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

**309 Bradley Boulevard, Suite 201, Richland, WA 99352**

**801-580-3201 – dshrum@llwforum.org**

**Disposition Options and Costs for Certain Brachytherapy**

**Radioactive Sealed Sources**

Brachytherapy or internal radiation therapy involves placing small radioactive sealed sources in or near the tissue to be treated or injecting radioactive material in the bloodstream or body cavity. The type of radioactive material and delivery method is determined based on the tissue being treated and the required dose to be administered. Placement of the sources can be temporary or permanent. In temporary brachytherapy, the source is placed inside a catheter or tube that has been inserted in or near the tissue to be treated for a short period of time and then withdrawn. Permanent brachytherapy involves placing the source in or near the tissue to be treated and leaving it there permanently.

Table 1 identifies the radionuclides associated with brachytherapy. Some of the radionuclides have short half-lives and can be decayed in storage until they are no longer radioactive. Disposal and recycling of the longer-lived radionuclides range from approximately $5 per Ir-192 seed to $1,500 to $4,500 for the Cs-137 and Co-60 sources. A Sr-90 beta eye applicator disposal cost range is approximately $2,000 to $3,000.

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

| **Device** | **Radionuclide** | **Typical Activity in Curies (Ci) Range** | **IAEA Source Categorya** | **Waste Classb** |
| --- | --- | --- | --- | --- |
| Brachytherapy (high, medium and low dose rate), which uses either beta or gamma sources to irradiate tumors over a very small area and thickness of tissues. | Cobalt-60c | 1-20 | 2,3 | A, B, C, GTCC |
| Cesium-137 | 0.1-8 | 3,4,5 |
| Iridium-192 | 0.02-15 | 3,4,5 |
| Radium-226 | 0.005-0.05 | 4,5 |
| Iodine-125 | 0.005-1.3 | 4,5 |
| Gold-198 | 0.08 | 4 |
| Californium-252 | 0.083-0.54 | 3,4 |
| Strontium-90 | 0.02-0.12 | 4,5 |
| Ruthenium/ Rhodium-106 | 0.00022-0.0006 | 5 |
| Palladium-103 | 0.03-0.0056 | 5 |
| 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)