....             | 1,000 |
| Technetium-99m..... | 1,000 | Indium-114m.....             | 10    |
| Technetium-99.....  | 100   | Indium-115m.....             | 1,000 |
| Technetium-101..... | 1,000 | Indium-115.....              | 100   |
| Technetium-104..... | 1,000 | Indium-116m.....             | 1,000 |
| Ruthenium-94.....   | 1,000 | Indium-117m.....             | 1,000 |
| Ruthenium-97.....   | 1,000 | Indium-117.....              | 1,000 |
| Ruthenium-103.....  | 100   | Indium-119m.....             | 1,000 |
| Ruthenium-105.....  | 1,000 | Tin-110.....                 | 100   |
| Ruthenium-106.....  | 1     | Tin-111.....                 | 1,000 |
| Rhodium-99m.....    | 1,000 | Tin-113.....                 | 100   |
| Rhodium-99.....     | 100   | Tin-117m.....                | 100   |
| Rhodium-100.....    | 100   | Tin-119m.....                | 100   |
| Rhodium-101m.....   | 1,000 | Tin-121m.....                | 100   |
| Rhodium-101.....    | 10    | Tin-121.....                 | 1,000 |
| Rhodium-102m.....   | 10    | Tin-123m.....                | 1,000 |
| Rhodium-102.....    | 10    | Tin-123.....                 | 10    |
| Rhodium-103m.....   | 1,000 | Tin-125.....                 | 10    |
| Rhodium-105.....    | 100   | Tin-126.....                 | 10    |
| Rhodium-106m.....   | 1,000 | Tin-127.....                 | 1,000 |
| Rhodium-107.....    | 1,000 | Tin-128.....                 | 1,000 |
| Palladium-100.....  | 100   | Antimony-115.....            | 1,000 |
| Palladium-101.....  | 1,000 | Antimony-116m.....           | 1,000 |
| Palladium-103.....  | 100   | Antimony-116.....            | 1,000 |
| Palladium-107.....  | 10    | Antimony-117.....            | 1,000 |
| Palladium-109.....  | 100   | Antimony-118m.....           | 1,000 |
| Silver-102.....     | 1,000 | Antimony-119.....            | 1,000 |
| Silver-103.....     | 1,000 | Antimony-120 (16 min).....   | 1,000 |
| Silver-104m.....    | 1,000 | Antimony-120 (5.76 d).....   | 100   |
| Silver-104.....     | 1,000 | Antimony-122.....            | 100   |
| Silver-105.....     | 100   | Antimony-124m.....           | 1,000 |
| Silver-106m.....    | 100   | Antimony-124.....            | 10    |
| Silver-106.....     | 1,000 | Antimony-125.....            | 100   |
| Silver-108m.....    | 1     | Antimony-126m.....           | 1,000 |
| Silver-110m.....    | 10    | Antimony-126.....            | 100   |
| Silver-111.....     | 100   | Antimony-127.....            | 100   |
| Silver-112.....     | 100   | Antimony-128 (10.4 min)..... | 1,000 |
| Silver-115.....     | 1,000 | Antimony-128 (9.01 h).....   | 100   |
| Cadmium-104.....    | 1,000 | Antimony-129.....            | 100   |
| Cadmium-107.....    | 1,000 | Antimony-130.....            | 1,000 |
| Cadmium-109.....    | 1     | Antimony-131.....            | 1,000 |
| Cadmium-113m.....   | 0.1   | Tellurium-116.....           | 1,000 |
| Cadmium-113.....    | 100   | Tellurium-121m.....          | 10    |
| Cadmium-115m.....   | 10    | Tellurium-121.....           | 100   |
| Cadmium-115.....    | 100   | Tellurium-123m.....          | 10    |

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|---------------------|-------|------------------------|-------|
| Tellurium-123.....  | 100   | Cesium-137.....        | 10    |
| Tellurium-125m..... | 10    | Cesium-138.....        | 1,000 |
| Tellurium-127m..... | 10    | Barium-126.....        | 1,000 |
| Tellurium-127.....  | 1,000 | Barium-128.....        | 100   |
