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# Consolidated Guidance About Materials Licenses

## Program-Specific Guidance About Industrial Radiography Licenses

### Final Report

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Manuscript Completed: August 1998  
Date Published: August 1998

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## ABSTRACT

As part of its redesign of the materials licensing process, NRC is consolidating and updating numerous guidance documents into a single comprehensive repository as described in NUREG-1539, "Methodology and Findings of the NRC's Materials Licensing Process Redesign" and NUREG-1541, "Process and Design for Consolidating and Updating Materials Licensing Guidance" (to obtain, see Availability Notice). NUREG-1556, Vol. 2 is the second program-specific guidance developed for the new process. This document is intended for use by applicants, licensees, and NRC staff and will also be available to Agreement States. This guidance corresponds with the revision to 10 CFR Part 34 published in May 1997. This document combines and supersedes the guidance previously found in draft Regulatory Guide FC 401-4, "Guide for the Preparation of Applications for the Use of Sealed Sources and Devices for Performing Industrial Radiography," and in NMSS Policy and Guidance Directive FC 84-15, "Standard Review Plan for Applications for the Use of Sealed Sources and Devices for Performing Industrial Radiography." This report, where applicable, provides a more risk-informed, performance-based approach to industrial radiography licensing consistent with the current regulations. This final report should be used in preparing requests for licensing actions. NRC staff will use this final report in its review of requests for licensing actions.



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## FOREWORD

The United States Nuclear Regulatory Commission (NRC) used Business Process Redesign (BPR) techniques to redesign its materials licensing process. This effort is described in NUREG-1539 (to obtain, see Availability Notice). A critical element of the new process is consolidating and updating numerous guidance documents into a NUREG series of reports. Below is a list of volumes currently included in the NUREG-1556 series:

Vol. No.	Volume Title	Status
1	Program-Specific Guidance About Portable Gauge Licenses	Final Report
2	Program-Specific Guidance About Radiography Licenses	Final Report
3	Applications for Sealed Source and Device Evaluation and Registration	Draft for Comment
4	Program-Specific Guidance About Fixed Gauge Licenses	Draft for Comment
5	Program-Specific Guidance About Self-Shielded Irradiators Licenses	Draft for Comment
6	Program-Specific Guidance About 10 CFR Part 36 Irradiators Licenses	Draft for Comment
7	Program-Specific Guidance About Academic, Research and Development, and Other Licenses of Limited Scope	Draft for Comment

NUREG-1556, Vol. 2, "Consolidated Guidance about Materials Licenses: Program-Specific Guidance about Industrial Radiography Licenses," dated August 1998, provides program-specific guidance for the new process. It is intended for use by applicants, licensees, NRC license reviewers, and other NRC personnel. It supersedes the guidance previously found in Regulatory Guide FC 401-4, "Guide for the Preparation of Applications for the Use of Sealed Sources and Devices for Performing Industrial Radiography," dated October 1984, and in NMSS Policy and Guidance Directive FC 84-15, "Standard Review Plan for Applications for the Use of Sealed Sources and Devices for Performing Industrial Radiography," dated October 1984. This guidance has been prepared to correspond to the new requirements and format established in the revision of 10 CFR Part 34 published in 1997. Appendix A provides a list of Technical Assistance Requests, Information Notices, and Policy and Guidance Directives applicable to radiography which have been considered in the development of this NUREG Report. This Appendix also identifies those documents that have been superseded.

NUREG-1556, Vol. 2, takes, where applicable, a more graded (or risk-informed) and performance-based approach to licensing industrial radiography. A team composed of NRC staff from headquarters and regional offices prepared NUREG-1556, Vol. 2. The team drew on its collective experience in radiation safety in general and as specifically applied to industrial radiography. A representative of NRC's Office of the General Counsel provided a legal perspective.

## FOREWORD

NUREG-1556, Vol. 2, "Consolidated Guidance about Materials Licenses: Program-Specific Guidance about Radiography Licenses," dated August 1998, represents a step in the transition from the current paper-based process to the new electronic process. NUREG-1556, Vol. 2 is also available electronically by visiting NRC's Home Page <http://www.nrc.gov/NRC/NUREGS/SR1556/V2/index.html>.

This report describes and makes available to the public information on: methods acceptable to the NRC staff for implementing specific parts of the Commission's regulations; techniques the staff uses in evaluating applications, including specific problems or postulated accidents; and data the NRC staff needs to review applications for licenses. NUREG-1556, Vol. 2, "Consolidated Guidance about Materials Licenses: Program-Specific Guidance about Industrial Radiography Licenses," dated August 1998, is not a substitute for NRC regulations, and compliance is not required. The approaches and methods described in this report are provided for information only. Methods and solutions different from those described in this report will be acceptable if they provide a basis for the staff to make the determinations needed to issue or continue a license.

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## **ACKNOWLEDGMENTS**

The writing team thanks the individuals listed below for assisting in the development and review of both the draft and final reports. All participants provided valuable insights, observations, and recommendations.

The team also thanks Kay Avery, Mary Carnahan, Angela Case, Elaine Gerdine, Alyce Martin, Tim Woods, Gina Thompson, and Tina Jordan of Computer Sciences Corporation, and Cindy Caldwell from the State of Texas.

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## ABBREVIATIONS

ALARA	As low as reasonably is achievable
ANSI	American National Standards Institute
Bq	Becquerel
BPR	Business Process Redesign
CFR	Code of Federal Regulations
cm	centimeter
COC	Certificate of Compliance
DOE	United States Department of Energy
DOT	United States Department of Transportation
DU	depleted uranium
GPO	Government Printing Office
hr	hour
IN	Information Notice
mrem	millirem
mSv	millisievert
NARM	Naturally-occurring and Accelerator-produced Radioactive Material
NIST	National Institute of Standards and Technology
NMSS	Office of Nuclear Materials Safety and Safeguards
NRC	United States Nuclear Regulatory Commission
NVLAP	National Voluntary Laboratory Accreditation Program
OC	Office of the Controller
OCR	optical character reader
OMB	Office of Management and Budget
OSP	Office of State Programs
RQ	reportable quantities
RSO	Radiation Safety Officer
SI	International System of Units (abbreviated SI from the French Le Systeme Internationale d'Unites)
SSD	Sealed Source and Device
Sv	Sievert
TEDE	Total effective dose equivalent
TI	Transportation Index
TLD	thermoluminescent dosimeters
URL	Uniform Resource Locator



# 1 PURPOSE OF REPORT

This NUREG report provides guidance to an applicant in preparing an industrial radiography (radiography) license application as well as NRC criteria for evaluating a radiography license application. The term “radiography” as used in this report means an examination of the structure of materials by nondestructive methods, using ionizing radiation to make radiographic images generally using gamma-emitting byproduct materials (radioisotopes). The radioisotopes most commonly used for radiography are cobalt-60 and iridium-192; however, other radioisotopes (e.g. californium-252) with unique radiological characteristics may also be used. This report does not address the research and development of radiography devices or associated equipment, or the commercial aspects of manufacturing, distribution, and service of such devices or equipment.

This NUREG report identifies the information needed to complete NRC Form 313 (Appendix B), “Application for Material License,” for the use of sealed sources containing byproduct material in radiography devices. The information collection requirements in 10 CFR Parts 30 and 34 and NRC Form 313 have been approved under the Office of Management and Budget (OMB) Clearance Nos. 3150-0017, 3150-0007, and 3150-0120, respectively.

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

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

Notes, Boxes, and References are self-explanatory and may not be found for each item on NRC Form 313.

NRC Form 313 does not have sufficient space for applicants to provide full responses to Items 5 through 11. As indicated on the form, the answers to those items are to be provided on separate sheets of paper and submitted with the completed NRC Form 313.

Appendix C provides information on certain topics which may be used in the application and can be used to complete items 5 - 11 of NRC Form 313. Appendix C may also be used as a checklist that NRC staff can use to review applications and applicants can use to check for completeness. Appendix D is a sample radiography license. It contains the conditions most often found on these licenses, although not all licenses will have all conditions.

## 2 AGREEMENT STATES

Certain states, called Agreement States (see Figure 2.1), have entered into agreements with the NRC that give them the authority to license and inspect byproduct, source, or special nuclear materials used or possessed within their borders. Any applicant other than a Federal agency who wishes to possess or use licensed material in one of these Agreement States needs to contact the responsible officials in that State for guidance on preparing an application; file these applications with State officials, not with the NRC. Naturally-occurring and Accelerator-produced Radioactive Material (NARM) and X-rays are always regulated by the states, not the NRC.

In general, NRC's materials licensees who wish to conduct operations at temporary jobsites in an Agreement State should contact that State's radiation control program office for information about State regulations. To ensure compliance with Agreement State reciprocity requirements, a licensee should request authorization well in advance of scheduled use.

In the special situation of work at Federally-controlled sites in Agreement States, it is necessary to know the jurisdictional status of the land in order to determine whether NRC or the Agreement State has regulatory authority. NRC has regulatory authority over land determined to be "exclusive Federal jurisdiction," while the Agreement State has jurisdiction over non-exclusive Federal jurisdiction land. Licensees are responsible for finding out, in advance, the jurisdictional status of the specific areas where they plan to conduct licensed operations. NRC recommends that licensees ask their local contact 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 Agreement State regulatory requirements, as appropriate. Additional guidance on determining jurisdictional status is found in All Agreement States Letter, SP-96-022, dated February 16, 1996.

Table 2.1 provides a quick way to check on which agency, if any, has regulatory authority.

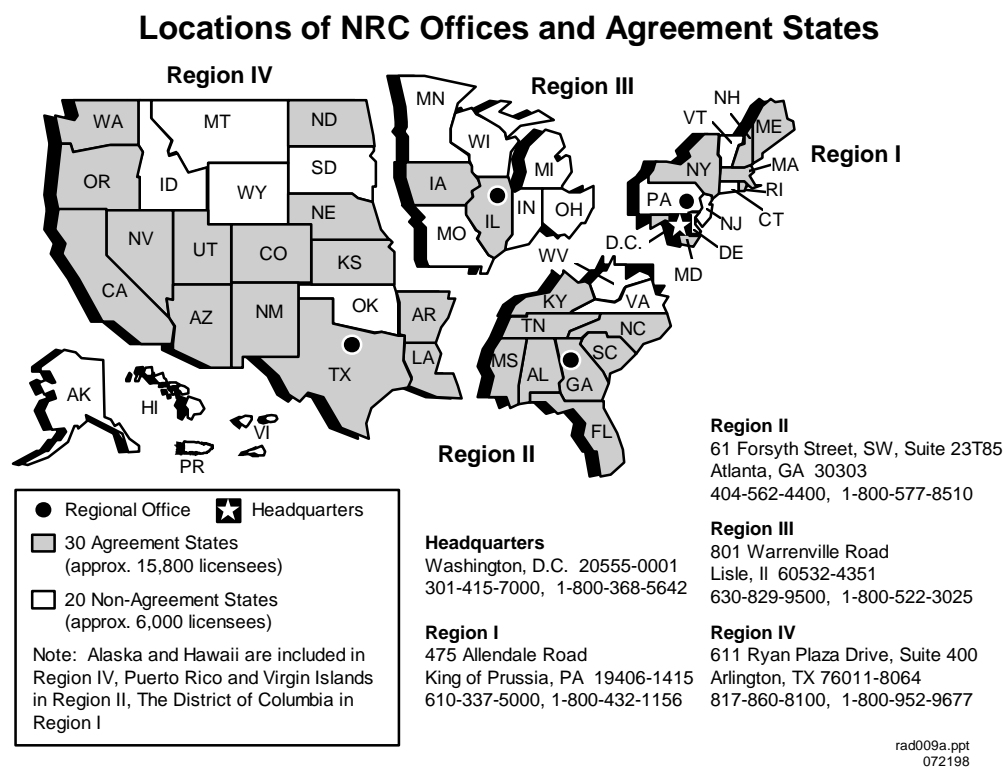
**Table 2.1     Who Regulates the Activity?**

