

Appendix Clearance Level for Radioactive Waste

Table I. Single-radionuclide: the radionuclide concentration should be less than the relevant value on one of the column

| Clearance level Nuclide | Annual release activity (Bq) | Specific activity (annual release waste amount ≥ 1 t) (Bq/g) | Specific activity (annual release waste amount < 1 t) (Bq/g) |
|-------------------------------|---------------------------------------|--|---|
| H-3 | 1.E+9 | 1.E+2 | 1.E+6 |
| Be-7 | 1.E+7 | 1.E+1 | 1.E+3 |
| C-14 | 1.E+7 | 1.E+0 | 1.E+4 |
| F-18 | 1.E+6 | 1.E+1 | 1.E+1 |
| Na-22 | 1.E+6 | 1.E-1 | 1.E+1 |
| Na-24 | 1.E+5 | 1.E+0 | 1.E+1 |
| Si-31 | 1.E+6 | 1.E+3 | 1.E+3 |
| P-32 | 1.E+5 | 1.E+3 | 1.E+3 |
| P-33 | 1.E+8 | 1.E+3 | 1.E+5 |
| S-35 | 1.E+8 | 1.E+2 | 1.E+5 |
| Cl-36 | 1.E+6 | 1.E+0 | 1.E+4 |
| Cl-38 | 1.E+5 | 1.E+1 | 1.E+1 |
| K-40 | 1.E+6 | 1.E+1 | 1.E+2 |
| K-42 | 1.E+6 | 1.E+2 | 1.E+2 |
| K-43 | 1.E+6 | 1.E+1 | 1.E+1 |
| Ca-45 | 1.E+7 | 1.E+2 | 1.E+4 |
| Ca-47 | 1.E+6 | 1.E+1 | 1.E+1 |
| Sc-46 | 1.E+6 | 1.E-1 | 1.E+1 |
| Sc-47 | 1.E+6 | 1.E+2 | 1.E+2 |
| Sc-48 | 1.E+5 | 1.E+0 | 1.E+1 |
| V-48 | 1.E+5 | 1.E+0 | 1.E+1 |
| Cr-51 | 1.E+7 | 1.E+2 | 1.E+3 |
| Mn-51 | 1.E+5 | 1.E+1 | 1.E+1 |
| Mn-52 | 1.E+5 | 1.E+0 | 1.E+1 |
| Mn-52m | 1.E+5 | 1.E+1 | 1.E+1 |

| Clearance level Nuclide | Annual release activity (Bq) | Specific activity (annual release waste amount ≥ 1 t) (Bq/g) | Specific activity (annual release waste amount < 1 t) (Bq/g) |
|-------------------------------|---------------------------------------|--|---|
| Mn-53 | 1.E+9 | 1.E+2 | 1.E+4 |
| Mn-54 | 1.E+6 | 1.E-1 | 1.E+1 |
| Mn-56 | 1.E+5 | 1.E+1 | 1.E+1 |
| Fe-52 | 1.E+6 | 1.E+1 | 1.E+1 |
| Fe-55 | 1.E+6 | 1.E+3 | 1.E+4 |
| Fe-59 | 1.E+6 | 1.E+0 | 1.E+1 |
| Co-55 | 1.E+6 | 1.E+1 | 1.E+1 |
| Co-56 | 1.E+5 | 1.E-1 | 1.E+1 |
| Co-57 | 1.E+6 | 1.E+0 | 1.E+2 |
| Co-58 | 1.E+6 | 1.E+0 | 1.E+1 |
| Co-58m | 1.E+7 | 1.E+4 | 1.E+4 |
| Co-60 | 1.E+5 | 1.E-1 | 1.E+1 |
| Co-60m | 1.E+6 | 1.E+3 | 1.E+3 |
| Co-61 | 1.E+6 | 1.E+2 | 1.E+2 |
| Co-62m | 1.E+5 | 1.E+1 | 1.E+1 |
| Ni-59 | 1.E+8 | 1.E+2 | 1.E+4 |
| Ni-63 | 1.E+8 | 1.E+2 | 1.E+5 |
| Ni-65 | 1.E+6 | 1.E+1 | 1.E+1 |
| Cu-64 | 1.E+6 | 1.E+2 | 1.E+2 |
| Zn-65 | 1.E+6 | 1.E-1 | 1.E+1 |
| Zn-69 | 1.E+6 | 1.E+3 | 1.E+4 |
| Zn-69m | 1.E+6 | 1.E+1 | 1.E+2 |
| Ga-72 | 1.E+5 | 1.E+1 | 1.E+1 |
| Ge-71 | 1.E+8 | 1.E+4 | 1.E+4 |
| As-73 | 1.E+7 | 1.E+3 | 1.E+3 |

