

*Wisconsin*  
*Chapter DHS 157- Radiation Protection*  
*Regulatory Guide*

**January, 2011**

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**Guidance for Uses of Sealed Sources**

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PPH 45050 (01/11)



## EXECUTIVE SUMMARY

Wisconsin Regulatory Guides (WISREGS) are issued to describe and make available to the applicant or licensee, acceptable methods of implementing specific parts of **Wisconsin Administrative Code, Chapter DHS 157 ‘Radiation Protection’**, to delineate techniques used by Department of Health Services (DHS) staff in evaluating past specific problems or postulated accidents, and to provide guidance to applicants or licensees. WISREGS are not substitutes for **Chapter DHS 157 ‘Radiation Protection’**, therefore compliance with them is not required. Methods and solutions different from those set forth in this guide will be acceptable if they provide a basis for the Department of Health Services (DHS), Radiation Protection Section to determine if a radiation protection program meets the current rule and protects health and safety.

To request copies of this guide (which may be reproduced) call DHS, Radiation Protection Section at (608) 267-4797 or for electronic copy go to our web site at:

[http://DHS.wisconsin.gov/dph\\_beh/RadioactiveMat/IndexRM.htm](http://DHS.wisconsin.gov/dph_beh/RadioactiveMat/IndexRM.htm).

This WISREG, ‘Guidance for Uses of Sealed Sources’ has been developed to streamline the application process for a Sealed Source license. A copy of the application DPH form 45017 ‘*Application for A Radioactive Material License Authorizing the Use of Sealed Sources*’ is located in **Appendix A** of this guide.

**Appendixes C** through **K** provide examples, models and additional information that can be used when completing the application.

It typically takes 60-90 days for a license to be processed and issued if the application is complete. When submitting the application be sure to include the appropriate application fee listed in **DHS 157.10** for a commercial pharmacy.

In summary, the applicant will need to do the following to submit an application for a commercial pharmacy license:

- Use this regulatory guide to prepare the application, DPH form 45017: *‘Application for a Radioactive Material License Authorizing the Use of Sealed Sources’* (**Appendix A**).
- Complete the application, DPH form 45017 *‘Application for a Radioactive Material License Authorizing the Use of Sealed Sources’* (**Appendix A**). See ‘Contents of Application’ of the guide for additional information.
- Include any additional attachments.
  - All supplemental pages should be on 8 ½” x 11” paper.
  - Please identify all attachments with the applicant’s name and license number (if a renewal).
- Avoid submitting proprietary information unless it is absolutely necessary.
- Submit an original signed application along with attachments (if any) and if possible a copy on a diskette or CD (Microsoft Word is preferred).
- Submit the application fee.
- Retain one copy of the licensee application and attachments (if any) for your future reference. You will need this information because the license will require that radioactive material be possessed and used in accordance with statements, representation, and procedures provided in the application and supporting documentation.

If you have any questions about the application process please contact DHS Radiation Protection Section at (608) 267-4797.

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## ABBREVIATIONS

ALARA	As low as reasonably achievable
AU	Authorized User
Bq	Becquerel
DHS	Department of Health Services (State of Wisconsin)
DOE	United States Department of Energy
DOT	United States Department of Transportation
GPO	Government Printing Office
IN	Information Notice
mrem	millirem
mSv	millisievert
NIST	National Institute of Standards and Technology
NRC	United States Nuclear Regulatory Commission
NVLAP	National Voluntary Laboratory Accreditation Program
OSL	Optical Stimulated Luminescent Dosimeters
RQ	Reportable Quantities
RSO	Radiation Safety Officer
SS&D	Sealed Source and Devices Bulletin Board System (BBS)
SSD	Sealed Source and Device
Sv	Sievert
TEDE	Total effective dose equivalent
TI	Transportation Index
TLD	Thermoluminescent dosimeters

## PURPOSE OF GUIDE

This WISREG provides guidance to an applicant in preparing a sealed source license application for sources other than portable gauges, XRFs or fixed gauges. It also provides the Wisconsin Department of Health Services (DHS) Radiation Protection Section criteria for evaluating a license application. It is not intended to address the commercial aspects of manufacturing, distribution, and service of devices containing sealed sources.

This guide addresses radiation safety issues associated with sealed sources such as calibration and reference sources. If higher activity sources are being requested, consult with DHS staff for the appropriate guidance and application form.

This report identifies information needed to complete form DPH 45017(**Appendix A**), *"Application for Radioactive Material License Authorizing the Use of Sealed Sources."*

The format within this document for each item of technical information is as follows:

- **Rule**--references the rule(s) applicable to the item;
- **Criteria**--outlines the criteria used to judge the adequacy of the applicant's response;
- **Discussion**--provides additional information on the topic sufficient to meet the needs of most readers; and
- **Response from Applicant**--provides suggested response(s), offers the option of an alternative reply, or indicates that no response is needed on that topic during the licensing process.

The information submitted in the application must be sufficient to demonstrate that proposed equipment, facilities, personnel, and procedures are adequate to protect the health and safety of the citizens of Wisconsin according to DHS's guidelines. Submission of incomplete or inadequate information will result in delays in the approval process for the license. Additional information will be requested when necessary to ensure that an adequate radiation safety program has been established. Such requests for additional information will be requested when necessary. Such requests for additional information will delay completion of the application's review and may be avoided by a thorough study of the rule(s) and these instructions prior to submitting the application.

# WHO REGULATES AT FEDERAL FACILITIES IN WISCONSIN?

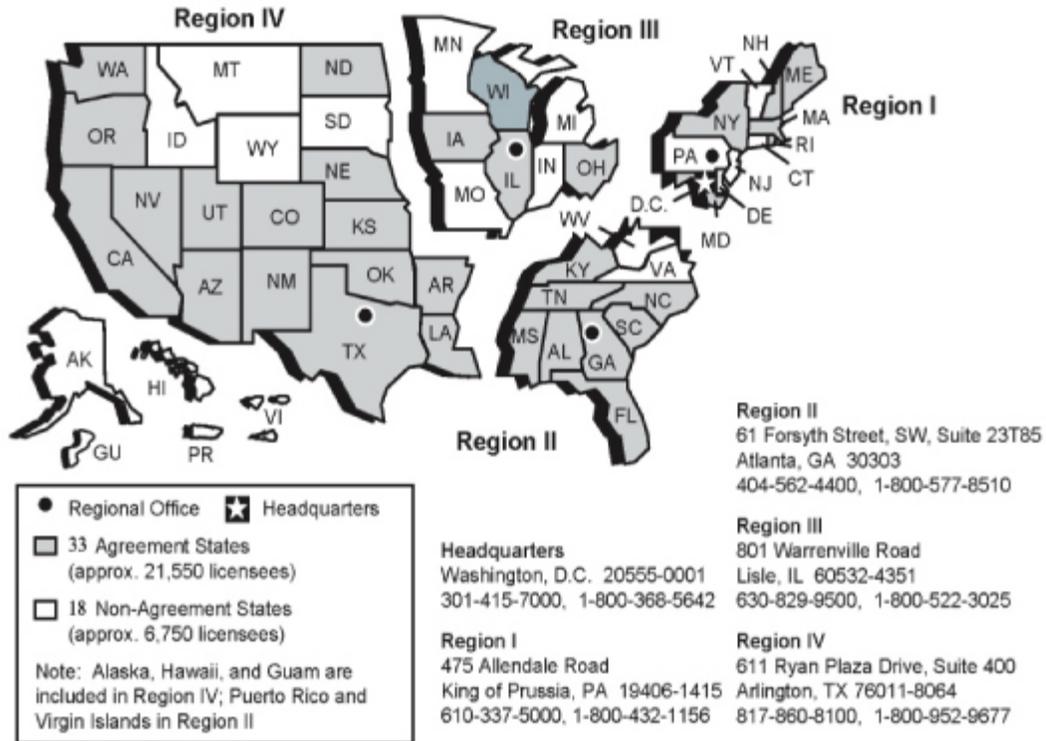
In the special situation of work at federally-controlled sites in Wisconsin, it is necessary to know the jurisdictional status of the land to determine whether Nuclear Regulatory Commission (NRC) or DHS has regulatory authority. NRC has regulatory authority over land determined to be under “exclusive federal jurisdiction,” while DHS has jurisdiction over non-exclusive federal jurisdiction land (see **Table 1**).

Applicants and licensees are responsible for finding out, in advance, the jurisdictional status of the specific areas where they plan to conduct licensed operations. DHS recommends that applicants and licensees ask their local contacts for the federal agency controlling the site (e.g., contract officer, base environmental health officer, district office staff) to help determine the jurisdictional status of the land and to provide the information in writing, so that licensees can comply with NRC or DHS regulatory requirements, as appropriate.

**Table 1. Who Regulates the Activity?**

Applicant and Proposed Location of Work	Regulatory Agency
Federal agency regardless of location (except that Department of Energy [DOE] and, under most circumstances, its prime contractors are exempt from licensing [10 CFR 30.12])	NRC
Non-federal entity in non-Agreement State (see map on next page), U.S. territory, or possession	NRC
Non-federal entity in WI at non-federally controlled site	DHS
Non-federal entity in WI at federally-controlled site <i>not</i> subject to exclusive Federal jurisdiction	DHS
Non-federal entity in WI at federally-controlled site subject to exclusive federal jurisdiction	NRC

## Locations of NRC Offices and Agreement States



**Figure 1.** *U.S. Map. Location of NRC Offices and Agreement States.*

**Reference:** A current list of Agreement States (States that have entered into agreements with the NRC that give them the authority to license and inspect radioactive material used or possessed within their borders), including names, addresses, and telephone numbers of responsible officials may be obtained upon request from NRC’s Regional Offices. NRC Office of State and Tribal Programs (STP) also provides the current list of Agreement States which can be found at <http://www.hsrdo.ornl.gov/NRC>.

## MANAGEMENT RESPONSIBILITY

DHS recognizes that effective radiation safety program management is vital to achieving safe and compliant operations. DHS also believes that consistent compliance with **Chapter DHS 157 ‘Radiation Protection’** provides reasonable assurance that licensed activities will be conducted safely. DHS has found that effective management has been shown to be key to a well-run radiation safety program. Management refers to a senior-level manager who has responsibility for overseeing licensed activities.

To ensure adequate management involvement, a management representative must sign the submitted application acknowledging management’s commitments and responsibility for all the following:

- Radiation safety, security and control of radioactive materials, and compliance with **Chapter DHS 157 ‘Radiation Protection’**;
- Completeness and accuracy of the radiation safety records and all information provided to DHS;
- Knowledge about the contents of the license and application;
- Committing adequate resources (including space, equipment, personnel, time and if needed, contractors) to the radiation protection program to ensure that public and worker safety is protected from radiation hazards and compliance with the rule is maintained; and
- Selecting and assigning a qualified individual to serve as the Radiation Safety Officer (RSO) for their licensed activities.

## APPLICABLE RULE

It is the applicant's or licensee's responsibility to obtain, read and follow **Chapter DHS 157 'Radiation Protection'**.

The following subchapters of **Chapter DHS 157 'Radiation Protection'** contain rules applicable to other sealed sources.

- Subchapter I: 'General Provisions';
- Subchapter II: 'Licensing of Radioactive Materials';
- Subchapter III: 'Standards for Protection from Radiation';
- Subchapter X: 'Notices, Instructions and Reports to Workers';
- Subchapter XI: 'Inspection by the Department';
- Subchapter XII: 'Enforcement'; and
- Subchapter XIII: 'Transportation'.

To request copies of the above documents, call Department of Health Services (DHS), Radiation Protection Section at (608) 267-4797 or for electronic copy go to our web site at:

[http://DHS.wisconsin.gov/dph\\_beh/RadioactiveMat/IndexRM.htm](http://DHS.wisconsin.gov/dph_beh/RadioactiveMat/IndexRM.htm).

# HOW TO FILE

## PAPER APPLICATION

Applicants for a materials license should do the following:

- Be sure to use the current guidance from DHS in preparing an application.
- Complete DPH 45017 '*Application for Radioactive Material License Authorizing the Use of Sealed Sources*'. (**Appendix A**).
- For each separate sheet, other than submitted with the application, identify and key it to the item number on the application, or the topic to which it refers.
- Submit all documents on 8 ½ x 11 inch paper.
- Avoid submitting proprietary information unless it is absolutely necessary.
- Submit an original, signed application.
- Retain one copy of the license application for your future reference.

Deviations from the suggested wording of responses as shown in this document or submission of alternative procedures may require a custom review.

Personal employee information, i.e., home address, home telephone number, Social Security Number, date of birth, and radiation dose information, should not be submitted unless specifically requested by DHS.

## **WHERE TO FILE**

Applicants wishing to possess or use radioactive material in Wisconsin are subject to the requirements of **Wisconsin Administrative Code Chapter DHS 157 ‘Radiation Protection’** and must file a license application with:

*Department of Health Services  
Radiation Protection Section  
P.O. Box 2659  
Madison, WI 53701-2659*

## LICENSE FEES

The appropriate fee must accompany each application or license amendment request. Refer to *DHS 157.10* to determine the amount of the fee. DHS will not issue the new license prior to fee receipt. Once technical review has begun, no fees will be refunded. Application fees will be charged regardless of DHS' disposition of an application or the withdrawal of an application.

Licensees are also subject to annual fees; refer to *DHS 157.10*.

Direct all questions about DHS' fees or completion of **Item 10** of DPH 45017 "*Application for Radioactive Material License Authorizing the Use of Sealed Sources*" (**Appendix A**) to the Department of Health and Family Services, Radiation Protection Section at (608) 267-4797.

# CONTENTS OF AN APPLICATION

## Item 1: License Action Type

On the application check the appropriate box and list the license number for renewal and amendments.

### Response from Applicant:

<b>Item 1 Type of Application</b> (Check one box) <input type="checkbox"/> New License <input type="checkbox"/> Renewal License Number <input type="checkbox"/> Amendment License Number
---

## Item 2: Name and Mailing Address of Applicant

List the legal name of the applicant’s corporation or other legal entity with direct control over use of the radioactive material; a division or department within a legal entity may not be a licensee. An individual may be designated as the applicant only if the individual is acting in a private capacity and the use of the radioactive material is not connected with employment in a corporation or other legal entity. Provide the mailing address where correspondence should be sent. A Post Office box number is an acceptable mailing address.

Notify DHS of changes in the mailing address.

**Note:** DHS must be notified in the event of change of ownership or control and bankruptcy proceedings; see below for more details.

### Response from Applicant:

<b>Item 2. Name and Mailing Address of Applicant</b>   <hr/> <b>Applicant’s Telephone Number (Include Area Code)</b>
---

## **Timely Notification of Change of Ownership or Control:**

**Rule:** *DHS 157.13(10)*

**Criteria:** Licensees must provide full information and obtain DHS's **written consent prior** to transferring ownership or control of the license, or, as some licensees call it, "transferring the license."

**Discussion:** Changes in ownership may be the results of mergers, buyouts, or majority stock transfers. Although it is not DHS's intent to interfere with the business decisions of licensees, it is necessary for licensees to obtain prior DHS written consent. This is to ensure the following:

- Radioactive materials are possessed, used, or controlled only by persons who have valid DHS licenses;
- Materials are properly handled and secured;
- Persons using these materials are competent and committed to implementing appropriate radiological controls;
- A clear chain of custody is established to identify who is responsible for final disposal of the sealed source; and
- Public health and safety are not compromised by the use of such materials.

**Appendix C** identifies the information to be provided about changes of ownership or control.

## **Notification of Bankruptcy Proceedings**

**Rule:** *DHS 157.13(10)*

**Criteria:** Within 10 days following filing of voluntary or involuntary petition for bankruptcy for or against a licensee, the licensee must notify DHS in writing, identifying the bankruptcy court in which the petition was filed and the date of filing.

**Discussion:** Even though a licensee may have filed for bankruptcy, the licensee remains responsible for all regulatory requirements. DHS needs to know when licensees are in bankruptcy proceedings in order to



**Response from Applicant:**

Item 4 List all address(es) where radioactive material(s) will be used or possessed. (Attach additional pages if necessary)		
	Address (Do not use Post Office box)	Telephone Number (Include area code)
<input type="checkbox"/> Used <input type="checkbox"/> Stored <input type="checkbox"/> Used and Stored		
<input type="checkbox"/> Used <input type="checkbox"/> Stored <input type="checkbox"/> Used and Stored		
<input type="checkbox"/> Used <input type="checkbox"/> Stored <input type="checkbox"/> Used and Stored		
Are sealed sources used at temporary jobsites?: <input type="checkbox"/> Yes <input type="checkbox"/> No		

**Note:** As discussed later under "Financial Assurance and Record keeping for Decommissioning," licensees need to maintain permanent records on where licensed material was used or stored while the license was in force. This is important for making future determinations about the release of these locations for unrestricted use (e.g., before the license is terminated). For licensees, acceptable records are sketches or written descriptions of storage or use locations specifically listed on the license. Licensees do not need to maintain this information for temporary job sites or temporary storage locations where sources have never leaked.