<b>Applicant and Proposed Location of Work</b>	<b>Regulatory Agency</b>
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, US territory or possession	NRC
Non-Federal entity in Agreement State at non-Federally controlled site	Agreement State



## AGREEMENT STATES

Applicant and Proposed Location of Work	Regulatory Agency
Non-Federal entity in Agreement State at Federally-controlled site NOT subject to exclusive Federal jurisdiction	Agreement State
Non-Federal entity in Agreement State at Federally-controlled site subject to exclusive Federal jurisdiction	NRC



**Figure 2.1 U.S. Map.** *Location of NRC Offices and Agreement States.*

**Reference:** A current list of Agreement States (including names, addresses, and telephone numbers of responsible officials) by visiting the NRC Office of State Programs' (OSP's) Home Page <<http://www.hsrn.ornl.gov/nrc>> and choose "Directories" and then "State Program Directors." Or may be obtained upon request from NRC's Regional Offices (see Figure 2.1 for addresses and telephone numbers).

All Agreement States Letter, SP-96-022, dated February 16, 1996, is available by visiting OSP's Home Page <<http://www.hsrn.ornl.gov/nrc>>, choose "NRC-State Communications," and then choose "Other"; scroll down to find "1996" and then "SP-96-022." Or by calling OSP; call NRC's toll free number (800) 368-5642 and then ask for extension 415-3340.

### 3 MANAGEMENT RESPONSIBILITY

The NRC recognizes that effective radiation safety program management is vital to achieving safe and compliant operations. NRC also believes that consistent compliance with its regulations provides reasonable assurance that licensed activities will be conducted safely. NRC believes that effective management will result in increased safety and compliance. NRC frequently finds ineffective management is the underlying cause of safety and compliance problems.

“Management” refers to the processes for conduct and control of a radiation safety program and to the individuals who are responsible for those processes and who have authority to provide necessary resources to achieve regulatory compliance.

To ensure adequate management involvement, a management representative, (pursuant to 10 CFR 30.32(c)), must be a person duly authorized to act for and on behalf of the applicant or licensee) must sign the submitted application acknowledging management's commitments and responsibility for the following:

- C Ensuring radiation safety, security, and control of radioactive materials, and compliance with regulations;
- C Ensuring completeness and accuracy of the radiation safety records and all information provided to NRC (10 CFR 30.9);
- C Knowing the contents of the license and application;
- C 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 regulations is maintained;
- C Selecting and assigning a qualified individual to serve as the Radiation Safety Officer (RSO) and, as necessary, identifying individual(s) as potential designees (10 CFR 34.13(g)) for their licensed activities;
- C Confirming that the RSO has independent authority to stop unsafe operations and will be given sufficient time to fulfill his/her radiation safety duties and responsibilities;
- C Ensuring worker audits are conducted at 6-month intervals (may be performed by the RSO);
- C Ensuring workers have had adequate training;
- C Reporting equipment failures as required under 10 CFR Part 21 and 34; ensuring current, up-to-date NRC, Department of Transportation (DOT) regulations and Operating & Emergency Procedures are available to all employees.

For information on NRC enforcement policy, see “General Statement of Policy and Procedures for NRC Enforcement Actions,” (NUREG-1600), which is available from NRC upon request (to obtain, see Availability Notice). NUREG-1600 is also available on the Internet. Visit NRC's Home Page <<http://www.nrc.gov>>, choose “Nuclear Materials,” then “Enforcement Program,”

## MANAGEMENT RESPONSIBILITY

“Enforcement Guidance Documents,” and then “Enforcement Policy.” For information on NRC's radiography inspection procedures, see Inspection Procedure 87120.

## 4 APPLICABLE REGULATIONS

It is the licensee's responsibility to have up-to-date copies of applicable regulations, read them, and abide by each applicable regulation.

The following Parts of 10 CFR Chapter I contain regulations applicable to radiography devices:

- C 10 CFR Part 2, "Rules of Practice for Domestic Licensing Proceedings and Issuance of Orders"
- C 10 CFR Part 19, "Notices, Instructions and Reports to Workers: Inspection and Investigations"
- C 10 CFR Part 20, "Standards for Protection Against Radiation"
- C 10 CFR Part 21, "Reporting of Defects and Noncompliance"
- C 10 CFR Part 30, "Rules of General Applicability to Domestic Licensing of Byproduct Material"
- C 10 CFR Part 34, "Licenses for Radiography and Radiation Safety Requirements for Radiographic Operations"
- C 10 CFR Part 40, "Domestic Licensing of Source Material"
- C 10 CFR Part 71, "Packaging and Transportation of Radioactive Material"

Part 71 requires that licensees who transport licensed material outside the site of usage, as specified in the NRC license, or where transport is on public highways, or who may offer such material to a carrier for transport, must comply with the applicable requirements of the United States Department of Transportation (DOT) that are found in 49 CFR Parts 170 through 189. Copies of DOT regulations can be ordered from the Government Printing Office (GPO) whose address and telephone number are listed below.

- C 10 CFR Part 150, "Exemptions and Continued Regulatory Authority in Agreement States and in Offshore Waters under Section 274"
- C 10 CFR Part 170, "Fees for Facilities, Materials, Import and Export Licenses and Other Regulatory Services Under the Atomic Energy Act of 1954, as Amended"
- C 10 CFR Part 171, "Annual Fees for Reactor Operating Licenses, and Fuel Cycle Licenses and Materials Licenses, Including Holders of Certificates of Compliance, Registrations, and Quality Assurance Program Approvals and Government Agencies Licensed by NRC"

To request copies of the above documents, call GPO's order desk in Washington, DC at (202) 512-1800. Order the two-volume bound version of Title 10, Code of Federal Regulations, Parts 0-50 and 51-199 from the GPO, Superintendent of Documents, Post Office Box 371954, Pittsburgh, Pennsylvania 15250-7954. The GPO may also be contacted at <[www.gpo.gov](http://www.gpo.gov)>.

## APPLICABLE REGULATIONS

Request single copies of the above documents from NRC's Regional or Field Offices (see Figure 2.1 for addresses and telephone numbers). Note that changes to NRC regulations are published in the Federal Register.

## 5 HOW TO FILE

### 5.1 PAPER APPLICATION

Applicants for a materials license should do the following:

- C Be sure to use the most recent guidance in preparing an application.
- C This document is the NUREG Report for filing applications.
- C Complete NRC Form 313 (Appendix B) Items 1 through 4, 12, and 13 on the form itself.
- C Complete NRC Form 313 Items 5 through 11 on supplementary pages and, as needed, use Appendix C.
- C Identify each separate sheet (other than Appendix C) submitted with the application by keying each sheet to an item number on the application or to the topic to which it refers.
- C Submit all documents, typed, on 8-1/2 x 11 inch paper.
- C Avoid submitting proprietary information (e.g., confidential company information, etc.) unless it is absolutely necessary.
- C Submit an original, signed application and one copy.
- C **Retain one copy of the license application for future reference in order to maintain an awareness of license commitments.**

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

All license applications will be available for review by the general public in NRC's Public Document Rooms. If it is necessary to submit proprietary information, follow the procedure in 10 CFR 2.790. Failure to follow this procedure may result in disclosure of the proprietary information to the public or substantial delays in processing the application. Employee personal information (e.g., home address, home telephone number, social security number, date of birth, radiation dose information) should not be submitted unless specifically requested by NRC.

NRC's future licensing process will be faster and more efficient, in part, through acceptance and processing of electronic applications. NRC recommends using a signed NRC Form 313. Other components may be submitted in paper or electronic media. However, those components submitted in paper format will be scanned and converted to electronic format. To ensure a smooth transition, applicants are requested to follow these suggestions:

- C Submit printed or typewritten, not handwritten, text on smooth, crisp paper that will feed easily into the scanner.
- C Choose typeface designs that are sans serif, such as Arial, Helvetica, Futura, or Univers (the text of this document is in a serif font called Times New Roman).

## HOW TO FILE

- C Choose 12-point or larger font size.
- C Avoid stylized characters, such as script, italic, etc.
- C Be sure the print is clear and sharp.
- C Be sure there is high contrast between the ink and paper (black ink on white paper is best).

## **5.2 ELECTRONIC APPLICATION**

As the electronic licensing process develops, it is anticipated that NRC may provide mechanisms for filing applications via diskettes or CD-ROM, and through the Internet. Additional filing instructions will be provided as these new mechanisms become available.

## **6 WHERE TO FILE**

Applicants wishing to possess or use licensed material in any State or U. S. territory or possession subject to NRC jurisdiction must file an application with the NRC Regional Office for the locale in which the material will be possessed and/or used. Figure 2.1 shows NRC's four Regional Offices and their respective areas for licensing purposes. Figure 2.1 also identifies Agreement States.

In general, applicants wishing to possess or use licensed material in Agreement States must file an application with the Agreement State, not NRC. However, if work will be conducted at Federally controlled sites in Agreement States, applicants must first determine the jurisdictional status of the land in order to determine whether NRC or the Agreement State has regulatory authority. See the section on “Agreement States” for additional information.





## **7 LICENSE FEES**

Each application for which a fee is specified, including applications for new licenses and license amendments, must be accompanied by the appropriate fee. Refer to 10 CFR 170.31 to determine the amount of the fee. NRC 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 the NRC's disposition of an application or the withdrawal of an application.

Most NRC licensees are also subject to annual fees; refer to 10 CFR 171.16. Consult 10 CFR 171.11 for additional information on exemptions from annual fees and 10 CFR 171.16(c) on reduced annual fees for licensees that qualify as “small entities.”

Direct all questions about NRC's fees or completion of Item 12 of NRC Form 313 (Appendix B) to the Office of the Controller (OC) at NRC headquarters in Rockville, Maryland, (301) 415-7554. You may also call NRC's toll free number (800) 368-5642 and then ask for extension 415-7554.



## 8 CONTENTS OF AN APPLICATION

The following comments apply to the indicated items on NRC Form 313 (Appendix B).

### 8.1 ITEM 1: LICENSE ACTION TYPE

**THIS IS AN APPLICATION FOR (Check appropriate item)**

Type of Action	License No.
<input type="checkbox"/> A. New License	Not applicable
<input type="checkbox"/> B. Amendment to License No	XX-XXXXXX-XX
<input type="checkbox"/> C. Renewal of License No.	XX-XXXXXX-XX

Check box A for a new license request.