| Tellurium-129m..... | 10    | Barium-131m.....       | 1,000 |
| Tellurium-129.....  | 1,000 | Barium-131.....        | 100   |
| Tellurium-131m..... | 10    | Barium-133m.....       | 100   |
| Tellurium-131.....  | 100   | Barium-133.....        | 100   |
| Tellurium-132.....  | 10    | Barium-135m.....       | 100   |
| Tellurium-133m..... | 100   | Barium-139.....        | 1,000 |
| Tellurium-133.....  | 1,000 | Barium-140.....        | 100   |
| Tellurium-134.....  | 1,000 | Barium-141.....        | 1,000 |
| Iodine-120m.....    | 1,000 | Barium-142.....        | 1,000 |
| Iodine-120.....     | 100   | Lanthanum-131.....     | 1,000 |
| Iodine-121.....     | 1,000 | Lanthanum-132.....     | 100   |
| Iodine-123.....     | 100   | Lanthanum-135.....     | 1,000 |
| Iodine-124.....     | 10    | Lanthanum-137.....     | 10    |
| Iodine-125.....     | 1     | Lanthanum-138.....     | 100   |
| Iodine-126.....     | 1     | Lanthanum-140.....     | 100   |
| Iodine-128.....     | 1,000 | Lanthanum-141.....     | 100   |
| Iodine-129.....     | 1     | Lanthanum-142.....     | 1,000 |
| Iodine-130.....     | 10    | Lanthanum-143.....     | 1,000 |
| Iodine-131.....     | 1     | Cerium-134.....        | 100   |
| Iodine-132m.....    | 100   | Cerium-135.....        | 100   |
| Iodine-132.....     | 100   | Cerium-137m.....       | 100   |
| Iodine-133.....     | 10    | Cerium-137.....        | 1,000 |
| Iodine-134.....     | 1,000 | Cerium-139.....        | 100   |
| Iodine-135.....     | 100   | Cerium-141.....        | 100   |
| Xenon-120.....      | 1,000 | Cerium-143.....        | 100   |
| Xenon-121.....      | 1,000 | Cerium-144.....        | 1     |
| Xenon-122.....      | 1,000 | Praseodymium-136.....  | 1,000 |
| Xenon-123.....      | 1,000 | Praseodymium-137.....  | 1,000 |
| Xenon-125.....      | 1,000 | Praseodymium-138m..... | 1,000 |
| Xenon-127.....      | 1,000 | Praseodymium-139.....  | 1,000 |
| Xenon-129m.....     | 1,000 | Praseodymium-142m..... | 1,000 |
| Xenon-131m.....     | 1,000 | Praseodymium-142.....  | 100   |
| Xenon-133m.....     | 1,000 | Praseodymium-143.....  | 100   |
| Xenon-133.....      | 1,000 | Praseodymium-144.....  | 1,000 |
| Xenon-135m.....     | 1,000 | Praseodymium-145.....  | 100   |
| Xenon-135.....      | 1,000 | Praseodymium-147.....  | 1,000 |
| Xenon-138.....      | 1,000 | Neodymium-136.....     | 1,000 |
| Cesium-125.....     | 1,000 | Neodymium-138.....     | 100   |
| Cesium-127.....     | 1,000 | Neodymium-139m.....    | 1,000 |
| Cesium-129.....     | 1,000 | Neodymium-139.....     | 1,000 |
| Cesium-130.....     | 1,000 | Neodymium-141.....     | 1,000 |
| Cesium-131.....     | 1,000 | Neodymium-147.....     | 100   |
| Cesium-132.....     | 100   | Neodymium-149.....     | 1,000 |
| Cesium-134m.....    | 1,000 | Neodymium-151.....     | 1,000 |
| Cesium-134.....     | 10    | Promethium-141.....    | 1,000 |
| Cesium-135m.....    | 1,000 | Promethium-143.....    | 100   |
| Cesium-135.....     | 100   | Promethium-144.....    | 10    |
| Cesium-136.....     | 10    | Promethium-145.....    | 10    |

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|                             |       |                     |       |
|-----------------------------|-------|---------------------|-------|
| Promethium-146.....         | 1     | Terbium-160.....    | 10    |
| Promethium-147.....         | 10    | Terbium-161.....    | 100   |
| Promethium-148m.....        | 10    | Dysprosium-155..... | 1,000 |