**Item 5: Radiation Safety Officer (RSO)**

**Rule:** *DHS 157.13(2)*

**Criteria:** RSO must have adequate training and experience.

**Discussion:** The person responsible for the radiation protection program is called the RSO. The RSO needs independent authority to stop operations that he or she considers unsafe. He or she must have sufficient time and commitment from management to fulfill certain duties and responsibilities to ensure

that radioactive materials are used in a safe manner. DHS requires the name of the RSO on the license to ensure that licensee management has identified a qualified person and that the named individual knows of his or her designation as RSO. This individual should have specific training and experience in the use and handling of sealed sources.

**Response from Applicant:**

<b>Item 5 Radiation Safety Officer (RSO)</b> (Check both boxes)	
<input type="checkbox"/> The name of the proposed RSO and other potential designees who will be responsible for ensuring that the licensee's radiation safety program is implemented in accordance with approved procedures.	
NAME: _____	TELEPHONE NUMBER: _____ (Include area code)
<input type="checkbox"/> Information demonstrating that the proposed RSO is qualified by training and experience is attached.	

**Note:**

- It is important to notify DHS, as soon as possible, of changes in the designation of the RSO.

**Item 6: Authorized Users**

**Rule:** *DHS 157.88(1-2); DHS 157.13(2).*

**Criteria:** Authorized users must have adequate training and experience.

**Discussion:** An AU is a person whose training and experience meet DHS's criteria. This individual is named on the license and uses or directly supervises the use of licensed material. AUs must ensure the proper use and security of the sealed sources. An AU is considered to be supervising the use of licensed material when he or she directs personnel in operations involving the material. Although the AU may delegate specific tasks to supervised users (e.g., maintaining records), he or she is still responsible for safe use of licensed material.

A trained individual must perform any operation that involves the removal of a sealed source from a device or maintenance and repair of a device that involves a sealed source. The trained individual shall have received instruction and training in the principles and practices of radiation safety, the use of radiation detection instruments, and the performance of these operations. See **Appendix D** for suggested training topics. In the application, provide the following information:

- Name of each trained individual who will perform the operations
- Outline of the instruction and training that each individual has received. The amount of time spent on each topic in the training should be specified.

**Response from Applicant:**

<p><b>Item 6 Authorized Users</b> (check all that apply)</p> <p><input type="checkbox"/> We will attach a list of each proposed authorized user with the types and quantities of licensed material to be used.</p> <p style="text-align: center;">AND</p> <p><input type="checkbox"/> Information is attached demonstrating that each proposed authorized user is qualified by training and experience to use the requested licensed material.</p> <p><b>NOTE:</b> If requesting authorization to perform non-routine maintenance, submit outline of the instruction and training for individuals performing non-routine maintenance.</p>
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**Note:** Persons who will only use a sealed source and device, if applicable, under the supervision of the trained individual named in **Item 6** need no special training. These individuals should not be permitted to perform any maintenance or repair operations. Only trained individuals specifically named in **Item 6** shall perform such operations.

**Item 7: Radioactive Material**

**Item 7.1: Sealed Sources**

**Rule:** *DHS 157.13(1-2)*

**Criteria:** Licensees will only be authorized for sealed sources and devices listed in the Sealed Source and Device Registry. Sealed sources and devices may be used only for the purposes for which they are designed and specified in an SSD Registration Sheet.

**Discussion:** Consult with the proposed manufacturer or distributor to ensure that sources and devices conform to the sealed source and device designations registered with NRC or another Agreement State. Licensees may not make any changes to the sealed source, device, or source/device combination that would alter the description or specifications from those indicated in the respective registration certificates, without obtaining DHS’s prior permission in a license amendment. Such changes may necessitate a custom review, increasing the time needed to process a licensing action.

SSD Registration Certificates contain sections on “Conditions of Normal Use” and “Limitation and Other Considerations of Use.” These sections may include limitations derived from conditions imposed by the manufacturer or distributor, in particular conditions of use that would reduce radiation safety of the device, or by circumstances unique to the sealed source or device. For example, working life of the device or appropriate temperature and other environmental conditions may be specified. Except as specifically approved by DHS, licensees are required to use devices containing sealed sources according to their respective SSD Registration Certificates. Applicants should obtain a copy of the certificate and review it with the manufacturer or distributor or with DHS, NRC or the issuing Agreement State to ensure that it correctly reflects the radiation safety properties of the source or device.

The applicant should provide the following:

- The radioisotopes(s) that will be used.
- The manufacturer and model number of the sealed source that will be used.
- The quantity (activity) of radioactive material that will be in each sealed source. Provide the number of sources of sealed source that will be possessed, if known. If the total number for each type of source is unknown, provide an anticipated total.
- The manufacturer and model number of the device containing the sealed source-if applicable.
- The purpose for which each sealed source(s) will be used (e.g., State that possession of sealed sources will be used for commercial calibration of radiation survey instruments and/or personnel dosimetry).

**Note:** Unusual uses will be evaluated on a case-by-case basis and the authorized use condition will reflect approved uses.

**Response from Applicant:**

<b>Item 7 Radioactive Material</b> (Attach additional pages if necessary)	
Element and mass number	Chemical and physical form <b>SEALED SOURCE</b>
Source manufacturer and model number	Maximum activity per source
Sealed source and device registration sheet number	Device manufacturer and model number
Intended use	

**Note:** Information on SSD registration certificates is also available electronically on NRC's Sealed Source and Devices Bulletin Board System (SS&D BBS) which can be accessed, free of charge, on the internet at: <http://www.hsr.d.o.gov/nrc/ssdrform.htm>. For information about the SS&D BBS or the new electronic location, contact the NRC's Registration Assistant at (301) 415-7231 or alternatively contact DHS.

**Item 7.2: Financial Assurance and Record Keeping for Decommissioning**

**Rule:** *DHS 157.13(10) and (15); DHS 157.15*

**Criteria:** Licensees possessing sealed sources containing radioactive material in excess of the limits specified in *DHS 157.15* must provide evidence of financial assurance for decommissioning.

Licensees are required to maintain, in an identified location, decommissioning records related to structures and equipment where sealed sources are used or stored and for any leaking sources. Licensees must transfer records important to decommissioning either to the new licensee before licensed activities are transferred or assigned in accordance with *DHS 157.13(10) & (15)* or to DHS before the license is terminated.

**Discussion:** The requirements for financial assurance are specific to the types and quantities of radioactive material authorized on a license. Most applicants and licensees do not need to comply with the financial assurance requirements because the thresholds for sealed sources are  $3.7 \times 10^6$  gigabecquerels (100,000

curies) of cesium-137 or  $3.7 \times 10^3$  gigabecquerels (100 curies) of americium-241 or californium-252. Since the standard license may not specify the maximum number of sealed sources that the licensee may possess (allowing the licensee flexibility in obtaining sealed sources as needed without amending its license), it may contain a condition requiring the licensee to limit its possession of sealed sources to quantities not requiring financial assurance for decommissioning. Applicants and licensees desiring to possess sealed sources exceeding the threshold amounts must submit evidence of financial assurance.

The same rule also requires that licensees maintain records important to decommissioning in an identified location. All sealed source licensees need to maintain records of structures and equipment where sealed sources are used or stored at locations specifically listed on the license. As-built drawings with modifications of structures and equipment shown as appropriate fulfill this requirement. If drawings are not available, licensees may substitute appropriate records concerning the areas and locations. In addition, if licensees have experienced unusual occurrences (e.g., leaking sources), they also need to maintain records about contamination that remains after cleanup or that may have spread to inaccessible areas.

For sealed source licensees whose sources have never leaked, acceptable records important to decommissioning are sketches or written descriptions of storage or use locations specifically listed on the license. Similar information need not be maintained for temporary job sites.

Licensees must transfer records important to decommissioning either to the new licensee before licensed activities are transferred or assigned in accordance with *DHS 157.13(10) & (15)* or to DHS before the license is terminated.

**Reference:** NRC *Regulatory Guide 3.66* “Standard Format and Content of Financial Assurance Mechanisms Required for Decommissioning Under 10 CFR Parts 30, 40, 70 and 72,” is available from NRC at <http://www.nrc.gov>.

## **Item 8: Facilities and Equipment**

**Rule:** *DHS 157.13(2); DHS 157.21; DHS 157.22; DHS 157.23; DHS 157.28*

**Criteria:** *DHS 157.13(2)* states that an application will be approved if the applicant's proposed equipment and facilities are adequate to protect health and to minimize danger to life or property. *DHS 157.28(1)* also states that licensed material stored in an unrestricted area must be secured from unauthorized removal, and licensed materials in an unrestricted area and not in storage must be under the constant surveillance and immediate control of the licensee.

**Discussion:** The room or storage area in which the sealed source and device, if applicable, is located should be:

- Accessible only to persons authorized to use the sealed source or device and
- Locked when an authorized person is not physically present.

The application should state that the room or storage area will be locked or secured when an authorized person is not present. The room or storage area cannot be considered a restricted area if it is accessible to unauthorized persons.

The key elements for applicants are ensuring compliance with public dose limits and maintaining adequate security and control over the sealed sources.

**Response from Applicant:**

<p><b>Item 8 Facilities And Equipment</b> (Check boxes and attach diagram.)</p> <p><input type="checkbox"/> Diagrams of radioactive material storage area(s) are attached.</p> <p style="text-align: center;">And</p> <p><input type="checkbox"/> We will lock or secure the room or storage area when the authorized user is not physically present.</p>
---

**ITEM 9: Radiation Safety Program**

**Item 9.1: Audit Program**

**Rule:** *DHS 157.21; DHS 157.31(2)*

**Criteria:** Licensees must review the content and implementation of their radiation protection programs annually to ensure the following:

- Compliance with DHS and DOT regulations, and the terms and conditions of the license;
- Occupational doses and doses to members of the public are as low as reasonably achievable (*ALARA*) (*DHS 157.21*); and
- Records of audits and other reviews of program content are maintained for 3 years.

**Discussion:** Licensees must review the content and implementation of their radiation protection programs annually, to ensure compliance with DHS rules and with the terms and conditions of the license.

**Appendix F** contains a suggested audit program that is acceptable to DHS. All areas indicated in **Appendix F** may not be applicable to every licensee and may not need to be addressed during each audit.

With regard to audit records, *DHS 157.31 (2)* requires licensees to maintain records of "... audits and other reviews of program content and implementation." DHS has found audit records that contain the following information to be acceptable: date of audit, name of person(s) who conducted audit, persons contacted by the auditor(s), areas audited, audit findings, corrective actions, and follow-up.

**Response From Applicant:**

**Item 9.1 Audit Program**  
The applicant is not required to submit its audit program to the department for review during the licensing phase. This matter will be examined during an inspection.

**Item 9.2: Radiation Monitoring Instruments**

**Rule:** *DHS 157.13(2); DHS 157.25(1); DHS 157.31(3)*

**Criteria:** Licensees must possess, or have access to, radiation monitoring instruments that are necessary to protect health and minimize danger to life or property.

**Discussion:** Licensees shall possess, or have access to, calibrated radiation measurement instruments or licensed services to perform, as necessary the following:

- Package receipt surveys
- Sealed source leak tests
- Unrestricted area dose rate measurements

For the purposes of this document, survey instruments are defined as any device used to measure the radiation exposure or contamination levels at a licensed facility. Survey instruments that may be used to perform these measurements include exposure rate meters or contamination survey meters.

Applicants should include descriptions of the instrumentation available for use and instrumentation applicants intend to purchase prior to starting licensed activities. The description should include type of instrument and detector and its intended purpose.

DHS requires that calibrations be performed by the instrument manufacturer or a person specifically authorized by DHS, the NRC or an Agreement State. Applicants seeking authorization to perform survey instrument calibrations shall submit procedures for review. **Appendix E** provides information about instrument specifications and calibration procedures.

**Response from Applicant:**

<p><b>Item 9.2 Radiation Monitoring Instruments</b> (Check all that apply)</p> <p><input type="checkbox"/> We will have access to a survey meter that meets the Criteria in the section titled "Radiation Monitoring Instruments" in WISREG "Guidance for Uses of Sealed Sources". (Description attached)</p> <p style="text-align: center;">OR</p> <p><input type="checkbox"/> We will possess a survey meter that meets the Criteria in the section titled "Radiation Monitoring Instruments" in WISREG "Guidance for Uses of Sealed Sources."</p> <p style="text-align: center;">AND ONE OF THE FOLLOWING</p> <p><input type="checkbox"/> Each survey meter will be calibrated by an organization licensed by DHS, the NRC or an Agreement State to perform survey meter calibrations.</p> <p style="text-align: center;">OR</p> <p><input type="checkbox"/> We will implement the model survey meter calibration program published in Appendix E in WISREG "Guidance for Uses of Sealed Sources."</p> <p style="text-align: center;">OR</p> <p><input type="checkbox"/> We will submit alternative calibration procedures for DHS review. (Procedures are attached)</p>
---

**Item 9.3: Material Receipt and Accountability**

**Rule:** *DHS 157.06, DHS 157.13(9)(b), (10),(15) and (18); DHS 157.31*

**Criteria:** Licensees must do the following:

- Maintain records of receipt, transfer, and disposal for all sealed sources; and
- Conduct physical inventories at intervals not to exceed 6 months (or some other interval justified by the applicant) to account for all sealed sources.

**Discussion:** Licensees are required to maintain records of receipt, transfer, and disposal of licensed material. Loss, theft, or misplacement of radioactive material can occur; therefore control and

accountability of sealed sources must be ensured. Licensees who use and/or possess sealed sources are required by license conditions to perform inventories of sealed sources every six months. Sealed sources that are not in use may be placed in storage and shall be inventoried at least every 6 months.

Inventory records should be maintained and contain the following types of information:

- Radionuclide and amount (in units of becquerels or curies) of radioactive material in each sealed source;
- Manufacturer's name, model number, and serial number (if appropriate) of each device containing radioactive material;
- Location of each sealed source and device; and
- Date of the inventory.

**Response from Applicant:**

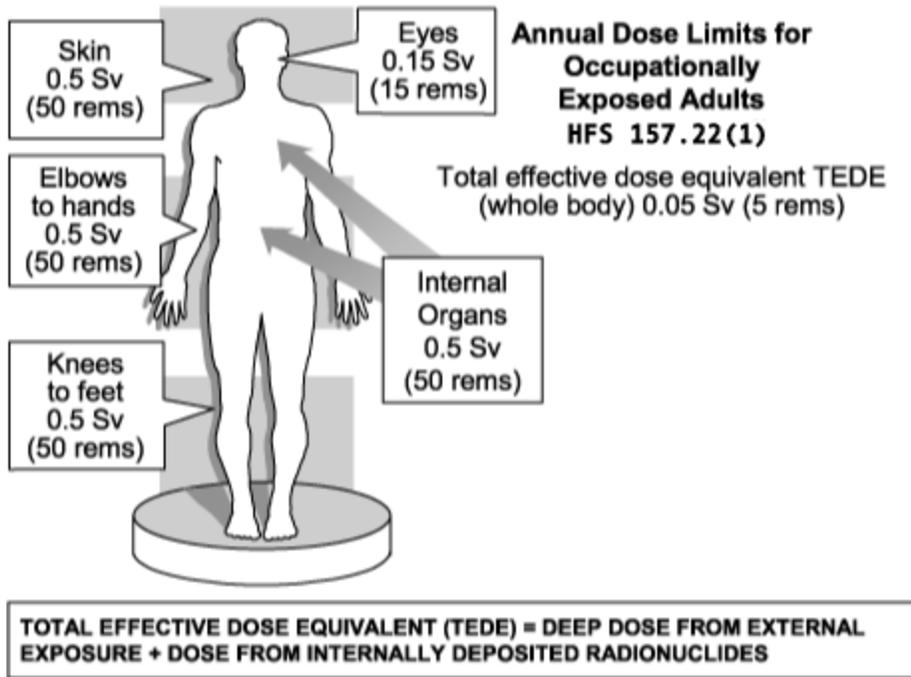
<p><b>Item 9.3 Material Receipt And Accountability</b> (Check one box)</p> <p><input type="checkbox"/> We will conduct physical inventories at intervals not to exceed 6 months, to account for all sealed sources and devices received and possessed under the license.</p> <p style="text-align: center;">OR</p> <p><input type="checkbox"/> We will submit a description of the frequency and procedures for ensuring that no sealed sources have been lost, stolen, or misplaced. (Procedures are attached)</p>
---

**Item 9.4: Occupational Dosimetry**

**Rule:** *DHS 157.25(2); DHS 157.22(1)(7-8); DHS 157.25(2)(a)(6)*

**Criteria:** Applicants must do either of the following:

- Provide dosimetry processed and evaluated by a National Voluntary Laboratory Accreditation Program (NVLAP) approved processor that is exchanged at a frequency recommended by the processor.
- OR
- Maintain, for inspection by DHS, documentation demonstrating that unmonitored individuals are not likely to receive, in one year, a radiation dose in excess of 10 percent of the allowable limits as shown in **Figure 2**.