Check box B for an amendment of an existing license and provide license number. See “Amendments and Renewals to a License,” Section 9 of this document.

Check box C for a renewal of an existing license and provide license number.

### 8.2 ITEM 2: APPLICANT'S NAME AND MAILING ADDRESS

**Response from 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.

**Note:** NRC must be notified in the event of transfer of control and bankruptcy proceedings; see below for more details.

#### Timely Notification of Transfer of Control

**Regulations:** 10 CFR 30.34(b).

**Criteria:** Licensees must provide full information and obtain NRC's prior written consent before transferring control of the license, directly or indirectly, or, as some licensees call it, “transferring the license.”

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

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

For additional guidance, see IN 89-25, rev. 1 dated Dec. 7, 1994.

**Response from Applicant:** None from an applicant for a new license; Appendix E identifies the information to be provided about transfer of control.

## Notification of Bankruptcy Proceedings

**Regulation:** 10 CFR 30.34(h)

**Criteria:** Immediately (within 24 hours) following filing of voluntary or involuntary petition for bankruptcy for or against a licensee, the licensee must notify the appropriate NRC Regional Administrator, in writing, identifying the bankruptcy court in which the petition was filed and the date of filing.

**Response from Applicant:** None at time of application for a new license.

## 8.3 ITEM 3: ADDRESS(ES) WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED

**Regulations:** 10 CFR 30.33(a)(2), 10 CFR 34.11, 10 CFR 34.13(j), 10 CFR 34.33, 10 CFR 34.89, 10 CFR 34.101(c).

**Criteria:** Applicants must provide a specific address for each location where radioactive material will be used or stored, or dispatched.

**Discussion:** Specify the street address, city, and state or other descriptive address (such as on Highway 10, 5 miles east of the intersection of Highway 10 and State Route 234, Anytown, State) for each permanent storage or use facility and field station. A field station is a location where licensed material may be stored or used and from which the applicant will dispatch equipment to jobsites. A Post Office Box address is insufficient because NRC needs a specific address to allow an NRC inspector to find the use and/or storage location. If devices will NOT be stored at a dispatch site or field station, indicate this. Also the applicant should state whether a location will be used to perform radiographic operations or only for storage of sources and devices.

**Response from Applicant:**

- C If a device will be used in a permanent radiographic installation, give the specific address of each location. If applicable, describe the locations outside of the installation where radiographic operations will be conducted.
- C If radiography equipment will be stored and /or used at a field station, give the specific address of each field station.
- C If radiography operations will be conducted at temporary jobsites (i.e., locations where work is conducted for limited periods of time), specify “temporary jobsites anywhere in the United States where NRC maintains jurisdiction.”

**Note:** If radiography operations are expected to exceed 180 days at a temporary jobsite, then provide written notification to the appropriate NRC regional office prior to exceeding the 180 days (a license amendment is not required).

## 8.4 ITEM 4: PERSON TO BE CONTACTED ABOUT THIS APPLICATION

Identify the individual who can answer questions about the application and include his or her telephone number. This is typically the proposed radiation safety officer (RSO) or knowledgeable management official. The NRC will contact this individual if there are questions about the application.

Notify NRC if the contact person or telephone number changes. This notice is for “information only” and does not require a license amendment or a fee.

As indicated on NRC Form 313 (Appendix B), Items 5 through 11 should be submitted on separate sheets of paper.

## **8.5 ITEM 5: RADIOACTIVE MATERIAL**

### **8.5.1 SEALED SOURCES AND DEVICES**

**Regulation:** 10 CFR 30.32(g), 10 CFR 30.33(a)(2), 10 CFR 32.210, 10 CFR 34.20.

**Criteria:** Applicants must provide the manufacturer's (or distributor's) name and model number for each requested source assembly (sealed source), exposure device, and source changer. Licensees will only be authorized for radiographic exposure devices, source assemblies or sealed sources containing byproduct material and associated equipment meeting NRC performance requirements and specifically approved or registered by NRC or an Agreement State. Also, identify any depleted uranium that is used as shielding material (radiographic exposure devices, source changers and some collimators contain depleted uranium).

**Discussion:** NRC or an Agreement State performs a safety evaluation of radiography source assemblies (sealed sources) exposure devices and source changers prior to distribution of these sources/devices to specific licensees. The safety evaluation is documented in a Sealed Source and Device (SSD) Registration Certificate issued to the manufacturer (or distributor). Therefore, if the source assemblies, exposure devices, or source changers are approved for use by NRC or an Agreement State agency, the applicant need only note the manufacturer's (or distributor's) name and model number of the sources/devices in its license application to demonstrate that the requirements are met.

Consult with the proposed supplier to ensure that sources and devices conform to the sealed source and device designations registered with NRC or an Agreement State. For licensees to ensure that they use radiographic equipment in accordance with registration certificates, licensees may want to review the certificate, discuss with the manufacturer, or obtain a copy of the certificate. Licensees may not make modifications to exposure devices, source changers, source assemblies and associated equipment unless the design of any replacement component, including source holder, source assembly, controls or guide tubes would not compromise the safety features of the system.

Consult with the manufacturer of the associated equipment (i.e., equipment that is used in conjunction with the exposure device that drives, guides, or comes in contact with the source) to be sure that the associated equipment is compatible with the sources and devices. Licensees must demonstrate that associated equipment meet the performance requirements in 10 CFR 34.20. Information Notice 96-20: "Demonstration of Associated Equipment Compliance with 10 CFR 34.20" (Appendix F) contains a number of ways that licensees can demonstrate that their associated equipment meets performance requirements.

**Response from Applicant:**

- C Identify each radionuclide that will be used. Identify the manufacturer (or distributor) and model number of each sealed source, source assembly, exposure device, and/or source changer to be possessed. Identify any depleted uranium that is used as shielding material.
- C Confirm that each sealed source, device, and source/device combination possessed is registered as an approved sealed source or device by NRC or an Agreement State and will be possessed and used in accordance with the conditions specified in the registration certificate.
- C Confirm that associated equipment is compatible with the exposure devices, source changers, and sealed sources containing byproduct material.
- C Identify by radioisotope and manufacturer (or distributor) and model number any other sealed sources containing byproduct material (i.e., any source that will not be used for performing radiography).
- C Confirm that all radiographic exposure devices, source assemblies or sealed sources, and all associated equipment which meet the requirements specified in 10 CFR 34.20 will be used in radiographic operations.

**Table 8.1 Industrial Nuclear Model Ir-100 Exposure Device Maximum Authorization — 120 Ci**

Element	Sealed Source	Curies	Source Changer Meeting 10 CFR 34 Requirements	Maximum Curies Authorized
Ir-192	C IN Model 32	<b>120 Ci</b>	C Amersham 550-SU C IN IR-50	120 Ci 120 Ci
Ir-192	C IN Model 33	<b>120 Ci</b>	C Amersham 550 -SU C IN IR-50	120 Ci 120 Ci
Ir-192	C Amersham 87703	<b>120 Ci</b>	C Amersham 550 -SU C Amersham 650L C Amersham 820 C Amersham 855 C IN IR-50	120 Ci 240 Ci 1,000 Ci 960 Ci 120 Ci
Ir-192	C Amersham 87704	<b>120 Ci</b>	C Amersham 550 -SU C Amersham 650 C Amersham 820 C Amersham 855	120 Ci 240 Ci 1,000 Ci 960 Ci



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Element	Sealed Source	Curies	Source Changer Meeting 10 CFR 34 Requirements	Maximum Curies Authorized
Ir-192	C SPEC G-40F	120 Ci	C Amersham 550 -SU C SPEC C-1 C IN IR-50	120 Ci 150 Ci 120 Ci
Ir-192	C SPEC G-40T	120 Ci	C Amersham 550 -SU C SPEC C-1 C IN IR-50	120 Ci 150 Ci 120 Ci

**Table 8.2 Spec Model 150 Exposure Device Maximum Authorization — 150 Ci**

Element	Sealed Source	Curies	Source Changer	Curie Authorization
Ir-192	C SPEC G-60	240 Ci	C SPEC C-1	150 Ci

**Table 8.3 Amersham Model 680 System Exposure Device Maximum Authorization — 110 Ci**

Element	Sealed Source	Curies	Source Changer	Curie Authorization
Co-60	C Amersham A424-14	110 Ci	C Amersham 770 C Amersham 771	550 Ci 110 Ci
Co-60	C Amersham 943	110 Ci	C Amersham 770 C Amersham 771	550 Ci 110 Ci

**Table 8.4 Amersham Model 660 System Exposure Device Maximum Authorization — 140 Ci**

Element	Sealed Source	Curies	Source Changer	Curie Authorization
Ir-192	IN Model 7	100 Ci	Amersham 550 -SU Amersham 650L Amersham 820 Amersham 855 IN IR-50 SPEC C-1	120 Ci 240 Ci 1,000 Ci 960 Ci 120 Ci 150 Ci

Element	Sealed Source	Curies	Source Changer	Curie Authorization
Ir-192	CIS-US 702	120 Ci	Amersham 550 -SU IN IR-50 SPEC C-1	120 Ci 120 Ci 150 Ci
Ir-192	Amersham 91813	20 Ci	Amersham 650L	240 Ci
Ir-192	Amersham A424-22	240 Ci	Amersham 550 -SU Amersham 650L Amersham 820 Amersham 855	120 Ci 240 Ci 1,000 Ci 960 Ci
Ir-192	Amersham A424-9	240 Ci	Amersham 550 -SU Amersham 650L Amersham 820 Amersham 855 IN IR-50 SPEC C-1	120 Ci 240 Ci 1,000 Ci 960 Ci 120 Ci 150 Ci

**Note:** For information on SSD registration certificates, contact the Registration Assistant by calling NRC's toll free number (800) 368-5642 and then asking for extension 415-7217.

## 8.5.2 FINANCIAL ASSURANCE AND RECORDKEEPING FOR DECOMMISSIONING

**Regulations:** 10 CFR 30.34(b), 10 CFR 30.35, 10 CFR 34.13(k).

**Criteria:** Industrial radiography licensees authorized to possess sealed sources containing byproduct material in excess of the limits specified in 10 CFR 30.35 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 devices are used or stored and records related to leaking sources. Licensees must transfer these records important to decommissioning either to any new licensee before licensed activities are transferred or assigned in accordance with 10 CFR 30.34(b), or to the appropriate NRC regional office before the license is terminated.

**Discussion:** The requirements for financial assurance are specific to the types and quantities of byproduct material authorized on a license. Most industrial radiography applicants and licensees do not need to comply with the financial assurance requirements because the thresholds for sealed sources containing byproduct material are  $3.7 \times 10^5$  Bq (10,000 curies) of cobalt-60 and  $3.7 \times 10^6$

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Bq (100,000 curies) of cesium-137 or byproduct material with half-lives less than 120 days (e.g., iridium-192). Thus, a licensee would need to possess hundreds of sources before the financial assurance requirements would apply. Since the standard industrial radiography license does not specify the maximum number of sources that the licensee may possess (allowing the licensee flexibility in obtaining sources/devices as needed without amending its license), it contains a condition requiring the licensee to limit its possession of sources to quantities not requiring financial assurance for decommissioning. Applicants and licensees desiring to possess sources exceeding the threshold amounts must submit evidence of financial assurance.

