# Chapter DHS 157
## APPENDIX A

**Exempt Concentrations**

| Element (atomic number) | Radionuclide | Column I Gas concentration microcuries/ml 1/ | Column II Liquid and solid concentration microcuries/ml 2/ |
|---|---|---|---|
| Antimony (51) | Sb-122 | | $3X10^{-4}$ |
| | Sb-124 | | $2X10^{-4}$ |
| | Sb-125 | | $1X10^{-3}$ |
| Argon (18) | Ar-37 | $1X10^{-3}$ | |
| | Ar-41 | $4X10^{-7}$ | |
| Arsenic (33) | As-73 | | $5X10^{-3}$ |
| | As-74 | | $5X10^{-4}$ |
| | As-76 | | $2X10^{-4}$ |
| | As-77 | | $8X10^{-4}$ |
| Barium (56) | Ba-131 | | $2X10^{-3}$ |
| | Ba-140 | | $3X10^{-4}$ |
| Beryllium (4) | Be-7 | | $2X10^{-2}$ |
| Bismuth (83) | Bi-206 | | $4X10^{-4}$ |
| Bromine (35) | Br-82 | $4X10^{-7}$ | $3X10^{-3}$ |
| Cadmium (48) | Cd-109 | | $2X10^{-3}$ |
| | Cd-115m | | $3X10^{-4}$ |
| | Cd-115 | | $3X10^{-4}$ |
| Calcium (20) | Ca-45 | | $9X10^{-5}$ |
| | Ca-47 | | $5X10^{-4}$ |
| Carbon (6) | C-14 | $1X10^{-6}$ | $8X10^{-3}$ |
| Cerium (58) | Ce-141 | | $9X10^{-4}$ |
| | Ce-143 | | $4X10^{-4}$ |
| | Ce-144 | | $1X10^{-4}$ |
| Cesium (55) | Cs-131 | | $2X10^{-2}$ |
| | Cs-134m | | $6X10^{-2}$ |
| | Cs-134 | | $9X10^{-5}$ |
| Chlorine (17) | Cl-38 | $9X10^{-7}$ | $4X10^{-3}$ |
| Chromium (24) | Cr-51 | | $2X10^{-2}$ |
| Cobalt (27) | Co-57 | | $5X10^{-3}$ |
| | Co-58 | | $1X10^{-3}$ |
| | Co-60 | | $5X10^{-4}$ |
| Copper (29) | Cu-64 | | $3X10^{-3}$ |
| Dysprosium (66) | Dy-165 | | $4X10^{-3}$ |
| | Dy-166 | | $4X10^{-4}$ |
| Erbium (68) | Er-169 | | $9X10^{-4}$ |
| | Er-171 | | $1X10^{-3}$ |
| Europium (63) | Eu-152(9.2 h) | | $6X10^{-4}$ |
| | Eu-155 | | $2X10^{-3}$ |
| Fluorine (9) | F-18 | $2X10^{-6}$ | $8X10^{-3}$ |
| Gadolinium (64) | Gd-153 | | $2X10^{-3}$ |
| | Gd-159 | | $8X10^{-4}$ |
| Gallium (31) | Ga-72 | | $4X10^{-4}$ |
| Germanium (32) | Ge-71 | | $2X10^{-2}$ |
| Gold (79) | Au-196 | | $2X10^{-3}$ |
| | Au-198 | | $5X10^{-4}$ |
| | Au-199 | | $2X10^{-3}$ |

1/ Values are given in Column I only for those materials normally used as gases.
2/ microcuries /g for solids

