March 3, 2010

MEMORANDUM TO: Charles L. Miller, Director
Office of Federal and State Materials
and Environmental Management Programs

FROM: Larry W. Camper, Director **/RA/**
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

SUBJECT: INTERAGENCY WORKING GROUP REPORT ON FINANCIAL ASSURANCE FOR DISPOSITION OF CATEGORY 1, 2 AND 3 RADIOACTIVE SEALED SOURCES

The Energy Policy Act of 2005 stipulated the establishment of an Interagency Task Force, chaired by the U. S. Nuclear Regulatory Commission (NRC), on Radiation Source Protection and Security. The Task Force delivered its first report (Task Force Report) to Congress and the President in August 2006. To respond to the financial assurance concerns outlined in the Task Force Report, an interagency Working Group (WG) was established on December 17, 2008.

The WG was tasked with proposing a comprehensive list of viable financial assurance solutions to increase the likelihood that Category 1, 2 and 3 Radioactive Sealed Sources will be disposed of in a safe, appropriate and timely manner. The WG was tasked with summarizing its work in the form of a report to be delivered to management of the Office of Federal and State Materials and Environmental Management Programs (FSME). The enclosed report summarizes the progress of the WG.

The enclosed report identifies three main areas of concern: (1) lack of disposal capacity for sources, (2) an inadequate supply of containers (packagings) for transportation of these sources for final disposition/disposal and (3) licensees storing sources for extended periods of time which is a result of the first and second areas of concern. The main focus needs to be placed on resolving the first and second areas of concern and the third area of concern will ultimately be resolved by focusing on the other two areas. The financial assurance related recommendations in the report do not resolve the larger concern of lack of disposal capacity, but the recommendations can be used as interim remedies until the larger issue can be addressed.

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The main recommendations in the report include: (1) applying financial assurance regulations to small quantities of materials to capture Category 1, 2 and 3 Radioactive Sealed Sources, (2) using risk based financial assurance requirements similar to the regulations the State of Florida has in place and (3) developing a universal surcharge to all licensees to be used as an additional measure of financial assurance which is similar to the regulations the State of Texas has in place. These recommendations will require rulemaking. Given that the rulemaking process is a multi-year process, an alternative to the above recommendations would be to focus directly on the main area of concern, lack of disposal capacity, rather than spending significant amount of time working on interim solutions, such as broadening the financial assurance thresholds and assessing a surcharge to the licensees. As such, the enclosed report does touch upon additional nominal recommendations which may require less time to implement such as offering grants to companies who manufacture transportation packagings, encouraging licensees to apply for available stimulus money, encouraging the creation of additional state compacts and encouraging recycling of sources. Finally, as the report is a consensus of members from various Federal and State agencies comprising the WG, the substantive content has not been modified by NRC staff.

Enclosure:
Financial Assurance for Disposition
of Category 1, 2, and 3 Radioactive
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FINANCIAL ASSURANCE FOR DISPOSITION OF CATEGORY 1, 2 AND 3 RADIOACTIVE SEALED SOURCES

Financial Assurance Working Group Executive Summary

The Energy Policy Act of 2005 stipulated the establishment of an interagency Task Force, chaired by the U. S. Nuclear Regulatory Commission (NRC), on Radiation Source Protection and Security. The Task Force delivered its first report (Task Force Report) to Congress and the President in August 2006. To respond to the financial assurance concerns outlined in the Task Force Report, an interagency Working Group (WG) was established to propose a comprehensive list of viable financial assurance solutions to increase the likelihood that Category 1, 2 and 3 Radioactive Sealed Sources (RSSs) will be disposed of in a safe, appropriate and timely manner. In its deliberations, the WG identified three challenges to concern in determining financial assurance: (1) lack of commercial low level radioactive waste (LLRW) disposal capacity; (2) limited availability of Type B transportation packagings; and (3) the long-term storage of risk-significant sources not in use.

To address these three challenges, the WG considered the following interim measures that may provide some partial remedy until disposal capacity is increased:

The first challenge in determining appropriate financial assurance is due, in large part, to the lack of commercial disposal capacity for Category 1, 2 and 3 sources. Presently, 36 States do not have commercial disposal capacity. The State of Texas recently issued a license for a LLRW disposal facility to serve the needs of Texas and Vermont (the Texas Compact). Except for this license, there has been essentially no progress in the development of new disposal capacity. The U. S. Department of Energy (DOE) has statutory responsibility for development of disposal capacity of all greater than Class C (GTCC) LLRW including RSSs that are considered risk-significant. DOE is presently evaluating several GTCC disposal methods; however, Congressional review and action is required before DOE is permitted to select a disposal option.

A second challenge that the WG has identified is that due to the expiration of many shipment packaging certifications, there is limited availability of packagings required to ship certain sources. The U. S. Department of Transportation and NRC have provided a limited number of special permits for continued use on an as-needed basis. On average, designing, testing and producing new transportation packagings takes 30 to 36 months. Since disposal capacity is limited, manufacturers do not have a great incentive to certify new packagings needed for disposal. This limited supply of available packagings has increased the cost of radioactive waste transportation.

A third challenge identified by the WG is in response to the aforementioned challenges: many licensees store risk-significant sources onsite, which may lead to storage for an indefinite term or, in some situations, misuse, abandonment, loss, or theft.

Enclosure

Until disposal capacity increase, the strategies considered by the WG were:

(1) Broadening the requirements of Title 10 of the *Code of Federal Regulations*, Part 30 Section 35 (10 CFR 30.35) to capture a greater number of sources (which would include all Category 1, 2 and 3 sources), and applying a lower threshold of radioactivity for determining financial assurance requirements (lowering the quantities of materials which trigger a financial assurance requirement). This option would require affected licensees to set aside adequate funds to properly dispose of sealed sources prior to decommissioning. However, it would not provide funds to dispose of sources that are either orphaned or have no financially capable party. This may also be overly punitive to small licensees, especially if implemented retroactively.

(2) Developing risk-based financial assurance requirements and lowering the financial assurance thresholds in 10 CFR 30.35 to capture all Category 1, 2 and 3 RSSs. Although such a solution may ensure that individual licensees would be financially responsible for disposal, it would not address the disposal of orphan sources. Retroactive application may encourage those without sufficient resources to dispose of their source improperly.

(3) Assessing a universal surcharge on all licensees of radioactive material to cover the costs of disposal. Such a program may prevent or mitigate the adverse effects of abandonment of radioactive materials, default on a lawful obligation, insolvency, or other inability by the owner(s) to manage its proper disposition. The disadvantage is spreading the cost burden to those who would not directly benefit from the program, and statutory and implementation concerns would need to be addressed.

(4) Assessing an up-front surcharge on all new Category 1, 2 and 3 sources to cover the entire anticipated costs of packaging and disposal. Those funds which are not used to cover commercial or DOE costs when the source becomes disused and unwanted will be returned to the source owner. Similarly, if no commercial or DOE disposition pathway exists, the source owner may access the funds for storage costs. A cost-benefit analysis, from the licensee's point of view, would need to be conducted to determine what the expected cost would be to implement such a program (e.g. increased prices, and thus additional cost, to patients receiving irradiated blood).

Other countries have adopted options 2 or 3, or a combination thereof, to address financial liability with respect to the ultimate disposition of radioactive sources, especially in cases where returning sources back to a manufacturer is not an option.