| Promethium-148.....         | 10    | Dysprosium-157..... | 1,000 |
| Promethium-149.....         | 100   | Dysprosium-159..... | 100   |
| Promethium-150.....         | 1,000 | Dysprosium-165..... | 1,000 |
| Promethium-151.....         | 100   | Dysprosium-166..... | 100   |
| Samarium-141m.....          | 1,000 | Holmium-155.....    | 1,000 |
| Samarium-141.....           | 1,000 | Holmium-157.....    | 1,000 |
| Samarium-142.....           | 1,000 | Holmium-159.....    | 1,000 |
| Samarium-145.....           | 100   | Holmium-161.....    | 1,000 |
| Samarium-146.....           | 1     | Holmium-162m.....   | 1,000 |
| Samarium-147.....           | 100   | Holmium-162.....    | 1,000 |
| Samarium-151.....           | 10    | Holmium-164m.....   | 1,000 |
| Samarium-153.....           | 100   | Holmium-164.....    | 1,000 |
| Samarium-155.....           | 1,000 | Holmium-166m.....   | 1     |
| Samarium-156.....           | 1,000 | Holmium-166.....    | 100   |
| Europium-145.....           | 100   | Holmium-167.....    | 1,000 |
| Europium-146.....           | 100   | Erbium-161.....     | 1,000 |
| Europium-147.....           | 100   | Erbium-165.....     | 1,000 |
| Europium-148.....           | 10    | Erbium-169.....     | 100   |
| Europium-149.....           | 100   | Erbium-171.....     | 100   |
| Europium-150 (12.62 h)..... | 100   | Erbium-172.....     | 100   |
| Europium-150 (34.2 y).....  | 1     | Thulium-162.....    | 1,000 |
| Europium-152m.....          | 100   | Thulium-166.....    | 100   |
| Europium-152.....           | 1     | Thulium-167.....    | 100   |
| Europium-154.....           | 1     | Thulium-170.....    | 10    |
| Europium-155.....           | 10    | Thulium-171.....    | 10    |
| Europium-156.....           | 100   | Thulium-172.....    | 100   |
| Europium-157.....           | 100   | Thulium-173.....    | 100   |
| Europium-158.....           | 1,000 | Thulium-175.....    | 1,000 |
| Gadolinium-145.....         | 1,000 | Ytterbium-162.....  | 1,000 |
| Gadolinium-146.....         | 10    | Ytterbium-166.....  | 100   |
| Gadolinium-147.....         | 100   | Ytterbium-167.....  | 1,000 |
| Gadolinium-148.....         | 0.001 | Ytterbium-169.....  | 100   |
| Gadolinium-149.....         | 100   | Ytterbium-175.....  | 100   |
| Gadolinium-151.....         | 10    | Ytterbium-177.....  | 1,000 |
| Gadolinium-152.....         | 100   | Ytterbium-178.....  | 1,000 |
| Gadolinium-153.....         | 10    | Lutetium-169.....   | 100   |
| Gadolinium-159.....         | 100   | Lutetium-170.....   | 100   |
| Terbium-147.....            | 1,000 | Lutetium-171.....   | 100   |
| Terbium-149.....            | 100   | Lutetium-172.....   | 100   |
| Terbium-150.....            | 1,000 | Lutetium-173.....   | 10    |
| Terbium-151.....            | 100   | Lutetium-174m.....  | 10    |
| Terbium-153.....            | 1,000 | Lutetium-174.....   | 10    |
| Terbium-154.....            | 100   | Lutetium-176m.....  | 1,000 |
| Terbium-155.....            | 1,000 | Lutetium-176.....   | 100   |
| Terbium-156m (5.0 h).....   | 1,000 | Lutetium-177m.....  | 10    |
| Terbium-156m (24.4 h).....  | 1,000 | Lutetium-177.....   | 100   |
| Terbium-156.....            | 100   | Lutetium-178m.....  | 1,000 |
| Terbium-157.....            | 10    | Lutetium-178.....   | 1,000 |
| Terbium-158.....            | 1     | Lutetium-179.....   | 1,000 |

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|                           |       |                             |       |