| Clearance level Nuclide | Annual release activity (Bq) | Specific activity (annual release waste amount ≥ 1 t) (Bq/g) | Specific activity (annual release waste amount < 1 t) (Bq/g) |
|-------------------------------|---------------------------------------|--|---|
| As-74 | 1.E+6 | 1.E+1 | 1.E+1 |
| As-76 | 1.E+5 | 1.E+1 | 1.E+2 |
| As-77 | 1.E+6 | 1.E+3 | 1.E+3 |
| Se-75 | 1.E+6 | 1.E+0 | 1.E+2 |
| Br-82 | 1.E+6 | 1.E+0 | 1.E+1 |
| Rb-86 | 1.E+5 | 1.E+2 | 1.E+2 |
| Sr-85 | 1.E+6 | 1.E+0 | 1.E+2 |
| Sr-85m | 1.E+7 | 1.E+2 | 1.E+2 |
| Sr-87m | 1.E+6 | 1.E+2 | 1.E+2 |
| Sr-89 | 1.E+6 | 1.E+3 | 1.E+3 |
| Sr-90 | 1.E+4 | 1.E+0 | 1.E+2 |
| Sr-91 | 1.E+5 | 1.E+1 | 1.E+1 |
| Sr-92 | 1.E+6 | 1.E+1 | 1.E+1 |
| Y-90 | 1.E+5 | 1.E+3 | 1.E+3 |
| Y-91 | 1.E+6 | 1.E+2 | 1.E+3 |
| Y-91m | 1.E+6 | 1.E+2 | 1.E+2 |
| Y-92 | 1.E+5 | 1.E+2 | 1.E+2 |
| Y-93 | 1.E+5 | 1.E+2 | 1.E+2 |
| Zr-93 | 1.E+7 | 1.E+1 | 1.E+3 |
| Zr-95 | 1.E+6 | 1.E+0 | 1.E+1 |
| Zr-97 | 1.E+5 | 1.E+1 | 1.E+1 |
| Nb-93m | 1.E+7 | 1.E+1 | 1.E+4 |
| Nb-94 | 1.E+6 | 1.E-1 | 1.E+1 |
| Nb-95 | 1.E+6 | 1.E+0 | 1.E+1 |
| Nb-97 | 1.E+6 | 1.E+1 | 1.E+1 |
| Nb-98 | 1.E+5 | 1.E+1 | 1.E+1 |
| Mo-90 | 1.E+6 | 1.E+1 | 1.E+1 |