I. Introduction

The Energy Policy Act of 2005 created a multiagency Task Force on Radiation Source Protection and Security. The Task Force, chaired by the U. S. Nuclear Regulatory Commission (NRC) and comprised of representatives of Federal agencies, State representatives and other stakeholder organizations, was charged with documenting the criteria relevant to the security of radiation sources, developing recommendations and reporting to the President and Congress periodically. The first report, "Interagency Radiation Source Protection and Security Task Force Report to Congress and the President" (Task Force Report), was completed in August 2006. The next report will be sent to Congress and the President in August 2010.

One of the parameters in the analysis of the national system was to provide for proper disposal of Low Level Radioactive Waste (LLRW), including Radioactive Sealed Sources (RSSs). One of the recommendations that evolved from deliberations was Recommendation 9-2 entitled, "Evaluation of Financial Assurance Required for the Final Disposition of Category 1 & 2 Sources." In order to address this recommendation, an interagency Working Group (WG) was established on December 17, 2008. The WG is comprised of several representatives from NRC, the U. S. Department of Energy (DOE), the U. S. Environmental Protection Agency (EPA), ICF International LLC (ICF), as well as representatives from State regulatory agencies. This report is a summary of the work completed by the WG.

In order to address Recommendation 9-2, the WG has met on a monthly basis since its formation. As the WG progressed, additional staff members and agencies joined the WG. In addition, the WG also was asked to consider Action 7-1 entitled, "long-term storage of risk-significant sources not in use" from the Task Force Report. Finally, the WG was asked to consider Category 3 sources, as well. As a result, the scope of the WG has evolved to its current mission which is to propose a comprehensive list of viable financial assurance related solutions to increase the likelihood that Category 1, 2 and 3 Radioactive Sealed Sources (RSS) (see Table A) will be disposed of in a safe, appropriate and timely manner. This report outlines the major challenges the WG has identified, and will outline potential solutions to better address these challenges.

In accordance with existing regulations, not all possessors of sealed sources are required to have financial assurance to cover the cost of disposal or disposition methods. This may result in prolonged storage and possible misuse, abandonment, loss, or theft. Even where it is available, the costs of disposal often can be high, prompting a licensee to delay disposal either by choice or financial necessity.

II. Background

As a result of the use of radioactive materials at a facility or as part of licensed activity, satisfactory radiological clean-up and restoration (decommissioning) is required in order to protect the public and the environment. The term "decommissioning" encompasses multiple actions including the disposal of radioactive materials; the actual actions required (i.e. groundwater restoration) varies from licensee to licensee. In general, decommissioning refers to the restoration of, and a reduction in the residual radioactivity of, a facility. The term decommissioning, however, need not necessarily refer to the cessation of operations and commencement of final restoration of the facility. Additionally, the final disposition of source materials may be part of decommissioning but they need not occur simultaneously. For instance, if a licensee operates multiple labs in a particular building, the licensee may dispose of source materials from a lab, and/or restore others. The facility, as a whole, is still operating, even though certain labs are in the process of radiological clean up.

As part of the regulations promulgated by the NRC, (Title 10 *Code of Federal Regulations*, Part 30.35) those licensees that are required to provide financial assurance must provide it in either a predetermined amount (certified amount) or an amount sufficient to cover the estimated cost of decommissioning (based on a detailed decommissioning cost estimate). Prior to the receipt of radioactive materials, licensees are required to establish such financial assurance. Therefore, decommissioning is considered far in advance of the actual decommissioning of the facility. The costs are estimated using generally accepted costs for locality, labor, machinery, waste disposal, et cetera. Additionally, materials licensees are required to include a contingency factor for unforeseen cost overruns and are required to submit a new decommissioning cost estimate periodically. The intent of these updates is to capture any changes in the decommissioning cost estimate and to update the amount of financial assurance provided. For instance, if a licensee properly disposes of radioactive material, the cost estimate may be reduced appropriately. Conversely, if additional contamination is discovered, the cost estimate may increase.

LLRW is an inevitable byproduct of the country's beneficial use and production of radioactive material. The NRC has consistently reiterated the policy that permanent disposal of LLRW is the preferred option for its long-term management, rather than protracted storage, from both a radiation safety and security standpoint. Disposal is the permanent, underground burial of LLRW, with no intent of retrieval. The DOE provides for permanent disposal of DOE-generated LLRW, while LLRW generated by NRC and Agreement State licensees has historically been disposed of by commercial entities that operate commercial disposal facilities. In the early 1970's, there were six commercial Low-Level Radioactive Waste Disposal Facilities (LLRWDF) operating across the United States. The sites were licensed in accordance with regulations for radiation protection and management of radioactive material. At the time, there were no specific regulations for land disposal of radioactive waste.

Beginning in the 1970's, controversy began to develop as a result of transportation incidents at a few licensed disposal facilities that released small amounts of radioactive material into the environment. By the late 1970's, three commercial disposal facilities had closed permanently. Governors of the remaining three States with operating facilities (Nevada (NV), South Carolina (SC), and Washington (WA)) put pressure on the Federal Government to equalize the burden for disposing of LLRW. In 1980, Congress passed the Low-Level Radioactive Waste Policy Act

(LLRWPA), which gave the States responsibility for managing the disposal of LLRW and encouraged the formation of regional Compacts. It was intended that the development of new disposal capacity in host States would relieve the burden of the three existing host States and allow them to close their disposal sites. However, with one exception, there has been no progress in the development of new disposal capacity per the LLRWPA. In September 2009 the State of Texas issued a license for a LLRW disposal facility to be operated in Andrews County, Texas by Waste Control Specialists to serve the needs of the Texas Compact (Texas and Vermont).

In the early 1980's, NRC promulgated regulations for land disposal of radioactive waste. The regulations, Title 10 of the *Code of Federal Regulations*, Part 61 (10 CFR Part 61), contained licensing requirements; citing, design, and operations criteria; minimum performance objectives; and other requirements for land disposal of LLRW. 10 CFR Part 61 also established a classification system for LLRW based on its potential hazards -- considering protection of a potential inadvertent intruder -- and has specified disposal and waste form requirements for each of the general classes of waste. Class A waste represents the greatest volume and the lowest risk; Class B represents much less volume but greater risk per unit volume; and Class C represents the greatest risk per unit volume. For LLRW which is not suitable for near surface disposal, the requirements in 10 CFR Part 61 also introduced the concept that certain waste was not generally suitable for near surface disposal. That waste is referred to as greater than Class C (GTCC) waste. Slow progress was made in forming interstate compacts and identifying successor host states. In response to proposed deadlines for site operations in NV, SC, and WA, Congress in 1985 amended the LLRWPA to establish a series of milestones and incentives for the development of new disposal capacity under the Low-Level Radioactive Waste Policy Amendments Act of 1985 (LLRWPAA). The LLRWPAA used the 10 CFR Part 61 waste classification system as a basis for dividing responsibility for LLRW management between the States, responsible for Class A, B and C LLRW, and the Federal Government, which was made responsible for GTCC LLRW.

The development of new disposal capacity outside of the existing host States was very limited due to intense public and political opposition. In that environment, host States for two of the three operating sites significantly changed their status in 1993. NV permanently closed the Low Level Radioactive Waste Disposal Facility (LLRWDF) near Beatty, NV, and WA limited access to the facility near Richland, WA to the 11 States that comprised the Northwest and Rocky Mountain Compacts. SC, itself a member of the Southeast (SE) Compact, agreed to allow continued access to the rest of the nation until mid-1994. Meanwhile, some relief was being provided by the availability of a facility in Clive, Utah, that was gaining regulatory approval to accept most Class A LLRW absent many of the constraints of the LLRW compact process. However, Clive, Utah facility only accepts Class A waste and has never accepted sealed sources.