|---------------------------|-------|-----------------------------|-------|
| Hafnium-170.....          | 100   | Iridium-192m (1.4 min)..... | 10    |
| Hafnium-172.....          | 1     | Iridium-192 (73.8 d).....   | 1     |
| Hafnium-173.....          | 1,000 | Iridium-194m.....           | 10    |
| Hafnium-175.....          | 100   | Iridium-194.....            | 100   |
| Hafnium-177m.....         | 1,000 | Iridium-195m.....           | 1,000 |
| Hafnium-178m.....         | 0.1   | Iridium-195.....            | 1,000 |
| Hafnium-179m.....         | 10    | Platinum-186.....           | 1,000 |
| Hafnium-180m.....         | 1,000 | Platinum-188.....           | 100   |
| Hafnium-181.....          | 10    | Platinum-189.....           | 1,000 |
| Hafnium-182m.....         | 1,000 | Platinum-191.....           | 100   |
| Hafnium-182.....          | 0.1   | Platinum-193m.....          | 100   |
| Hafnium-183.....          | 1,000 | Platinum-193.....           | 1,000 |
| Hafnium-184.....          | 100   | Platinum-195m.....          | 100   |
| Tantalum-172.....         | 1,000 | Platinum-197m.....          | 1,000 |
| Tantalum-173.....         | 1,000 | Platinum-197.....           | 100   |
| Tantalum-174.....         | 1,000 | Platinum-199.....           | 1,000 |
| Tantalum-175.....         | 1,000 | Platinum-200.....           | 100   |
| Tantalum-176.....         | 100   | Gold-193.....               | 1,000 |
| Tantalum-177.....         | 1,000 | Gold-194.....               | 100   |
| Tantalum-178.....         | 1,000 | Gold-195.....               | 10    |
| Tungsten-188.....         | 10    | Gold-198m.....              | 100   |
| Rhenium-177.....          | 1,000 | Gold-198.....               | 100   |
| Rhenium-178.....          | 1,000 | Gold-199.....               | 100   |
| Rhenium-181.....          | 1,000 | Gold-200m.....              | 100   |
| Rhenium-182 (12.7 h)..... | 1,000 | Gold-200.....               | 1,000 |
| Rhenium-182 (64.0 h)..... | 100   | Gold-201.....               | 1,000 |
| Rhenium-184m.....         | 10    | Mercury-193m.....           | 100   |
| Rhenium-184.....          | 100   | Mercury-193.....            | 1,000 |
| Rhenium-186m.....         | 10    | Mercury-194.....            | 1     |
| Rhenium-186.....          | 100   | Mercury-195m.....           | 100   |
| Rhenium-187.....          | 1,000 | Mercury-195.....            | 1,000 |
| Rhenium-188m.....         | 1,000 | Mercury-197m.....           | 100   |
| Rhenium-188.....          | 100   | Mercury-197.....            | 1,000 |
| Rhenium-189.....          | 100   | Mercury-199m.....           | 1,000 |
| Osmium-180.....           | 1,000 | Mercury-203.....            | 100   |
| Osmium-181.....           | 1,000 | Thallium-194m.....          | 1,000 |
| Osmium-182.....           | 100   | Thallium-194.....           | 1,000 |
| Osmium-185.....           | 100   | Thallium-195.....           | 1,000 |
| Osmium-189m.....          | 1,000 | Thallium-197.....           | 1,000 |
| Osmium-191m.....          | 1,000 | Thallium-198m.....          | 1,000 |
| Osmium-191.....           | 100   | Thallium-198.....           | 1,000 |
| Osmium-193.....           | 100   | Thallium-199.....           | 1,000 |
| Osmium-194.....           | 1     | Thallium-200.....           | 1,000 |
| Iridium-182.....          | 1,000 | Thallium-201.....           | 1,000 |