The same regulation also requires that licensees maintain records important to decommissioning in identified locations other than at any temporary jobsite. All industrial radiography licensees need to maintain records of structures and equipment where devices are used or stored. As-built drawings showing modifications to structures and equipment fulfill this requirement. If drawings are not available, licensees may substitute appropriate records (e.g., a sketch of the room, building or a narrative description of the area) concerning the areas and locations. In addition, industrial radiography licensees who have experienced unusual occurrences (e.g., leaking sources or other incidents that involve spread of contamination, such as S-tube breakthrough) also need to maintain records about contamination that remains after cleanup or contamination that may have spread to inaccessible areas.

**Response from Applicants:** State: “Pursuant to 10 CFR 30.35(g), we shall maintain drawings and records important to decommissioning and to transfer these records to a new licensee before licensed activities are transferred, or to assign the records to the appropriate NRC regional office before the license is terminated.”

**AND**

If financial assurance is required, submit evidence.

**Reference:** 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 upon request.

## **8.6 ITEM 6: PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED**

**Regulations:** 10 CFR 30.33(a)(1), 10 CFR 34.1.

**Criteria:** Sources and devices will be used only for the purposes for which they were designed and in accordance with the manufacturer's recommendations for use as specified in an approved Sealed Source and Device (SSD) Registration Certificate.

**Discussion:** The typical license authorizes persons to perform source exchanges and to conduct industrial radiography at temporary jobsites, field stations, and/or permanent radiographic installations. Unusual uses will be evaluated on a case-by-case basis and the authorized use condition will reflect approved uses. Applicants who plan to perform radiographic operations on lay-barges, on offshore platforms, or underwater must specifically request these operations.

**Response from Applicant:**

C Check off on Appendix C that the equipment will only be used for industrial radiography.

**OR**

C Specify the purposes for which the sources and device(s) will be used other than those included in the manufacturer's recommendations, as specified on the SSD Registration Certificate.

**AND**

C In addition, specify any plans to perform radiography underwater, on lay-barges, or on off-shore platforms.

## **8.7 ITEM 7: INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCE**

### **8.7.1 RADIATION SAFETY OFFICER (RSO)**

**Regulations:** 10 CFR 34.13(f), 10 CFR 34.13(g), 10 CFR 34.42.

**Criteria:** RSOs and potential designees responsible for ensuring that the licensee's radiation safety program is implemented in accordance with approved procedures must have adequate training and experience.

**Discussion:** The person responsible for the radiation protection program is called the RSO. The NRC believes the RSO is the key to overseeing and ensuring safe operation of the licensee's radiography program. 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.

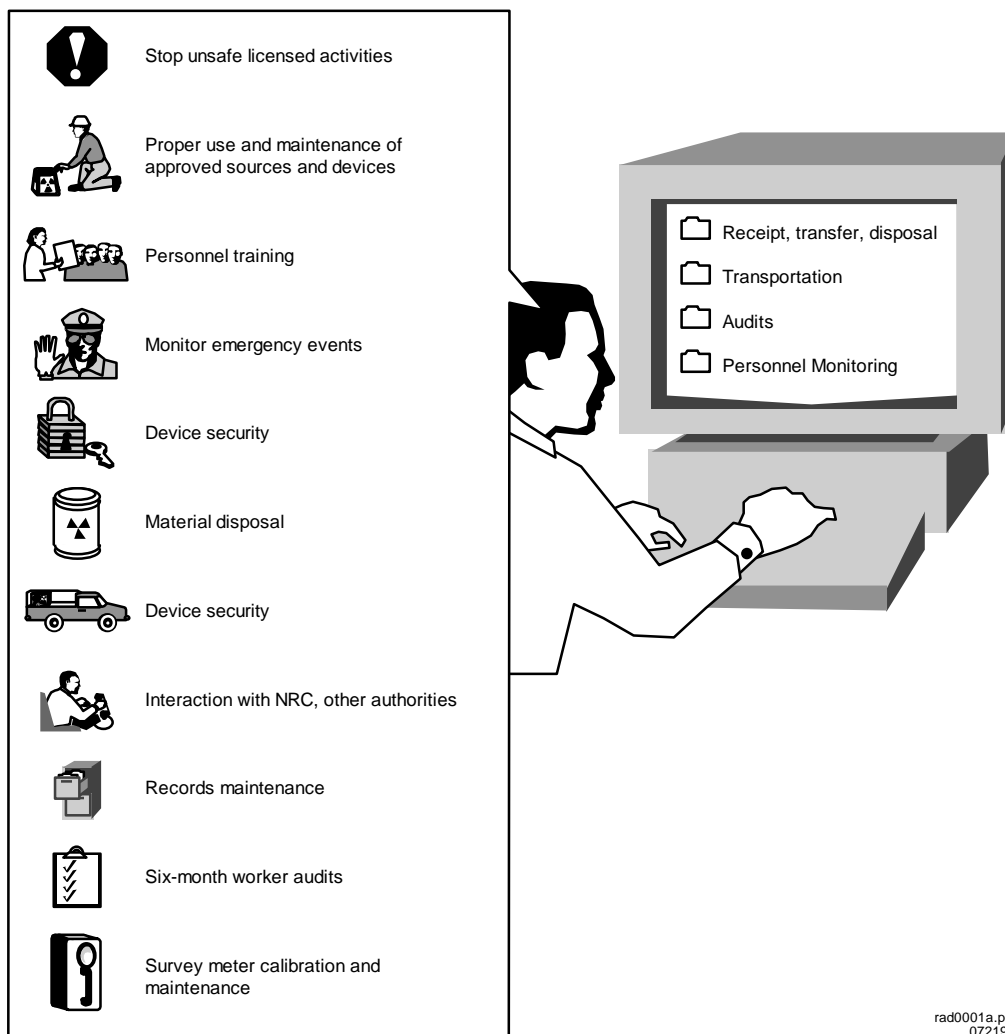
The RSO may delegate certain day-to-day tasks of the radiation protection program to other responsible individuals (potential designees). For example, a large testing company with multiple field stations may appoint individuals designated as "site RSOs" who assist the RSO and are responsible for the day-to-day activities at the field stations. Licensees may also appoint other individuals who may "step-in" as an emergency contact when the RSO is unavailable. The potential designees do not need to meet the required RSO qualifications; however, these

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individuals should be qualified, experienced radiographers who are adequately knowledgeable of the activities to which they are assigned. Applicants do not have to identify other responsible individuals if day-to-day tasks, etc. will not be delegated.

Typical RSO duties are illustrated in Figure 8.1. NRC requires the name of the RSO on the license to ensure that licensee management has always identified a responsible, qualified person and that the named individual knows of his or her designation as RSO. Provide NRC with a copy of an organizational chart showing the RSO (and other designated responsible individuals) to demonstrate that he or she has sufficient independence and direct communication with responsible management officials. Also, show in the organizational chart the position of the individual who signs the application in Item 13 of the NRC Form 313.

To be considered eligible for the RSO position, an individual must be a qualified radiographer, have a minimum of 2,000 hours (one year full-time field experience) of hands-on experience as a qualified radiographer, and have formal training in establishing and maintaining a radiation protection program. This should be a course specifically designed to provide training in running a radiation safety program, a basic radiation safety course is not acceptable. While a course particular to industrial radiography would be highly encouraged, this is not required. Acceptable training programs would be a classroom course typical of those provided through universities or commercial training facilities. Hands-on experience means experience in all areas considered to be directly involved in the radiography process. This includes taking radiographs, surveying device and radiation areas, transporting the radiography equipment to temporary jobsites, posting, work sites, radiation area surveillance, completing and maintaining records, etc. Excessive time spent in only one or two of these operations (film development and/or area surveillance) should not be counted toward the 2,000 hours. Experience with radiography using x-rays can be included; however, the majority of experience should be in isotope radiography.



**Figure 8.1 Responsibilities.** *Typical duties and responsibilities of RSOs.*

**Note:** The NRC will consider individuals with alternative training and experience as RSOs. For example, a person certified in health physics or industrial hygiene with previous experience in managing a radiation safety program of comparable size and scope could be considered as an individual case. The qualifications, training, and experience required of the RSO may vary depending upon the complexity of the applicant's operations and number of radiography personnel.

**Response from Applicant:** Provide the following:

- C 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.

**AND**

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- C Demonstrate that the RSO has sufficient independence and direct communication with responsible management officials by providing a copy of an organizational chart by position, demonstrating day-to-day oversight of the radiation safety activities.

### AND EITHER

- C The specific training and experience of the RSO and other potential designees.
- C Include the specific dates of certification and/or training in radiation safety.
- C Documentation to show that the RSO has a minimum of 2,000 hours of hands-on experience as a qualified radiographer in industrial radiographic operations.
- C Documentation to show that the RSO has obtained formal training in the establishment and maintenance of a radiation protection program.

### OR

- C Alternative information demonstrating that the proposed RSO is qualified by training and experience (e.g., Board Certification by the American Board of Health Physicists, completion of a bachelor's and/or master's degree in the sciences with at least one year of experience in the conduct of a radiation safety program of comparable size and scope).
- C Documentation to show that the RSO has obtained formal training in the establishment and maintenance of a radiation protection program.

**Note:** It is important to notify NRC and obtain a license amendment prior to making changes in the designation of the RSO responsible for the radiation safety program. If the RSO leaves the organization before an amendment is approved by the NRC, a potential designee, who meets the RSO qualification requirements, is responsible for ensuring that the licensee's radiation safety program is implemented in accordance with the license and NRC regulations. Alternative responses will be reviewed against the criteria listed above.

## 8.8 ITEM 8: TRAINING FOR RADIOGRAPHERS AND RADIOGRAPHER'S ASSISTANTS

**Regulations:** 10 CFR 19.12, 10 CFR 30.33, 10 CFR 34.13, 10 CFR 34.43.

**Criteria:** Radiographers and radiographer's assistants must have adequate training and experience as outlined in 10 CFR 34.43.

**Discussion:**

- C A radiographer is a person who performs or personally supervises industrial radiography and is responsible for ensuring compliance with NRC regulations and the safe use of radioactive materials.
- C A certified radiographer is an individual who has been certified by a certifying entity that he/she has met established radiation safety, testing, and experience criteria.
- C A radiographer's assistant is an individual, who under the direct supervision (in the physical presence) of the radiographer uses radiographic equipment (sealed sources containing byproduct material or related handling tools, exposure devices, and radiation survey instruments) in performing industrial radiographic operations.

10 CFR Part 34.43 describes specific training requirements for radiographers and radiographer's assistants and requires that all radiographers be certified. It also addresses annual refresher training and semiannual audits of radiographers and radiographers assistants.

Refer to Appendix G as an aid to determining the specific training requirements for radiographers and radiographer's assistants. The applicant must submit a description of their training program for radiographers and radiographers assistants.

