

Chapter HFS 157

APPENDIX H

CLASSIFICATION AND CHARACTERISTICS OF LOW-LEVEL RADIOACTIVE WASTE

Section I. – Classification of Radioactive Waste for Land Disposal.

(a) Considerations. Determination of the classification of radioactive waste involves 2 considerations. First, consideration must be given to the concentration of long-lived radionuclides, and their shorter-lived precursors, whose potential hazard will persist long after such precautions as institutional controls, improved waste form, and deeper disposal have ceased to be effective. These precautions delay the time when long-lived radionuclides could cause exposures. In addition, the magnitude of the potential dose is limited by the concentration and availability of the radionuclide at the time of exposure. Second, consideration must be given to the concentration of shorter-lived radionuclides for which requirements on institutional controls, waste form, and disposal methods are effective.

(b) Classes of waste.

(1) Class A waste is waste that is usually segregated from other waste classes at the disposal site. The physical form and characteristics of Class A waste must meet the minimum requirements set forth in Section II (a). If Class A waste also meets the stability requirements set forth in Section II (b), it is not necessary to segregate the waste for disposal.

(2) Class B waste is waste that must meet more rigorous requirements on waste form to ensure stability after disposal. The physical form and characteristics of Class B waste must meet both the minimum and stability requirements set forth in Section II.

(3) Class C waste is waste that not only must meet more rigorous requirements on waste form to ensure stability but also requires additional measures at the disposal facility to protect against inadvertent intrusion. The physical form and characteristics of Class C waste must meet both the minimum and stability requirements set forth in Section II.

(4) Waste that is not generally acceptable for near-surface disposal is waste for which form and disposal methods shall be different, and in general more stringent, than those specified for Class C waste. Such waste must be disposed of in a geologic repository as defined in 10 CFR 60.

(c) Classification determined by long-lived radionuclides. If the radioactive waste contains only radionuclides listed in Table IV, classification shall be determined as follows:

(1) If the concentration does not exceed 0.1 times the value in Table IV, the waste is Class A.

(2) If the concentration exceeds 0.1 times the value in Table IV, but does not exceed the value in Table IV, the waste is Class C.

(3) If the concentration exceeds the value in Table IV, the waste is not generally acceptable for land disposal.

(4) For wastes containing mixtures of radionuclides listed in Table IV, the total concentration shall be determined by the sum of fractions rule described in Section I (g).

TABLE IV

| Radionuclide | Concentration | |
|--|---------------------------------|------------------------------|
| | Curie/Cubic Meter ^{a/} | Nanocurie/Gram ^{b/} |
| C-14 | 8 | |
| C-14 in activated metal | 80 | |
| Ni-59 in activated metal | 220 | |
| Nb-94 in activated metal | 0.2 | |
| Tc-99 | 3 | |
| I-129 | 0.08 | |
| Alpha emitting transuranic radionuclides with half-life greater than 5 years | | 100 |
| Pu-241 | | 3,500 |
| Cm-242 | | 20,000 |
| Ra-226 | | 100 |

a/ To convert the Ci/m³ values to gigabecquerel (GBq) per cubic meter, multiply the Ci/m³ value by 37.

b/ To convert the nCi/g values to becquerel (Bq) per gram, multiply the nCi/g value by 37.

(d) Classification determined by short-lived radionuclides. If the waste does not contain any of the radionuclides listed in Table IV, classification shall be determined based on the concentrations shown in Table V. However, as specified in Section I (f), if radioactive waste does not contain any nuclides listed in either Table IV or V, it is Class A.

- (1) If the concentration does not exceed the value in Column 1, the waste is Class A.
- (2) If the concentration exceeds the value in Column 1 but does not exceed the value in Column 2, the waste is Class B.
- (3) If the concentration exceeds the value in Column 2 but does not exceed the value in Column 3, the waste is Class C.
- (4) If the concentration exceeds the value in Column 3, the waste is not generally acceptable for near-surface disposal.
- (5) For wastes containing mixtures of the radionuclides listed in Table V, the total concentration shall be determined by the sum of fractions rule described in Section I (g).

TABLE V

| Radionuclide | Concentration Column 1 | Curie/Cubic Meter ^{a/} | |
|--|---------------------------|---------------------------------|----------|
| | | Column 2 | Column 3 |
| Total of all radionuclides with less than 5-year half-life | 700 | * | * |
| H-3 | 40 | * | * |
| Co-60 | 700 | * | * |
| Ni-63 | 3.5 | 70 | 700 |
| Ni-63 in activated metal | 35 | 700 | 7000 |
| Sr-90 | 0.04 | 150 | 7000 |
| Cs-137 | 1 | 44 | 4600 |

a/ Note: To convert the Ci/m³ value to gigabecquerel (GBq) per cubic meter, multiply the Ci/m³ value by 37. There are no limits established for these radionuclides in Class B or C wastes. Practical considerations such as the effects of external radiation and internal heat generation on transportation, handling, and disposal will limit the concentrations for these wastes. These wastes shall be Class B unless the concentrations of other radionuclides in Table V determine the waste to be Class C independent of these radionuclides.

