3701:1-50-25 Determination of A[1] and A[2] values for radionuclides.

(A) Values of A_1 and A_2 for individual radionuclides, which are the bases for many activity limits elsewhere in these rules are given in table 25-1 of appendix A to this rule. The curie (Ci) values specified are obtained by converting from the terabecquerel (TBq) value. The terabecquerel values are the regulatory standard. The curie values are for information only and are not intended to be the regulatory standard. Where values of A_1 or A_2 are unlimited, it is for radiation control purposes only. For nuclear criticality safety, some materials are subject to controls placed on fissile material.

(B)

(1) For individual radionuclides whose identities are known, but which are not listed in table 25-1 of appendix A to this rule, the A_1 and A_2 values contained in table 25-3 of appendix C to this rule may be used. Otherwise, the licensee shall obtain prior department approval of the A_1 and A_2 values for radionuclides not listed in table 25-1 of appendix A to this rule, before shipping the material.

(2) For individual radionuclides whose identities are known, but which are not listed in table 25-2 of appendix B to this rule, the exempt material activity concentration and exempt consignment activity values contained in table 25-3 of appendix C to this rule may be used. Otherwise, the licensee shall obtain prior department approval of the exempt material activity concentration and exempt consignment activity values for radionuclides not listed in table 25-2 of appendix B to this rule, before shipping the material.

(3) The licensee shall submit requests for prior approval, described under paragraphs (B)(1) and (B)(2) of this rule, to the department, in accordance with rule 3701:1-50-03 of the Administrative Code.

(C) In the calculations of A_1 and A_2 for a radionuclide not in table 25-1 of appendix A to this rule, a single radioactive decay chain, in which radionuclides are present in their naturally occurring proportions, and in which no daughter radionuclide has a half-life either longer than ten days, or longer than that of the parent radionuclide, shall be considered as a single radionuclide, and the activity to be taken into account, and the A_1 or A_2 value to be applied shall be those corresponding to the parent radionuclide of that chain. In the case of radioactive decay chains in which any daughter radionuclide has a half-life either longer than ten days, or greater than that of the parent radionuclide, the parent and those daughter radionuclides shall be considered as mixtures of different radionuclides.

(D) For mixtures of radionuclides whose identities and respective activities are known, the following conditions apply:

(1) For special form radioactive material, the maximum quantity transported in a type A package is as follows:

$$\sum_i \frac{B(i)}{A_1(i)} \leq 1$$

where B(i) is the activity of radionuclide i in special form and $A_1(i)$ is the A_1 value for radionuclide i.

(2) For normal form radioactive material, the maximum quantity transported in a type A package is as follows:

$$\sum_i \frac{B(i)}{A_2(i)} \leq 1$$

where B(i) is the activity of radionuclide i in normal form and $A_2(i)$ is the A_2 value for radionuclide i.

(3) If the package contains both special and normal form radioactive material, the activity that may be transported in a Type A package is as follows:

$$\sum_i \frac{B(i)}{A_1(i)} + \sum_j \frac{C(j)}{A_2(j)} \leq 1$$

where B(i) is the activity of radionuclide i as special form radioactive material, $A_1(i)$ is the A_1 value for radionuclide i, C(j) is the activity of radionuclide j as normal form radioactive material, and $A_2(j)$ is the A_2 value for radionuclide j.

(4) Alternatively, an A_1 value for mixtures of special form material may be determined as follows:

$$A_1 \text{ for mixture} = \frac{1}{\sum_i \frac{f(i)}{A_1(i)}}$$

where f(i) is the fraction of activity of radionuclide i in the mixture and A_1 (i) is the appropriate A_1 value for radionuclide i.

(5) Alternatively, an A_2 value for mixtures of normal form material may be determined as follows:

$$A_2 \text{ for mixture} = \frac{1}{\sum_i \frac{f(i)}{A_2(i)}}$$

where f(i) is the fraction of activity of radionuclide i in the mixture and $A_2(i)$ is the appropriate A_2 value for radionuclide i.

(6) The exempt activity concentration for mixtures of radionuclides may be determined as follows:

$$\text{Exempt activity concentration for mixture} = \frac{1}{\sum_i \frac{f(i)}{[A](i)}}$$

where f(i) is the fraction of activity concentration of radionuclide i in the mixture, and [A] is the activity concentration for exempt material containing radionuclide i.

(7) The activity limit for an exempt consignment for mixtures of radionuclides may be determined as follows:

$$\text{Exempt consignment activity limit for mixture} = \frac{1}{\sum_i \frac{f(i)}{A(i)}}$$

where f(i) is the fraction of activity of radionuclide i in the mixture, and A is the activity limit for exempt consignments for radionuclide i.

(E)

(1) When the identity of each radionuclide is known, but the individual activities of some of the radionuclides are not known, the radionuclides may be grouped, and the lowest A_1 or A_2 value, as appropriate, for the radionuclides in each group may be used in applying the formulas in paragraph (D) of this rule. Groups may be based on the total alpha activity and the total beta/gamma activity when these are known, using the lowest A_1 or A_2 values for the alpha emitters and beta/gamma emitters.

(2) When the identity of each radionuclide is known but the individual activities of some of the radionuclides are not known, the radionuclides may be grouped and the lowest [A] (activity concentration for exempt material) or A (activity limit for exempt consignment) value, as appropriate, for the radionuclides in each group may be used in applying the formulas in paragraph (D) of this rule. Groups may be based on the total alpha activity and the total beta/gamma activity when these are known, using the lowest [A] or A values for the alpha emitters and beta/gamma emitters, respectively.

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