**Figure 2. Annual Dose Limits for Radiation Workers.**

**Discussion:** Under conditions of routine use, many sealed source users do not require a personnel monitoring device (dosimetry). If a written evaluation demonstrates that sealed source users are not likely to exceed 10 percent of the applicable limits, users are not required to have personnel dosimetry.

**Appendix I Part I** provides guidance on preparing this written evaluation.

Licensees who do provide personnel monitoring use either film badges, optically stimulated luminescent (OSLs) dosimetry or thermoluminescent dosimeters (TLDs) that are supplied by a NVLAP-approved processor. Applicants should verify that the processor is NVLAP-approved. Consult the NVLAP-approved processor for its recommendations for exchange frequency and proper use.

**Response from Applicant:**

**Item 9.4 Occupational Dosimetry** (Check one)

- We will maintain, for inspection by DHS, documentation demonstrating that unmonitored individuals are not likely to receive, in one year, a radiation dose in excess of 10 percent of the allowable limits in s. DHS 157.22.

OR

- We will provide dosimetry processed and evaluated by a NVLAP-approved processor that is exchanged at a frequency recommended by the processor

**Reference:** *National Institute of Standards and Technology (NIST) Publication 810*, "National Voluntary Laboratory Accreditation Program Directory," is published annually and is available for purchase from **United States Government Printing Office** and on the Internet at the following address: <http://nvl.nist.gov/>

### **Item 9.5: Public Dose**

**Rule:** *DHS 157.23 (1-2); DHS 157.03; DHS 157.28 (1) (a) and (b); DHS 157.31 (8)*

**Criteria:** Licensees must do the following:

- Ensure that sealed sources will be used, transported, and stored in such a way that members of the public will not receive more than 1 millisievert (100 millirem) in one year, and the dose in any unrestricted area will not exceed 0.02 millisievert (2 millirem) in any one hour, from licensed operations.
- Control and maintain constant surveillance over sealed sources that are not in storage and secure sealed sources from unauthorized removal or use.

**Discussion:** "Public dose" is defined in *DHS 157.03* as the dose received by a member of the public from exposure to radiation and/or radioactive material released by a licensee, or to any other source of radiation under the control of a licensee. Public dose excludes doses received from background radiation and from medical procedures. Whether the dose to an individual is an occupational dose or a public dose depends on the individuals assigned duties. It does not depend on the area (restricted, controlled, or unrestricted) the individual is in when the dose is received.

Members of the public include persons who live, work, or may be near locations where sealed sources are used or stored and employees whose assigned duties do not include the use of licensed materials and who work in the vicinity where sealed sources are used or stored.

Operating and emergency procedures regarding security and surveillance specified under that section of this document should be sufficient to limit the exposure to the public during use or storage and after accidents. Public dose is controlled, in part, by ensuring that sealed sources not in use are stored securely (e.g., stored in a locked area) to prevent unauthorized access or use. If sealed sources are not in storage, then authorized users must maintain constant surveillance to ensure that members of the public, who could be co-workers, cannot get near the sealed sources and thus receive unneeded radiation exposure.

Public dose is also affected by the choice of storage location and conditions. Since a sealed source presents a radiation field during storage, it must be stored so that the radiation level in an unrestricted area (e.g., an office or the exterior surface of an outside wall) does not exceed 1 mSv (100 mrem) in a year or 0.02 mSv (2 mrem) in any one hour. Use the concepts of time, distance, and shielding when choosing a permanent or temporary storage location. Decreasing the time spent near an unshielded sealed source, increasing the distance from the unshielded sealed source, and using shielding (i.e., brick, concrete, lead, or other solid walls) will reduce the radiation exposure. As a rule of thumb, sealed sources should be stored as far away as possible from areas that are occupied by members of the public.

Licensees can determine the radiation levels adjacent to the storage location either by calculations or a combination of direct measurements and calculations using any or all of the following: typical known radiation levels provided by the manufacturer, the "inverse square" law to evaluate the effect of distance on radiation levels, and occupancy factors to account for the actual presence of the member of the public and of the sealed sources used. See **Part 2 of Appendix I** for examples.

If, after making an initial evaluation, a licensee makes changes affecting the storage area (e.g., changing the location of sealed sources within the storage or use area, removing shielding, adding sealed sources, changing the occupancy of adjacent areas, moving the storage area to a new location), then the licensee must ensure that sealed sources are properly secured, perform a new evaluation to ensure that the public dose limits are not exceeded, and take corrective action, as needed.

**Response from Applicant:**

**Item 9.5 Public Dose**

No response is required, in this license application, however the licensee's evaluation of public dose will be examined during an inspection.

**Item 9.6: Operating and Emergency Procedures**

**Rule:** *DHS 157.13 (9) (a) and (b); DHS 157.21; DHS 157.32 (1-3); DHS 157.13(17);  
DHS 157.28 (1) (a) and (b);*

**Criteria:** Operating and emergency procedures must be developed to minimize risks of loss or theft as well as to ensure safe use of radioactive material. DHS considers security of sealed sources extremely important and lack of security is a significant violation for which licensees are fined.

**Discussion:** Operating and emergency procedures shall contain the following elements:

- Instructions for using the sealed sources and device-if applicable and performing routine maintenance, according to the manufacturer's recommendations and instructions;
- Instructions for maintaining security during use, storage and transportation;
- Instructions for keeping the sealed source under control and immediate surveillance during use;
- Instructions for keeping radiation exposures ALARA.

Notify DHS when sealed sources are lost or stolen. Refer to **Chapter DHS 157 'Radiation Protection'** for a description of when and where notifications are required.

**Response from Applicant:**

**Item 9.6 Operating And Emergency Procedures** (Check box)

- Operating and emergency procedures will be developed, implemented, and maintained, and will meet criteria in the section titled 'Operating and Emergency Procedures' in WISREG "Guidance for Uses of Sealed Sources."  
(Procedures are attached)

## Item 9.7: Leak Tests

**Rule:** *DHS 157.24*

**Criteria:** DHS requires testing to determine whether there is any radioactive leakage from the source in the device. Records of leak tests results must be maintained.

**Discussion:** DHS finds testing to be acceptable if it is conducted by an organization approved by DHS, the NRC or an Agreement State or according to procedures approved by DHS.

A licensee will be required to ensure performance of leak tests at intervals approved by the NRC or another Agreement State and specified by the SSD Registration Certificate. The measurement of the leak-test sample is a quantitative analysis requiring that instrumentation used to analyze the sample be capable of detecting 185 Bq (0.005  $\mu$ Ci) of radioactivity.

Manufacturers, consultants, and other organizations may be authorized by DHS, the NRC or an Agreement State either to perform the entire leak test sequence for other licensees or to provide leak test kits to licensees. In the latter case, the licensee is expected to take the leak test sample according to the sealed source manufacturer's (distributor's) and the kit supplier's instructions and return it to the kit supplier for evaluation and reporting results. Leak test samples should be collected at the most accessible area where contamination would accumulate if the sealed source were leaking. Licensees may also be authorized to conduct the entire leak test sequence themselves by adopting the procedures in **Appendix J** or submitting alternative procedures.

**Response from Applicant:**

**Item 9.7 Leak Tests** (Check one box)

Leak tests will be performed by an organization authorized by DHS, the NRC or an Agreement State to provide leak testing services to other licensees; or by using a leak test kit supplied by an organization licensed by DHS, the NRC or an Agreement State to provide leak test kits to other licensees according to kit supplier's instructions.

List name and license number of organization authorized to perform or analyze leak test ( Specify whether DHS, NRC, or other Agreement State)

Organization Name \_\_\_\_\_ License Number \_\_\_\_\_

**Note:** An alternate organization may be used to perform or analyze leak test, without amending the license, provided the Organization is specifically authorized by DHS, NRC, or an Agreement State.

OR

We will perform leak testing and sample analysis and will follow the procedures in Appendix J of WISREG "Guidance for Uses of Sealed Sources." (Procedures are attached)

OR

We will submit alternative procedures. (Procedures are attached)

**Item 9.8: Maintenance and Repair**

**Rule:** *DHS 157.21; DHS 157.13 (9) (b) and (10);*

**Criteria:** Radiation safety procedures must consider the possibility of receiving exposures to the whole body, as well as to the hands, from handling the sealed sources during maintenance and repair. Licensees should keep such exposures ALARA and ensure that the device functions as designed and source integrity is not compromised.

**Discussion:** Licensees may need to clean and maintain devices containing sealed sources according to manufacturer recommendations and instructions. Written procedures provided by the device manufacturer should be followed. If a procedure other than that provided by the device manufacturer, submit a proposed procedure.

**Response from Applicant:**

<p><b>Item 9.8 Maintenance and Repair</b> (Check one box)</p> <p><input type="checkbox"/> We will send the device to the manufacturer or other person authorized by DHS, the NRC or an Agreement State to perform maintenance or repair operations.</p> <p style="text-align: center;">OR</p> <p><input type="checkbox"/> We will implement and maintain procedures for maintenance of devices containing sealed sources according to each manufacturer's recommendations and instructions.</p> <p style="text-align: center;">OR</p> <p><input type="checkbox"/> We will develop, implement and maintain procedures for maintenance of devices containing sealed sources. (Procedures are attached)</p> <p style="text-align: center;">OR</p> <p><input type="checkbox"/> We will only possess sealed sources not in devices. No maintenance or repair is required.</p>
--

**Item 9.9: Transportation**

**Rule:** *DHS 157.92 (3); DHS 157.21; 49 CFR Parts 171-178*

**Criteria:** Applicants must develop, implement, and maintain safety programs for public transport of radioactive material to ensure compliance with DOT regulations.

**Discussion:** If authorization has been requested in the application to use sealed sources at a temporary jobsite, the applicant must consider DOT regulations. The applicant is not required to submit transportation information with the application.

**Response from Applicant:**

<p><b>Item 9.9 Transportation</b></p> <p>No response is needed during the license process; this issue will be reviewed during inspection.</p>
---

**Item 9.10: Waste Management**

**Rule:** *DHS 157.30 (1); DHS 157.13 (15); DHS 157.13(18)*

**Criteria:** Licensed materials must be disposed of in accordance with DHS requirements by transfer to an authorized recipient. Appropriate records must be maintained.

**Discussion:** The usual disposal option is to transfer the licensed material to an authorized recipient. Authorized recipients are the original supplier of the sealed source or device, a commercial firm licensed by DHS, the NRC or an Agreement State to accept radioactive waste from other persons, or another specific licensee authorized to possess the licensed material. No one else is authorized to receive licensed material.

**Response from Applicant:**

<p><b>Item 9.10 Waste Management</b> (Check box)</p> <p><input type="checkbox"/> We will transfer the sealed source or device containing the sealed source to the manufacturer or a specifically licensed recipient for disposal.</p>
---

**Item 9.11: Termination of Activities**

**Rule:** *DHS 157.13(10),(11) and (15); DHS 157.15; DHS 157.31*

**Criteria:** The licensee must do the following:

- Notify DHS in writing, within 30 days of the decision to permanently discontinue all activities involving materials authorized under the license.
- Notify DHS in writing, within 60 days, when principal activities have not been conducted for a period of 24 months.
- Certify the disposition of licensed materials by submission of *DHS DPH 45007 "Certificate of Disposition of Materials."* (See **Appendix B**).
- Before a license is terminated, send the records important to decommissioning (as required by *DHS 157.15*) to DHS. If licensed activities are transferred or assigned in accordance with *DHS 157.13(15)*, transfer records important to decommissioning to the new licensee.

**Discussion:** For guidance on the disposition of licensed material, see the **Item 9.10 Waste Management**. For guidance on decommissioning records, see the section on **Item 7.2 Radioactive Materials - Financial Assurance and Record keeping for Decommissioning**.

**Response from Applicant:**

<p><b>Item 9.11 Termination Of Activities</b> (Check box)</p> <p><input type="checkbox"/> We will notify DHS, in writing, within 30 days of the decision to permanently cease radioactive material use. s. DHS 157.13 (10)(d)</p>
---

**Item 10: Fees**

On *DHS Application for Radioactive Material License Authorizing the Use of Sealed Sources, DPH 45017* enter the fee category and the amount. Enclose fee with the application.

**Response from Applicant:**

<b>Item 10 License Fees</b> (Refer to Wisconsin Administrative Code DHS 157.10)	
Category:	License Fee Enclosed <input type="checkbox"/> Yes <input type="checkbox"/> No    Amount Enclosed \$

**Item 11: Certification**

Individuals acting in a private capacity are required to sign and date *DHS Application for Radioactive Material License Authorizing the Use of Sealed Sources, DPH 45017*. Otherwise, senior representatives of the corporation or legal entity filing the application should sign and date *DHS Application for Radioactive Material License Authorizing the Use of Sealed Sources* .

**Representatives signing an application must be authorized to make binding commitments and sign official documents on behalf of the applicant. DHS will return all unsigned applications for proper signature.**

*Note:*

- It is a violation of **Wisconsin Administrative Code, Chapter DHS 157 ‘Radiation Protection’** to make a willful false statement or representation on applications or correspondence.
- When the application references commitments, those items become part of the licensing conditions and regulatory requirements.

**Response from Applicant:**

<b>Item 11</b>	
I hereby certify that this application was prepared in conformance with Wisconsin Administrative Code Chapter DHS 157 "Radiation Protection" and that all information contained herein, including any supplements attached hereto, is true and correct to the best of my knowledge and belief.	
<b>SIGNATURE</b> - Applicant Or Authorized Individual	Date signed
Print Name and Title of above signatory	

**Appendix A:**

**DPH 45017**

***Application For Radioactive Material License  
Authorizing the Use of Sealed Sources***

**To access this form please go to**  
**<http://DHS.wisconsin.gov/forms/DPH/dph45017.pdf>**

**Appendix B:**

***DPH 45007***

***Certificate of Disposition of Materials***

**To access this form please go to**  
**<http://DHS.wisconsin.gov/forms/DPH/dph45007.pdf>**

**Appendix C:**  
**Information Needed for Change of Ownership or Control  
Application**

Licensees must provide full information and obtain DHS's **prior written consent** before transferring ownership or control of the license; some licensees refer to this as "transferring the license." Provide the following information concerning changes of ownership or control by the applicant (transferor and/or transferee, as appropriate). If any items are not applicable, so state.

1. The new name of the licensed organization. If there is no change, the licensee should so state.
2. The new licensee contact and telephone number(s) to facilitate communications.
3. Any changes in personnel having control over licensed activities (e.g., officers of a corporation) and any changes in personnel named in the license such as radiation safety officer, authorized users, or any other persons identified in previous license applications as responsible for radiation safety or use of licensed material. The licensee should include information concerning the qualifications, training, and responsibilities of new individuals.
4. An indication of whether the transferor will remain in non-licensed business without the license.
5. A complete, clear description of the transaction, including any transfer of stocks or assets, mergers, etc., so that legal counsel is able, when necessary, to differentiate between name changes and changes of ownership.
6. A complete description of any planned changes in organization, location, facility, equipment, or procedures (i.e., changes in operating or emergency procedures).
7. A detailed description of any changes in the use, possession, location, or storage of the licensed materials.
8. Any changes in organization, location, facilities, equipment, procedures, or personnel that would require a license amendment even without the change of ownership.
9. An indication of whether all surveillance items and records (e.g., calibrations, leak tests, surveys, inventories, and accountability requirements) will be current at the time of transfer. Provide a description of the status of all surveillance requirements and records.