(e) Classification determined by both long- and short-lived radionuclides. If the radioactive waste contains a mixture of radionuclides, some of which are listed in Table IV and some of which are listed in Table V, classification shall be determined as follows:

- (1) If the concentration of a radionuclide listed in Table IV does not exceed 0.1 times the value listed in Table IV, the class shall be that determined by the concentration of radionuclides listed in Table V.
 - (2) If the concentration of a radionuclide listed in Table IV exceeds 0.1 times the value listed in Table IV, but does not exceed the value in Table IV, the waste shall be Class C, provided the concentration of radionuclides listed in Table V does not exceed the value shown in Column 3 of Table V.
- (f) Classification of wastes with radionuclides other than those listed in Tables IV and V. If the waste does not contain any radionuclides listed in either Table IV or V, it is Class A.
- (g) The sum of the fractions rule for mixtures of radionuclides. For determining classification for waste that contains a mixture of radionuclides, it is necessary to determine the sum of fractions by dividing each radionuclide's concentration by the appropriate limit and adding the resulting values. The appropriate limits must all be taken from the same column of the same table. The sum of the fractions for the column must be less than 1.0 if the waste class is to be determined by that column. Example: A waste contains Sr-90 in a concentration of 1.85 TBq/m³ (50 Ci/m³) and Cs-137 in a concentration of 814 GBq/m³ (22 Ci/m³). Since the concentrations both exceed the values in Column 1, Table V, they must be compared to Column 2 values. For Sr-90 fraction, $50/150 = 0.33$, for Cs-137 fraction, $22/44 = 0.5$; the sum of the fractions = 0.83. Since the sum is less than 1.0, the waste is Class B.
- (h) Determination of concentrations in wastes. The concentration of a radionuclide may be determined by indirect methods such as use of scaling factors which relate the inferred concentration of one radionuclide to another that is measured, or radionuclide material accountability, if there is reasonable assurance that the indirect methods can be correlated with actual measurements. The concentration of a radionuclide may be averaged over the volume of the waste, or weight of the waste if the units are expressed as becquerel (nanocurie) per gram.

Section II. – Radioactive Waste Characteristics.

- (a) The following are minimum requirements for all classes of waste and are intended to facilitate handling and provide protection of health and safety of personnel at the disposal site.
- (1) Wastes shall be packaged in conformance with the conditions of the license issued to the site operator to which the waste will be shipped. Where the conditions of the site license are more restrictive than the provisions of this section, the site license conditions shall govern.
 - (2) Wastes may not be packaged for disposal in cardboard or fiberboard boxes.
 - (3) Liquid waste shall be packaged in sufficient absorbent material to absorb twice the volume of the liquid.
 - (4) Solid waste containing liquid shall contain as little free-standing and non-corrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1 percent of the volume.
 - (5) Waste may not be readily capable of detonation or of explosive decomposition or reaction at normal pressures and temperatures, or of explosive reaction with water.
 - (6) Waste may not contain, or be capable of generating, quantities of toxic gases, vapors, or fumes harmful to persons transporting, handling, or disposing of the waste. This does not apply to radioactive gaseous waste packaged under Section II (a) (8).
 - (7) Waste must not be pyrophoric. Pyrophoric materials contained in wastes shall be treated, prepared, and packaged to be nonflammable.
 - (8) Wastes in a gaseous form shall be packaged at an absolute pressure that does not exceed 1.5 atmospheres at 20°C. Total activity may not exceed 3.7 TBq (100 Ci) per container.
 - (9) Wastes containing hazardous, biological, pathogenic, or infectious material shall be treated to reduce to the maximum extent practicable the potential hazard from the non-radiological materials.
- (b) The following requirements are intended to provide stability of the waste. Stability is intended to ensure that the waste does not degrade and affect overall stability of the site through slumping, collapse, or other failure of the disposal unit and thereby lead to water infiltration. Stability is also a factor in limiting exposure to an inadvertent intruder, since it provides a recognizable and nondispersible waste.
- (1) Waste shall have structural stability. A structurally stable waste form will generally maintain its physical dimensions and its form, under the expected disposal conditions such as weight of overburden and compaction equipment, the presence of moisture, and microbial activity, and internal factors such as radiation effects and

chemical changes. Structural stability may be provided by the waste form itself, processing the waste to a stable form, or placing the waste in a disposal container or structure that provides stability after disposal.

(2) Notwithstanding the provisions in Section II (a) (3) and (4), liquid wastes, or wastes containing liquid, shall be converted into a form that contains as little free-standing and non-corrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1 percent of the volume of the waste when the waste is in a disposal container designed to ensure stability, or 0.5 percent of the volume of the waste for waste processed to a stable form.

(3) Void spaces within the waste and between the waste and its package shall be reduced to the extent practicable.

Section III. – Labeling.

Each package of waste shall be clearly labeled to identify whether it is Class A, Class B or Class C waste, under Section I.