In the recent past, the Barnwell, SC facility (Barnwell) alone has provided full service disposal capacity on a national basis for Class A, B and C waste. However, as of July 1, 2008, SC limited access to the three member States of the Atlantic Compact (SC, New Jersey (NJ) and Connecticut (CT)). The result is that only disused sources located in 14 states can be commercially disposed as LLRW, with the exception of disused Radium (Ra-226) sources. Sources are considered disused when they are either of no economic value or of no use to the possessor. There remains no commercial disposal site for GTCC LLRW.

The 2006 TF Report listed three financial assurance related options. The three options and the WG's discussion of these options follow.

Option 1: Broadening the NRC Financial Assurance Thresholds

This option would broaden the requirements of 10 CFR Part 30.35 by applying a lower threshold of radioactivity for determining financial assurance requirements. It would impose a decommissioning financial assurance requirement on the licensee as a function of cost of disposition of all radioactive material in its possession. Disposal cost of sealed sources and other radioactive material would be a subset of these decommissioning activities. Funds are designated for the exclusive purpose of decommissioning activities associated with the possession of sealed sources and other radioactive material. This option would ensure that affected licensees set aside adequate funds to properly dispose of sealed sources prior to decommissioning. These funds are generally guaranteed by a third party financial institution and, in some instances, may be used to reimburse commercial companies or DOE. However, this method would not provide funds to dispose of orphan sources or other sources for which there was not a responsible or financially capable party.

Option 2: Assessing a Source-Specific Surcharge for Disposal

This option would develop a financial assurance system by assessing a source-specific surcharge assessed either at the time of acquisition or throughout a source's service life to cover the costs of disposal. The option would provide flexibility to spread the surcharge over the life of the source to reduce the financial burden at acquisition and consequently not discourage the licensee/service provider from utilizing sealed sources to provide a service (e.g., use of sealed sources for medical procedures). A sinking fund, earmarked for source disposal, would be created and the amount of monies collected would be based on the source's projected disposal cost at time of acquisition, its service life, and its residual value, if any. The fund would include an appropriate surcharge at the time of purchase that would be supplemented periodically with a surcharge on the license fee. A third-party financial institution would hold the fund in an interest-bearing escrow account. Although the monies collected per source would be comingled in a single account, the monies in the fund associated with each source would follow said source from licensee to licensee throughout its service life. If the monies in the fund exceed the source's disposal costs, the excess would be returned, on a pro rata basis, to contributors. Potentially, these funds could be made available to commercial companies or DOE.

The size of the fund and rate of contribution into the fund would depend on a variety of factors, including specific isotope and radioactivity, service life of the source, and residual value. Licensees could seek relief, in whole or in part, by demonstrating an enforceable and fungible "path forward" other than disposal.

The NRC would periodically evaluate (during license renewal) the sufficiency of the accumulated monies in the sinking fund, accounting for increases or decreases in anticipated disposal costs. If, at the time of license termination, the licensee made alternative arrangements for disposition using monies other than those contained in the sinking fund, the NRC would return the monies to the licensee. Although such a solution may ensure that individual licensees would remain financially responsible for disposal of their sealed sources, it

would not address the costs of disposal of orphan or other sources for which there is no financially capable/responsible party. Prospective application of this method is preferred, as retroactive application may encourage source owners without sufficient financial resources to dispose of their source improperly.

Option 3: Assessing a Universal Disposal Surcharge on All Licensees

This option would involve assessing a small surcharge on all licensees of radioactive material (i.e., not limited to sealed source licensees) to cover the costs of disposal. The monies raised via this program would be held in a trust fund in order to prevent or mitigate the adverse effects of abandonment of radioactive materials, default on a lawful obligation, insolvency, or other inability by the possessors or users of radioactive material to manage its proper disposition. The monies in the trust fund may be used for decontamination, disposal, closure, decommissioning, reclamation, surveillance, or other care. Such a solution would address a broader range of problematic disposition situations (e.g., existing backlog of disused sources). However, it would have the disadvantage of spreading the cost burden to licensees who would not specifically benefit from the program, which may discourage the beneficial use of RSSs.

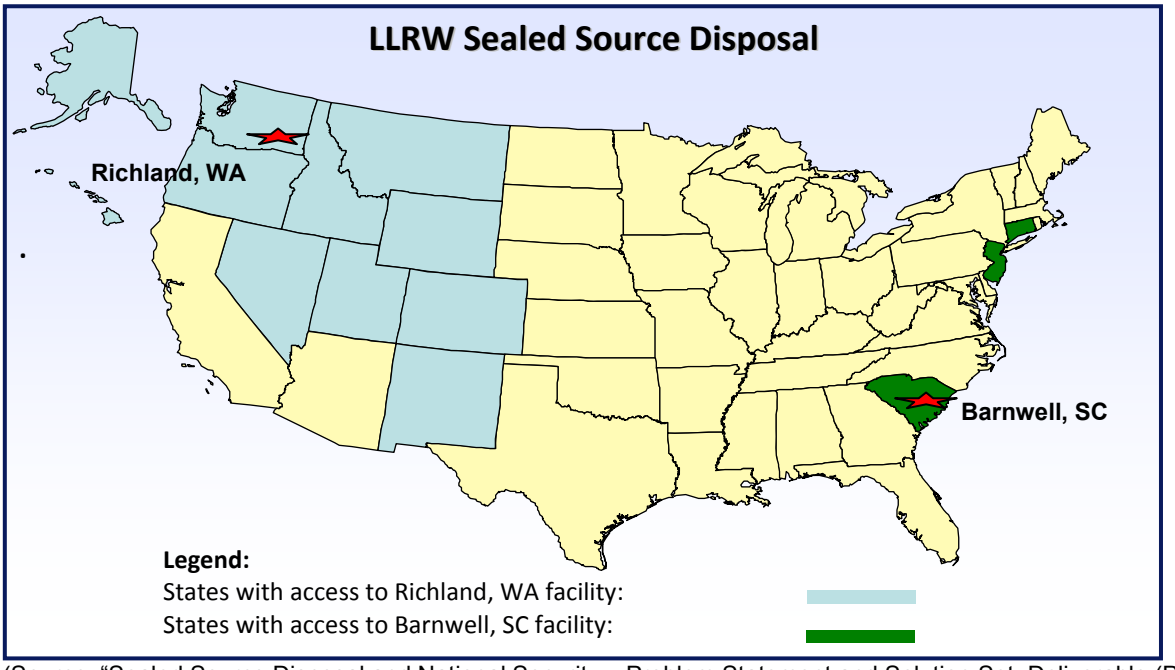
III. Challenges to Financial Adequacy Assessment

1. LLRW Disposal Access

The first challenge that the WG identified is the lack of disposal capacity for a number of Category 1, 2 and 3 sources due in large part to the lack of access to commercial LLWR disposal facilities and limitations in the characteristics of wastes that can be accepted for disposal (see Table B). At the end of their useful life, many sources will be considered Class B, C or GTCC radioactive waste in accordance with 10 CFR Part 61. The lack of disposal access poses a significant challenge in determining adequate levels of financial assurance, as financial assurance should be based on expected decommissioning costs, and without disposal capacity, it is difficult, if not impossible, to determine reasonable future decommissioning costs. Furthermore, if demand for disposal capacity rises, the cost of disposal can be reasonably expected to increase if there is no corresponding expansion in disposal capacity.

As discussed above, the Barnwell, SC and Richland, WA facilities are currently the only two commercial disposal facilities that accept sealed sources. Currently, 36 states lack disposal options (see Fig. 1).