The effective date of the certification requirement is June 27, 1999. After this date applicants will no longer be required to describe their initial training and examination program in the topics outlined in 10 CFR 34.43(g). There are no licensing actions required when radiographers are certified. The NRC will verify radiographer certification during routine NRC inspections.

Because 10 CFR Part 34 contains different requirements for radiographers and radiographer's assistants, include training programs for each. When describing the training programs for these positions, include the sequence of events from the time of hiring through the designation of individuals as radiographers or radiographer's assistants. Experienced radiographers who have worked for another licensee should receive formal instruction similar to that given to prospective radiographer's assistants. This instruction must include training in your operating and emergency procedures, in the use of your exposure devices and associated equipment, and in the use of survey meters and other radiation monitoring devices.

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 radiographers. Individuals who provide instruction in the hands-on use of radiography equipment should be qualified radiographers with at least 1 year of experience in performing radiography, or should possess a thorough understanding of the operation of radiographic equipment (e.g., a manufacturer's service representative).



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An internal inspection program (audit program) of the job performance of each radiographer and radiographer's assistant ensures that the Commission's regulations, license requirements, and the licensee's operating and emergency procedures are followed. The audit must include observation of the performance of each radiographer and radiographer's assistant during an actual industrial radiographic operation at intervals not to exceed 6 months. If a radiographer or radiographer's assistant has not participated in an industrial radiographic operation for more than 6 months, the individual must demonstrate knowledge of the training requirements by practical examination before participating in a radiographic operation. The person conducting internal inspections should have a minimum of one year actual experience as a radiographer.

**Response from Applicant:** Submit an outline of the training to be given to prospective radiographers and radiographer's assistants. Submit your procedures for experienced radiographers who have worked for another licensee.

Provide a copy of a typical examination and the correct answers to the examination questions. Indicate the passing grade.

Prior to June 27, 1999, you may affirm that all individuals acting as radiographers will be certified in radiation safety in lieu of providing a description of your training and examination program in the topics listed in 10 CFR 34.43(g). (All other training program descriptions must still be submitted.)

Specify the qualifications of your instructors in radiation safety principles and describe their experience with radiography. If training will be conducted by someone outside the applicant's organization, identify the course by title and provide the name and address of the company providing the training.

Describe the field (practical) examination that will be given to prospective radiographers and radiographer's assistants. The NRC suggests using the checklist in Appendix H as a source of potential areas to review during the field examination.

Describe the annual refresher training program, including topics to be covered and how the training will be conducted.

Submit your procedures for verifying and documenting the certification status of radiographers and for verifying that their certification remains valid. As a minimum your procedures for newly hired, previously certified individuals should require documentation of your contacting the certifying entity and confirming the certification. Your procedures should also ensure you are aware of certification expiration dates and that individuals with expired certifications do not act as radiographers.

Submit a description of your program for inspecting the job performance of each radiographer and radiographers' assistant at intervals not to exceed 6 months as described in 10 CFR 34.43(e).

X-ray training by itself will not be considered adequate experience for performing gamma radiography.

## 8.9 ITEM 9: FACILITIES AND EQUIPMENT

**Regulations:** 10 CFR 20.1003, 10 CFR 20.1301, 10 CFR 20.1601, 10 CFR 20.1801, 10 CFR 20.1802, 10 CFR 30.33, 10 CFR 34.13(j), 10 CFR 34.33, 10 CFR 34.89.

**Criteria:** Licensees must specifically identify and describe permanent radiographic installations and field stations, and any other locations where radiography will be conducted.

**Discussion:** A permanent radiographic installation is an enclosed shielded room, cell, or vault in which radiography may be performed. A facility is considered “permanent” if it is intended to be used for radiography, even if radiography is rarely performed there. The nature of the facility, rather than the frequency of use, determines a permanent radiographic installation. All radiographic operations conducted at locations of use authorized on the license must be conducted in a permanent radiographic installation, unless specifically authorized by NRC. If licensees need to perform radiography at their place of business outside of a permanent facility due to unique circumstances (the item to be radiographed is too large for the facility), then the NRC must authorize this method of use. In this case two individuals must be present whenever radiographic operations occur outside of a permanent installation.

The one primary (and perhaps the most important) reason licensees have for conducting radiography in a permanent radiographic installation is that they can limit access restrictions imposed at a work location. In order to ensure this control a permanent radiographic installation, if located on the ground, must be enclosed by a minimum of four shielded walls (otherwise the floor must also be shielded). The use of materials that do not realistically provide shielding, do not qualify. Areas outside of the facility generally should qualify as unrestricted areas. While the area outside of an installation should qualify as an unrestricted area (i.e., not exceed 2mR/hr), the regulation did not specify radiation limits in order to allow for design flexibility for moving equipment into and out of the installation, or other considerations. Radiation levels slightly exceeding these levels outside of the facility should only be considered or allowed when the higher levels are due to “sky shine” or the need for equipment movement. If the roof of the facility does not qualify as a restricted area, or if no roof exists, mechanical access restrictions (fence, etc.) must be utilized and additional administrative controls must be imposed to ensure that unwanted access can be gained only through extraordinary effort. All entrance ways into the facility must be interlocked with 10 CFR Part 34 required control devices. Unless all entrance ways are locked, at least one radiographer must be present at the facility whenever radiography is being conducted.

A field station is a facility where licensed material may be stored and/or used and from which equipment is dispatched. Radiographic operations may be conducted in a permanent radiographic installation or at the place of business in the same manner as described above.

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A restricted area is an area that licensees limit access for the purpose of protecting individuals from undue risks from exposure to radiation and radioactive materials. A restricted area cannot include areas used as residential quarters. Consequently, industrial radiography devices must not be stored in motel rooms or similar locations.

Requirements for a permanent radiographic installation:

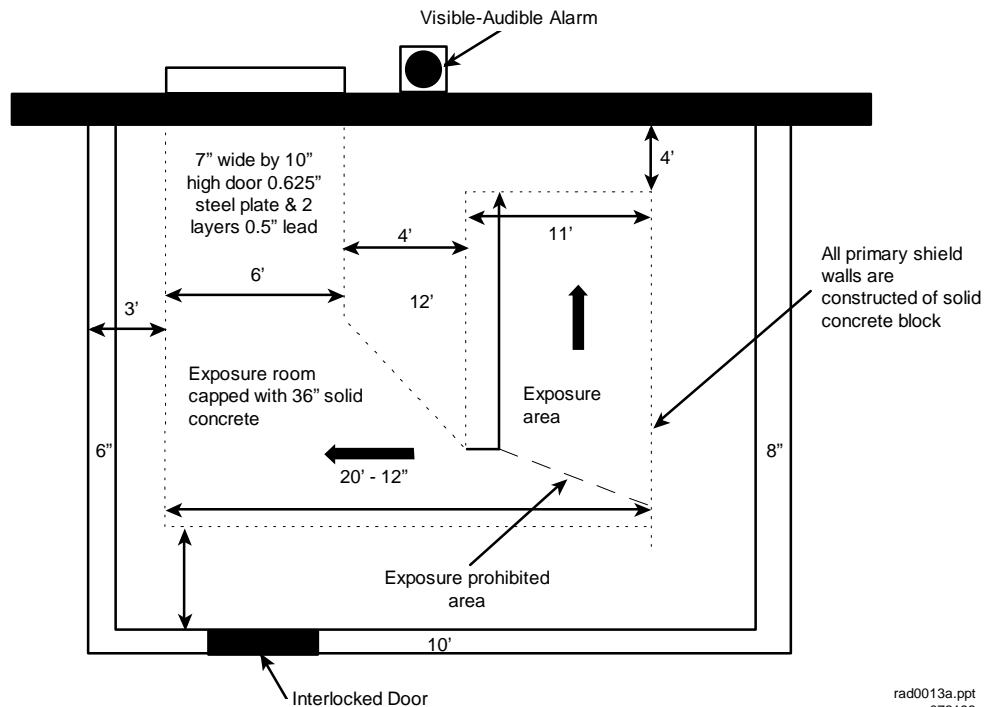
### C Audible-visible signals

Each access point is equipped with a visible-audible signal system. The visible signal is activated by radiation whenever the source is exposed. The audible signal will sound if anyone tries to enter the installation while the source is exposed. The requirement for the visible-audible signal system is in addition to other measures that may be taken to prevent access to the installation, such as locked doors.

As an alternative to the visible-audible alarm system, it is acceptable to use a control system that will reduce the radiation level if the entrance to a high-radiation area is opened while the source is out. The system must be automatic and independent of radiography personnel action. If this alternative is planned, provide a description of the system.

### C Diagram depicting the shielding, layout, and audible-visual alarms

A diagram of the installation is helpful in evaluating the shielding and determining compliance with regulations regarding restricted and unrestricted areas, location of access points, and locations of audible-visible signals. Figure 8.2 shows an example installation diagram.



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072198

**Figure 8.2 Example Diagram of a Permanent Radiographic Installation**

**C Calculations or survey results of radiation levels**

For a determination of installation adequacy, provide information showing that the radiation level in all directions around the installation, including the roof, will not exceed a dose of 0.02 mSv (2 mrem) in any one hour. Take into account the highest quantity of radioactive material that will be used in the installation and any limitations on source positioning in the installation. Radiation levels in all directions around the installation that are below 0.02 mSv (2 mrem) in any one hour are considered acceptable. If the radiation levels will exceed 0.02 mSv (2 mrem) in any one hour, then steps should be taken (use lower-activity source, use collimator, or move setup farther away) to reduce the radiation to the acceptable level.

A radiation level on the roof that exceeds 1.0 mSv (100 mrems) in one hour at 30 cm from the surface is considered a “high radiation area” and requires special precautions to control access to the area. Licensees should make efforts to lower a radiation level exceeding 1.0 mSv (100 mrems) in any one hour by using additional shielding, collimators, or other engineering controls. The roof of a fixed radiography cell is a potentially occupied area, and applicants must demonstrate that no individual member of the public could receive effective doses in excess of 0.02 mSv (2 mrems) in any one hour or 1 mSv (100 mrems) in a year.

**Response from Applicant:** Provide the following:

**C If radiography is planned in a permanent radiography installation or installations (including field stations with permanent exposure cells), provide the following information for each installation:**

- An annotated sketch or drawing of the facility and its surroundings.
- The scale to which the sketch or drawing is made. The same scale should be used for all sketches and drawings. The recommended scale is 1/4 inch = 1 foot. Drawings to this scale that do not fit on 8 1/2 X 11 paper may be provided as sectional drawings.
- The type, thickness and density of shielding materials on all sides, including the floor and the roof.
- The locations of entrance ways and other points of access to the facility.
- A description of the areas adjacent to the facility and the distance to these areas. Include information on areas adjacent to, above, and below the facility.
- A description of the general location of each proposed permanent installation listed in Item 3 (e.g., located in an industrial park, an office complex, etc.) and its current use. If any proposed permanent installation is a private residence, provide diagrams of the installation that include the building, the proposed restricted area(s), and adjacent areas, including above and below the restricted areas; provide commitments that restricted areas do not

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include residential quarters, and explain how radiation levels in unrestricted areas will be maintained at less than 1 mSv (100 mrem) per year.