| Iridium-184.....          | 1,000 | Thallium-202.....           | 100   |
| Iridium-185.....          | 1,000 | Thallium-204.....           | 100   |
| Iridium-186.....          | 100   | Lead-195m.....              | 1,000 |
| Iridium-187.....          | 1,000 | Lead-198.....               | 1,000 |
| Iridium-188.....          | 100   | Lead-199.....               | 1,000 |
| Iridium-189.....          | 100   | Lead-200.....               | 100   |
| Iridium-190m.....         | 1,000 | Lead-201.....               | 1,000 |
| Iridium-190.....          | 100   | Lead-202m.....              | 1,000 |

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|-----------------------|-------|--------------------------------|-------|
| Lead-202.....         | 10    | Protactinium-230.....          | 0.1   |
| Lead-203.....         | 1,000 | Protactinium-231.....          | 0.001 |
| Lead-205.....         | 100   | Protactinium-232.....          | 1     |
| Lead-209.....         | 1,000 | Protactinium-233.....          | 100   |
| Lead-210.....         | 0.01  | Protactinium-234.....          | 100   |
| Lead-211.....         | 100   | Uranium-230.....               | 0.01  |
| Lead-212.....         | 1     | Uranium-231.....               | 100   |
| Lead-214.....         | 100   | Uranium-232.....               | 0.001 |
| Bismuth-200.....      | 1,000 | Uranium-233.....               | 0.001 |
| Bismuth-201.....      | 1,000 | Uranium-234.....               | 0.001 |
| Bismuth-202.....      | 1,000 | Uranium-235.....               | 0.001 |
| Bismuth-203.....      | 100   | Uranium-236.....               | 0.001 |
| Bismuth-205.....      | 100   | Uranium-237.....               | 100   |
| Bismuth-206.....      | 100   | Uranium-238.....               | 100   |
| Bismuth-207.....      | 10    | Uranium-239.....               | 1,000 |
| Bismuth-210m.....     | 0.1   | Uranium-240.....               | 100   |
| Bismuth-210.....      | 1     | Uranium-natural.....           | 100   |
| Bismuth-212.....      | 10    | Neptunium-232.....             | 100   |
| Bismuth-213.....      | 10    | Neptunium-233.....             | 1,000 |
| Bismuth-214.....      | 100   | Neptunium-234.....             | 100   |
| Polonium-203.....     | 1,000 | Neptunium-235.....             | 100   |
| Polonium-205.....     | 1,000 | Neptunium-236 (1.15E+5 y)..... | 0.001 |
| Polonium-207.....     | 1,000 | Neptunium-236 (22.5 h).....    | 1     |
| Polonium-210.....     | 0.1   | Neptunium-237.....             | 0.001 |
| Astatine-207.....     | 100   | Neptunium-238.....             | 10    |
| Astatine-211.....     | 10    | Neptunium-239.....             | 100   |
| Radon-220.....        | 1     | Neptunium-240.....             | 1,000 |
| Radon-222.....        | 1     | Plutonium-234.....             | 10    |
| Francium-222.....     | 100   | Plutonium-235.....             | 1,000 |
| Francium-223.....     | 100   | Plutonium-236.....             | 0.001 |
| Radium-223.....       | 0.1   | Plutonium-237.....             | 100   |
| Radium-224.....       | 0.1   | Plutonium-238.....             | 0.001 |
| Radium-225.....       | 0.1   | Plutonium-239.....             | 0.001 |
| Radium-226.....       | 0.1   | Plutonium-240.....             | 0.001 |
| Radium-227.....       | 1,000 | Plutonium-241.....             | 0.01  |
| Radium-228.....       | 0.1   | Plutonium-242.....             | 0.001 |
| Actinium-224.....     | 1     | Plutonium-243.....             | 1,000 |
| Actinium-225.....     | 0.01  | Plutonium-244.....             | 0.001 |