Fig. 1



(Source: "Sealed Source Disposal and National Security – Problem Statement and Solution Set: Deliverable (Part 1) of the Removal and Disposition of Disused Sources Focus Group of the Radioisotopes Suncouncil of the Nuclear Government and Sector Coordinating Council" (Source: Focus Group Deliverable 9.2.1).

Even if available, disposal costs at commercial facilities are generally based on complex formulas taking into account (among other factors) volume, weight, and radioactivity. Special fees, taxes, and surcharges also add to the cost. Sources are often physically very small with a relatively high radioactivity per unit volume or mass. Consideration must be given to the concentration of the radionuclides as part of the basis for the NRC waste classification system. Disposal criteria often require that such small sources be encapsulated in an inert, stable medium such as concrete. This significantly increases disposal weight and volume, while radioactivity remains the same. This may result in a substantial disposal cost (tens of thousands of dollars for a single small source). This high cost may pose a disincentive for a licensee to properly dispose of disused sources, potentially leading to misuse or abandonment.

Some members of the radioactive waste community claim that the lack of competition in the commercial disposal industry results in excessive costs to the generators of waste. They also believe that the high cost may impede the use of nuclear technologies which provide significant benefits to society, such as certain medical services and treatments.

The timing, location and type of additional disposal capacity for commercial RSS in states that currently do not have access to disposal capacity for Class B and C LLRW have not been determined. States continue to have responsibility for disposal of Class A, B and C LLRW, and this lack of disposal capacity has put pressure on Federal and State programs. (Source: Focus Group Deliverable 9.2.1)

DOE has statutory responsibility for development of disposal capacity of all GTCC waste including RSSs that are considered risk-significant. DOE is presently evaluating several GTCC disposal methods "including deep geologic disposal at the Waste Isolation Pilot Plant in New Mexico, and enhanced near surface or intermediate depth disposal at several DOE sites." Public comment on a draft of an Environmental Impact Statement (EIS) prepared by DOE is planned for 2010, and DOE expects to publish a final EIS by 2011. Afterwards, Congressional review and action is required before DOE is permitted to select a disposal option. Although DOE is evaluating several alternatives for the disposal of GTCC LLRW, commercial GTCC disposal capacity is at least several years away (Source: Focus Group Deliverable 9.2.2).

2. Transportation

A secondary problem that the WG has identified is the limited availability of Type B packagings that are required to ship many of these sources. On October 1, 2008, a significant number of older "specification" Type B packaging certifications expired, as the U. S. Department of Transportation (DOT) and NRC aligned with international transport regulations (HM-230: Docket No. RSPA-99-6283). The DOT specification packages, which are no longer authorized for use, were often used for the transport of irradiators, calibration and teletherapy sources. Additionally, several NRC certified packages for cobalt-60 sources expired. Per NRC Regulatory Issue Summary 2008-18 (RIS 2008-19) DOT and NRC have provided a limited number of special permits and authorizations for continued use of expired packagings on an as-needed basis where efforts include a good faith effort to transition to currently certified packagings in the near future and an adequate safety case has been demonstrated. Although there is a financial incentive for manufacturers to produce and have certified packages for moving usable radioactive material, there is little impetus to produce packaging for end of life transportation. Furthermore, a number of the manufacturers that produce such packagings have gone out of business. As end-of-life disposal options are limited, manufacturers do not have a great incentive to certify the type of packagings needed for disposal. The limited number of available packagings has driven up the cost of radioactive waste transportation. This creates a significant challenge in determining reasonable future decommissioning costs.

Designing, testing and producing new transportation packagings is a multi-year project. NRC's approval process for new package designs averages 12 to 18 months including the time for applicants to respond to staff's questions. Fabrication of the new packages typically is an additional six months, and testing typically requires at least one year. This is generally a minimum time frame to bring a new package into service.

Faced with decreasing numbers and types of certified transportation packagings to support movement of both actinide-bearing and beta/gamma radiation emitting sources, the National Nuclear Security Administration's Global Threat Reduction Initiative (GTRI) has initiated actions to ensure the continued success of the timely recovery and management of sealed radioactive sources. Efforts include procurement of vendor services for the design, development, testing and certification of a new Type B packaging to support transportation of irradiators, teletherapy heads or sources removed from these devices using remote handling capabilities. However, for the reasons discussed above, these new packagings will not be available for several years.

3. Extended Storage of Unwanted Sources

A third problem identified by the WG is a result of a lack of disposal capacity and a lack of type B packagings. In response to those challenges, many licensees store risk-significant sources onsite long-term. While secure storage is a temporary measure, prolonged storage increases the likelihood of misuse, abandonment or theft[1]. Due to high costs, some licensees cannot or do not wish to pay to dispose of disused sealed sources. In addition, long term storage increases the lifecycle cost associated with disused sources[2]. Hence, the need for increasing the number of disposal facilities. Some of these disused sources may be acceptable for disposal at the two existing commercial disposal facilities, assuming the owner is located in one of 14 states that have access to a disposal facility available to them. As a result, these sources may remain in storage indefinitely or, in some situations, possibly be misused, abandoned, lost, or stolen (if there are no other disposition alternatives, such as recycling or reuse).

4. Difficulty Assessing Appropriate Enforcement and Civil Penalties

Due to the lack of disposal access, NRC's Office of Enforcement has indicated that it is difficult to establish a meaningful fine basis for fines to act as a deterrent to improper disposal (e.g. 3X cost of disposal) if disposal costs are unknown or if disposal is simply not an option. Although the Office of Enforcement (OE) has not noted a recent increasing trend of enforcement cases involving improper disposal of such sources, a few cases occur each year. If the OE notes an increasing trend of such cases, especially in areas of the country where disposal currently is not available, then there may be a need to revise the Enforcement Policy to re-establish a proper deterrent action for licensees who choose to improperly dispose of their sources, rather than properly dispose of the materials or optionally safe store the source(s) until proper disposal or transfer can be achieved.

IV. Initiatives Underway

The Federal Government has existing programs to recover sealed sources, including Category 1 and 2 sources that are unwanted or orphaned. These national programs have successfully recovered and securely disposed sources, and these programs should continue. These programs will be discussed in further detail in later sections of this paper.

In response to concerns related to the lack of disposal for disused sealed sources, the Nuclear Government Coordinating Council (NGCC) and Nuclear Sector Coordinating Council (NSCC), through the U. S. Department of Homeland Security's Nuclear Critical Infrastructure Protection Advisory Council (CIPAC), created the Removal and Disposition of Disused Sources Focus Group (Focus Group) in February 2009. The object of this Focus Group (FG) is to recommend to the NGCC and NSCC a strategy for communicating with the appropriate stakeholders to implement a solution by having the public and private sector collaborate to fully characterize the challenge, develop a consensus problem statement, and identify medium and long-term solutions, the objective of this FG is to recommend to the NGCC and NSCC a strategy for communicating with the appropriate stakeholders to implement a solution. Several WG members have been active participants in the FG.

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[1] GAO-05-967 at 6-7.

[2] *Report of the Radiation Source Security and Protection Task Force* at 84 (August 15, 2006).