- A description of the visible-audible signal system or entrance control system and its location.
- The results of radiation-level calculations or actual radiation measurements adjacent to, above, and below the installation. The radiation level in all directions around the installation, including the roof, should not exceed 0.02 mSv (2 mrem) in any one hour. Clearly identify the type of source (isotope), the amount of radioactive material in the source, and the position of the source within the installation for the calculations or measurements.

Variances will be considered if construction requirements preclude shielding the roof<sup>1</sup> in order to meet the requirement not to exceed 0.02 mSv (2 mrem) in any one hour. Provide the following information to obtain approval for a variance:

- C Procedures for ensuring that no individual is on the roof or could gain access to the roof during radiography
- C Means of preventing access to the roof
- C A commitment that the roof will be posted with “Caution (or Danger) Radiation Area” signs
- C Steps taken to minimize radiation on the roof
- C Limitations (if needed) on positioning of sources or type (isotope) and amount of radioactive material that may be used in the installation to ensure that areas adjacent to, above, and below the installation will be unrestricted areas during the performance of radiography

If radiation levels on the radiography installation roof<sup>1</sup> exceed 1.0 mSv (100 mrem) in any one hour, then provide the following information in addition to the items above to apply for this variance:

- C A commitment that the roof will be posted with “Caution (or Danger) High Radiation Area” signs
- C Evidence of constant surveillance of the roof by closed-circuit TV
- C Fluctuation of the dose rate
- C A description of a control device that would automatically reduce the radiation level to 1 mSv (100 mrem) in any one hour at 30 cm from the radiation source if someone enters the roof.

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<sup>1</sup> Facilities may or may not have a roof. Applicants are required to explain how these areas around the installation will be controlled to keep exposures to appropriate levels.

- C A description of a control device that activates a visible-audible signal so that both an individual entering the roof and the radiographer on duty are made aware of the entry

Field Stations:

- C Describe the storage location(s) at the address(es) listed in Item 3 of the application and submit a diagram showing where the radiography camera will be stored at the field stations. Indicate whether or not radiography will be performed at the place of business outside of a permanent radiography installation. If radiography will be performed at a site outside of a permanent radiography installation, provide a diagram of the location where radiography may be performed and its surroundings, including a description of adjacent property. **Note:** Certain records described in the regulations which pertain to radiation safety may need be on file at these field stations and each temporary jobsite.

**Note:** Rem, and its SI equivalent Sievert, will be used in this report whenever units of radiation exposure or dose are required. This is done since 10 CFR Part 20 sets dose limits in terms of rem, not rad or roentgen, and the sealed sources used in radiography emit gamma rays, which means that 1 roentgen = 1 rad = 1 rem.

## 8.10 ITEM 10: RADIATION SAFETY PROGRAM

**Regulations:** 10 CFR 20.1101, 10 CFR 30.33, 10 CFR 34.13.

**Criteria:** A radiation safety program must be established and submitted to the NRC as part of the application. The program must be commensurate with the scope and extent of activities for the use of licensed materials in industrial radiography.

Each applicant for an industrial radiography license must develop, document, and implement a radiation protection program containing the following elements:

- C Steps to keep radiation exposures ALARA
- C Description of equipment and facilities adequate to protect personnel, the public and the environment
- C Conduct of licensed activities by individuals qualified by training and experience
- C Written operating and emergency procedures
- C Program to inspect the job performance of radiographic personnel
- C Description of organization structure and individuals responsible for ensuring implementation of radiation safety program

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### C Records management

**Discussion:** The specific components of the applicant's radiation safety program are detailed in the following topics found in this NUREG. Some topics will not require the applicant to submit information as part of an application, but simply provide the applicant with guidance to comply with a specific NRC requirement.

### 8.10.1 RADIATION SAFETY PROGRAM AUDIT

**Regulations:** 10 CFR 20.1101, 10 CFR 20.2102.

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

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

**Discussion:** Appendix I contains a suggested annual audit program that is specific to industrial radiography and is acceptable to NRC. All areas indicated in Appendix I may not be applicable to every licensee and may not need to be addressed during each audit.

Audit records acceptable to NRC should contain the following information:

- C Date of audit
- C Name of person(s) who conducted the audit
- C Names of persons contacted by the auditor(s)
- C Areas audited
- C Audit findings, corrective actions
- C Follow-up.

It is essential that once identified, problems be corrected in a timely manner. Information Notice (IN) 96-28, "Suggested Guidance Relating to Development and Implementation of Corrective Action," provides guidance on this subject. The NRC will review the licensee's audit results and determine if corrective actions are thorough, timely, and sufficient to prevent recurrence. If violations are identified by the licensee and these steps are taken, the NRC can exercise discretion

and may elect not to cite a violation. The NRC's goal is to encourage prompt identification and prompt, comprehensive correction of violations and deficiencies. For additional information on NRC's use of discretion on issuing violations, refer to "General Statement of Policy and Procedures for NRC Enforcement Actions," (NUREG-1600) (to obtain, see below).

**Response from Applicant:** The applicant is not required to submit its audit program applicable to 10 CFR Part 20 for review during the licensing phase. Appendix I, Radiation Safety Program Audit, provides an example of an acceptable annual audit.

**References:** The following documents are available from NRC upon request: Inspection Procedure 87120, "Industrial Radiography Field Notes," NUREG-1600, "General Statement of Policy and Procedures on NRC Enforcement Actions," (to obtain, see Availability Notice) and IN 96-28, "Suggested Guidance Relating to Development and Implementation of Corrective Action." NUREG-1600 is also available on the Internet. Visit NRC's Home Page <<http://www.nrc.gov>>, choose "Nuclear Materials," then "Enforcement Program," "Enforcement Guidance Documents," and then "Enforcement Policy."

## 8.10.2 INSTRUMENTS

**Regulations:** 10 CFR 30.33(a)(2), 10 CFR 34.25, 10 CFR 34.31, 10 CFR 34.65.

**Criteria:** A radiation survey meter intended for industrial radiography that utilizes sealed radioisotope sources should be capable of accurately measuring the radiation fields produced by the sealed radiography source currently in use, and be visually checked for damage and for proper operation with a check source or other appropriate means, such as an exposure device, before use on each day it is to be used. The survey meter shall be calibrated at intervals not to exceed 6 months and after each servicing, (except for battery changes). Written procedures are required for inspection and routine maintenance of the survey meters, which is to be performed at intervals not to exceed 3 months or before the first use thereafter to ensure proper functioning of components important to safety.

**Discussion:** Licensee shall keep an adequate number of appropriate radiation survey instruments that are both calibrated and operable, at each location where radioactive material is present to make the required radiation surveys. The instruments shall be capable of measuring a range from 0.02 mSv (2 mrem) per hour through 10 mSv(1 rem) per hour. Each radiation survey instrument shall be calibrated at intervals not to exceed 6 months and after each instrument servicing, except for battery changes. Records of survey instrument calibrations will be retained for a minimum of 3 years (10 CFR 34.65). Records are to be made of equipment problems and maintenance performed and these shall be retained for 3 years (10 CFR 34.73).



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**Response from Applicant:** Provide the following:

C A statement that: “We will possess and use calibrated and operable radiation survey meters.”

**AND**

C If calibration is performed by a person or firm outside the applicant's organization, specify the calibration will be performed by a NRC or Agreement State licensee specifically authorized to perform instrument calibration.

**OR**

C If the calibration is to be performed in-house either state that the model procedures in Appendix J will be followed or describe alternative procedures. Identify the qualifications of the individuals who will perform the calibrations.

**Note:** For detailed information about survey instrument calibration, refer to ANSI N323-1978, “Radiation Protection Instrumentation Test and Calibration.” Reaffirmed 1993 copies may be obtained from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

### 8.10.3 MATERIAL RECEIPT AND ACCOUNTABILITY

**Regulations:** 10 CFR 30.34(e), 10 CFR 30.41, 10 CFR 30.51, 10 CFR 34.29, 10 CFR 34.63, 10 CFR 34.69.

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

C Maintain records of receipt, transfer, and disposal of sources/devices and

C Conduct physical inventories at quarterly intervals (not to exceed 3 months) to account for all sealed sources containing byproduct material and devices containing depleted uranium.

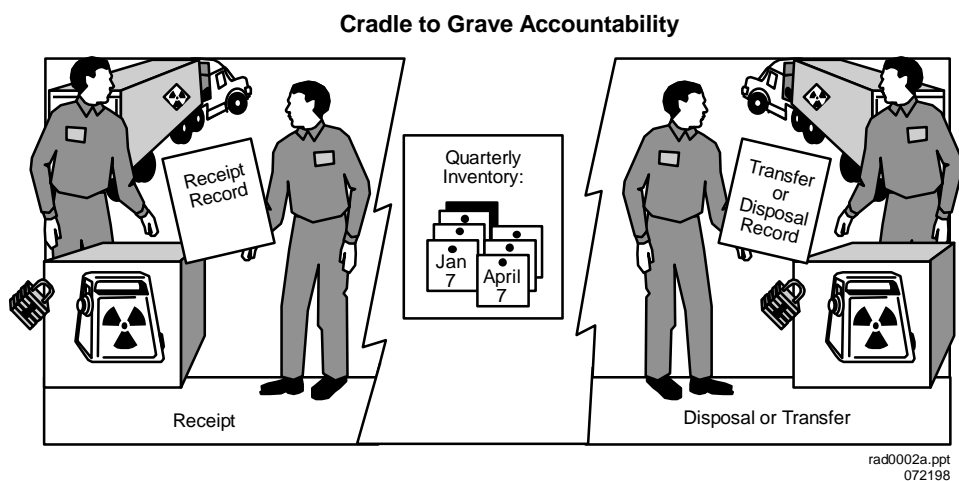
**Discussion:** As illustrated in Figure 8.3, licensed materials must be tracked from “cradle to grave” in order to ensure accountability; identify when sources/devices may be lost, stolen, or misplaced; and ensure that the possession limit stated on the license is not exceeded.

Conduct physical inventories (i.e., locate, verify the presence of the material, and account for it in material transfer records) at quarterly intervals (not to exceed 3 months) to account for all sealed sources and devices containing depleted uranium.

Maintain inventory records that contain the following types of information:

C Radionuclide and amount (in units of Bq or curies) of byproduct material in each sealed source

- C Manufacturer's name, model number, and serial number of each sealed source containing byproduct material.
- C Manufacturer's name, model number, and serial number of each device containing depleted uranium or byproduct material.
- C Location of each sealed source and device.
- C Date of the inventory.
- C Name of individual performing inventory.



**Figure 8.3 Material Receipt and Accountability.** Licensees must maintain records of receipt and disposal and conduct physical inventories quarterly (not to exceed 3 months).

**Response from Applicant:** Provide the following:

A statement that: “Physical inventories will be conducted and documented at quarterly intervals (not to exceed 3 months) to account for all sealed sources containing byproduct material and devices containing depleted uranium received and possessed under the license.”

#### 8.10.4 MINIMIZATION OF CONTAMINATION

**Regulations:** 10 CFR 20.1406.

**Criteria:** Applicants for new licenses must describe how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

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**Discussion:** All applicants for new licenses need to consider the importance of designing and operating their facilities so as to minimize the amount of radioactive contamination generated at the site during its operating lifetime and to minimize the generation of radioactive waste during decontamination. Industrial Radiography applicants usually do not need to address these issues as a separate item since they are included in responses to other items of the application.