| Clearance level Nuclide | Annual release activity (Bq) | Specific activity (annual release waste amount ≥ 1 t) (Bq/g) | Specific activity (annual release waste amount < 1 t) (Bq/g) |
|-------------------------------|---------------------------------------|--|---|
| Mo-93 | 1.E+8 | 1.E+1 | 1.E+3 |
| Mo-99 | 1.E+6 | 1.E+1 | 1.E+2 |
| Mo-101 | 1.E+6 | 1.E+1 | 1.E+1 |
| Tc-96 | 1.E+6 | 1.E+0 | 1.E+1 |
| Tc-96m | 1.E+7 | 1.E+3 | 1.E+3 |
| Tc-97 | 1.E+8 | 1.E+1 | 1.E+3 |
| Tc-97m | 1.E+7 | 1.E+2 | 1.E+3 |
| Tc-99 | 1.E+7 | 1.E+0 | 1.E+4 |
| Tc-99m | 1.E+7 | 1.E+2 | 1.E+2 |
| Ru-97 | 1.E+7 | 1.E+1 | 1.E+2 |
| Ru-103 | 1.E+6 | 1.E+0 | 1.E+2 |
| Ru-105 | 1.E+6 | 1.E+1 | 1.E+1 |
| Ru-106 | 1.E+5 | 1.E-1 | 1.E+2 |
| Rh-103m | 1.E+8 | 1.E+4 | 1.E+4 |
| Rh-105 | 1.E+7 | 1.E+2 | 1.E+2 |
| Pd-103 | 1.E+8 | 1.E+3 | 1.E+3 |
| Pd-109 | 1.E+6 | 1.E+2 | 1.E+3 |
| Ag-105 | 1.E+6 | 1.E+0 | 1.E+2 |
| Ag-110m | 1.E+6 | 1.E-1 | 1.E+1 |
| Ag-111 | 1.E+6 | 1.E+2 | 1.E+3 |
| Cd-109 | 1.E+6 | 1.E+0 | 1.E+4 |
| Cd-115 | 1.E+6 | 1.E+1 | 1.E+2 |
| Cd-115m | 1.E+6 | 1.E+2 | 1.E+3 |
| In-111 | 1.E+6 | 1.E+1 | 1.E+2 |
| In-113m | 1.E+6 | 1.E+2 | 1.E+2 |
| In-114m | 1.E+6 | 1.E+1 | 1.E+2 |
| In-115m | 1.E+6 | 1.E+2 | 1.E+2 |

| Clearance level Nuclide | Annual release activity (Bq) | Specific activity (annual release waste amount ≥ 1 t) (Bq/g) | Specific activity (annual release waste amount < 1 t) (Bq/g) |
|-------------------------------|---------------------------------------|--|---|
| Sn-113 | 1.E+7 | 1.E+0 | 1.E+3 |
| Sn-125 | 1.E+5 | 1.E+1 | 1.E+2 |
| Sb-122 | 1.E+4 | 1.E+1 | 1.E+2 |
| Sb-124 | 1.E+6 | 1.E+0 | 1.E+1 |
| Sb-125 | 1.E+6 | 1.E-1 | 1.E+2 |
| Te-123m | 1.E+7 | 1.E+0 | 1.E+2 |
| Te-125m | 1.E+7 | 1.E+3 | 1.E+3 |
| Te-127 | 1.E+6 | 1.E+3 | 1.E+3 |
| Te-127m | 1.E+7 | 1.E+1 | 1.E+3 |
| Te-129 | 1.E+6 | 1.E+2 | 1.E+2 |
| Te-129m | 1.E+6 | 1.E+1 | 1.E+3 |
| Te-131 | 1.E+5 | 1.E+2 | 1.E+2 |
| Te-131m | 1.E+6 | 1.E+1 | 1.E+1 |
| Te-132 | 1.E+7 | 1.E+0 | 1.E+2 |
| Te-133 | 1.E+5 | 1.E+1 | 1.E+1 |
| Te-133m | 1.E+5 | 1.E+1 | 1.E+1 |
| Te-134 | 1.E+6 | 1.E+1 | 1.E+1 |
| I-123 | 1.E+7 | 1.E+2 | 1.E+2 |
| I-125 | 1.E+6 | 1.E+2 | 1.E+3 |
| I-126 | 1.E+6 | 1.E+1 | 1.E+2 |
| I-129 | 1.E+5 | 1.E-1 | 1.E+2 |
| I-130 | 1.E+6 | 1.E+1 | 1.E+1 |
| I-131 | 1.E+6 | 1.E+1 | 1.E+2 |
| I-132 | 1.E+5 | 1.E+1 | 1.E+1 |
| I-133 | 1.E+6 | 1.E+1 | 1.E+1 |
| I-134 | 1.E+5 | 1.E+1 | 1.E+1 |
| I-135 | 1.E+6 | 1.E+1 | 1.E+1 |