GTRI is implementing the Off-Site Source Recovery Project (OSRP) for recovering, consolidating and disposing of security significant RSSs that have been identified as unwanted by their users. GTRI prioritizes the recovery of registered disused RSSs based on threat reduction criteria developed in coordination with the NRC. Cost is borne by the public. A similar source recovery program is available for smaller sources. The Conference of Radiation Control Program Directors (CRCPD) and GTRI have also collaborated to recover disused and orphaned sources through the Source Collection and Threat Reduction (SCATR) Program. SCATR's goal is to collect unwanted sealed sources that pose a potential threat to public health and safety. The CRCPD SCATR program is generally limited to non-actinide[3] sources less than 10 curies (Ci) in activity. Disposition pathways vary (reuse, recycle, storage and disposal). Cost is borne by the licensee and the public.

V. Deliberations of Working Group

As discussed above, the WG identified three major problems with determining financial adequacy for disposition of RSS: lack of disposal capacity, transportation issues (including limited number of shipping containers) and the long-term storage of risk-significant sources not in use. Due to uncertainties in the timing of future disposal access, the WG found it difficult to quantify with any specificity, the financial consequences or burden related to these various end-of-life circumstances for sources (see Attachment 1 for cost data). Thus, the WG recommends that the immediate focus be placed on mitigation strategies for these problems.

1. Financial Assurance Strategies Currently Utilized Abroad

The WG asked how other countries are addressing these issues. The European Union has a directive on management of disused sealed sources. Besides tracking and continuity of control, there are requirements for a fund by each Member State, financed by guarantees to cover the costs for recovering the orphaned sources when the liabilities cannot be identified or when the liable entity is insolvent. However, the directive does not specify how the Member State established and maintains this funding mechanism.

During the June WG meeting, the WG heard from United States representatives that participated in a technical meeting on implementation of the Code of Conduct on the Safety and Security of Radioactive Sources with regard to long-term strategies for the management of sealed sources which was held from June 29 to July 1, 2009, at the International Atomic Energy Agency (IAEA) Headquarters in Vienna, Austria. The June WG meeting included discussions about the various strategies utilized by many foreign governments, including: (1) utilizing storage facilities for these sources, (2) establishing disposal capacity though the construction of deep well/geologic disposal pathways or intermediate depth boreholes and (3) returning sources to manufacturers (recycling) and having the polluter pay the costs of dispositioning.

The financial assurance strategies used varies across Member States, especially with respect to disused sealed sources. However, the common method is returning the source back to the manufacturer and having the licensee pay. In many cases, the licensee may be another governmental entity, in which case there is a transfer of funds or else the cost is absorbed by the Government as a whole. Additionally, many countries assess a fee on all licensees (not just those using RSSs) to create a Decommissioning and Dispositioning Fund that is utilized for the

[3] Actinide sources include Americium, Plutonium, Curium, Californium, Uranium, and Neptunium.

dispositioning of sources held by private firms. The Republic of Korea utilizes this type of fund to cover financial liability. In some instances, the licensee and the licensee's Government each contribute monies to such a fund to cover dispositioning costs (e.g., Brazil). Switzerland's Government shares storage costs with the owner or licensee, and the Government pays the costs associated with orphaned sources. Although some progress has been made in this sector, much still needs to be done to meet the challenge of establishing financial resources for such liabilities.[4]

In France, the association of source suppliers and manufacturers contribute to a common fund to reimburse the Government for recovering sealed radiological sources from any supplier or manufacturer that is unable to disposition them. In cases where the supplier cannot be identified, the Government is reimbursed by an insurance system implemented by the source manufacturers. There is a requirement that a disposal fee be assessed when a sealed source is purchased to pay for the cost of future central storage and/or disposal. ("Low-Level Radioactive Waste Management: Approaches Used by Foreign Countries May Provide Useful Lessons for Managing U.S. Radioactive Waste" GAO-07-221)

2. Financial Assurance Strategies Currently Utilized Domestically

During the April WG meeting, participants heard from the State of Illinois, a member of Organization of Agreement States (OAS), about a Radioactive Material Recovery and Remediation Fee assessed on most licensees, according to Illinois' Administrative Code Title 32, Part 331. Pursuant to section 331.115, all specific and general licensees, except for licensees with prepackaged units for in vitro testing, pay an annual fee for two years. The dollar amount of each fee is listed in Appendix F to Section 331 of the Illinois Administrative Code. The purpose of collecting these fees is to pay for recovery and remediation if the licensee, and/or their surety, is unable to provide funds for recovery and remediation in a timely manner. Additionally, Section 326.70 stipulates that, unless specified in section 326.70(b), licensees that possess or use more than 1Ci of RSSs (per source) must provide financial surety. Further, section 326.70(b) specifies which licensees are required to submit a reclamation plan with a cost estimate and financial surety.

During the May WG meeting, participants heard from the State of Texas, a member of OAS, about a surcharge that Texas assesses to its licensees (Texas Radiation and Perpetual Care Fund [the Fund]). Monies for the Fund are from an additional fee assessed on the State's radioactive materials licensees and administrative penalties collected by the enforcement program (from radioactive materials licensees as well as from the registrants of machine-produced radiation). There is no cap on the amount of penalties accrued in the Fund. Texas utilizes the monies in the Fund to pay for unexpected costs that fall outside of costs covered by a licensee's primary financial assurance. These monies may be used to pay for the disposal of abandoned sources and to cover sites that have inadequate financial assurance. CRCPD and the State of Texas indicated that they both work with licensees that possess sources which are no longer in-use to assist these licensees in locating other licensees, such as universities, which may be interested in accepting the disused sources as donations.

[4] Summary Report of the Joint Convention Third Review Meeting of the Contracting Parties 11 to 20 May 2009, Vienna, Austria.

During, the June WG meeting, participants heard from the State of Florida, a member of OAS, about a risk based financial assurance requirement Florida utilizes (see Attachment 2). Florida requires financial assurance for smaller quantities, as measured in Ci, of material as compared to NRC's requirements.

Finally, discussions were held about a deposit system where a small percentage of the sales price of a source is retained, and this deposit can be claimed when the source is returned or properly disposed of, such as at the time of decommissioning. A concern surrounding this is that if deposits are held by manufacturers, there is a risk of loss in the event that the manufacturers go out of business. It was suggested that either a Federal agency or another third-party manage such a deposit system. Additionally, if the source is returned to the vendor, there is the potential for additional contamination at the vendor's site. This may necessitate financial assurance requirements for vendors.

Some other ideas that were discussed during the WG meetings included:

A) Placing labeling/shipping information on all sources similar to a warning label which indicates proper disposal or recycling pathways and including CRCPD information.

B) Recycling was a recurring theme of the WG. Source recycling can be cost effective and in the short-term reduce the number of disused sealed sources. However, due to damage, low activity, or physical configuration recycling is not always an option.

C) There are a number of sources that are imported into the United States, and many of these sources may not be able to be returned to the original manufacturers. There are numerous reasons for this including, in some cases being, prohibited by United States export laws, manufacturers that simply will not accept sealed sources back, manufactures that are no longer in business and due to security concerns. GTRI and the State Department have raised this issue with the IAEA and source exporting countries.

D) NRC's OE discussed fines that may be levied against licensees which do not dispose of sources in an appropriate manner and indicated that the fines should be adjusted to reflect current data, such as three times actual disposal costs.

E) In order to increase the number of containers which are available for end of life transportation, the Federal Government may offer incentives, such as grants/cooperative agreements, to companies that manufacture these types of containers.