10. Confirmation that all records concerning the safe and effective decommissioning of the facility, pursuant to *DHS 157.15*; public dose; and waste disposal by release to sewers, incineration, radioactive material spills, and on-site burials, have been transferred to the new licensee, if licensed activities will continue at the same location, or to DHS for license terminations.
11. A description of the status of the facility. Specifically, the presence or absence of contamination should be documented. If contamination is present, will decontamination occur before transfer? If not, does the successor company agree to assume full liability for the decontamination of the facility or site?
12. A description of any decontamination plans, including financial assurance arrangements of the transferee, as specified in *DHS 157.15*. Include information about how the transferee and transferor propose to divide the transferor's assets, and responsibility for any cleanup needed at the time of transfer.
13. Confirmation that the transferee agrees to abide by all commitments and representations previously made to DHS by the transferor. These include, but are not limited to: maintaining decommissioning records required by *DHS 157.15*; implementing decontamination activities and decommissioning of the site; and completing corrective actions for open inspection items and enforcement actions.

With regard to contamination of facilities and equipment, the transferee should confirm, in writing, that it accepts full liability for the site, and should provide evidence of adequate resources to fund decommissioning; or the transferor should provide a commitment to decontaminate the facility before change of control or ownership.

With regard to open inspection items, etc., the transferee should confirm, in writing, that it accepts full responsibility for open inspection items and/or any resulting enforcement actions; or the transferee proposes alternative measures for meeting the requirements; or the transferor provides a commitment to close out all such actions with DHS before license transfer.

14. Documentation that the transferor and transferee agree to the change in ownership or control of the licensed material and activity, and the conditions of transfer; and the transferee is made aware of all open inspection items and its responsibility for possible resulting enforcement actions.
  
15. A commitment by the transferee to abide by all constraints, conditions, requirements, representations, and commitments identified in the existing license. If not, the transferee must provide a description of its program, to ensure compliance with the license and DHS Rule.

**Appendix D:**  
**Criteria for Acceptable Training and Experience for**  
**Authorized Users**

## **Criteria for Acceptable Training and Experience for Authorized Users Classroom Training**

Classroom training may be in the form of lecture, videotape, or self-study that emphasize practical subject matter important to the safe handling of licensed materials. Duration and technical level of training should be commensurate with the expected hazards encountered during routine and emergency conditions.

### **Frequency of Training**

- Before assuming duties with, or in the vicinity of, radioactive materials;
- Whenever there is a significant change in duties, regulations, or the terms and conditions of the license;
- Annually for refresher training.

### **Suggested Radiation Safety Topics**

- Fundamentals of Radiation Safety:
  - Characteristics of radiation;
  - Units of radiation dose and quantity of radioactivity;
  - Hazards of exposure to radiation;
  - Levels of radiation from licensed material;
  - Methods of controlling radiation dose (time, distance, and shielding);
  - ALARA concept.
- Radiation Detection Instruments:
  - Operation;
  - Calibration;
  - Limitations of radiation survey instruments;
  - Radiation survey techniques for measuring radiation field;
  - Radiation survey techniques for measuring removable/fixed contamination;
  - Handling and proper use of personnel monitoring equipment.
- Radiation Protection Equipment and Use:
  - Proper use of protective equipment;
  - Decontamination of contaminated protection equipment.
- **Chapter DHS 157 ‘Radiation Protection’**
- Licensee's operating and emergency procedures.

- Case histories relevant to operations.
- Course Examination (Didactic):
  - Successful completion of closed-book written/oral examination depending on the complexity and hazards of authorized activities;
  - Review of incorrect answers with student.
- On-the Job Training and Examination (Practical):
  - On-the-job training done under the supervision of a qualified individual (AU, RSO, or manufacturer's representative authorized by DHS, the NRC or an Agreement State) that includes supervised hands-on experience performing the task authorized on the license that are commensurate with the expected hazards during routine and emergency conditions;
  - Practical examination consisting of an assessment by the RSO to ensure that each proposed AU is qualified to work independently and that each individual is knowledgeable of the radiation safety aspects of licensed activities. This may be demonstrated by observing the proposed AU perform licensed activities.
- Discussion and/or drill on emergency procedures.
- Retraining on areas found to be deficient in both the practical and didactic areas.

### **Classroom Course Instructor Qualifications**

The person conducting the training should be a qualified individual (e.g., a person who meets the qualifications for RSO or authorized user on the license and is familiar with the licensee's program). Instructors who provide classroom training to individuals in the principles of radiation and radiation safety should have knowledge and understanding of these principles beyond those obtainable in a course similar to the one given to prospective authorized users. Individuals who provide instruction in the hands-on use of licensed materials should have training and experience that would qualify them to be authorized users, or should possess a thorough understanding of the licensee operations.

## **Appendix E:**

# **Radiation Monitoring Instrument Specifications and Survey Instrument Calibration Program**

## Radiation Monitoring Instrument Specifications and Survey Instrument Calibration Program

The specifications in **Table 2** will help the applicants and licensees choose the proper radiation detection equipment for monitoring the radiological conditions at their facilities or job sites.

**Table 2. Typical Survey Instruments<sup>1</sup>**

<b>Portable Instruments Used for Contamination and Ambient Radiation Surveys</b>			
<b>Detectors</b>	<b>Radiation</b>	<b>Energy Range</b>	<b>Efficiency</b>
Exposure Rate Meters	Gamma, X-Ray	FR-R	N/A
Count Rate Meters			
GM	Alpha	All energies (dependent on window thickness)	Moderate
	Beta	All energies (dependent on window thickness)	Moderate
	Gamma	All energies	< 1%
NaI Scintillator	Gamma	All energies (dependent on crystal thickness)	Moderate
Plastic Scintillator	Beta	C-14 or higher (dependent on window thickness)	Moderate
<b>Stationary Instruments Used to Measure Wipe, Bioassay and Effluent Samples</b>			
<b>Detectors</b>	<b>Radiation</b>	<b>Energy Range</b>	<b>Efficiency</b>
LSC*	Alpha	All energies	High
	Beta	All energies	High
	Gamma		Moderate
Gamma Counter (NaI)*	Gamma	All energies	High
Gas Proportional	Alpha	All energies	High
	Beta	All energies	Moderate
	Gamma	All energies	< 1%

<sup>1</sup> Table from The Health Physics & Radiological Health Handbook, Revised Edition, Edited by Bernard Shleien, 1992 (except for \* items).

## Instrument Calibration Program

### Training

Before allowing an individual to perform survey instrument calibrations, the RSO will ensure that he or she has sufficient training and experience to perform independent survey instrument calibrations.

Classroom training may be in the form of lecture, videotape, or self-study and will cover the following subject areas:

- Principles and practices of radiation protection;
- Radioactivity measurements, monitoring techniques, and using instruments;
- Mathematics and calculations basic to using and measuring radioactivity;
- Biological effects of radiation.

Appropriate on-the-job training consists of the following:

- Observing authorized personnel performing survey instrument calibration;
- Conducting survey meter calibrations under the supervision and in the physical presence of an individual authorized to perform calibrations.

### **Facilities and Equipment for Calibration of Dose Rate or Exposure Rate Instruments**

- To reduce doses received by individuals not calibrating instruments, calibrations will be conducted in an isolated area of the facility or at times when no one else is present.
- Individuals conducting calibrations will wear assigned dosimetry.
- Individuals conducting calibrations will use a calibrated and operable survey instrument to ensure that unexpected changes in exposure rates are identified and corrected.

### **Procedure for Calibrating Survey Instruments**

A radioactive sealed source(s) used for calibrating survey instruments will:

- Approximate a point source;
- Have its apparent source activity or the exposure rate at a given distance traceable by documented measurements to a standard certified to be within  $\pm 5\%$  accuracy by the National Institutes of Standards and Technology (NIST);
- Approximately the same energy and type of radiation as the environment in which the calibrated device will be employed or develop energy curves to compensate for differing energies;
- For dose rate and exposure rate instruments, the source should be strong enough to give an exposure rate of at least about  $7.7 \times 10^{-6}$  coulombs/kilogram/hour (30 mR/hr) at 100 cm [e.g., 3.1 GBqs (85 mCi) of cesium-137 or  $7.8 \times 10^2$  MBqs (21 mCi) of cobalt-60].

The three kinds of scales frequently used on dose or dose rate survey meters are calibrated as follows:

- Linear readout instruments with a single calibration control for all scales should be adjusted at the point recommended by the manufacturer or at a point within the normal range of use. Instruments with calibration controls for each scale should be adjusted on each scale. After adjustment, the

response of the instrument should be checked at approximately 20% and 80% of full scale. The instrument's readings should be within  $\pm 15\%$  of the conventionally true values for the lower point and  $\pm 10\%$  for the upper point.

- Logarithmic readout instruments, which commonly have a single readout scale spanning several decades, normally have two or more adjustments. The instrument should be adjusted for each scale according to site specifications or the manufacturer's specifications. After adjustment, calibration should be checked at a minimum of one point on each decade. Instrument readings should have a maximum deviation from the conventionally true value of no more than 10% of the full decade value.
- Meters with a digital display device shall be calibrated the same as meters with a linear scale.
- Readings about  $2.58 \times 10^{-4}$  coulomb/kilogram/hour (1 R/hr) need not be calibrated, but such scales should be checked for operation and response to radiation.
- The inverse square and radioactive decay laws should be used to correct changes in exposure rate due to changes in distance or source decay.

## **Surface Contamination Measurement Instruments**

- A survey meter's efficiency must be determined by using radiation sources with similar energies and types of radiation that the survey instrument will be used to measure or develop energy curves to compensate for differing energies.
- If each scale has a calibration potentiometer, the reading should be adjusted to read the conventionally true value at approximately 80% of full scale, and the reading at approximately 20% of full scale should be observed. If only one calibration potentiometer is available, the reading should be adjusted at mid-scale on one of the scales, and readings on the other scales should be observed. Readings should be within 20% of the conventionally true value.

## **Procedures for Calibrating, Liquid Scintillation Counters, Gamma Counters, Gas Flow Proportional Counters, and Multichannel Analyzers**

A radioactive sealed source used for calibrating instruments will do the following:

- Approximate the geometry of the samples to be analyzed;
- Have its apparent source activity traceable by documented measurements to a standard certified to be within  $\pm 5\%$  accuracy by the National Institutes of Standards and Technology (NIST).
- Approximately the same energy and type of radiation as the samples that the calibrated device will be used to measure.

## **Calibration**

- Calibration of survey instruments used in assessing dose or exposure rates must be conducted at 6 to 12 month intervals or after instrument servicing.
- Calibration must produce readings within  $\pm 20$  percent of the actual values over the range of the instrument.

- Calibration of liquid scintillation counters will include quench correction.

## **Calibration Records**

Calibration records, for all survey instruments, should indicate the procedure used and the date obtained. The description of the calibration should include:

- The owner or user of the instrument;
- A description of the instrument, including the manufacturer's name, model number, serial number, and type of detector
- A description of the calibration source, including the exposure rate at a specified distance or activity on a specified date;
- For each calibration point, the calculated exposure rate or count rate, the indicated exposure rate or count rate, the deduced correction factor (the calculated exposure rate or count rate divided by the indicated exposure rate or count rate), and the scale selected on the instrument;
- For instruments with external detectors, the angle between the radiation flux field and the detector (i.e., parallel or perpendicular);
- For instruments with internal detectors, the angle between the radiation flux field and a specified surface of the instrument;
- For detectors with removable shielding, an indication whether the shielding was in place or removed during the calibration procedure;
- The exposure rate or count rate from a check source, if used;
- The name of the person who performed the calibration and date it was performed.

The following information should be attached to the instrument as a calibration sticker or tag:

- For exposure rate meters, the source isotope used to calibrate the instrument (with correction factors) for each scale;
- The efficiency, of the instrument, for each isotope the instrument will be used to measure (if efficiency is not calculated before each use);
- For each scale or decade not calibrated, an indication that the scale or decade was checked only for function but not calibrated;
- The date of the calibration and the next calibration due date;
- The apparent exposure rate or count rate from the check source, if used.

**References:**

1. NRC Draft Regulatory Guide FC 413-4, "Guide for the Preparation of Applications for Licenses for the Use of Radioactive Material in Calibrating Radiation Survey and Monitoring Instruments," dated June 1985.
2. "The Health Physics & Radiological Health Handbook, Revised Edition," edited by Bernard Shleien, dated 1992.
3. ANSI N323A-1997, "Radiation Protection Instrumentation Test and Calibration." Copies may be obtained from the American National Standards Institute, 1430 Broadway, New York, NY 10018 or ordered electronically at the following address <http://www.ansi.org>.

**Appendix F:**  
**Audit Checklist**

**NOTE:** All areas indicated in audit notes may not be applicable to every license and may not need to be addressed during each audit.

Licensee's name: \_\_\_\_\_ License No. \_\_\_\_\_

Auditor: \_\_\_\_\_ Date of Audit \_\_\_\_\_ Telephone No. \_\_\_\_\_

\_\_\_\_\_  
(Signature)

**1. AUDIT HISTORY**

- a. Last audit of this location conducted on (date) \_\_\_\_\_
- b. Are audits conducted yearly? (*DHS 157.21*)
- c. Are records of previous audits maintained? (*DHS 157.31(2)*)
- d. Were any deficiencies identified during last two audits or two years, whichever is longer?

If yes, were corrective actions taken? (Look for repeated deficiencies).

**2. ORGANIZATION AND SCOPE OF PROGRAM**

- a. If the mailing address or places of use changed, was the license amended?
- b. If ownership changed was prior DHS consent obtained?
- c. If bankruptcy was filed was DHS notified within 10 days?
- d. If the RSO was changed, was license amended? Does new RSO meet DHS training requirements?
- e. If the designated contact person changed, was DHS notified?
- f. Does the license authorize all of the DHS regulated radionuclides?
- g. Are the sealed sources and devices being used as described in the Sealed Source and Device (SSD) Registration Certificate or Sheet? Are copies of SSD Certificates available? Are manufacturers' manuals for operation and maintenance available?
- h. Are the actual uses of sealed sources consistent with the authorized uses listed on the license?
- i. Is RSO fulfilling his/her duties?

**3. TRAINING AND INSTRUCTIONS TO WORKERS**

- a. Are all workers who are likely to exceed 100 mrem (1 mSv) in a year given training annually per (*DHS 157.88 (2)*)?
- b. Did each authorized user receive training as committed to in the license application?
- c. Are training records maintained for each authorized user?
- d. Did interviews with authorized users reveal that they know the operating and emergency procedures?
- e. Did this audit include observations of authorized users using the sealed sources or devices (i.e., routine use, transporting, storage)?

If yes, was safe handling and security demonstrated during transportation, use and storage of the sealed source?

- f. HAZMAT training provided as required? [*49 CFR 172.700, 49 CFR 172.701, CFR 172.702, 49 CFR 172.703, 49 CFR 172.704*]

#### 4. RADIATION SURVEY INSTRUMENTS

- a. Does the licensee possess or have access to a survey meter? **L/C**

Is the survey meter calibrated at least annually? (*DHS 157.25(1)(b)*)

Are calibration records maintained (*DHS 157.31 (3)*)?

#### 5. SEALED SOURCE INVENTORY

- a. Are records kept showing the receipt of each sealed source? (*DHS 157.31*)  
b. Are all sealed sources physically inventoried every 6 months?  
c. Are records of inventory results maintained (See **Item 9.3**)?

#### 6. PERSONNEL RADIATION PROTECTION

- a. Are ALARA considerations incorporated into the radiation protection program? (*DHS 157.21*)  
b. Is documentation kept showing that unmonitored authorized users receive <10% of limit?  
c. Did unmonitored users' activities change during the year which could put them over 10% of limit?  
If yes, was a new evaluation performed?  
d. Is external dosimetry required and is dosimetry provided to users?  
1) Is the dosimetry supplier *NVLAP* approved? (*DHS 157.25(1)*)  
2) Are the dosimeters exchanged at vendors recommended frequency?  
3) Are dosimetry reports reviewed by the RSO when they are received?  
4) Are the records DHS Forms or equivalent? (*DHS 157.31 (5) and (7)*)  
DHS *DPH 45003* "Occupational Exposure Record for a Monitoring Period" completed?  
5) If a worker declared her pregnancy, did licensee comply with (*DHS 157.22(8)*)?  
Are records kept of embryo/fetus dose per (*DHS 157.31 (7)*)?  
6) Are annual dosimetry reports provided to monitored individuals? (*DHS 157.88(3)(a)*)  
e. Are records of exposures, surveys, monitoring, and evaluations maintained? (*DHS 157.31 (2-3) and (7)*)

#### 7. PUBLIC DOSE AND SECURITY

- a. Are sealed sources stored in a manner to keep doses below 100 mrem (1 mSv) in a year and 2 mrem in any one hour? (*DHS 157.23 (1)*)  
b. Has a survey or evaluation been performed per *DHS 157.25 (1)*? Have there been any additions or changes to the storage, security, or use of surrounding areas that would

necessitate a new survey or evaluation?

