

## Decommissioning and Disposal Costs in 2008 Dollars

**Data Obtained from *Cost-Benefit Analysis for Potential Alternative Technologies for Category 1 and 2 Radioactive Sources* Report produced by ICF Incorporated, L.L.C. on August 31, 2009**

### Blood Irradiation

	Cs-137 Irradiators	Co-60 Irradiators
<b>Device Decommissioning and Disposal</b>	<ul style="list-style-type: none"> <li>○ \$110,000 - \$125,000 for recovery and disposal<sup>a</sup> depending on the location (2009 USD)</li> </ul> <p style="margin-left: 40px;"><b>Assumption:</b> Median value of \$72,000 for recovery and median value of \$38,000 to \$53,000<sup>b</sup> for disposal</p>	<ul style="list-style-type: none"> <li>○ \$165,000 to \$180,000 for recovery and disposal<sup>c</sup> depending on the location (2009 USD)</li> </ul> <p style="margin-left: 40px;"><b>Assumption:</b> Median value of \$129,000 for recovery and median value of \$38,000 to \$53,000 for disposal.</p>
<b>Recycling</b>	<ul style="list-style-type: none"> <li>○ No information available at this time</li> </ul>	<ul style="list-style-type: none"> <li>○ No information available at this time</li> </ul>
<b>Storage</b>	<ul style="list-style-type: none"> <li>○ No information available at this time</li> </ul>	<ul style="list-style-type: none"> <li>○ No information available at this time</li> </ul>

### Calibrators Back end costs

	Calibration System Containing Cs-137	Calibration System Containing Co-60
<b>Recycling / Storage / Disposal</b>	<ul style="list-style-type: none"> <li>○ Suppliers charge approximately \$35,000 to \$45,000 (US 2008 dollars) for stand-alone disposal cost of an undamaged device (including estimates for travel, expenses, labor, shipping, and rigging charges)</li> <li>○ Labor costs associated with packaging a source for transport and then transporting the source is estimated to be over \$30,000 (2008 US dollars)</li> <li>○ Costs incurred by OSRP for storage not available</li> </ul> <p><b>Assumption:</b> Median value of \$35,000 to \$45,000 was used.</p>	<ul style="list-style-type: none"> <li>○ The cost for returning used Co-60 sources to a manufacturer/ distributor/supplier varies according to the quantity and age of the material and the cost of transportation, but is typically in the tens of thousands of U.S. dollars</li> <li>○ Costs incurred by OSRP for storage not available</li> </ul> <p><b>Assumption:</b> Same device disposal cost as for the Cs-137 calibrator was used, i.e. median value of \$35,000 to \$45,000.</p>

<sup>a</sup> Recovery costs are the averaged proposed costs from 4 vendors and 13 Cs-137 devices from a recent procurement.

<sup>b</sup> Disposal costs are estimated for two different disposal sites.

<sup>c</sup> Recovery costs are the averaged proposed costs from 4 vendors and 6 Co-60 devices from a recent procurement.

**Industrial Radiography- Iridium-192/ Cobalt-60**  
**Back end costs**

<b>Recycling</b>	<ul style="list-style-type: none"> <li>○ No information available at this time</li> </ul>
<b>Disposal</b>	<p align="center"><u>Device Disposal</u></p> <ul style="list-style-type: none"> <li>○ Ir-192: \$600 (2009 US dollars)</li> <li>○ Co-60 (DU): \$5,000 (2009 US dollars)</li> <li>○ Co-60 (lead): \$500 (2009 US dollars)</li> </ul> <p><b>Assumption:</b> Ir-192 device is disposed at the end of 20 years at a cost of \$600.</p> <p><b>Assumption:</b> Co-60 device is disposed at the end of 20 years at a cost of \$5,000.</p> <p align="center"><u>Source Disposal</u></p> <ul style="list-style-type: none"> <li>○ Co-60 sources 25 Ci and below: \$8,000 (2009 US dollars)</li> <li>○ Co-60 sources 26 Ci to 50 Ci: \$15,000 (2009 US dollars)</li> <li>○ Co-60 sources 300 Ci: over \$100,000 (2006 US dollars)</li> </ul> <p><b>Assumption:</b> Ir-192 source of 4,000 GBq is replaced every 3 months.</p> <p><b>Assumption:</b> Co-60 source with strength of 26 Ci to 50 Ci is disposed every 5 years at a cost of \$15,000.</p>

**Panoramic Irradiation- Cobalt-60**  
**Back end costs**

<b>Recycling / Storage</b>	<ul style="list-style-type: none"> <li>○ Generally, when a Co-60 source no longer has sufficient strength, it is returned to the manufacturer who will either re-encapsulate it and sell it to an irradiation company with a lower energy requirement, mix the old Co-60 with new Co-60 (recycle), or store it until it is completely depleted</li> </ul>
<b>Disposal</b>	<ul style="list-style-type: none"> <li>○ Final return shipment of Co-60 is estimated to be \$250,000 (2008 US dollars)</li> <li>○ Disposal costs: \$345 per Co-60 source, plus \$3,200 per container handling fee, plus shipping (2006 US dollars)</li> </ul> <p><b>Assumption:</b> Final return shipment costs obtained from data source (NAS, 2008) were used.</p>

**Radiosurgery- Cobalt-60**

<b>Device Decommissioning and Disposal</b>	<ul style="list-style-type: none"> <li>○ Assumed the decommissioning and disposal cost to be same as the source replacement cost, i.e., median value of \$700,000 to \$850,000.</li> </ul>
<b>Recycling</b>	<ul style="list-style-type: none"> <li>○ No information available at this time</li> </ul>
<b>Storage</b>	<ul style="list-style-type: none"> <li>○ No information available at this time</li> </ul>

**Research Irradiation**  
**Back end costs**

	<b>Cesium-137</b>	<b>Cobalt-60</b>
<b>Device Decommissioning</b>	<ul style="list-style-type: none"> <li>○ \$110,000 - \$125,000 for recovery and disposal depending on the location (2009 USD)</li> </ul> <p><b>Assumption:</b> <i>Median value of \$72,000 for recovery and median value of \$38,000 to \$53,000 for disposal.</i></p>	<ul style="list-style-type: none"> <li>○ \$165,000 to \$180,000 for recovery and disposal depending on the location (2009 USD)</li> </ul> <p><b>Assumption:</b> <i>Median value of \$129,000 for recovery and median value of \$38,000 to \$53,000 for disposal.</i></p>
<b>Recycling</b>	○ No information available at this time	○ No information available at this time
<b>Disposal</b>	○ See device decommissioning	○ See device decommissioning
<b>Storage</b>	○ No information available at this time	○ No information available at this time

**Well Logging**  
**Back end costs (at end of useful life)**

	<b>AmBe</b>	<b>Cf-252</b>
Transportation of Device	\$1,500 to send to Los Alamos OSRP for permanent storage. [This is the average cost of transportation]	\$1,500 to send to Los Alamos OSRP for permanent storage. [This is the average cost of transportation]
Residual Value of Source	About \$100,000 after 15 years	\$750  <b>Assumption:</b> <i>Source has 25% residual activity at a value of \$110 per mCi</i>