3. Summary of Challenges to Calculating a Basis for Establishment of an Appropriate Amount

The uncertainties discussed in detail above create a significant impediment to determining the real costs of total life cycle management of these sources. However, the WG has some historical data regarding costs of disposal. Over the last several years, GTRI/OSRP, as part of its threat reduction mission, has recovered high-activity beta-gamma radiation emitting sources comprising about 90,000 decayed Ci, excluding Strontium (Sr-90) radioisotope thermoelectric generators (RTGs), from approximately 40 sites. The average cost per recovery was about $60,000. Major factors influencing cost include the complexity and size of the device, quantity of radionuclide, and availability and model of Type B container that was required, as well as site characteristics that might make removal difficult, such as lack of freight elevators or walls that

have to be breached. The range of recovery costs for irradiator devices with greater than 1800 Ci of Cobalt (Co-60) was $54,000-$140,000, with an average of about $82,000. Cesium (Cs-137) irradiator recovery costs averaged about $42,000 for smaller devices (for approximately 250 Ci of material). GTRI expects that all of these costs may increase in the next year or two due, in large part, to the lack of availability of containers/packages to ship these sources.

VI. WG Recommendations

The WG recommendations are based on the current decommissioning environment with limited disposal capacity. If the disposal capacity concerns are addressed, the recommendations may change. However, the WG recommends continuing enforcement efforts as these are a deterrent to licensees abandoning sources.

In order to increase the number of containers which are available for end of life transportation, the WG recommends that the Federal Government offer incentives, such as grants/cooperative agreements, to companies which manufacture these types of containers. In addition, commercial companies with radiological waste may wish to apply for Federal funding such as funding available through the American Recovery and Reinvestment Act of 2009.

The WG noted GTRI's source recovery efforts implemented by Los Alamos National Laboratory, Idaho National Laboratory and the CRCPD. The WG recommends the Federal Government continue to support these projects. In addition, the WG encourages Compacts and States to site additional disposal facilities.

The WG recommends that CRCPD and the States continue and expand upon matching licensees that possess disused sources with licensees which may be interested in accepting the disused sources as donations.

VII. Financial Assurance Mechanisms Recommended by the WG and Concluding Remarks

The WG recommends rulemaking to establish several new regulations, including:

(1) Broaden thresholds in 10 CFR 30.35 to capture a greater number of sources that would include all Category 1, 2 and 3 RSSs. NRC would be able to implement this mechanism internally through rulemaking. However, it would be very difficult to establish a defensible disposal surcharge with all of the variables. This may also be overly punitive to small licensees, especially if implemented retroactively.

(2) Similar to Florida's program, the WG recommends that NRC implement risk based financial assurance requirements and lower the quantities of materials that trigger a financial assurance requirement in 10 CFR 30.35 to capture all Category 1, 2 and 3 RSSs. This should include updating the dollar amount requirements to represent current disposal costs. NRC would be able to implement this mechanism internally through rulemaking. This method may also provide for a more equitable cost distribution, as the financial assurance requirements are source specific. However, this may inadvertently provide an incentive for licensees to improperly dispose of sources.

(3) Similar to the program in Texas, the WG recommends that the Federal Government implement such a surcharge and pool of funds. The concept would be to compute the aggregate annual cost of management of all disused RSSs and pro rate the cost over all radioactive materials licensees in the form of an annual surcharge based on a formula tied to factors associated with various radioactive materials. This would spread the liability to all licensees not just individual RSS licensees. There are significant authority and implementation questions. Staff members from NRC's Office of General Counsel and Office of Chief Financial Officer indicated that it may be difficult for NRC to establish such a fund, as these monies would have to be turned over to the United States Treasury Department under the Miscellaneous Receipts statute (31 U.S.C. 3302). Based on this, WG members recommend DOE[5] pursue Congressional authorization to recover costs associated with source recovery and disposal from such a fund.

Alternatively, rather than assessing an up-front surcharge, the Federal Government may assess a "fee plus fee" surcharge, wherein a small up-front charge is assessed on all RSSs, along with a surcharge equal to a percentage of the gross revenue generated as a result of the use of the RSSs. The benefit of such a program is that the financial impact on smaller licensees who do not generate significant revenue from the use of RSSs is smaller in comparison to a flat-fee surcharge. Larger licensees who generate significant revenue from the use of RSSs would effectively be "subsidizing" the disposal costs of smaller licensees. However, if the percentage of gross revenue fee is too high, it may become burdensome on larger licensees and thus act as a disincentive for the beneficial use of radioactive materials. Furthermore, there are several legal and implementation concerns related to this strategy.

(4) The majority of disused sources is still under regulatory control and is owned by licensees who are not in the process of decommissioning or going out of business. Based on this, the WG recommends the implementation of an up-front surcharge on all new Category 1, 2 and 3 sources to cover the entire anticipated costs of packaging and disposal. Those funds which are not used to cover commercial or DOE costs when the source becomes disused and unwanted will be returned to the source owner. Similarly, if no commercial or DOE disposition pathway exists, the source owner may access the funds for storage costs.

Regarding Action 7.1, the WG finds that that there is no need to impose additional reporting requirements on licensees. Sources in question are already being stored under additional security measures (Increased Controls) and licensees are storing because: (1) disposal is not available; (2) the cost of disposal is prohibitive in comparison to the cost of long-term storage; or, (3) the licensee has plans for future use/disposition.

Finally, implementation of any of these recommendations would require consideration of the potential financial impact to the licensee. As an unintended consequence, the options could also discourage beneficial use of the radioactive materials due to the increased financial burden (e.g. increased prices, and thus additional cost, to patients receiving irradiated blood).

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[5] GTRI does not currently recoup from source owners costs associated with source recovery activities. Without specific statutory authority to retain and utilize funds collected from the source owners, DOE would also be required to deposit such funds into the general Treasury under the Miscellaneous Receipts statute (31 USC 3302). Such funds would not be available, absent subsequent further appropriation by Congress, for use by DOE in furtherance of GTRI's threat reduction mission.

Table A[6]

			CATEGORY 1, 2 AND 3 SOURCES WITH NO FINANCIAL ASSURANCE REQUIREMENTS		
Device/Use	Isotope	Category	**Typical activity (Ci) per source**	**Unity Rule Applies	**Notes**
IRRADIATORS					
self-shielded	Cs-137	1	15000	FA required for greater than (>) 100,000 Ci of Cs-137	
blood/tissue	Co-60	1	2400	FA required for >10,000 Ci of Co-60	
sterilization(food pres)	Cs-137	1	5000(min)-7000	FA required for >1000 Ci of Ir-192	
				FA required for >1000 Ci Se-75	
GAMMA KNIFE	Co-60	1	7000	FA required for > 1000 Ci Yb-169	
				FA required for >100 Ci Am-241	
TELETHERAPY	Co-60	1	4000	FA required for >100 Ci Cf-252	
	Cs-137	1	500	FA required for >100 Ci Pu-239	
				FA required for >100 Ci Pu-238	
				FA required for >1000Ci Tm-170	
INDUSTRIAL	Co-60	2	60		
RADIOGRAPHY	Ir-192	2	100		
	Se-75	2	80		
	Yb-169	2	5		
	Tm-170	2	150		
BRACHYTHERAPY	Co-60	2	10		
(Medium and High)	Cs-137	2	3		
	Ir-192	2	6		
CALIBRATION	Co-60	2	20		
SOURCES	Cs-137	2	60		

[6] Source: International Atomic Energy Agency, Safety Guide No. RS-G-1.9, Categorization of Radioactive Sources, August 2005