- c. Are sealed sources being stored in a manner that would prevent unauthorized use or removal? (*DHS 157.28 (1) (a)*)
- d. Are records of surveys or evaluations maintained? (*DHS 157.31 (3) and (8)*)

**8. OPERATING AND EMERGENCY PROCEDURES**

Are operating and emergency procedures available?

Are they being followed?

Are they current?

**9. LEAK TESTS**

- a. Was each sealed source leak tested every 6 months or at other approved intervals? (*DHS 157.24*)
- b. Was the leak test performed as described in license application?
- c. Are records of results with appropriate information retained for three years (see **Appendix J**)?
- d. Are any sources found leaking and if yes, was DHS notified?

**10. MAINTENANCE OF SEALED SOURCE DEVICES**

Is any maintenance of the sealed source device performed?

If yes, was it performed according to license requirements (e.g., scope of work, authorized individuals performing the work, procedures, dosimetry, survey instrument, compliance with *DHS 157.22* limits)?

**11. TRANSPORTATION OF SEALED SOURCES OR DEVICES**

- a. DOT-7A or other authorized packages used? (*49 CFR 173.415, 49 CFR 173.416(b)*)
- b. Package performance test records on file?
- c. Special form sources documentation? (*49 CFR 173.476(a)*)
- d. Package has 2 labels (ex. Yellow-II) with TI, Nuclide, Activity, and Hazard Class? (*49 CFR 172.403, 49 CFR 173.441*)
- e. Package properly marked? (*49 CFR 172.301, 49 CFR 172.304, 49 CFR 172.310, 49 CFR 172.324*)
- f. Package closed and sealed during transport? (*49 CFR 173.475(f)*)
- g. Shipping papers prepared and used? (*49 CFR 172.200(a)*)
- h. Shipping papers contain proper entries? {Shipping name, Hazard Class, Identification Number (UN Number), Total Quantity, Package Type, Nuclide, RQ, Radioactive Material, Physical and Chemical Form, Activity, category of label, TI, Shipper's Name, Certification and Signature, Emergency Response Phone Number, Cargo Aircraft Only (if applicable)} (*49 CFR 172.200, 49 CFR 172.201, 49 CFR 172.202, 49 CFR 172.203, 49 CFR 172.204, 49 CFR 172.604*)
- i. Shipping papers within drivers reach and readily accessible during transport? (*49 CFR 177.817(e)*)
- j. Secured against movement? (*49 CFR 177.834*)
- k. Placarded on vehicle, if needed? (*49 CFR 172.504*)
- l. Proper overpacks, if used? (*49 CFR 173.25*)

- m. Any incidents reported to DOT? (*49 CFR 171.15, 16*)

**12. AUDITOR'S SURVEY MEASUREMENTS (IF MADE)**

Were radiation surveys performed?

If yes, describe the type, location, and results measurements.

Did any radiation level exceed regulatory limits?

If yes, were corrective actions taken?

**13. NOTIFICATION AND REPORTS**

- a. Was any radioactive material lost or stolen and reports made to DHS? (*DHS 157.32*)
- b. Did any reportable incidents occur? Are reports made? (*DHS 157.32*)
- c. Did any overexposures and high radiation levels occur? Reported? (*DHS 157.32*)
- d. If any events (as described in items a through c above) did occur, what were the root causes? Are corrective actions appropriate?
- e. Is the licensee's management/RSO/authorized individuals aware of how to contact DHS for radiological incidents?  
Note: DHS office hour number (608) 267-4797 or  
24 hour emergency number (608) 258-0099.

**14. POSTING AND LABELING**

- a. Is DHS-PPH 45025 "Notice to Employees" posted? (*DHS 157.88 (1)*)
- b. Are **Chapter DHS 157 'Radiation Protection', Subchapter III and X**, license documents posted or a notice posted? (*DHS 157.88 (1)*)
- c. Were any notice of violation, forfeiture assessment or order issued under *s. 254.37 or 254.45, Stats.*, or **Chapter DHS 157 'Radiation Protection'** and any response from the licensee or registrant is posted until removal is authorized by DHS? (*DHS 157.88(1)*)
- d. Are emergency procedures posted?  
(*DHS 157.88(1)*).
- e. Are storage/use areas posted, if required? (*DHS 157.29(2)*)
- f. Is the sealed source/device properly labeled? (*DHS 157.29(4)*)

**15. RECORD KEEPING FOR DECOMMISSIONING**

- a. Are records kept of information important to decommissioning? (*DHS 157.15(7)*)
- b. Do records include all information as outlined in *DHS 157.15(7)*?

**16. INFORMATION NOTICES**

- a. Are Information Notices received?
- b. Was appropriate action taken in response?

**17. LICENSE CONDITIONS OR ISSUES**

Did auditor review license conditions or other issues (e.g., maintenance)?

**18. DEFICIENCIES IDENTIFIED IN AUDIT; CORRECTIVE ACTIONS**

- a. Summarize problems/deficiencies identified during audit.  
If problems/deficiencies were identified in this audit, describe the corrective actions planned or taken.
- b. Are corrective actions planned or taken at ALL licensed locations (not just location audited)?
- c. Provide any other recommendations for improvement.

**19. EVALUATION OF OTHER FACTORS**

- a. Is senior licensee management appropriately involved with the radiation protection program and RSO oversight?
- b. Does the RSO have sufficient time to perform his/her radiation safety duties?
- c. Does the licensee have sufficient staff to support the radiation protection program?

## **Appendix G:**

### **Information Needed to Support a Sealed Source Licensee's Request to Perform Maintenance and Repair**

Applicants wishing to perform maintenance must use personnel with special training and follow appropriate procedures consistent with the manufacturer's instructions and recommendations that address radiation safety concerns (e.g., use of radiation survey meter, shielded container for the source, personnel dosimetry). Applicants should include the following information:

- Describe the type of work that necessitates performing maintenance on the sealed source device. The principal reason for obtaining this information is to assist DHS in the evaluation of the qualifications of individuals who will conduct the work and the radiation safety procedures they will follow.
- Identify who will perform maintenance, their training and experience, and why they are competent to perform maintenance.
- Submit procedures for the safe handling of the radioactive source while the maintenance is being performed. These procedures should ensure the following:
  - doses to personnel and members of the public are within regulatory limits and ALARA (e.g., use of shielded containers or shielding);
  - the sealed source is secured against unauthorized removal access or under constant surveillance;
  - appropriate labels and signs are used; and
  - manufacturer's instructions and recommendations will be followed.
- Confirm that individuals performing maintenance on the sealed source device will always wear appropriate monitoring devices or that an evaluation will be available to demonstrate that these individuals are not likely to receive, in one year, more than 10 percent of the applicable dose limits. The dose limits are illustrated in **Figure 2**.
- Verify possession of at least one survey instrument meeting the following criteria:
  - Be capable of detecting gamma radiation;
  - Be capable of measuring from 0.01 to 0.5 mSv/hr [1 to 50 mrem/hr];

- Be calibrated at least annually with radionuclide point sources emitting radiation of the type and energy of the sealed sources;
- Be calibrated at least 2 points located at approximately 1/3 and 2/3 of each scale; readings within  $\pm 20\%$  are acceptable;
- Be calibrated by a person specifically licensed by DHS, the NRC, or an Agreement State to calibrate radiation detection instruments; and
- Be checked for functionality prior to use (e.g., with the gauge or a check source).

**Note:** Records of instrument calibration must be maintained for 3 years after the record is made (*DHS 157.31 (3)*).

- Describe steps to be taken to ensure that radiation levels in areas where maintenance will take place do not exceed *DHS 157.23(1)* limits. For example, applicants can do the following:
  - commit to performing surveys with a survey instrument (as described above);
  - specify where and when surveys will be conducted during maintenance; and
  - commit to maintaining, for 3 years from the date of the survey, records of the survey (e.g., who performed the survey, date of the survey, instrument used, measured radiation levels correlated to location of those measurements), as required by *DHS 157.31 (3)*.

**Appendix H:**  
**Operating and Emergency Procedures**

## **Operating Procedures**

- If personnel dosimetry is provided:
  - Always wear your assigned TLD, OSL or film badge when using or around the sealed source;
  - Never wear another person's TLD, OSL or film badge; and
  - Never store your TLD, OSL or film badge near the sealed source.
- Use the sealed source according to the manufacturer's instructions and recommendations.
- Do not touch the unshielded sealed source with your fingers, hands, or any part of your body.
- Do not place hands, fingers, feet, or other body parts in the radiation field from an unshielded sealed source.
- Perform routine cleaning and maintenance according to the manufacturer's instructions and recommendations.
- When not in use, place the sealed source in a secured location.
- After making changes affecting the sealed source storage area (e.g., changing the location of sealed sources within the storage area, removing shielding, adding sealed sources, changing the occupancy of adjacent areas, moving the storage area to a new location), reevaluate compliance with public dose limits and ensure proper security of the sealed sources.

## **Emergency Procedures for Sealed Sources.**

If the sealed source is lost, damaged or stolen, or if any other emergency or unusual incident occurs:

- Immediately secure the area and keep people a safe distance away from the sealed source until the situation is assessed and radiation levels are known. However, perform first aid for any injured individuals and remove them from the area only when medically safe to do so.

- Authorized users and other potentially contaminated individuals should not leave the scene until emergency assistance arrives.
- Notify the persons in order listed below of the situation.
- Follow the directions provided by the person contacted.

NAME*	WORK PHONE NUMBER*	HOME PHONE NUMBER*

\* Fill in with (and update, as needed) the names and telephone numbers of appropriate personnel (e.g., the **RSO**, or other knowledgeable licensee staff, licensee's consultant, Sealed Source manufacturer) to be contacted in case of emergency.

### **RSO and Licensee Management:**

- Arrange for a radiation survey to be conducted as soon as possible by a knowledgeable person using appropriate radiation detection instrumentation. This person could be a licensee employee using a survey meter located at the jobsite or a consultant. To accurately assess the radiation danger, it is essential that the person performing the survey be competent in the use of the survey meter.
- Make necessary notifications to local authorities as well as DHS. Even if not required to do so, you may report ANY incident to DHS by calling **(608) 267-4797 during office hours or (608) 258-0099 after hours**. DHS notification is required when sealed sources are lost or stolen, when sealed sources are damaged or involved in incidents that result in doses in excess of **DHS 157.22** and **DHS 157.23** limits.
- Reports to DHS must be made within the reporting timeframes specified by **DHS 157.32** and **DHS 157.13(17)**.

**Appendix I:**  
**Dosimetry-related Guidance**

**Part 1: Worksheet for Determining if Personnel Dosimetry  
is Required for Sealed Source Users**

# WORKSHEET FOR DETERMINING IF PERSONNEL DOSIMETRY IS REQUIRED FOR SEALED SOURCE USERS

**Instructions:** To meet the requirement of *DHS 157.25(2)* complete **Steps 1** through **6** and sign and date the evaluation on the line provided.

**Disclaimer:** If there is a change in workload or if a new sealed source is acquired a new evaluation will need to be performed.

---

## Step 1.

Determine the radiation level in one of the following ways. Record the results below.

- Obtain from the manufacturer's specifications: the radiation level approximately 30 centimeters from the sealed source, or
- Measure the radiation level with a calibrated survey meter.
  - When making the radiation measurement, place the survey instrument approximately 30 centimeters from the sealed source while following good radiation safety practices.

\_\_\_\_\_ mrem per hour

## Step 2.

Record the average number of minutes per week that the sealed source is used.

\_\_\_\_\_ minutes per week

## Step 3.

Divide the minutes per week (**Step 2.**) by 60 to determine hours per week and record below.

\_\_\_\_\_ minutes per week (**Step 2.**) / 60

= \_\_\_\_\_ hours per week

**Step 4.**

Multiply the hours per week (**Step 3.**) by 52 weeks to equal hours per year and record below.

\_\_\_\_\_ hours per week (**Step 3.**) X 52 weeks

= \_\_\_\_\_ hours per year

**Step 5.**

Multiply hours per year (**Step 4.**) by mrem per hour (**Step 1.**) to equal mrem received per year and record below.

\_\_\_\_\_ hours per year (**Step 4.**) X \_\_\_\_\_ mrem per hour (**Step 1.**)

= \_\_\_\_\_ mrem per year

**Step 6.**

Is the # of mrem per year (**Step 5.**) greater than 500?  Yes  No

- If yes provide dosimetry as required by *DHS 157.25(2)(a)1*
- If no, proceed to **Step 7.**

**Step 7.**

Is the # of mrem per year (**Step 5.**) greater than 100?  Yes  No

- If yes, and you have an employee that is a declared pregnant worker as defined by *DHS 157.03(90)* provide dosimetry to that individual. In addition, provide annual radiation safety training as required by *DHS 157.88(2)* to all employees that use the sealed source.
- If no, you are not required under *Wisconsin Administrative Code Chapter DHS 157 'Radiation Protection'* to provide dosimetry to your employees.

\_\_\_\_\_  
*Signature of Person Performing the Evaluation*

\_\_\_\_\_  
*Date*

**Part 2: Guidance for Demonstrating that Individual  
Members of the Public will not Receive Doses Exceeding  
the Allowable Limit**

Licensees must ensure that:

- The radiation dose received by individual members of the public does not exceed 1 mSv (100 mrem) in one calendar year resulting from the licensee's possession and/or use of licensed materials.

Members of the public include persons who live, work, or may be near locations where sealed sources are used or stored. (For storage of sealed sources in personal residences, occupants are considered members of the public.) Employees whose assigned duties do not include the use of licensed materials but who work in the vicinity where sealed sources are used or stored are also considered members of the public.

- The radiation dose in unrestricted areas does not exceed 0.02 mSv (2 mrem) in any one hour.

Typical unrestricted areas may include offices, shops, laboratories, areas outside buildings, property, and non-radioactive equipment storage areas. The licensee does not control access to these areas for purposes of controlling exposure to radiation or radioactive materials. However, the licensee may control access to these areas for other reasons such as security.

Licensees must show compliance with both portions of the rule. Calculations or a combination of calculations and measurements (e.g., using an environmental TLD) are often used to prove compliance.