| Clearance level Nuclide | Annual release activity (Bq) | Specific activity (annual release waste amount ≥ 1 t) (Bq/g) | Specific activity (annual release waste amount < 1 t) (Bq/g) |
|-------------------------------|---------------------------------------|--|---|
| Cs-129 | 1.E+5 | 1.E+1 | 1.E+2 |
| Cs-131 | 1.E+6 | 1.E+3 | 1.E+3 |
| Cs-132 | 1.E+5 | 1.E+1 | 1.E+1 |
| Cs-134 | 1.E+4 | 1.E-1 | 1.E+1 |
| Cs-134m | 1.E+5 | 1.E+3 | 1.E+3 |
| Cs-135 | 1.E+7 | 1.E+2 | 1.E+4 |
| Cs-136 | 1.E+5 | 1.E+0 | 1.E+1 |
| Cs-137 | 1.E+4 | 1.E-1 | 1.E+1 |
| Cs-138 | 1.E+4 | 1.E+1 | 1.E+1 |
| Ba-131 | 1.E+6 | 1.E+1 | 1.E+2 |
| Ba-140 | 1.E+5 | 1.E+0 | 1.E+1 |
| La-140 | 1.E+5 | 1.E+0 | 1.E+1 |
| Ce-139 | 1.E+6 | 1.E+0 | 1.E+2 |
| Ce-141 | 1.E+7 | 1.E+2 | 1.E+2 |
| Ce-143 | 1.E+6 | 1.E+1 | 1.E+2 |
| Ce-144 | 1.E+5 | 1.E+1 | 1.E+2 |
| Pr-142 | 1.E+5 | 1.E+2 | 1.E+2 |
| Pr-143 | 1.E+6 | 1.E+3 | 1.E+4 |
| Nd-147 | 1.E+6 | 1.E+2 | 1.E+2 |
| Nd-149 | 1.E+6 | 1.E+2 | 1.E+2 |
| Pm-147 | 1.E+7 | 1.E+3 | 1.E+4 |
| Pm-149 | 1.E+6 | 1.E+3 | 1.E+3 |
| Sm-151 | 1.E+8 | 1.E+3 | 1.E+4 |
| Sm-153 | 1.E+6 | 1.E+2 | 1.E+2 |
| Eu-152 | 1.E+6 | 1.E-1 | 1.E+1 |
| Eu-152m | 1.E+6 | 1.E+2 | 1.E+2 |
| Eu-154 | 1.E+6 | 1.E-1 | 1.E+1 |

| Clearance level Nuclide | Annual release activity (Bq) | Specific activity (annual release waste amount ≥ 1 t) (Bq/g) | Specific activity (annual release waste amount < 1 t) (Bq/g) |
|-------------------------------|---------------------------------------|--|---|
| Eu-155 | 1.E+7 | 1.E+0 | 1.E+2 |
| Gd-153 | 1.E+7 | 1.E+1 | 1.E+2 |
| Gd-159 | 1.E+6 | 1.E+2 | 1.E+3 |
| Tb-160 | 1.E+6 | 1.E+0 | 1.E+1 |
| Dy-165 | 1.E+6 | 1.E+3 | 1.E+3 |
| Dy-166 | 1.E+6 | 1.E+2 | 1.E+3 |
| Ho-166 | 1.E+5 | 1.E+2 | 1.E+3 |
| Er-169 | 1.E+7 | 1.E+3 | 1.E+4 |
| Er-171 | 1.E+6 | 1.E+2 | 1.E+2 |
| Tm-170 | 1.E+6 | 1.E+2 | 1.E+3 |
| Tm-171 | 1.E+8 | 1.E+3 | 1.E+4 |
| Yb-175 | 1.E+7 | 1.E+2 | 1.E+3 |
| Lu-177 | 1.E+7 | 1.E+2 | 1.E+3 |
| Hf-181 | 1.E+6 | 1.E+0 | 1.E+1 |
| Ta-182 | 1.E+4 | 1.E-1 | 1.E+1 |
| W-181 | 1.E+7 | 1.E+1 | 1.E+3 |
| W-185 | 1.E+7 | 1.E+3 | 1.E+4 |
| W-187 | 1.E+6 | 1.E+1 | 1.E+2 |
| Re-186 | 1.E+6 | 1.E+3 | 1.E+3 |
| Re-188 | 1.E+5 | 1.E+2 | 1.E+2 |
| Os-185 | 1.E+6 | 1.E+0 | 1.E+1 |
| Os-191 | 1.E+7 | 1.E+2 | 1.E+2 |
| Os-191m | 1.E+7 | 1.E+3 | 1.E+3 |
| Os-193 | 1.E+6 | 1.E+2 | 1.E+2 |
| Ir-190 | 1.E+6 | 1.E+0 | 1.E+1 |
| Ir-192 | 1.E+4 | 1.E+0 | 1.E+1 |
| Ir-194 | 1.E+5 | 1.E+2 | 1.E+2 |