	Am-241	3	10
	Pu-239/Be	3	3
GAUGES			
Fixed, level	Co-60	3	5
	Cs-137	3	5
Fixed, conveyor	Cs-137	3	3
	Cf-252	3	0.0037
Fixed, dredge	Co-60	3	0.75
	Cs-137	3	2
spinning pipe	Cs-137	3	2
blast furnace	Co-60	3	1
REACTOR STARTUP	Am-241	3	2
(research)			
PACEMAKERS	Pu-238	3	3
RADIOISOTOPE GEN	Pu-238	1	280 (min. 28)
WELL LOGGING	Am-241	3	20
	Cs-137	3	2
	Cf-252	3	0.03

Table B

The Current Commercial Sealed Source Disposal Landscape				
Radionuclide	**Maximum Limit Allowed[a]**			
	Non-GTCC Sources			**GTCC Sources**
	Barnwell Facility (3 States)	**Richland Facility (11 States)**	**No Facility (36 States)**	**GTCC Facility[b]**
Americium-241 Plutonium-238 Plutonium-239	10 nCi/gm	100 nCi/gm	No Disposal (ND)	>100 nCi/gm
Californium-252	10 Ci	13 Ci[c]	ND	Not applicable[d] (NA)
Curium-244	100 nCi/gm	100 nCi/gm	ND	>100 nCi/gm
Cobalt-60	10 Ci	145 Ci[c]	ND	NA[d]
Cesium-137	10 Ci	976 Ci	ND	>976 Ci
Iridium-192	10 Ci	13 Ci[c]	ND	NA[d]
Strontium-90	10 Ci	1,486 Ci	ND	>1,486 Ci
Radium-226	Disposal of radium is available to all states at the Richland facility up to 1.2 Ci per source[e].			NA[d]

Color Code	
	Disposal available commercially for Compact States up to maximum Class C limits for applicable radionuclides, considering concentration averaging.
	Disposal available commercially for Compact States but maximum limit is less than Class C limits for applicable radionuclides due to site-specific administrative limits, waste acceptance criteria, or license conditions
	Disposal capability being developed by DOE[b.].
	No disposal available.

a The maximum curie or activity limit allowed for an individual sealed source containing the specified radionuclide based on site-specific administrative limits, waste acceptance criteria, application of concentration averaging, or license conditions.

b A GTCC LLRW disposal facility does not currently exist; DOE is preparing an Environmental Impact Statement analyzing potential disposal alternatives for this waste. The maximum limit for the facility will be determined during the implementation and licensing phase for the selected alternative and will be greater than the Class C waste classification values shown in the Table (which assumes application of concentration averaging).

c The facility may accept sources in excess of this limit on a case-by-case basis based on worker exposure and other site-specific considerations.

d Sealed sources consisting of these radionuclides are not classified as GTCC LLRW when sent for disposal because there is no maximum Class C limit for the radionuclide or the radionuclide is not included in the list of radionuclides in 10 CFR 61.55, Tables 1 and 2 that determine LLRW classification.

e Diffuse radium-226 is still considered naturally occurring radioactive material (NORM) for purposes of disposal, but discrete radium-226 sources are now considered “byproduct material” per the NRC and compatible Agreement State regulations. However, the 2005 Energy Policy Act has excluded radium-226 sources as LLRW, and some compact regulations still consider radium-226 containing waste as NORM. Disposal options are therefore still available to all states.

Attachment 1

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	X-ray Irradiators	Linac
Back-end Costs				
Device Decommissioning and Disposal	○ $110,000 - $125,000 for recovery and disposal[a] depending on the location (2009 USD) **Assumption**: *Median value of $72,000 for recovery and median value of $38,000 to $53,000[b] for disposal.*	○ $165,000 to $180,000 for recovery and disposal[c] depending on the location (2009 USD) **Assumption**: *Median value of $129,000 for recovery and median value of of $38,000 to $53,000 for disposal.*	○ No information available at this time.	○ No information available at this time.
Recycling	○ No information available at this time.	○ No information available at this time.	○ No information available at this time.	○ No information available at this time.
Storage	○ No information available at this time.	○ No information available at this time.	○ No information available at this time.	○ No information available at this time.

Calibrators

	Calibration System Containing Cs-137	Calibration System Containing Co-60
Back-end Costs		
Recycling / Storage / Disposal	○ 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). ○ Labor costs associated with packaging a source for transport and then transporting the source is estimated to be over $30,000 (2008 US dollars). ○ Costs incurred by OSRP for storage not available. **Assumption:** *Median value of $35,000 to $45,000 was used.*	○ 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. ○ Costs incurred by OSRP for storage not available. **Assumption:** *Same device disposal cost as for the Cs-137 calibrator was used, i.e. median value of $35,000 to $45,000.*

[a] Recovery costs are the averaged proposed costs from 4 vendors and 13 Cs-137 devices from a recent procurement.

[b] Disposal costs are estimated for two different disposal sites.

[c] Recovery costs are the averaged proposed costs from 4 vendors and 6 Co-60 devices from a recent procurement.

Industrial Radiography

	Gamma Radiography	X-Ray Radiography	Ultrasonic Testing	Eddy Current Testing	Magnetic Particle Testing	Penetrant Testing
Back-end Costs						
Recycling	○ No information available at this time.	○ Less expensive than gamma radiography, since it does not involve a sealed radioactive source.	○ Less expensive than gamma radiography. ○ Device and parts are treated like regular equipment (e.g., computer). [e]	○ Less expensive than gamma radiography, since it does not involve a sealed radioactive source.	○ Less expensive than gamma radiography, since it does not involve a sealed radioactive source.	○ Less expensive than gamma radiography, since it does not involve a sealed radioactive source.
Disposal	Device Disposal ○ Ir-192: $600 (2009 US dollars) ○ Co-60 (DU): $5,000 (2009 US dollars) [h] ○ Co-60 (lead): $500 (2009 US dollars) **Assumption**: *Ir-192 device is disposed at the end of 20 years at a cost of $600.* **Assumption**: *Co-60 device is disposed at the end of 20 years at a cost of $5,000.* Source Disposal ○ Co-60 sources 25 Ci and below: $8,000 (2009 US dollars). ○ Co-60 sources 26 Ci to 50 Ci: $15,000 (2009 US dollars). ○ Co-60 sources 300 Ci: over $100,000 (2006 US dollars). **Assumption**: *Ir-192 source of 4,000 GBq is replaced every 3 months.* **Assumption**: *Co-60 source with strength of 26 Ci to 50 Ci is disposed every 5 years at a cost of $15,000.*	○ Less expensive than gamma radiography, since it does not involve a sealed radioactive source.	○ Less expensive than gamma radiography, since it does not involve a sealed radioactive source. ○ Typically older devices are replaced with newer products and the old device is sold [e]	○ Less expensive than gamma radiography, since it does not involve a sealed radioactive source.	○ Less expensive than gamma radiography, since it does not involve a sealed radioactive source.	○ Less expensive than gamma radiography, since it does not involve a sealed radioactive source.