### **Calculational Method**

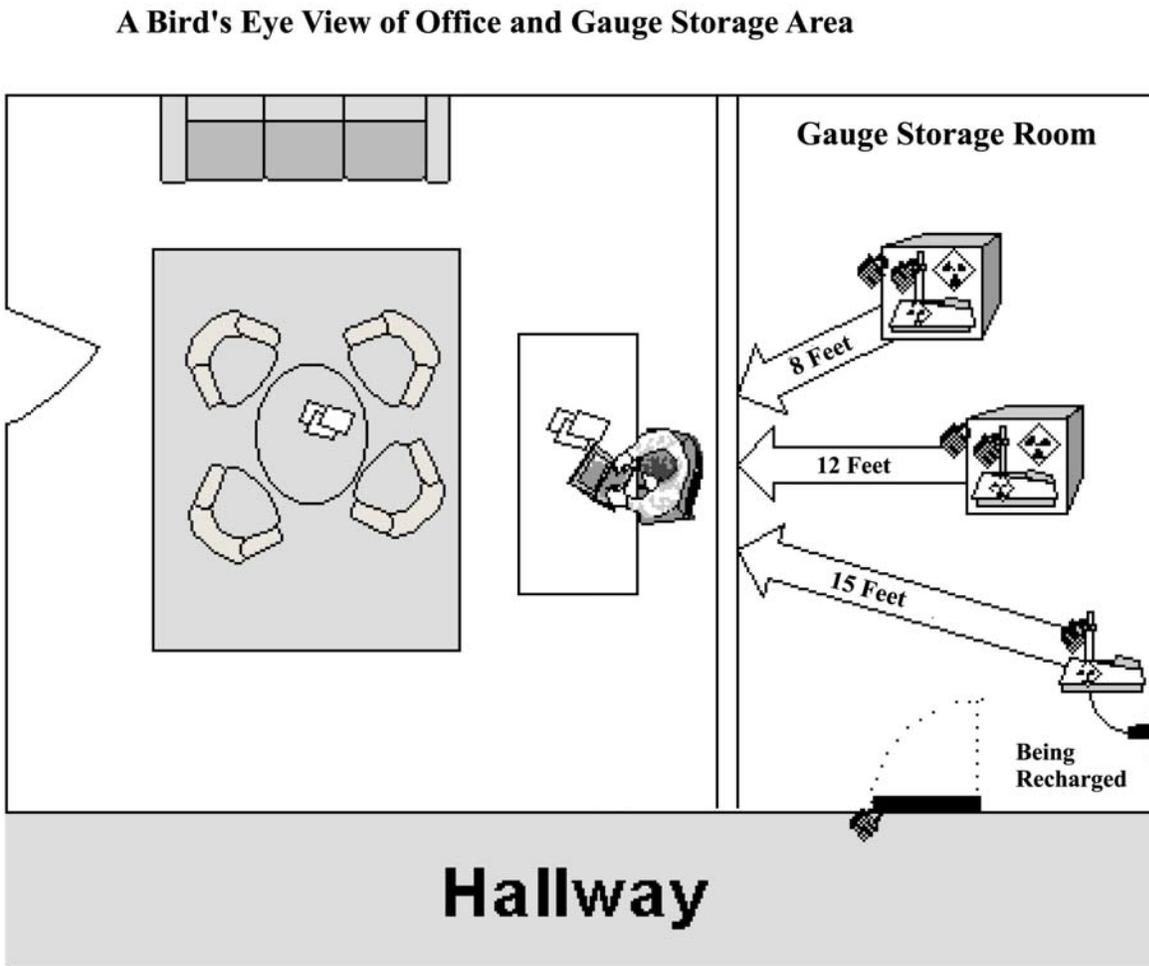
The calculational method takes a tiered approach, going through a three-part process starting with a worst case situation and moving toward more realistic situations. It makes the following simplifications: (1) each sealed source is a point source, (2) typical radiation levels encountered when the source is in the shielded position are taken from either the SSD Registration Sheet or the manufacturer's literature, and (3) no credit is taken for any shielding found between the sealed sources and the unrestricted areas.

Part 1 of the calculational method is simple but conservative. It assumes that an affected member of the public is present 24 hours a day and uses only the "inverse square law" to determine if the distance between the sealed source and the affected member of the public is sufficient to show compliance with the public dose limits. Part 2 considers not only distance, but also the time that the affected member of the public is actually in the area under consideration. Part 3 considers distance and the portion of time that both the sealed source and the affected member of the public are present. Using this approach, licensees make only those calculations that are needed to demonstrate compliance. In many cases licensees will need to use the calculational method through Part 1 or Part 2. The results of these calculations typically result in higher radiation levels than would exist at typical facilities, but provide a method for estimating conservative doses which could be received.

**Example 1**

To better understand the calculational method, we will look at a sealed source licensee. Yesterday, the company's president noted that the new sealed source storage area is very close to his secretary's desk and he asked Joe, the RSO, to determine if the company is complying with **Chapter DHS 157 'Radiation Protection.'**

The secretary's desk is near the wall separating the reception area from the designated, locked sealed source storage area, where the company is storing its three sealed sources. Joe measures the distances from each sealed source to the wall and looks up in the manufacturer's literature the radiation levels individuals would encounter for each sealed source. **Figure 3** is Joe's sketch of the areas in question, and **Table 3** summarizes the information Joe has on each sealed source.



**Figure 3.** *Diagram of Office and Sealed Source Storage Area. This sketch shows the areas described in Examples 1 and 2.*

**Table 3. Information Known about Each Sealed Source**

DESCRIPTION OF KNOWN INFORMATION	GAUGE 1	GAUGE 2	GAUGE 3
How sealed source is stored	Sealed Source in storage container	Sealed Source in storage container	Sealed Source out of storage container
Dose rate in mrem/hr encountered at specified distance from the sealed source (from manufacturer's literature)	2 mrem/hr at 1 ft	8 mrem/hr at 1 ft	2 mrem/hr at 3 ft
Distance in ft to secretary's chair	8 ft	12 ft	15 ft

**Example 1: Part 1**

Joe's first thought is that the distance between the sealed sources and the secretary's chair may be sufficient to show compliance with the rule in *DHS 157.23 (1)*. So, taking a "worst case" approach, he assumes: 1) the sealed sources are constantly present (i.e., 24 hr/d), 2) all three sealed sources remain in storage with no other use, and 3) the secretary is constantly sitting in the desk chair (i.e., 24 hr/d). Joe proceeds to calculate the dose she might receive hourly and yearly from each sealed source as shown in **Tables 4, 5, and 6** below.

**Table 4. Calculational Method, Part 1---Hourly and Annual Dose Received from Sealed Source 1**

		Sealed Source 1	
Step No.	Description	Input Data	Results
1	Dose received in an hour at known distance from the sealed source (e.g., from manufacturer's data), in mrem/hr	2	2
2	Square of the distance (ft) at which the Step 1 rate was measured, in ft <sup>2</sup>	(1) <sup>2</sup>	1
3	Square of the distance (ft) from the sealed source to the secretary's desk in an unrestricted area, in ft <sup>2</sup>	(8) <sup>2</sup>	64
4	Multiply the results of Step 1 by the results of Step 2 (this is an intermediate result)	2 x 1 = 2	
5	Divide the result of Step 4 by the result of Step 3 to calculate the dose received by an individual at the secretary's desk, <b>HOURLY DOSE RECEIVED FROM SEALED SOURCE 1</b> , in mrem in an hour.	2/64 = <b>0.031</b>	
6	Multiply the result of Step 5 by 24 hr/d x 365 d/yr = <b>MAXIMUM ANNUAL DOSE RECEIVED FROM SEALED SOURCE 1</b> , in mrem in a year.	0.031 x 24 x 365 = 0.031 x 8760 = <b>272</b>	

**Table 5. Calculational Method, Part 1---Hourly and Annual Dose Received from Sealed Source 2**

		Sealed Source 2	
Step No.	Description	Input Data	Results
1	Dose received in an hour at known distance from the sealed source (e.g., from manufacturer's data), in mrem/hr	8	8
2	Square of the distance (ft) at which the Step 1 rate was measured, in ft <sup>2</sup>	(1) <sup>2</sup>	1
3	Square of the distance (ft) from the sealed source to the secretary's desk in an unrestricted area, in ft <sup>2</sup>	(12) <sup>2</sup>	144
4	Multiply the results of Step 1 by the results of Step 2 (this is an intermediate result)	8 x 1 = 8	
5	Divide the result of Step 4 by the result of Step 3 to calculate dose received in an hour by an individual at the secretary's desk, <b>HOURLY DOSE RECEIVED FROM SEALED SOURCE 2</b> , in mrem in an hour	8/144 = <b>.056</b>	
6	Multiply the result of Step 5 by 24 hr/d x 365 d/yr = <b>MAXIMUM ANNUAL DOSE RECEIVED FROM SEALED SOURCE 2</b> , in mrem in a year	0.056 x 24 x 365 = 0.056 x 8760 = <b>491</b>	

**Table 6. Calculational Method, Part 1---Hourly and Annual Dose Received from Sealed Source 3**

		Sealed Source 3	
Step No.	Description	Input Data	Results
1	Dose received in an hour at known distance from the sealed source (e.g., from manufacturer's data), in mrem/hr	2	2
2	Square of the distance (ft) at which the Step 1 rate was measured, in ft <sup>2</sup>	(3) <sup>2</sup>	9
3	Square of the distance (ft) from the sealed source to the secretary's desk in an unrestricted area, in ft <sup>2</sup>	(15) <sup>2</sup>	225
4	Multiply the results of Step 1 by the results of Step 2 (this is an intermediate result)	2 x 9 = 18	
5	Divide the result of Step 4 by the result of Step 3 to calculate dose received by an individual at the secretary's desk, <b>HOURLY DOSE RECEIVED FROM SEALED SOURCE 3</b> , in mrem in an hour	18/225 = <b>0.08</b>	
6	Multiply the result of Step 5 by 24 hr/d x 365 d/yr = <b>MAXIMUM ANNUAL DOSE RECEIVED FROM SEALED SOURCE 3</b> , in mrem in a year	0.08 x 24 x 365 = 0.08 x 8760 = <b>701</b>	

To determine the total hourly and total annual dose received, Joe adds the pertinent data from the preceding tables.

**Table 7. Calculational Method, Part 1---Total Hourly and Annual Dose Received from Sealed Sources 1, 2, and 3**

Step No.	Description	Sealed Source 1	Sealed Source 2	Sealed Source 3	Sum
7	<b>TOTAL HOURLY DOSE RECEIVED</b> from Step 5 of Tables 4, 5, and 6, in mrem in an hour	0.031	0.056	0.08	$0.031 + 0.056 + 0.08 = \mathbf{0.167}$
8	<b>TOTAL ANNUAL DOSE RECEIVED</b> from Step 6 of Tables I-3, I-4, and I-5, in mrem in a year	272	491	701	$272 + 491 + 701 = \mathbf{1464}$

**NOTE:** The Sum in Step 7 demonstrates compliance with the 2 mrem in any one hour limit. Reevaluate if assumptions change. If the Sum in Step 8 exceeds 100 mrem/yr, proceed to Part 2 of the calculational method.

At this point, Joe is pleased to see that the total dose that an individual could receive in any one hour is only 0.167 mrem, but notes that an individual could receive a dose of 1,464 mrem in a year, much higher than the 100 mrem limit.

### Example 1: Part 2

Joe reviews his assumptions and recognizes that the secretary is not at the desk 24 hr/d. He decides to make a realistic estimate of the number of hours the secretary sits in the chair at the desk, keeping his other assumptions constant (i.e., the gauges are constantly present (i.e., 24 hr/d), all three sealed sources remain in storage with no other use). He then recalculates the annual dose received.

**Table 8. Calculational Method, Part 2--Annual Dose Received from Sealed Sources 1, 2, and 3**

Step No.	Description	Results
9	A. Average number of hours per day that individual spends in area of concern (e.g., secretary sits at desk 5 hr/day; the remainder of the day the secretary is away from the desk area copying, filing, etc.)	5
	B. Average number of days per week in area (e.g., secretary is part time and works 3 days/week)	3
	C. Average number of weeks per year in area (e.g., secretary works all year )	52
10	Multiply the results of Step 9.A. by the results of Step 9.B. by the results of Step 9.C. = <b>AVERAGE NUMBER OF HOURS IN AREA OF CONCERN PER YEAR</b>	$5 \times 3 \times 52 = \mathbf{780}$
11	Multiply the sum in Step 7 by the results of Step 10 = <b>ANNUAL DOSE RECEIVED FROM SEALED SOURCES CONSIDERING REALISTIC ESTIMATE OF TIME SPENT IN AREA OF CONCERN</b> , in mrem in a year	$0.167 \times 780 = \mathbf{130}$

**NOTE:** If Step 11 exceeds 100 mrem in a year, proceed to Part 3 of the calculational method.

Although Joe is pleased to note that the calculated annual dose received is significantly lower, he realizes it still exceeds the 100 mrem in a year limit.

### Example 1, Part 3

Again Joe reviews his assumptions and recognizes that the sealed sources are not always in storage when the secretary is seated at the desk. As he examines the situation, he realizes he must consider each sealed source individually.

**Table 9. Calculational Method, Part 3---Summary of Information**

**INFORMATION ON WHEN SEALED SOURCES ARE PRESENT IN THE STORAGE AREA:**

- **SEALED SOURCE 1: an old sealed source located in the storage area continuously (24 hr/d)**
- **SEALED SOURCE 2: a new sealed source located in the storage area continuously (24 hr/d) for 8 months of the year; for the remaining 4 months of the year**
- **SEALED SOURCE 3: a new sealed source located in the storage area overnight; it is used every day all year and returned to the storage location at the end of each day. The sealed source is usually present during the secretary's first and last hours of work each day.**

**INFORMATION FROM EXAMPLE 1, PART 2 ON WHEN THE SECRETARY IS SITTING AT THE DESK**

- **5 hours per day**
- **3 days per week**
- **52 weeks per year**

**Table 10. Calculational Method, Part 3---Annual Dose Received from Sealed Sources 1, 2, and 3**

Step No.	Description	Sealed Source 1	Sealed Source 2	Sealed Source 3
12	Average number of <b>hours per day</b> sealed source is in storage while secretary is present	5	5	2
13	Average number of <b>days per week</b> sealed source is in storage while secretary is present	3	3	3
14	Average number of <b>weeks per year</b> sealed source is in storage while secretary is present	52	32	52
15	Multiply the results of Step 12 by the results of Step 13 by the results of Step 14 = <b>TOTAL HOURS EACH SEALED SOURCE IS STORED PER YEAR WHILE SECRETARY IS PRESENT</b>	$5 \times 3 \times 52 =$ <b>780</b>	$5 \times 3 \times 32 =$ <b>480</b>	$2 \times 3 \times 52 =$ <b>312</b>
16	Multiply the results of Step 15 by the results of Step 7 = <b>ANNUAL DOSE RECEIVED FROM EACH SEALED SOURCE, in mrem in a year</b>	$780 \times 0.031 =$ <b>24</b>	$480 \times 0.056 =$ <b>27</b>	$312 \times 0.08 =$ <b>25</b>
17	Sum the results of Step 16 for each sealed source = <b>TOTAL ANNUAL DOSE RECEIVED CONSIDERING REALISTIC ESTIMATE OF TIME SPENT IN AREA</b>	$24 + 27 + 25 =$ <b>76</b>		

<b>OF CONCERN AND TIME SEALED SOURCE IS IN STORAGE</b> , in mrem in a year	
--	--

**NOTE: If the result in Step 17 is greater than 100 mrem/yr, the licensee must take corrective actions.**

Joe is pleased that the result in Step 17 shows compliance with the 100 mrem/yr limit. Had the result in Step 17 been higher than 100 mrem/yr, then Joe could have done one or more of the following:

- Consider whether the assumptions used to determine occupancy and the time each sealed source is in storage are accurate, revise the assumptions as needed, and recalculate using the new assumptions;
- Calculate the effect of any shielding located between the sealed source storage area and the secretarial workstation--such calculation is beyond the scope of this Appendix;
- Take corrective action (e.g., move sealed source within storage area, move the storage area, move the secretarial workstation) and perform new calculations to demonstrate compliance; and
- Designate the area outside the storage area as a restricted area and the secretary as an occupationally exposed individual. This would require controlling access to the area for purposes of radiation protection and training the secretary as required by *DHS 157.88 (2)*.

Note that in the example, Joe evaluated the unrestricted area outside only one wall of the sealed source storage area. Licensees also need to make similar evaluations for other unrestricted areas and to keep in mind the *ALARA* principle, taking reasonable steps to keep radiation dose received below regulatory requirements. In addition, licensees need to be alert to changes in situations (e.g., moving any of the sealed source closer to the secretarial workstation, adding a sealed source to the storage area, changing the secretary to a full-time worker, or changing the estimate of the portion of time spent at the desk) and to perform additional evaluations, as needed.

**RECORD KEEPING: *DHS 157.31(8)* requires licensees to maintain records demonstrating compliance with the dose limits for individual members of the public.**

### **Combination Measurement-Calculational Method**

This method, which allows the licensee to take credit for shielding between the sealed source and the area in question, begins by measuring radiation levels in the areas, as opposed to using manufacturer-supplied rates at a specified distance from each sealed source. These measurements must be made with calibrated survey meters sufficiently sensitive to measure background levels of radiation. However, licensees must exercise caution when making measurements with currently calibrated radiation survey instruments. A maximum dose of 1 mSv (100 mrem) received by an individual over a period of 2080 hours (i.e., a "work" year of 40 hr/wk for 52 wk/yr) is equal to less than 0.5 microsievert (0.05 mrem) per hour.

This rate is well below the minimum sensitivity of most commonly available G-M survey instruments.

Instruments used to make measurements for calculations must be sufficiently sensitive. An instrument equipped with a scintillation-type detector (e.g., NaI(Tl)) or a micro-R meter used in making very low gamma radiation measurements should be adequate.

Licensees may also choose to use environmental TLDs in unrestricted areas next to the sealed source storage area for monitoring. This direct measurement method would provide a definitive measurement of actual radiation levels in unrestricted areas without any restrictive assumptions. Records of these measurements can then be evaluated to ensure that rates in unrestricted areas do not exceed the 1 mSv/yr (100 mrem/yr) limit.