Sealed sources and devices that are approved by NRC or an Agreement State and located and used according to their respective SSD Registration Certificates usually pose little risk of contamination. Leak tests performed as specified in 10 CFR 34.27 should identify defective sources. Leaking sources must be withdrawn from use and decontaminated, repaired, or disposed of according to NRC requirements. These steps minimize the spread of contamination and reduce radioactive waste associated with decontamination efforts. Other efforts to minimize radioactive waste do not apply to programs using only sealed sources and devices that have not leaked.

**Response from Applicant:** The applicant does not need to provide a response to this item under the following condition. NRC will consider that the above criteria have been met if the applicant's responses meet the criteria for the following sections: "Radioactive Material - Sealed Sources and Devices," "Facilities and Equipment," "Radiation Safety Program - Leak Tests," "Radiation Safety Program - Operating and Emergency Procedures," and "Waste Management - Sealed Source / DU Device Transfer and Disposal."

### 8.10.5 LEAK TESTS

**Regulations:** 10 CFR 30.53, 10 CFR 34.13(h), 10 CFR 34.27, 10 CFR 34.67.

**Criteria:** NRC requires testing to determine whether there is any radioactive leakage from the source or from devices containing depleted uranium shielding. NRC finds testing to be acceptable if it is conducted by an organization licensed by NRC or an Agreement State, or conducted in accordance with procedures approved by NRC or an Agreement State.

**Discussion:** Manufacturers, consultants, and other organizations may be authorized by NRC or an Agreement State to either perform the entire leak test sequence for other licensees or provide leak test kits to licensees. In the latter case, the licensee is expected to take the leak test sample according to the device manufacturer's and the kit supplier's instructions and return it to the kit supplier for evaluation and reporting results. Licensees may also be authorized to conduct the entire leak test sequence themselves. 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 microcurie) of radioactivity.

Sealed sources containing byproduct material must be leak tested at intervals not to exceed 6 months and DU devices tested at intervals not to exceed 12 months.

**Response from Applicant:** Do either of the following:

C State: “Leak tests will be performed by an organization authorized by 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 NRC or an Agreement State to provide leak test kits and/or services to other licensees and according to the instructions provided in the leak test kit.”

**OR**

C State: “Leak testing will be done by the applicant.” Provide the information in Appendix K supporting a request to perform leak testing and sample analysis and either state that you will follow the model procedures in Appendix K or describe alternative procedures.

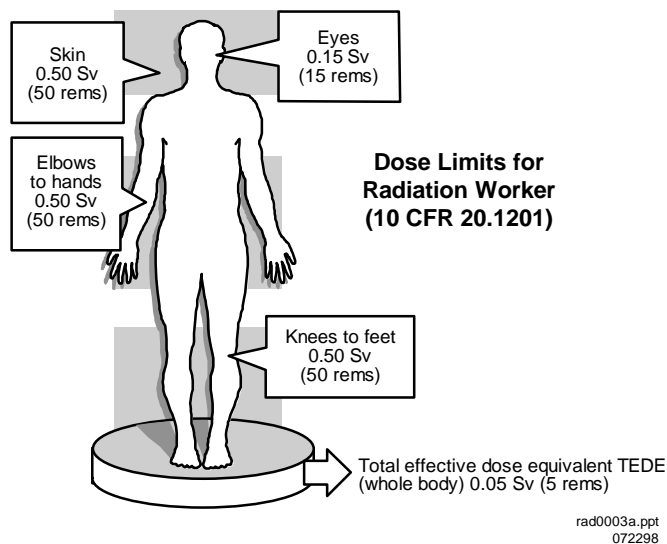
**Note:** Requests for authorization to perform leak testing and sample analysis will be reviewed on a case-by-case basis and, if approved, NRC staff will authorize via a license condition.

### 8.10.6 OCCUPATIONAL DOSIMETRY

**Regulations:** 10 CFR 20.1201, 10 CFR 20.1207, 10 CFR 20.1208, 10 CFR 20.1501, 10 CFR 20.1502, 10 CFR 34.47.

**Criteria:** Licensees must:

Provide to employees, film or TLD dosimetry processing that has been accredited under the National Voluntary Laboratory Accreditation Program (NVLAP) operated by the National Institute of Standards and Technology (NIST).



**Figure 8.4 Dose Limits.** *Dose limits for radiation workers.*

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**Discussion:** The licensee may not permit any individual to act as a radiographer or a radiographer's assistant unless, at all times during radiographic operations each individual wears, on the trunk of the body, a combination of a direct-reading dosimeter (pocket dosimeter or electronic personal dosimeter), an operating alarm ratemeter, and either a film badge or a TLD. At permanent radiography installations where other appropriate alarming or warning devices are in routine use, wearing an alarming ratemeter is not required. The pocket dosimeters must have a range from zero to 2 mSv (200 mrem), must be recharged at the start of each shift, and must be checked for correct response to radiation at intervals not to exceed 12 months. Electronic personal dosimeters may only be used in place of ion-chamber pocket dosimeters. Alarm ratemeters must be preset to give an alarm signal at a dose rate of 5 mSv/hr (500 mrem/hr) and must be calibrated for correct response at intervals not to exceed 12 months.

Film badges must be replaced at intervals not to exceed 1 month and TLDs must be replaced at intervals not to exceed 3 months.

**Response from Applicant:** Provide the following:

- C A statement that film or TLD dosimetry, processed and evaluated by a NVLAP-accredited processor and exchanged at the required frequency, will be worn by radiography personnel.
- C A statement that the required personnel monitoring equipment, including 0 to 2 mSv (200 mrem) dosimeters or electronic personal dosimeters, will be worn by radiographic personnel.
- C A statement that alarming ratemeters will be worn by all radiography personnel except those at permanent radiography installations where other appropriate alarming or warning devices are in use.
- C A statement that pocket dosimeters and alarm ratemeters will be checked for correct response at intervals not to exceed 12 months. If adjustment is necessary, state either that the devices will be returned to the manufacturer, or describe in-house procedures if adjustments are made in house.

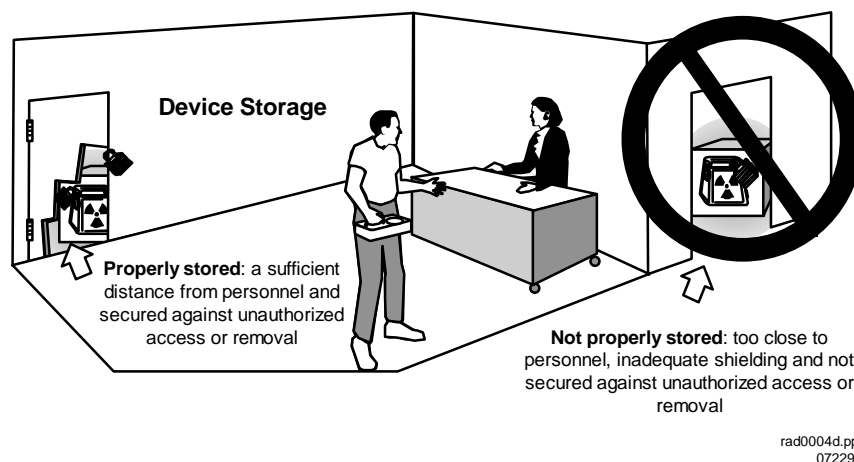
To obtain a copy of the NIST Publication 810, "National Voluntary Laboratory Accreditation Program, 1997 Directory," contact the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402-9225. (For information on the program call NIST at 301-975-3679). Also NVLAP maintains a directory of accredited laboratories on the Internet which is updated quarterly. The URL for NVLAP's home page on the Internet is <<http://ts.nist.gov/nvlap>>.

### 8.10.7 PUBLIC DOSE

**Regulations:** 10 CFR 20.1003, 10 CFR 20.1301, 10 CFR 20.1302, 10 CFR 20.1801, 10 CFR 20.1802.

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

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



**Figure 8.5 Storing Devices.** *Devices must be stored away from occupied areas and secured against unauthorized removal.*

**Discussion:** Operating and emergency procedures that address security and surveillance should be sufficient to limit exposure of the public during use and after accidents. Public dose is controlled, in part, by ensuring that devices not in use are stored securely (e.g., stored in a locked area) to prevent unauthorized access or use. If devices are not in storage, then authorized users must maintain constant surveillance.

Public dose is also affected by the choice of the permanent radiographic installation and storage locations and conditions, as illustrated in Figure 8.5. Since radiation levels around a permanent radiographic installation or storage area will vary based on the type and strength of sources used, the frequency of use, and scatter radiation from radiographic operations, it is not sufficient to perform surveys with portable survey meters to determine the annual public dose. Use of area monitors such as environmental TLD is an acceptable means of demonstrating compliance with the annual limit of 1 mSv (100 mrem) in unrestricted areas.

Use the concepts of time, distance, and shielding when choosing a permanent radiographic installation or storage location. Decreasing the time spent near radiographic operations, increasing the distance of the device from occupied locations, using shielding material (i.e., high density concrete, solid block, or lead sheets), and implementing conservative operating

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procedures (i.e., use of collimators or limiting the direction of exposures towards the floor) will reduce the radiation exposure of personnel and members of the public. Alternatively, the remote location of and access to a permanent radiographic installation could prevent members of the public from receiving 1 mSv (100 mrem) in a year.

If, after an initial evaluation, a licensee makes changes affecting the permanent radiographic installation storage area (e.g., changing the location of devices within the storage area, removing shielding, adding devices, changing the occupancy of adjacent areas, moving the storage area to a new location), then the licensee must perform a new evaluation to ensure that the public dose limits are not exceeded and devices are properly secured.

**Response from Applicant:** No response is required from the applicant in a license application, but this matter will be examined during an inspection.

Appendix L provides additional information for determining that radiation doses for other licensee personnel and members of the public will not exceed allowable limits.

### 8.10.8 QUARTERLY MAINTENANCE

**Regulation:** 10 CFR 34.31, 10 CFR 34.73, 10 CFR 71.101(g).

**Criteria:** The licensee shall have written procedures for inspecting and maintaining radiographic exposure devices, source changers, associated equipment, transport and storage containers, and survey instruments. Inspection and maintenance must be conducted at intervals not to exceed every 3 months, or before the first use thereafter, to ensure the proper functioning of components important to safety. The licensee must also have procedures necessary to maintain the Type B packaging used to transport radioactive materials, ensure that Type B packages are shipped properly, and maintain Type B packages in accordance with the Certificate of Compliance (COC) issued by NRC or other agencies approving such transport packages.

If equipment problems are found, the equipment must be withdrawn from service until repaired. Records are required.

**Discussion:** These procedures are intended to allow the licensee's staff to evaluate equipment used in radiography for safe continued use, to provide a record of this evaluation, and to guide the staff in maintenance. Equipment found to be unsuitable for service must be withdrawn until repair and an evaluation for return to service is made. These procedures may be based on the manufacturer's recommendations. The procedures are to be specific to the equipment. For example, radiography drive cable assemblies should be cleaned and lubricated (when operationally appropriate) in accordance with the recommendations of the equipment manufacturer or the cable manufacturer or alternatively, with any lubrication and cleaning recommendations established by the industrial radiography community.

