**LOW-LEVEL RADIOACTIVE WASTE FORUM, INC.**

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**Disposition Options and Costs for Certain Irradiator**

**Radioactive Sealed Sources and Devices**

The American National Standards Institute (ANSI) has established four categories for irradiators. They include Category I – Self-Contained Irradiator (dry source storage); Category II – Panoramic Irradiator (dry source storage); Category III – Self-Contained Irradiator (wet source storage); and Category IV – Panoramic Irradiator (wet set source storage). These categories should not be confused with the International Atomic Energy Agency (IAEA) radioactive sealed source categories.

Panoramic Irradiators:

Panoramic irradiators are used for the bulk sterilization of medical supplies and equipment, consumer goods (such as cosmetics) and some food products. These devices use millions of curies of cobalt-60, a gamma emitter. The sources in a Category II and IV irradiators are typically stored below floor level and are raised to room level when in use. Source storage is either in a shielded storage container (Category II) or in a pool of water (Category IV). The irradiator room has access controls to prevent the sources from being raised while personnel are in the room.

The panoramic irradiator can be operated in either batch mode or in a continuous mode. When operated in batch mode, the items to be sterilized are placed in the irradiator room in an arrangement where they will be exposed to the sources when the sources are raised. In a continuous mode, the items to be irradiated are passed in front of the raised sources via an automated conveyor system. Exposure time is determined based on the desired dose the products are to receive.

Category IV irradiators contain millions of curies of Co-60. With this large quantity of sealed sources, the most viable disposition path is returning the sources to the manufacturer or to a recycler. Disposing of this quantity of radioactive material is not viable at the existing low-level radioactive waste disposal facilities.

There are many cost components in decommissioning a panoramic irradiator. These cost components include onsite source removal, equipment rental, Type B shipping container rental, transportation and source disposal fee. As a reference for the total cost to decommission, the aggregate costs can range from $750,000 to $2,500,000. Source disposal costs represent approximately 50% of the total cost to decommission. The remainder of the costs is associated with onsite work and transportation. Costs may vary due to location, distance for transportation and total source activity.

Self-Contained Irradiators:

Self-contained or self-shielding irradiators are used to irradiate small quantities of material in a batch mode process. These irradiators can use radioactive material (Cs-137 or Co-60) or x-rays to provide the required dose. The size of these irradiators will vary, but they typically have a footprint of 8 to 15 square feet and can weigh two thousand to six thousand pounds.

A Cs-137 blood irradiator is one example of a self-contained irradiator. These irradiators typically have a 15 to 20-year operating life and with a 30-year half-life they don’t require re-sourcing during their useful life. Total activity of the sources range from 600 to 3,000 curies or more. Disposal of Cs-137 at the existing low-level radioactive waste disposal facilities can be complex due to the waste acceptance criteria at the disposal facilities. Also, these items require transportation in a Type B shipping container, which currently costs approximately $80,000 to $100,000 to rent. Some irradiator manufacturers and recyclers maintain their own Type B shipping containers so the Type B rental cost might not be incurred when returning the device to the manufacturer or a recycler.

**Table 1 – Widely Used Radioactive Sealed Sources[[1]](#footnote-2)**

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| **Device** | **Radionuclide** | **Typical Activity in Curies (Ci) Range** | **IAEA Source Categorya** | **Waste Classb** |
| Panoramic irradiators used to irradiate single-use medical devices and products, cosmetics, food, and plastics. | Cobalt-60c | 150,000 -5,000,000 | 1 | B |
| Self-shielded irradiators/blood-tissue irradiators. | Cesium-137 | 2,500-42,000 | 1,2 | B, C, GTCC |
| Cobalt-60c | 1,500-50,000 | 1 |
| a. The International Atomic Energy Agency (IAEA) categorization system is based on “the potential for radioactive sources to cause deterministic health effects. This potential is due partly to the physical properties of the source, especially its activity, and partly to the way in which the source is used.” See, IAEA Safety Guide No. RS-G-1.9, Categorization of Radioactive Sources 2005, Annex I, page 37, available at http:// www-pub.iaea.org/MTCD/publications/PDF/Pub1227\_web.pdf.b. Refers to Nuclear Regulatory Commission’s (NRC’s) classification of LLRW for land disposal found in 10 CFR Part 61. Activity per unit mass or volume classification limits are related to relative hazard and necessity for waste isolation. Class A represents the least hazard, Class B represents a greater hazard, and Class C the greatest hazard appropriate for near surface disposal. Waste with an activity concentration Greater- Than-Class-C (GTCC) must be disposed of in a geologic repository unless NRC approves an alternate disposal site.c. There are no limits established for cobalt-60 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 nuclides in Table 2 in 10 CFR § 61.55 determine the waste to be Class C independently of these nuclides. |

Please note that this information is intended as a guide only and does not include the entire universe of radioactive sealed sources and devices. The listed costs are provided as estimates only based on current information and guidance and should not be relied upon as determinative of actual future disposal costs.

When radioactive sealed sources have decayed to a point where the source or device no longer functions as designed, the source can either be replaced or the entire source or device can be properly dispositioned (i.e. by return of the item to the manufacturer, transfer to a third party for reuse or recycle, or by disposal as low-level radioactive waste). Depending on the radionuclide and its activity, not all options may be available.

When evaluating alternatives, the user needs to consider the long-term liability associated with the chosen disposition method. Lower activity sources, or sources without adequate documentation, have a minimal reuse potential. Higher activity sources have a greater reuse potential since there may still be a useful purpose for the source. If the source is transferred to a third party for reuse or recycling, the user should seek written assurance or confirmation of the transfer of title to the source. This may help limit future financial liability. Transfer to a third party for recycle or reuse without this title transfer leaves the user liable for future financial expense. Disposal in one of the licensed disposal facilities provides the user with a substantial reduction in long-term liability.

1. Excerpted from *Sealed Source Disposal and National Security – Problem Statement and Solution Set,* which was a deliverable of the Removal and Disposition of Disused Sources Focus Group of the Radioisotopes Subcouncil of the Nuclear Government and Sector Coordinating Councils, dated December 9, 2009. This table identifies some of the sealed source devices and uses, the radionuclides and activity, categorization by the International Atomic Energy Agency (IAEA) and waste classification for disposal purposes. [↑](#footnote-ref-2)