Note: TLDs used for personnel monitoring (e.g., LiF) may not have sufficient sensitivity for this purpose. Generally, the minimum reportable dose received is 0.1 mSv (10 mrem). Suppose a TLD monitors dose received and is changed once a month. If the measurements are at the minimum reportable level, the annual dose received could have been about 1.2 mSv (120 mrem), a value in excess of the 1 mSv/yr (100 mrem/yr) limit. If licensees use TLDs to evaluate compliance with the public dose limits, they should consult with their TLD supplier and choose more sensitive TLDs, such as those containing  $\text{CaF}_2$  that are used for environmental monitoring.

## **Example 2**

As in Example 1, Joe is the RSO of a sealed source licensee. The company has three sealed sources stored in a designated, locked storage area that adjoins an unrestricted area where a secretarial workstation is located. See **Figure 3** and **Table 3** for information. Joe wants to see if the company complies with the public dose limits at the secretarial station.

During the winter while all the gauges are in storage, Joe placed an environmental TLD badge in the secretarial workspace for 30 days. Joe chose a winter month so he did not have to keep track of the number of hours that each sealed source was in the storage area. The TLD processor sent Joe a report indicating the TLD received 100 mrem.

**Table 11. Combination Measurement-Calculational Method**

Step No.	Description	Input Data and Results
<b>PART 1</b>		
1	Dose received by <i>TLD</i> , in mrem	<b>100</b>
2	Total hours <i>TLD</i> exposed	24 hr/d x 30 d/mo = <b>720</b>
3	Divide the results of Step 1 by the results of Step 2 to determine <b>HOURLY DOSE RECEIVED</b> , in mrem in an hour	<b>0.14</b>
4	Multiply the results of Step 3 by 365 d/yr x 24 hr/d = 8760 hours in one year = <b>MAXIMUM ANNUAL DOSE RECEIVED FROM SEALED SOURCES</b> , in mrem in a year	365 x 24 x 0.14 = 8760 x 0.14 = <b>1226</b>

**NOTE:** For the conditions described above, Step 3 indicates that the dose received in any one hour is less than the 2 mrem in any one hour limit. However, if there are any changes, then the licensee would need to reevaluate the potential doses which could be received in any one hour. Step 4 indicates that the annual dose received would be much greater than the 100 mrem in a year allowed by the rule.

**PART 2**

At this point Joe can adjust for a realistic estimate of the time the secretary spends in the area as he did in Part 2 of Example 1.

**PART 3**

If the results of Joe's evaluation in Part 2 show that the annual dose received in a year exceeds 100 mrem, then he can make adjustments for realistic estimates of the time spent in the area of concern while the sealed sources are actually in storage as in Part 3 of Example 1. (Recall that the *TLD* measurement was made while all the sealed sources are in storage--i.e., 24 hr/d for the 30 days that the *TLD* was in place.)

**Appendix J:**  
**Leak Test Program**

# Leak Test Program

## Training

Before allowing an individual to perform leak testing, the RSO will ensure that he or she has sufficient classroom and on-the-job training to show competency in performing leak tests independently.

Classroom training may be in the form of lecture, videotape, or self-study, and will cover the following subject areas:

- Principles and practices of radiation protection;
- Radioactivity measurements, monitoring techniques, and the use of instruments;
- Mathematics and calculations basic to the use and measurement of radioactivity; and
- Biological effects of radiation.

Appropriate on-the-job-training consists of:

- Observing authorized personnel collecting and analyzing leak test samples;
- Collecting and analyzing leak test samples under the supervision and in the physical presence of an individual authorized to perform leak tests.

## Facilities and Equipment

- To ensure achieving the required sensitivity of measurements, leak tests will be analyzed in a low-background area.
- Before leak test swipes are analyzed, individuals conducting leak tests will use a calibrated and operable survey instrument to check leak test samples for gross contamination. If the sensitivity of the counting system is unknown, the minimum detectable activity (MDA) needs to be determined. The MDA may be determined using the following formula:

$$\text{MDA} = \frac{3 + 4.65(\text{BR})^{*1/2}}{\text{Et}}$$

where MDA = activity level in disintegrations per minute (dpm)  
BR = background rate in counts per minute (cpm)  
t = counting time in minutes  
E = detector efficiency in counts per disintegration (cpd)

### For example:

$$\text{MDA} = \frac{3 + 4.65(200 \text{ cpm})^{*1/2}}{(0.1 \text{ cpd})(2 \text{ minutes})}$$

where           BR = 200 cpm  
                  E = 0.1 cpd (10% efficient)  
                  t = 2 minutes

- An NaI(Tl) well counter system with a single or multichannel analyzer will be used to count samples from gauges containing gamma-emitters (e.g., Cs-137, Co-60).
- A liquid scintillation or gas-flow proportional counting system will be used to count samples from gauges containing beta-emitters (e.g., Sr-90) or alpha emitters (e.g., Am-241).

### **Frequency for Conducting Leak Tests of Sealed Sources**

- Leak tests will be conducted at the frequency specified in the respective SSD Registration Certificate.

### **Procedure for Performing Leak Testing and Analysis**

- For each source to be tested, list identifying information such as gauge serial number, radionuclide, activity.
- If available, use a survey meter to monitor exposure.
- Prepare a separate wipe sample (e.g., cotton swab or filter paper) for each source.
- Number each wipe to correlate with identifying information for each source.
- Wipe the most accessible area where contamination would accumulate if the sealed source was leaking (e.g., the leak test can be taken on the part that connects to the source or the inside of the transport container that has recently transported the source).
- Select an instrument that is sensitive enough to detect 185 Bq (0.005 microcurie) of the radionuclide contained in the gauge.
- Using the selected instrument, count and record background count rate.

- Check the instrument's counting efficiency using standard source of the same radionuclide as the source being tested or one with similar energy characteristics. Accuracy of standards should be within +/-5 percent of the stated value and traceable to a primary radiation standard such as those maintained by the National Institutes of Standards and Technology (NIST).
- Calculate efficiency.

For example: 
$$\frac{[(\text{cpm from std}) - (\text{cpm from bkg})]}{\text{activity of std in Bq}} = \text{efficiency in cpm/Bq}$$

where: cpm = counts per minute  
 std = standard  
 bkg = background  
 Bq = Becquerel

- Count each wipe sample; determine net count rate.
- For each sample, calculate and record estimated activity in Bq (or microcuries).

For example: 
$$\frac{[(\text{cpm from wipe sample}) - (\text{cpm from bkg})]}{\text{efficiency in cpm/Bq}} = \text{Bq on wipe sample}$$

- Sign and date the list of sources, data, and calculations. Retain records for 3 years.
- If the wipe test activity is 185 Bq (0.005 microcurie) or greater, notify the RSO so that the source can be withdrawn from use and disposed of properly. Also notify DHS.

**Appendix K:**  
**Major DOT Regulations; Sample Bill of Lading**

The major areas in the DOT regulations that are most relevant for transportation of typical sealed sources that are shipped as Type A quantities are as follows:

- Table of Hazardous Materials and Special Provisions **49 CFR 172.101**, and App. A, Table 2: Hazardous materials table, list of hazardous substances and reportable quantities
- Shipping Papers **49 CFR 172.200-204**: general entries, description, additional description requirements, shipper's certification
- Package Markings **49 CFR 172.300, 49 CFR 172.301, 49 CFR 172.303, 49 CFR 172.304, 49 CFR 172.310, 49 CFR 172.324**: General marking requirements for non-bulk packagings, prohibited marking, marking requirements, radioactive material, hazardous substances in non-bulk packaging
- Package Labeling **49 CFR 172.400, 49 CFR 172.401, 49 CFR 172.403, 49 CFR 172.406, 49 CFR 172.407, 49 CFR 172.436, 49 CFR 172.438, 49 CFR 172.440**: General labeling requirements, prohibited labeling, radioactive materials, placement of labels, specifications for radioactive labels
- Placarding of Vehicles **49 CFR 172.500, 49 CFR 172.502, 49 CFR 172.504, 49 CFR 172.506, 49 CFR 172.516, 49 CFR 172.519, 49 CFR 172.556**: Applicability, prohibited and permissive placarding, general placarding requirements, providing and affixing placards: highway, visibility and display of placards, RADIOACTIVE placard
- Emergency Response Information, Subpart G, **49 CFR 172.600, 49 CFR 172.602, 49 CFR 172.604**: Applicability and general requirements, emergency response information, emergency response telephone number
- Training, Subpart H, **49 CFR 172.702, 49 CFR 172.704**: Applicability and responsibility for training and testing, training requirements
- Radiation Protection Program for Shippers and Carriers, Subpart I, **49 CFR 172.800**, etc.
- Shippers - General Requirements for Shipments and Packaging, Subpart I, **49 CFR 173.403, 49 CFR 173.410, 49 CFR 173.412, 49 CFR 173.415, 49 CFR 173.433, 49 CFR 173.435, 49 CFR**

**173.441, 49 CFR 173.475, 49 CFR 173.476:** Definitions, general design requirements, additional design requirements for Type A packages, authorized Type A packages, requirement for determining A<sub>1</sub> and A<sub>2</sub>, table of A<sub>1</sub> and A<sub>2</sub> values for radionuclides, radiation level limit, quality control requirements prior to each shipment, approval of special form radioactive materials

- Carriage by Public Highway **49 CFR 177.816, 49 CFR 177.817, 49 CFR 177.834(a), 49 CFR 177.842:** Driver training, shipping paper, general requirements (secured against movement), Class 7 (radioactive) material

Minimum Required Packaging For Class 7 (Radioactive) Materials				
This table must not be used as a substitute for the DOT and NRC regulations on the transportation of radioactive materials				
Quantity:	< 70 Bq/g ( < 0.002 $\mu$ Ci/g)	Limited Quantity (§173.421)	A <sub>1</sub> /A <sub>2</sub> value (§173.435)	1 rem/hr at 3 m, un-shielded (§173.427)
Non-LSA/SCO:	Excepted	Type A	Type B <sup>3</sup>	
Domestic or International LSA/SCO: • LSA-I solid, (liquid) <sup>1</sup> • SCO-I	Excepted	IP-I	Type B <sup>3</sup>	
• LSA-I Liquid • LSA-II Solid, (liquid or gas) <sup>1</sup> • (LSA-III) <sup>1</sup> • SCO-II		IP-II	Type B <sup>3</sup>	
• LSA-II Liquid or Gas • LSA-III		IP-III	Type B <sup>3</sup>	
Domestic (only) LSA/SCO: • LSA-I, II, III; SCO-I, II	Excepted	Strong-tight <sup>2</sup>	DOT Spec. 7A Type A	Type B <sup>3</sup> NRC Type A LSA <sup>3,4</sup>

- For entries in parentheses, exclusive use is required for shipment in an IP (e.g., shipment of LSA-I liquid in an IP-I packaging would require exclusive-use consignment)
- Exclusive use required for strong-tight container shipments made pursuant to §173.427(b)(2)
- Subject to conditions in Certificate, if NRC package
- Exclusive use required, see §173.427(b)(4). Use of these packages expires on 4/1/99 (10 CFR 71.52)

Package and Vehicle Radiation Level Limits (49 CFR 173.441) <sup>A</sup>				
This table must not be used as a substitute for the DOT and NRC regulations on the transportation of radioactive materials				
Transport Vehicle Use:	Non-Exclusive	Exclusive		
Transport Vehicle Type:	Open or Closed	Open (flat-bed)	Open w/Enclosure <sup>B</sup>	Closed
Package (or freight container) Limits:				
External Surface	2 mSv/hr (200 mrem/hr)	2 mSv/hr (200 mrem/hr)	10 mSv/hr (1000 mrem/hr)	10 mSv/hr (1000 mrem/hr)
Transport Index (TI) <sup>C</sup>	10	no limit		
Roadway or Railway Vehicle (or freight container) Limits:				
Any point on the outer surface	N/A	N/A	N/A	2 mSv/hr (200 mrem/hr)
Vertical planes projected from outer edges		2 mSv/hr (200 mrem/hr)	2 mSv/hr (200 mrem/hr)	N/A
Top of . . .		load: (200 mrem/hr)	enclosure: 2 mSv/hr (200 mrem/hr)	vehicle: 2 mSv/hr (200 mrem/hr)
2 meters from . . .		vertical planes: 0.1 mSv/hr (10 mrem/hr)	vertical planes: 0.1 mSv/hr (10 mrem/hr)	outer lateral surfaces: 0.1 mSv/hr (10 mrem/hr)
Underside	2 mSv/hr (200 mrem/hr)			
Occupied position	N/A <sup>D</sup>	0.02 mSv/hr (2 mrem/hr) <sup>E</sup>		
Sum of package TI's	50	no limit <sup>F</sup>		

- The limits in this table do not apply to excepted packages - see 49 CFR 173.421-426.
- Securely attached (to vehicle), access-limiting enclosure; package personnel barriers are considered as enclosures.
- For nonfissile radioactive materials packages, the dimensionless number equivalent to maximum radiation level at 1 m (3.3 feet) from the exterior package surface, in millirem/hour.
- No dose limit is specified, but separation distances apply to Radioactive Yellow-II or Radioactive Yellow-III labeled packages.
- This does not apply to private carrier wearing dosimetry if under radiation protection program satisfying 10 CFR 20 or 49 CFR 172 Subpart I.
- Some fissile shipments may have combined conveyance TI limit of 100 - see 10 CFR 71.59 and 49 CFR 173.457.

# Hazard Communications for Class 7 (Radioactive) Materials

## DOT Shipping Papers (49 CFR 172.200-205)

*NOTE:* IAEA, ICAO, and IMO may require additional hazard communication information for international shipments  
This table must not be used as a substitute for the DOT and NRC regulations on the transportation of radioactive materials

Entries Always Required Unless Excepted	Additional Entries Sometimes Required	Optional Entries
<ul style="list-style-type: none"> <li>● The basic description, in sequence:   <b>Proper Shipping Name, Hazard Class (7), U.N. Identification Number</b></li> <li>● 24 hour emergency response telephone number</li> <li>● Name of shipper</li> <li>● Proper page numbering (Page 1 of 4)</li> <li>● Except for empty and bulk packages, the <b>total quantity</b> (mass, or volume for liquid), in appropriate units (lbs, mL....)</li> <li>● If not special form, <b>chemical and physical form</b></li> <li>● The <b>name of each radionuclide</b> (95 percent rule) and total package activity. The activity must be in SI units (e.g., Bq, TBq), or both SI units and customary units (e.g., Ci, mCi). However, for <u>domestic shipments</u>, the activity <i>may</i> be expressed in terms of customary units only, until 4/1/97.</li> <li>● For each labeled package:               <ul style="list-style-type: none"> <li>- The <b>category of label</b> used;</li> <li>- The <b>transport index</b> of each package with a Yellow-II or Yellow-III label</li> <li>- Shipper's <b>certification</b> (not required of private carriers)</li> </ul> </li> </ul>	<p><b>Materials-Based Requirements</b></p> <ul style="list-style-type: none"> <li>● If hazardous substance, "RQ" as part of the basic description</li> <li>● The LSA or SCO group (e.g., LSA-II)</li> <li>● "Highway Route Controlled Quantity" as part of the basic description, if HRCQ</li> <li>● Fissile material information (e.g., "Fissile Exempt," controlled shipment statement [see §172.203(d)(7)])</li> <li>● If the material is considered hazardous waste and the word waste does not appear in the shipping name, then "waste" must precede the shipping name (e.g., Waste Radioactive Material, nos, UN2982)</li> <li>● "Radioactive Material" if not in proper shipping name</li> </ul> <p><b>Package-Based Requirements</b></p> <ul style="list-style-type: none"> <li>● Package identification for DOT Type B or NRC certified packages</li> <li>● IAEA CoC ID number for export shipments or shipments using foreign-made packaging (see §173.473)</li> </ul> <p><b>Administrative-Based Requirements</b></p> <ul style="list-style-type: none"> <li>● "Exclusive Use-Shipment"</li> <li>● Instructions for maintenance of exclusive use-shipment controls for LSA/SCO strong-tight or NRC certified LSA (§ 173.427)</li> <li>● If a DOT exemption is being used, "DOT-E" followed by the exemption number</li> </ul>	<ul style="list-style-type: none"> <li>● The type of packaging (e.g., Type A, Type B, IP-1, ....)</li> <li>● The technical/chemical name may be included (if listed in §172.203(k), in parentheses between the proper shipping name and hazard class; otherwise inserted in parentheses after the basic description)</li> <li>● Other information is permitted (e.g., functional description of the product), provided it does not confuse or detract from the proper shipping name or other required information</li> <li>● For fissile radionuclides, except Pu-238, Pu-239, and Pu-241, the weight in grams or kilograms may be used <i>in place of</i> activity units. For Pu-238, Pu-239, and Pu-241, the weight in grams or kilograms may optionally be entered <i>in addition to</i> activity units [see §172.203(d)(4)]</li> <li>● Emergency response hazards and guidance information (§§172.600-604) may be entered on the shipping papers, or may be carried with the shipping papers [§172.602(b)]</li> </ul>

### Some Special Considerations/Exceptions for Shipping Paper Requirements

- Shipments of Radioactive Material, excepted packages, under UN2910 (e.g., Limited Quantity, Empty packages, and Radioactive Instrument and Article), are excepted from shipping papers. For limited quantities (§173.421), this is only true if the limited quantity is not a hazardous substance (RQ) or hazardous waste (40 CFR 262).
- Shipping papers must be in the pocket on the left door, or readily visible to a person entering the driver's compartment and within arm's reach of the driver.
- For shipments of multiple cargo types, any HAZMAT entries must appear as the first entries on the shipping papers, be designated by an "X" (or "RQ") in the hazardous material column, or be highlighted in a contrasting color.