| Clearance level Nuclide | Annual release activity (Bq) | Specific activity (annual release waste amount ≥ 1 t) (Bq/g) | Specific activity (annual release waste amount < 1 t) (Bq/g) |
|-------------------------------|---------------------------------------|--|---|
| Pt-191 | 1.E+6 | 1.E+1 | 1.E+2 |
| Pt-193m | 1.E+7 | 1.E+3 | 1.E+3 |
| Pt-197 | 1.E+6 | 1.E+3 | 1.E+3 |
| Pt-197m | 1.E+6 | 1.E+2 | 1.E+2 |
| Au-198 | 1.E+6 | 1.E+1 | 1.E+2 |
| Au-199 | 1.E+6 | 1.E+2 | 1.E+2 |
| Hg-197 | 1.E+7 | 1.E+2 | 1.E+2 |
| Hg-197m | 1.E+6 | 1.E+2 | 1.E+2 |
| Hg-203 | 1.E+5 | 1.E+1 | 1.E+2 |
| Tl-200 | 1.E+6 | 1.E+1 | 1.E+1 |
| Tl-201 | 1.E+6 | 1.E+2 | 1.E+2 |
| T-202 | 1.E+6 | 1.E+1 | 1.E+2 |
| Tl-204 | 1.E+4 | 1.E+0 | 1.E+4 |
| Pb-203 | 1.E+6 | 1.E+1 | 1.E+2 |
| Bi-206 | 1.E+5 | 1.E+0 | 1.E+1 |
| Bi-207 | 1.E+6 | 1.E-1 | 1.E+1 |
| Po-203 | 1.E+6 | 1.E+1 | 1.E+1 |
| Po-205 | 1.E+6 | 1.E+1 | 1.E+1 |
| Po-207 | 1.E+6 | 1.E+1 | 1.E+1 |
| At-211 | 1.E+7 | 1.E+3 | 1.E+3 |
| Ra-225 | 1.E+5 | 1.E+1 | 1.E+2 |
| Ra-227 | 1.E+6 | 1.E+2 | 1.E+2 |
| Th-226 | 1.E+7 | 1.E+3 | 1.E+3 |
| Th-229 | 1.E+3 | 1.E-1 | 1.E+0 |
| Th-232 | 1.E+4 | 1.E+0 | 1.E+1 |
| Pa-230 | 1.E+6 | 1.E+1 | 1.E+1 |
| Pa-233 | 1.E+7 | 1.E+1 | 1.E+2 |