Panoramic Irradiation

	Gamma Irradiator (Co-60)	Electron-Beam Irradiator	X-Ray Irradiator
Back-end Costs			
Recycling / Storage	○ 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.	○ Less expensive than gamma irradiation, since it does not involve a sealed radioactive source.	○ Less expensive than gamma irradiation, since it does not involve a sealed radioactive source.
Disposal	○ $165,000 to $180,000 for recovery and disposal depending on the location (2009 USD). **Assumption**: *Median value of $129,000 for recovery and median value of of $38,000 to $53,000 for disposal.* **Assumption:** *Final return shipment costs obtained from data source "n" (NAS, 2008) were used.*	○ Less expensive than gamma irradiation, since it does not involve a sealed radioactive source. ○ No significant disposal costs associated with an electron-beam system. **Assumption**: *Negligible disposal costs, i.e., $0 per year.*	○ Less expensive than gamma irradiation, since it does not involve a sealed radioactive source. ○ Disposal of spent targets is estimated to be $0.02 M, i.e., $20,000 (2008 US dollars). **Assumption:** *Spent target disposal costs obtained from data source "n" (NAS, 2008) were used.*

Radiosurgery

	Co-60	Linac (Photons)	Proton
Back-end Costs			
Device Decommissioning and Disposal	○ **Assumed the decommissioning and disposal cost to be same as the source replacement cost, i.e., median value of $700,000 to $850,000.**	○ **No information available at this time.**	○ **No information available at this time.**
Recycling	○ **No information available at this time.**	○ **No information available at this time.**	○ **No information available at this time.**
Storage	○ **No information available at this time.**	○ **No information available at this time.**	○ **No information available at this time.**

Research Irradiation

	Cs-137 Irradiators	Co-60 Irradiators	X-ray Irradiators	Linac
Back-end Costs				
Device Decommissioning	○ **$110,000 - $125,000 for recovery and disposal depending on the location (2009 USD).** Assumption: ***Median value of $72,000 for recovery and median value of $38,000 to $53,000 for disposal.***	○ **$165,000 to $180,000 for recovery and disposal depending on the location (2009 USD).** Assumption: ***Median value of $129,000 for recovery and median value of of $38,000 to $53,000 for disposal.***	○ **No information available at this time.**	○ **No information available at this time.**
Recycling	○ **No information available at this time.**	○ **No information available at this time**	○ **No information available at this time.**	○ **No information available at this time.**

	Cs-137 Irradiators	Co-60 Irradiators	X-ray Irradiators	Linac
Disposal	○ **See device decommissioning.**	○ **See device decommissioning.**	○ **Companies will take back devices. (2009 USD)** [c] Assumption**:** ***Disposal Cost is covered by service contract.***	○ **No information available at this time.**
Storage	○ **No information available at this time.**	○ **No information available at this time.**	○ **No information available at this time.**	○ **No information available at this time.**

Well Logging

	AmBe	**Cf-252**	**Neutron Generator**
Back-end Costs (at the end of the useful life of the device)			
Transportation of Device	$1,500 to send to Los Alamos OSRP for permanent storage. [This is the average cost of transportation] [c]	$1,500 to send to Los Alamos OSRP for permanent storage. [This is the average cost of transportation] [c]	None
Residual Value of Source	About $100,000 after 15 years.	$750 **Assumption**: *Source has 25% residual activity at a value of $110 per mCi* [c.]	None

Attachment 2

Risk Based Financial Assurance Required by the State of Florida

64E-5.217 Bonding of Persons Licensed Pursuant to Subpart II C.

(1) Any applicant or licensee who is not exempt by the provisions of this subpart shall provide a performance bond.

(a) The bond shall be payable to the State of Florida and shall be in an amount determined by the department as sufficient to provide for the protection of the environment and the public health and safety in the event of abandonment, insolvency or other inability of the licensee to meet the requirements of the department. The department shall use (3), below, of this part to determine the amount of the bond required for each applicant or licensee. The mathematical product of the risk factors will be the amount of the required bond in dollars. In the event that an applicant or licensee feels that the amount of the bond determined by the use of the applicable risk factors is inappropriate, he may submit evidence to the department in support of a change to the bond amount. The department shall determine whether the evidence supports the requested change in the bond amount.

(b) An applicant or licensee may apply to the department for exemption from the requirement of a bond if he can demonstrate that funds will accrue to the State of Florida which are sufficient to provide for the protection of the environment and the public health and safety in the event of abandonment, insolvency or other inability of the licensee to meet the requirements of the department. If the department does not grant the exemption from the requirement of a bond, the licensee may request a hearing in accordance with the provisions of Chapter 120, Florida Statutes.

(c) Licensees must provide the required bond within 90 days after being given notice by the department of the requirements of a bond and its amount.

(d) The department may re-evaluate, at any time, the adequacy of an existing bond or guaranty and may require an adjustment by either increasing or decreasing the amount of the bonding or guaranty required.

(e) A bond may be issued by a fidelity or surety company authorized to do business in the State of Florida or it may be a cash bond. The bond must initially provide for at least 24 months of coverage from the date of issuance and at no time thereafter shall the period of coverage be less than 12 months, for as long as the license remains in effect.

(f) The department may order the bond to be forfeited if it finds any of the following:

1. The facility or site has been abandoned;
2. The licensee is insolvent; or
3. The licensee is unable to perform to the satisfaction of the department.

(g) Upon determining that a bond shall be forfeited, the department shall issue a notice to that effect.

(2) The following are exempt from the provisions of this subpart:

(a) Other governmental agencies;
(b) Educational institutions accredited by the Southern Association of Colleges and Schools and such other educational institutions as may be specifically exempted by the department if the department determines that such exemption will not endanger the public health, safety and welfare.
(c) Licensees of the State Licensing Board for the Healing Arts and those medical facilities possessing or using radioactive materials for medical purposes when supervised by such licensees.
(d) Any licensee whose mathematical product of the risk factors in (3), below, is less than 15,000.

(3) Risk factors for purposes of bonding:

Radioisotope	**Risk Factors**		**Half-Life or Radioisotope**	**Risk Factors**
U-nat, U-235, U-238 and associated decay products	1		Greater than 6 years	30
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, Ac-225, I-129	50		6 months to 6 years	10
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133, I-125, H-3, C-14	5		10 days to 6 months	5
Activity	**Risk Factors**		**Facility and Procedure**	**Risk Factors**
Greater than 100,000 curies	2,000		Greater than 5000 ft. ^{2} -------- High Risk -------- Low Risk	 30 10
10,000 to 100,000 curies	1,000		500 to 5000 ft. ^{2} -------- High Risk -------- Low Risk	 10 5
1,000 to 10,000 curies	500		Less than 500 ft. ^{2} -------- High Risk	 5
100 to 1,000 curies	200		Licensed issued for storage only	3
10 to 100 curies	30		License issued for manufacturing, benefaction or processing non-encapsulated radioactive materials	3
1 to 10 curies	2		Sealed sources not contained in a device with integral solid shielding	3
Physical Form	**Risk Factors**		**Physical Form**	**Risk Factors**
Single encapsulated or source plated	3		Non- encapsulated form	20

Specific Authority: 404.051, 404.061, 404.111, 404.141, F.S.
Law Implemented: 404.022, 404.051(1),(4), 404.061(2), 404.111, 404.141, F.S.
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Joel Dorfman	NRC
Earl Easton	NRC
Giorgio Gnugnoli	NRC
Jenny Johansen	NRC
Kenneth Kline	NRC
Kenneth Lambert	NRC
Catherine Matteson	NRC
Teresa Mixon	NRC
Kevin Null	NRC
Kevin O'Sullivan	NRC
Roman A. Przygodzki	NRC
Michelle Sampson	NRC
James Shaffner	NRC
Robert Summers	NRC
Robert J. Torres	NRC
Craig Dean	ICF
Tison Campbell	DOE
Abigail Cutherbertson	DOE
Jamie Joyce	DOE
Dale Ruhter	EPA
John Zarling	DOE/LANL
Julia Whitworth	DOE/LANL

Mike Stephens	STATE OF FLORIDA
John Barcalow	STATE OF ILLINOIS
Mike Dunn	STATE OF TEXAS
David Fogle	STATE OF TEXAS
Richard Ratliff	STATE OF TEXAS
Kirsten Cutler	U.S. DEPARTMENT OF STATE