## Hazard Communications for Class 7 (Radioactive) Materials

### Marking Packages (49 CFR 172.300-338)

*NOTE:* IAEA, ICAO, and IMO may require additional hazard communication information for international shipments  
This table must not be used as a substitute for the DOT and NRC regulations on the transportation of radioactive materials

Markings Always Required Unless Excepted	Additional Markings Sometimes Required	Optional Markings
<p><b>Non-Bulk Packages</b></p> <ul style="list-style-type: none"> <li>• Proper shipping name</li> <li>• U.N. identification number</li> <li>• Name and address of consignor or consignee, <i>unless</i>:                             <ul style="list-style-type: none"> <li>1. highway only and no motor carrier transfers; or</li> <li>part of carload or truckload lot or freight container load, and entire contents of railcar, truck, or freight container are shipped from one consignor to one consignee [see §172.301(d)]</li> </ul> </li> </ul> <hr style="border-top: 1px dashed black;"/> <p><b>Bulk Packages</b> (i.e., net capacity greater than 119 gallons as a receptacle for liquid, or 119 gallons and 882 pounds as a receptacle for solid, or water capacity greater than 1000 lbs, with no consideration of intermediate forms of containment)</p> <ul style="list-style-type: none"> <li>• U.N. identification number, on orange, rectangular panel (see §172.332) - some exceptions exist</li> </ul>	<p><b>Materials-Based Requirements</b></p> <ul style="list-style-type: none"> <li>• If in excess of 110 lbs (50 kg), Gross Weight</li> <li>• If non-bulk <i>liquid</i> package, underlined double arrows indicating upright orientation (two opposite sides) [ISO Std 780-1985 marking] </li> <li>• If a Hazardous substance in non-bulk package, the letters "RQ" in association with the proper shipping name</li> </ul> <p><b>Package-Based Requirements</b></p> <ul style="list-style-type: none"> <li>• The package type if Type A or Type B (½" or greater letters)</li> <li>• The specification-required markings [e.g., for Spec. 7A packages: "DOT 7A Type A" and "Radioactive Material" (see §178.350-353)]</li> <li>• For approved packages, the certificate ID number (e.g., USA/9166/B(U), USA/9150/B(U)-85, ...)</li> <li>• If Type B, the trefoil (radiation) symbol per Part 172 App. B [size: outer radius ≥ 20 mm (0.8 in)]</li> <li>• For NRC certified packages, the model number, gross weight, and package ID number (10 CFR 71.85)</li> </ul> <p><b>Administrative-Based Requirements</b></p> <ul style="list-style-type: none"> <li>• If a DOT exemption is being used, "DOT-E" followed by the exemption number</li> <li>• If an export shipment, "USA" in conjunction with the specification markings or certificate markings</li> </ul>	<ul style="list-style-type: none"> <li>• "IP-1," "IP-2," or "IP-3" on industrial packaging is recommended</li> <li>• Both the name and address of consignor and consignee are recommended</li> <li>• Other markings (e.g., advertising) are permitted, but must be sufficiently away from required markings and labeling</li> </ul>

### Some Special Considerations/Exceptions for Marking Requirements

- Marking is required to be: (1) durable, (2) printed on a package, label, tag, or sign, (3) unobscured by labels or attachments, (4) isolated from other marks, and (5) be representative of the hazmat contents of the package.
- Limited Quantity (§173.421) packages and Articles Containing Natural Uranium and Thorium (§173.426) must bear the marking "radioactive" on the outside of the inner package or the outer package itself, and are excepted from other marking. The excepted packages shipped under UN 2910 must also have the accompanying statement that is required by §173.422.
- Empty (§173.428) and Radioactive Instrument and Article (§173.424) packages are excepted from marking.
- Shipment of LSA or SCO required by §173.427 to be consigned as exclusive use are excepted from marking except that the exterior of each nonbulk package must be marked "Radioactive-LSA" or "Radioactive-SCO," as appropriate. Examples of this category are domestic, strong-tight containers with less than an A<sub>2</sub> quantity, and domestic NRC certified LSA/SCO packages using 10 CFR 71.52.
- For bulk packages, marking may be required on more than one side of the package (see 49 CFR 172.302(a)).

## Hazard Communications for Class 7 (Radioactive) Materials

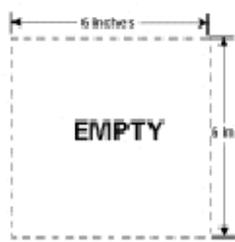
### Labeling Packages (49 CFR 172.400-450)

NOTE: IAEA, ICAO, and IMO may require additional hazard communication information for international shipments  
This table must not be used as a substitute for the DOT and NRC regulations on the transportation of radioactive materials

#### Placement of Radioactive Labels

- Labeling is required to be: (1) placed near the required marking of the proper shipping name, (2) printed or affixed to the package surface (not the bottom), (3) in contrast with its background, (4) unobscured by markings or attachments, (5) within color, design, and size tolerance, and (6) representative of the HAZMAT contents of the package.
- For labeling of radioactive materials packages, two labels are required on opposite sides excluding the bottom.

#### Determination of Required Label

<p><b>Size:</b></p> <p>Sides: ≥ 100 mm (3.9 in.)</p> <p>Border: 5-6.3 mm (0.2-0.25 in.)</p>	 <p>49 CFR 172.436</p>	 <p>49 CFR 172.438</p>	 <p>49 CFR 172.440</p>	 <p>49 CFR 172.450</p>
<b>Label</b>	<b>WHITE-I</b>	<b>YELLOW-II</b>	<b>YELLOW-III</b>	<b>EMPTY LABEL</b>
<b>Required when:</b>	Surface radiation level < 0.005 mSv/hr (0.5 mrem/hr)	0.005 mSv/hr (0.5 mrem/hr) < surface radiation level ≤ 0.5 mSv/hr (50 mrem/hr)	0.5 mSv/hr (50 mrem/hr) < surface radiation level ≤ 2 mSv/hr (200 mrem/h) [Note: 10 mSv/hr (1000 mrem/hr) for exclusive-use closed vehicle (§ 173.441(b))]	The EMPTY label is required for shipments of empty Class 7 (radioactive) packages made pursuant to §173.428. It must cover any previous labels, or they must be removed or obliterated.
<b>Or:</b>	TI = 0 [1 meter dose rate < 0.0005 mSv/hr (0.05 mrem/hr)]	TI ≤ 1 [1 meter dose rate < 0.01 mSv/hr (1 mrem/hr)]	TI ≤ 10 [1 meter dose rate < 0.1 mSv/hr (10 mrem/hr)] [Note: There is no package TI limit for exclusive-use]	
<b>Notes:</b>	<ul style="list-style-type: none"> <li>Any package containing a Highway Route Controlled Quantity (HRCQ) <b>must bear YELLOW-III label</b></li> <li>Although radiation level transport indices (TIs) are shown above, for fissile material, the TI is typically determined on the basis of criticality control</li> </ul>			

#### Content on Radioactive Labels

2. RADIOACTIVE Label must contain (entered using a durable, weather-resistant means):
- The radionuclides in the package (with consideration of available space). Symbols (e.g., Co-60) are acceptable.
  - The activity in SI units (e.g., Bq, TBq), or both SI units with customary units (e.g., Ci, mCi) in parenthesis. However, for domestic shipments, the activity *may* be expressed in terms of customary units only, until 4/1/97.
  - The Transport Index (TI) in the supplied box. The TI is entered *only* on YELLOW-II and YELLOW-III labels.

#### Some Special Considerations/Exceptions for Labeling Requirements

- For materials meeting the definition of another hazard class, labels for each secondary hazard class need to be affixed to the package. The subsidiary label *may* not be required on opposite sides, and must not display the hazard class number.
- Radioactive Material, excepted packages, under UN2910 (e.g., Limited Quantity, Empty packages, and Radioactive Instrument and Article), are excepted from labeling. However, if the excepted quantity meets the definition for another hazard class, it is re-classed for that hazard. Hazard communication requirements for the other class are required.
- Labeling exceptions exist for shipment of LSA or SCO required by § 173.427 to be consigned as exclusive use.
- The "Cargo Aircraft Only" label is typically required for radioactive materials packages shipped by air [§ 172.402(c)].

## Hazard Communications for Class 7 (Radioactive) Materials

### Placarding Vehicles (49 CFR 172.500-560)

*NOTE:* IAEA, ICAO, and IMO may require additional hazard communication information for international shipments  
This table must not be used as a substitute for the DOT and NRC regulations on the transportation of radioactive materials.

#### Visibility and Display of Radioactive Placard

- Placards are required to be displayed:
  - On four sides of the vehicle;
  - Visible from the direction they face, (for the front side of trucks, tractor-front, trailer, or both are authorized);
  - Clear of appurtenances and devices (e.g., ladders, pipes, tarpaulins);
  - At least 3 inches from any markings (such as advertisements) which may reduce placard's effectiveness;
  - Upright and on-point such that the words read horizontally;
  - In contrast with the background, or have a lined-border which contrasts with the background;
  - Such that dirt or water from the transport vehicle's wheels will not strike them;
  - Securely attached or affixed to the vehicle, or in a holder.
- Placard must be maintained by carrier to keep color, legibility, and visibility.

#### Conditions Requiring Placarding

- Placards are required for any vehicle containing a package with a RADIOACTIVE Yellow-III label.
- Placards are required for shipment of LSA or SCO required by §173.427 to be consigned as exclusive use. Examples of this category are domestic, strong-tight containers with less than an A<sub>2</sub> quantity, and domestic NRC certified LSA/SCO packages using 10 CFR 71.52. Also, for bulk packages of these materials, the orange panel marking with the UN Identification number is not required.
- Placards are required for any vehicle containing a package with a Highway Route Controlled Quantity (HRCQ). In this case, the placard must be placed in a square background as shown below (see §173.507(a)).

#### Radioactive Placard

<p><b>Size Specs:</b></p> <p><i>Sides:</i> ≥ 273 mm (10.8 in.)</p> <p><i>Solid line Inner border:</i> About 12.7 mm (0.5 in.) from edges</p> <p><i>Lettering:</i> ≥ 41 mm (1.6 in.)</p> <p><i>Square for HRCQ:</i> 387mm (15.25 in.) outside length by 25.4 mm (1 in.) thick</p>			
	49 CFR 172.556	IAEA SS 6 (1985) paras. 443-444	See 49 CFR 172.527 AND 556
	<b>RADIOACTIVE PLACARD (Domestic)</b>  <i>Base of yellow solid area:</i> 29 ± 5 mm (1.1 ± 0.2 in.) above horizontal centerline	<b>RADIOACTIVE PLACARD (International)</b>	<b>RADIOACTIVE PLACARD FOR HIGHWAY ROUTE CONTROLLED QUANTITY</b> (either domestic or international placard could be in middle)

#### Some Special Considerations/Exceptions for Placarding Requirements

- Domestically, substitution of the UN ID number for the word "RADIOACTIVE" on the placard is prohibited for Class 7 materials. However, some import shipments may have this substitution in accordance with international regulations.
- Bulk packages require the orange, rectangular panel marking containing the UN ID number, which must be placed adjacent to the placard (see §172.332) [NOTE: except for LSA/SCO exclusive use under §173.427, as above].
- If placarding for more than one hazard class, subsidiary placards must not display the hazard class number. Uranium Hexafluoride (UF<sub>6</sub>) shipments ≥ 454 kg (1001 lbs) require both RADIOACTIVE and CORROSIVE (Class 8) placarding.
- For shipments of radiography cameras in convenience overpacks, if the overpack does not require a RADIOACTIVE – YELLOW III label, vehicle placarding is not required (regardless of the label which must be placed on the camera).

## Package and Vehicle Contamination Limits (49 CFR 173.443)

This table must not be used as a substitute for the DOT and NRC regulations on the transportation of radioactive materials

**NOTE:** All values for contamination in DOT rules are to be averaged over each 300 cm<sup>2</sup>  
Sufficient measurements must be taken in the appropriate locations to yield representative assessments

βγ means the sum of beta emitters, gamma emitters, and low-toxicity alpha emitters

\* means the sum of all other alpha emitters (i.e., other than low-toxicity alpha emitters)

*The Basic Contamination Limits  
for All Packages:  
49 CFR 173.443(a), Table 11*

General Requirement: Non-fixed (removable) contamination must be kept as low as reasonably achievable (ALARA)

βγ: 0.4 Bq/cm<sup>2</sup> = 40 Bq/100 cm<sup>2</sup> = 1x10<sup>-5</sup> μCi/cm<sup>2</sup> = 2200 dpm/100 cm<sup>2</sup>

α: 0.04 Bq/cm<sup>2</sup> = 4 Bq/100 cm<sup>2</sup> = 1x10<sup>-6</sup> μCi/cm<sup>2</sup> = 220 dpm/100 cm<sup>2</sup>

*The following exceptions and deviations from the above basic limits exist:*

Deviation from Basic Limits	Regulation 49 CFR §§	Applicable Location and Conditions Which must Be Met:
10 times the basic limits	173.443(b) and 173.443(c)  Also see 177.843 (highway)	On any external surface of a package in an exclusive use shipment, during transport including end of transport. Conditions include: <ul style="list-style-type: none"> <li>• Contamination levels at beginning of transport must be below the basic limits.</li> <li>• Vehicle must not be returned to service until radiation level is shown to be ≤ 0.005 mSv/hr (0.5 mrem/hr) at any accessible surface, and there is no significant removable (non-fixed) contamination.</li> </ul>
10 times the basic limits	173.443(d)  Also see 177.843 (highway)	On any external surface of a package, at the beginning or end of transport, if a closed transport vehicle is used, solely for transporting radioactive materials packages. Conditions include: <ul style="list-style-type: none"> <li>• A survey of the interior surfaces of the empty vehicle must show that the radiation level at any point does not exceed 0.1 mSv/hr (10 mrem/hr) at the surface, or 0.02 mSv/hr (2 mrem/hr) at 1 meter (3.3 ft).</li> <li>• Exterior of vehicle must be conspicuously stenciled, "For Radioactive Materials Use Only" in letters at least 76 mm (3 inches) high, on both sides.</li> <li>• Vehicle must be kept closed except when loading and unloading.</li> </ul>
100 times the basic limits	173.428	<b>Internal</b> contamination limit for excepted package-empty packaging, Class 7 (Radioactive) Material, shipped in accordance with 49 CFR 173.428. Conditions include: <ol style="list-style-type: none"> <li>(1) The basic contamination limits (above) apply to <b>external</b> surfaces of package.</li> <li>(2) Radiation level must be ≤ 0.005 mSv/hr (0.5 mrem/hr) at any external surface.</li> <li>(3) Notice in §173.422(a)(4) must accompany shipment.</li> <li>(4) Package is in unimpaired condition &amp; securely closed to prevent leakage.</li> <li>(5) Labels are removed, obliterated, or covered, and the "empty" label (§172.450) is affixed to the package.</li> </ol>

In addition, after any incident involving spillage, breakage, or suspected contamination, the modal-specific DOT regulations (§177.861(a), highway; §174.750(a), railway; and §175.700(b), air) specify that vehicles, buildings, areas, or equipment have "no significant removable surface contamination" before being returned to service or routinely occupied. The carrier must also notify offeror at the earliest practicable moment after incident.