| Clearance level Nuclide | Annual release activity (Bq) | Specific activity (annual release waste amount ≥ 1 t) (Bq/g) | Specific activity (annual release waste amount < 1 t) (Bq/g) |
|-------------------------------|---------------------------------------|--|---|
| U-230 | 1.E+5 | 1.E+1 | 1.E+1 |
| U-231 | 1.E+7 | 1.E+2 | 1.E+2 |
| U-232 | 1.E+3 | 1.E-1 | 1.E+0 |
| U-233 | 1.E+4 | 1.E+0 | 1.E+1 |
| U-235 | 1.E+4 | 1.E+0 | 1.E+1 |
| U-236 | 1.E+4 | 1.E+1 | 1.E+1 |
| U-237 | 1.E+6 | 1.E+2 | 1.E+2 |
| U-238 | 1.E+4 | 1.E+0 | 1.E+1 |
| U-239 | 1.E+6 | 1.E+2 | 1.E+2 |
| U-240 | 1.E+7 | 1.E+2 | 1.E+3 |
| Np-237 | 1.E+3 | 1.E+0 | 1.E+0 |
| Np-239 | 1.E+7 | 1.E+2 | 1.E+2 |
| Np-240 | 1.E+6 | 1.E+1 | 1.E+1 |
| Pu-234 | 1.E+7 | 1.E+2 | 1.E+2 |
| Pu-235 | 1.E+7 | 1.E+2 | 1.E+2 |
| Pu-236 | 1.E+4 | 1.E+0 | 1.E+1 |
| Pu-237 | 1.E+7 | 1.E+2 | 1.E+3 |
| Pu-238 | 1.E+4 | 1.E-1 | 1.E+0 |
| Pu-239 | 1.E+4 | 1.E-1 | 1.E+0 |
| Pu-240 | 1.E+3 | 1.E-1 | 1.E+0 |
| Pu-241 | 1.E+5 | 1.E+1 | 1.E+2 |
| Pu-242 | 1.E+4 | 1.E-1 | 1.E+0 |
| Pu-243 | 1.E+7 | 1.E+3 | 1.E+3 |
| Pu-244 | 1.E+4 | 1.E-1 | 1.E+0 |
| Am-241 | 1.E+4 | 1.E-1 | 1.E+0 |
| Am-242 | 1.E+6 | 1.E+3 | 1.E+3 |
| Am-242m | 1.E+4 | 1.E-1 | 1.E+0 |

| Clearance level Nuclide | Annual release activity (Bq) | Specific activity (annual release waste amount ≥ 1 t) (Bq/g) | Specific activity (annual release waste amount < 1 t) (Bq/g) |
|-------------------------------|---------------------------------------|--|---|
| Am-243 | 1.E+3 | 1.E-1 | 1.E+0 |
| Cm-242 | 1.E+5 | 1.E+1 | 1.E+2 |
| Cm-243 | 1.E+4 | 1.E+0 | 1.E+0 |
| Cm-244 | 1.E+4 | 1.E+0 | 1.E+1 |
| Cm-245 | 1.E+3 | 1.E-1 | 1.E+0 |
| Cm-246 | 1.E+3 | 1.E-1 | 1.E+0 |
| Cm-247 | 1.E+4 | 1.E-1 | 1.E+0 |
| Cm-248 | 1.E+3 | 1.E-1 | 1.E+0 |
| Bk-249 | 1.E+6 | 1.E+2 | 1.E+3 |
| Cf-246 | 1.E+6 | 1.E+3 | 1.E+3 |
| Cf-248 | 1.E+4 | 1.E+0 | 1.E+1 |
| Cf-249 | 1.E+3 | 1.E-1 | 1.E+0 |
| Cf-250 | 1.E+4 | 1.E+0 | 1.E+1 |
| Cf-251 | 1.E+3 | 1.E-1 | 1.E+0 |
| Cf-252 | 1.E+4 | 1.E+0 | 1.E+1 |
| Cf-253 | 1.E+5 | 1.E+2 | 1.E+2 |
| Cf-254 | 1.E+3 | 1.E+0 | 1.E+0 |
| Es-253 | 1.E+5 | 1.E+2 | 1.E+2 |
| Es-254 | 1.E+4 | 1.E-1 | 1.E+1 |
| Es-254m | 1.E+6 | 1.E+1 | 1.E+2 |
| Fm-254 | 1.E+7 | 1.E+4 | 1.E+4 |
| Fm-255 | 1.E+6 | 1.E+2 | 1.E+3 |
| All Others | 1.E+3 | 1.E-1 | 1.E-1 |

II. Multi-radionulides: To determine if a mixture of radionuclides is below the limit a simple summation formula can be used

$$\sum_{i=1}^n \frac{C_i}{C_{i,o}} \leq 1$$

where

C_i : is the activity or specific activity of radionuclide i,

$C_{i,o}$: is the activity or specific activity limit of radionuclide i in Table I,

n: is the number of radionuclides in the mixture.

