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

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**Disposition Options and Costs for Certain Industrial Radiography Radioactive Sealed Sources and Devices**

Industrial radiography is a non-destructive inspection technique used to determine the integrity of pipes, vessels and other components and identify manufacturing defects and other flaws that may impact system performance. Defects including cracks, incomplete welds and porosity in tubes can be identified. Radiography can be accomplished using gamma or x-rays.

The primary radionuclides used in industrial radiography are Ir-192 and Co-60. The source is housed in a shielded storage container when not in use. When used, the source is advanced through a tube using a cable drive system to the item being inspected. The gamma rays passing through the item are recorded on film placed on the other side from the source or detected electronically.

Ir-192 has a relatively short half-life of 75 days. These sources require frequent exchange with used sources being returned to the manufacturer, the cost of which is included in the price of the new source. At the time of final source disposition, the source can be returned to the manufacturer or disposed as low-level radioactive waste. Even though the source has a relatively short half-life, decay in storage is not an option due to a long-lived contaminant (Co-60) present in the source.[[1]](#footnote-2)

Since Ir-192 has a relatively short half-life, it is unlikely that it can be used in another application and disposal as low-level radioactive waste is its only disposition option. The cost to dispose of an Ir-192 industrial radiography sourceis approximately $200 to $500.

Co-60 sealed sources are used in a wide variety of applications and industries. Depending on the activity and source condition, reuse or recycle may be an option. For those sources that are not recycled or reused, the cost to dispose of a Co-60 source is approximately $3,000 to $10,000*.* The licensee should consider any potential long-term liability when making this decision

**Table 1 – Widely Used Radioactive Sealed Sources[[2]](#footnote-3)**

| **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 |
| Industrial radiography widely used in the chemical, petrochemical, and building industries for radiographic inspection of pipes, boilers, and structures where consequences of failure can be severe. | Cesium-137 | 5-12 | 3 | A, B, C, GTCC |
| Cobalt-60c | 11-330 | 2 |
| Iridium-192 | 5-290 | 2,3 |
| Selenium-75 | 80 | 2 |
| Thulium-170 | 20-200 | 4 |
| Ytterbium-169 | 2.5-20 | 3,4 |
| 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. This long-lived contaminant was identified during the Conference of Radiation Control Program Director’s (CRCPD) Source Collection and Threat Reduction (SCATR) source collection program. [↑](#footnote-ref-2)
2. 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-3)