| Element (atomic number) | Radionuclide | Column I Gas concentration microcuries/ml 1/ | Column II Liquid and solid concentration microcuries/ml 2/ |
|---|---|---|---|
| Hafnium (72) | Hf-181 | | $7X10^{-4}$ |
| Hydrogen (1) | H-3 | $5X10^{-6}$ | $3X10^{-2}$ |
| Indium (49) | In-113m | | $1X10^{-2}$ |
| | In-114m | | $2X10^{-4}$ |
| Iodine (53) | I-126 | $3X10^{-9}$ | $2X10^{-5}$ |
| | I-131 | $3X10^{-9}$ | $2X10^{-5}$ |
| | I-132 | $8X10^{-8}$ | $6X10^{-4}$ |
| | I-133 | $1X10^{-8}$ | $7X10^{-5}$ |
| | I-134 | $2X10^{-7}$ | $1X10^{-3}$ |
| Iridium (77) | Ir-190 | | $2X10^{-3}$ |
| | Ir-192 | | $4X10^{-4}$ |
| | Ir-194 | | $3X10^{-4}$ |
| Iron (26) | Fe-55 | | $8X10^{-3}$ |
| | Fe-59 | | $6X10^{-4}$ |
| Krypton (36) | Kr-85m | $1X10^{-6}$ | |
| | Kr-85 | $3X10^{-6}$ | |
| Lanthanum (57) | La-140 | | $2X10^{-4}$ |
| Lead (82) | Pb-203 | | $4X10^{-3}$ |
| Lutetium (71) | Lu-177 | | $1X10^{-3}$ |
| Manganese (25) | Mn-52 | | $3X10^{-4}$ |
| | Mn-54 | | $1X10^{-3}$ |
| | Mn-56 | | $1X10^{-3}$ |
| Mercury (80) | Hg-197m | | $2X10^{-3}$ |
| | Hg-197 | | $3X10^{-3}$ |
| | Hg-203 | | $2X10^{-4}$ |
| Molybdenum (42) | Mo-99 | | $2X10^{-3}$ |
| Neodymium (60) | Nd-147 | | $6X10^{-4}$ |
| | Nd-149 | | $3X10^{-3}$ |
| Nickel (28) | Ni-65 | | $1X10^{-3}$ |
| Niobium (Columbium) (41) | Nb-95 | | $1X10^{-3}$ |
| | Nb-97 | | $9X10^{-3}$ |
| Osmium (76) | Os-185 | | $7X10^{-4}$ |
| | Os-191m | | $3X10^{-2}$ |
| | Os-191 | | $2X10^{-3}$ |
| | Os-193 | | $6X10^{-4}$ |
| Palladium (46) | Pd-103 | | $3X10^{-3}$ |
| | Pd-109 | | $9X10^{-4}$ |
| Phosphorus (15) | P-32 | | $2X10^{-4}$ |
| Platinum (78) | Pt-191 | | $1X10^{-3}$ |
| | Pt-193m | | $1X10^{-2}$ |
| | Pt-197m | | $1X10^{-2}$ |
| | Pt-197 | | $1X10^{-3}$ |
| Potassium (19) | K-42 | | $3X10^{-3}$ |
| Praseodymium (59) | Pr-142 | | $3X10^{-4}$ |
| | Pr-143 | | $5X10^{-4}$ |
| Promethium (61) | Pm-147 | | $2X10^{-3}$ |
| | Pm-149 | | $4X10^{-4}$ |
| Rhenium (75) | Re-183 | | $6X10^{-3}$ |
| | Re-186 | | $9X10^{-4}$ |
| Rhodium (45) | Rh-103m | | $1X10^{-1}$ |
| | Rh-105 | | $1X10^{-3}$ |
| Rubidium (37) | Rb-86 | | $7X10^{-4}$ |