| Actinium-226.....     | 0.1   | Plutonium-245.....             | 100   |
| Actinium-227.....     | 0.001 | Americium-237.....             | 1,000 |
| Actinium-228.....     | 1     | Americium-238.....             | 100   |
| Thorium-226.....      | 10    | Americium-239.....             | 1,000 |
| Thorium-227.....      | 0.01  | Americium-240.....             | 100   |
| Thorium-228.....      | 0.001 | Americium-241.....             | 0.001 |
| Thorium-229.....      | 0.001 | Americium-242m.....            | 0.001 |
| Thorium-230.....      | 0.001 | Americium-242.....             | 10    |
| Thorium-231.....      | 100   | Americium-243.....             | 0.001 |
| Thorium-232.....      | 100   | Americium-244m.....            | 100   |
| Thorium-234.....      | 10    | Americium-244.....             | 10    |
| Thorium-natural.....  | 100   | Americium-245.....             | 1,000 |
| Protactinium-227..... | 10    | Americium-246m.....            | 1,000 |
| Protactinium-228..... | 1     | Americium-246.....             | 1,000 |

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| Curium-238.....  | 100   | Californium-249.....  | 0.001 |
| Curium-240.....  | 0.1   | Californium-250.....  | 0.001 |
| Curium-241.....  | 1     | Californium-251.....  | 0.001 |
| Curium-242.....  | 0.01  | Californium-252.....  | 0.001 |
| Curium-243.....  | 0.001 | Californium-253.....  | 0.1   |
| Curium-244.....  | 0.001 | Californium-254.....  | 0.001 |
| Curium-245.....  | 0.001 | Einsteinium-250.....  | 100   |
| Curium-246.....  | 0.001 | Einsteinium-251.....  | 100   |
| Curium-247.....  | 0.001 | Einsteinium-253.....  | 0.1   |
| Curium-248.....  | 0.001 | Einsteinium-254m..... | 1     |
| Curium-249.....  | 1,000 | Einsteinium-254.....  | 0.01  |
| Berkelium-245.....   | 100   | Fermium-252.....      | 1     |
| Berkelium-246.....   | 100   | Fermium-253.....      | 1     |
| Berkelium-247.....   | 0.001 | Fermium-254.....      | 10    |
| Berkelium-249.....   | 0.1   | Fermium-255.....      | 1     |
| Berkelium-250.....   | 10    | Fermium-257.....      | 0.01  |
| Californium-244.....   | 100   | Mendelevium-257.....  | 10    |
| Californium-246.....   | 1     | Mendelevium-258.....  | 0.01  |
| Californium-248.....   | 0.01  |                       |       |
| Any alpha-emitting radionuclide not listed above or mixtures<br>of alpha emitters of unknown composition.....0.001                         |       |                       |       |
| Any radionuclide other than alpha-emitting radionuclides not listed<br>above, or mixtures of beta emitters of unknown composition.....0.01 |       |                       |       |

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**Note:** For purposes of s. DHS 157.29 (2) (e), (5) (a) and s. DHS 157.32 (1) (a) where there is involved a combination of radionuclides in known amounts, the limit for the combination shall 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” — that is, unity.

**Note:** The quantities listed above were derived by taking 1/10th of the most restrictive ALI listed in Table I, Columns 1 and 2, of Appendix E, rounding to the nearest factor of 10 and constraining the values listed between 37 Bq and 37 MBq (0.001 and 1,000 microcuries). Values of 3.7 MBq (100 microcuries) have been assigned for radionuclides having a radioactive half-life in excess of E+9 years, except rhenium, 37 MBq (1,000 microcuries, to take into account their low specific activity.