| Element (atomic number) | Radionuclide | Column I Gas concentration microcuries/ml 1/ | Column II Liquid and solid concentration microcuries/ml 2/ |
|---|---|---|---|
| Ruthenium (44) | Ru-97 | | $4X10^{-4}$ |
| | Ru-103 | | $8X10^{-4}$ |
| | Ru-105 | | $1X10^{-3}$ |
| | Ru-106 | | $1X10^{-4}$ |
| Samarium (62) | Sm-153 | | $8X10^{-4}$ |
| Scandium (21) | Sc-46 | | $4X10^{-4}$ |
| | Sc-47 | | $9X10^{-4}$ |
| | Sc-48 | | $3X10^{-4}$ |
| Selenium (34) | Se-75 | | $3X10^{-3}$ |
| Silicon (14) | Si-31 | | $9X10^{-3}$ |
| Silver (47) | Ag-105 | | $1X10^{-3}$ |
| | Ag-110m | | $3X10^{-4}$ |
| | Ag-111 | | $4X10^{-4}$ |
| Sodium (11) | Na-24 | | $2X10^{-3}$ |
| Strontium (38) | Sr-85 | | $1X10^{-4}$ |
| | Sr-89 | | $1X10^{-4}$ |
| | Sr-91 | | $7X10^{-4}$ |
| | Sr-92 | | $7X10^{-4}$ |
| Sulfur (16) | S-35 | $9X10^{-8}$ | $6X10^{-4}$ |
| Tantalum (73) | Ta-182 | | $4X10^{-4}$ |
| Technetium (43) | Tc-96m | | $1X10^{-1}$ |
| | Tc-96 | | $1X10^{-3}$ |
| Tellurium (52) | Te-125m | | $2X10^{-3}$ |
| | Te-127m | | $6X10^{-4}$ |
| | Te-127 | | $3X10^{-3}$ |
| | Te-129m | | $3X10^{-4}$ |
| | Te-131m | | $6X10^{-4}$ |
| | Te-132 | | $3X10^{-4}$ |
| Terbium (65) | Tb-160 | | $4X10^{-4}$ |
| Thallium (81) | Tl-200 | | $4X10^{-3}$ |
| | Tl-201 | | $3X10^{-3}$ |
| | Tl-202 | | $1X10^{-3}$ |
| | Tl-204 | | $1X10^{-3}$ |
| Thulium (69) | Tm-170 | | $5X10^{-4}$ |
| | Tm-171 | | $5X10^{-3}$ |
| Tin (50) | Sn-113 | | $9X10^{-4}$ |
| | Sn-125 | | $2X10^{-4}$ |
| Tungsten (Wolfram) (74) | W-181 | | $4X10^{-3}$ |
| | W-187 | | $7X10^{-4}$ |
| Vanadium (23) | V-48 | | $3X10^{-4}$ |
| Xenon (54) | Xe-131m | $4X10^{-6}$ | |
| | Xe-133 | $3X10^{-6}$ | |
| | Xe-135 | $1X10^{-6}$ | |
| Ytterbium (70) | Yb-175 | | $1X10^{-3}$ |

1/ Values are given in Column I only for those materials normally used as gases.
2/ microcuries /g for solids

| | | | |
|---|---|---|---|
| Yttrium (39) | Y-90 | | $2X10^{-4}$ |
| | Y-91m | | $3X10^{-2}$ |
| | Y-91 | | $3X10^{-4}$ |
| | Y-92 | | $6X10^{-4}$ |

| Element (atomic number) | Radionuclide | Column I Gas concentration microcuries/ml 1/ | Column II Liquid and solid concentration microcuries/ml 2/ |
|---|---|---|---|
| | Y-93 | | $3X10^{-4}$ |
| Zinc (30) | Zn-65 | | $1X10^{-3}$ |
| | Zn-69m | | $7X10^{-4}$ |
| | Zn-69 | | $2X10^{-2}$ |
| Zirconium (40) | Zr-95 | | $6X10^{-4}$ |
| | Zr-97 | | $2X10^{-4}$ |
| Beta- and gamma-emitting radioactive material not listed above with half-life of less than 3 years. | | $1X10^{-10}$ | $1X10^{-6}$ |

1/ Values are given in Column I only for those materials normally used as gases.
2/ microcuries /g for solids

**Note 1:** Many radionuclides transform into other radionuclides. In expressing the concentrations in Appendix A, the activity stated is that of the parent radionuclide and takes into account the radioactive decay products.

**Note 2:** For purposes of s. DHS 157.09 (2) where there is involved a combination of radionuclides, the limit for the combination should be derived as follows: Determine for each radionuclide in the product the ratio between the radioactivity concentration present in the product and the exempt radioactivity concentration established in Appendix A for the specific radionuclide when not in combination. The sum of such ratios may not exceed "1".

Example: $$\frac{Concentration\ of\ Radionuclide\ A\ in\ Product}{Exempt\ concentration\ of\ Radionuclide\ A} + \frac{Concentration\ of\ Radionuclide\ B\ in\ Product}{Exempt\ concentration\ of\ Radionuclide\ B} \leq 1$$

**Note 3:** To convert microcuries-/ml to SI units of megabecquerels per liter multiply the above values by 37.

**Example: Zirconium (40) Zr-97 ($2x10^{-4}$ microcuries/ml multiplied by 37 is equivalent to 74 x $10^{-4}$ MBq/l).**

2/ microcuries/g for solids.