Procedures are also required for Type B packaging used to transport radioactive materials. These procedures are to be used for shipping and maintenance, and may be properly drawn from the manufacturer's procedures and information submitted as a basis for the COC or other transport package approval.

**Response from Applicant:**

- C Submit the procedures to NRC for review and approval as Operating and Emergency Procedures. The applicant should use this guidance to craft its procedures to suit its equipment and program.

**AND**

- C State: "Before using a new sealed source/device combination, we will have written inspection and maintenance procedures that address the use of the new equipment as a Type B transport package. In addition, we will provide training to radiographic personnel before using a new sealed source/device combination."

As part of the Operating and Emergency procedures, the applicant will submit the above procedures for NRC technical review.

## **8.10.9 OPERATING AND EMERGENCY PROCEDURES**

**Regulations:** 10 CFR 34.13(d), 10 CFR 34.45.

**Criteria:** Operating and emergency procedures must be established and submitted to the NRC as part of the application package. In addition, if radiographers will perform other operations such as source exchange, leak-testing, and quarterly (not to exceed 3 months) inspection and maintenance of equipment, appropriate procedures and instructions for these operations should be included in the operating and emergency procedures.

Each licensee must develop, implement, and maintain operating and emergency procedures containing the following elements:

- C Instructions for maintaining security during storage and transportation;
- C Instructions to keep radiography devices under control and immediate surveillance during use;
- C Steps to take to keep radiation exposures ALARA;
- C Steps to maintain accountability during use;
- C Steps to control access to work sites;
- C Use of personnel monitoring and radiation survey equipment;



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C Instruction for packaging and transporting licensed material; and

C Steps to take and whom to contact when an emergency occurs.

**Discussion:** The purpose of operating and emergency procedures is to provide radiography personnel with specific guidance for all operations they will perform. These topics should be included in the operating and emergency procedures and need not be presented in order of importance. A sequential set of procedures and instructions from the beginning to the end of the workday is an acceptable format. Instructions for non-routine operations, for example, quarterly (not to exceed 3 months) inspection and maintenance or instrument calibration, may be included as separate appendices.

It is not necessary for operating and emergency procedures to be specific to a particular make and model of exposure device, source exchanger, or survey instrument. Procedures submitted to the NRC should provide sufficient guidance and instruction for each specific type of device. For example, you may submit a single operating procedure for crank-out regardless of the manufacturer and/or a single operating procedure for pipeliner exposure devices regardless of manufacturer.

Applicants who plan to conduct lay-barge, offshore platform, or underwater radiography are required to have their procedures approved by the NRC. If you plan to conduct lay-barge, offshore platform or underwater radiography, your radiation safety program will be reviewed to assure that it contains procedures that specifically address:

C Transport of licensed material

C Storage facilities for licensed material

C Methods for restricting access to radiation areas

C Radiation safety procedures and radiographer responsibilities unique to lay-barge, offshore platform, or underwater radiography

C Radiographic equipment and radiation safety procedures unique to underwater radiography

C Methods appropriate for use of equipment in water environments

C Applicable inspection and maintenance procedures unique to lay-barge, offshore platform, or underwater radiography equipment

C Emergency procedures unique to lay-barge, offshore platform, or underwater radiography.

Operating and emergency procedures must be submitted to the NRC for review.

Note that providing specific operating and emergency procedures for a particular manufacturer's make and model number will require an amendment to the license to obtain NRC's authorization for a new sealed source/device combination.

### 8.10.9.1 HANDLING AND USE OF SEALED SOURCES AND RADIOGRAPHY EXPOSURE DEVICES

**Regulations:** 10 CFR 34.41, 10 CFR 34.45, 10 CFR 34.46, 10 CFR 34.47, 10 CFR 34.49, 10 CFR 34.51.

**Criteria:** Licensees need to establish operating and emergency procedures.

**Discussion:** There are two types of devices normally used for radiography, crankout, and pipeliner. There should be separate instructions for each type of device. Separate instructions are not necessary for each different model of a given type of device since the operation of each type is essentially the same regardless of the manufacturer. Some applicants may choose to use one basic instruction for all crankout devices; others may choose to have separate instructions for each model. **Either approach is acceptable.**

Specific procedures should be required for performing source exchanges, including those at temporary jobsites, field stations, and in a permanent radiographic installations. The procedures should contain warnings of areas of concern during source exchanges. Recent incidents of sources becoming dislodged from the shielded position indicate the importance of training personnel in the appropriate techniques. Procedures should require the use of survey instruments, dosimetry, and surveys during and after movement of sources.

#### **Response from Applicant:**

- C Provide step-by-step instructions for using each type of radiographic device.
- C Include instructions for performing source exchanges.
- C Instructions for crankout devices should be separate from those for pipeliner devices.

Manufacturers' manuals and similar documents should not be incorporated into the procedures; rather, information should be extracted from them and paraphrased.

Appendix M provides information for applicants to consider when developing their procedures for operating radiography equipment.

### 8.10.9.2 METHODS AND OCCASIONS FOR CONDUCTING RADIATION SURVEYS

**Regulations:** 10 CFR 20.1301(a)(2), 10 CFR 20.1302(a)(1), 10 CFR 20.1906, 10 CFR 34.20(a), 10 CFR 34.21, 10 CFR 34.27(c)(1), 10 CFR 34.27(e), 10 CFR 34.49(b), 10 CFR 34.49(c), 49 CFR 172.403, 49 CFR 173.441.

**Criteria:** Perform radiation surveys during use, movement, and storage of licensed material to ensure its safe use and comply with regulatory requirements.

**Discussion:** In general, surveys need to be made whenever a source is manipulated or moved. Surveys should be made with a radiation survey instrument calibrated in accordance with 10 CFR 34.25. The following table provides examples of surveys, made during radiographic and associated operations, that should be included in the operating and emergency procedures.

**Table 8.5 Surveys Required for Radiographic Operations**

Requirement	Frequency	Type of Radiation Survey
10 CFR 20.1301(a)(2)	During the first exposure for each set up of radiographic device	Boundary of restricted area at temporary jobsite does not exceed 0.02 mSv (2 mrem) in any one hour
10 CFR 20.1302(a)(1)	At intervals not to exceed 12 months	Unrestricted area in vicinity of permanent radiographic installation or storage area does not exceed 1 mSv (100 mrem) per year
10 CFR 20.1906	Each receipt of package	External radiation levels when a package is received and opened
10 CFR 34.20(a)	Each installation of new source in exposure device	Exposure rate does not exceed 2 mSv/hr (200 mrem/hr) on surface and 0.1 mSv/hr (10 mrem/hr) at one meter
10 CFR 34.21	Each installation of new source in a storage container or source changer	Exposure rate does not exceed 2 millisieverts (200 millirem) per hour at any exterior surface, and 0.1 millisieverts (10 millirem) per hour at 1 meter from any exterior surface with the sealed source in the shielded position.
10 CFR 34.27(c)(1)	At intervals not to exceed 6 months	Contamination level for leak tests of sealed sources does not exceed 185 Bq (0.005 microcuries)

Requirement	Frequency	Type of Radiation Survey
10 CFR 34.27(e)	At intervals not to exceed 12 months	Contamination level for leak tests of S tube of exposure device does not exceed 185 Bq (0.005 microcuries)
10 CFR 34.49(b)	After every radiographic exposure	Confirm source has returned to a shielded position
10 CFR 34.49(c)	After every source exchange or exposure device is placed in storage	Confirm source is in shielded position
49 CFR 172.403	Every movement of licensed material on public roads	Exposure rates meet labeling of package (i.e., Yellow II) and determine Transportation Index
49 CFR 173.441	Every movement of a package labeled Yellow III	Exposure rates in and around vehicle do not exceed 0.002 mSv/hr (2 mrem/hr) in driver's seat, 2 mSv/hr (200 mrem/hr) on surface and 0.1 mSv/hr (10 mrem/hr) at 2 meters from vehicle

**Response from Applicant:** Where applicable, the operating and emergency procedures must include each of the surveys included in Table 8.1 above.

### 8.10.9.3 METHODS FOR CONTROLLING ACCESS TO RADIOGRAPHIC AREAS

**Regulations:** 10 CFR 20.1801, 10 CFR 20.1802, 10 CFR 20.1902(a), 10 CFR 20.1902(b), 10 CFR 34.33, 10 CFR 34.41(a), 10 CFR 34.51, 10 CFR 34.53.

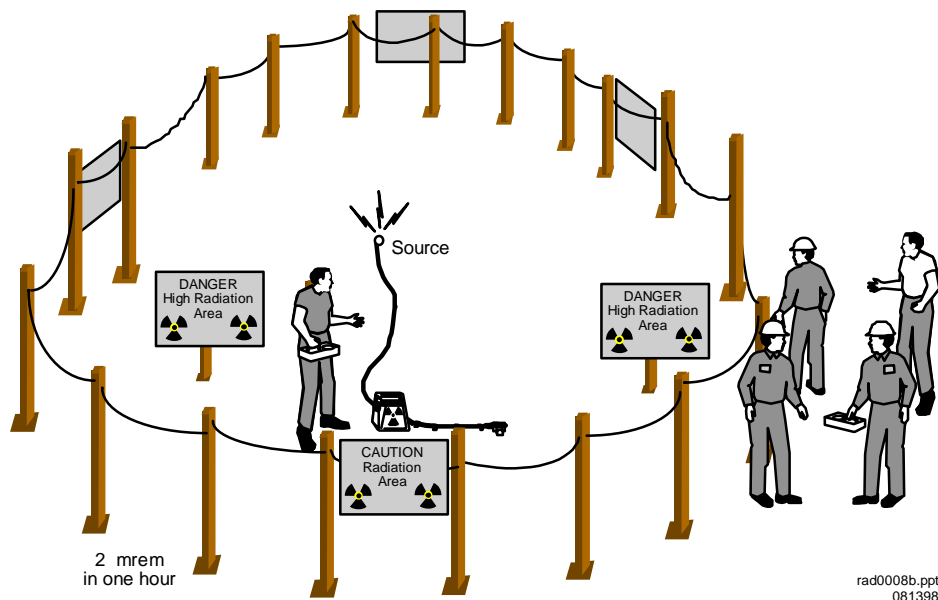
**Criteria:** Each licensee must control access to areas where licensed material is either used or stored to prevent the unnecessary exposure of members of the public. This can be achieved through the use of posting, by locking devices and areas where licensed materials are stored, and by maintaining constant control and continuous surveillance of areas where radiographic operations are conducted. Operating and emergency procedures should include steps for radiographic personnel to ensure that access to licensed materials is controlled for the types of operations that will be performed.

## Discussion:

### Field/Temporary Jobsites

After June 27, 1998, when radiographic operations are performed outside a permanent radiographic installation, at least two qualified radiographic personnel must be present. At least one of the individuals must be a radiographer; the other may be another radiographer or a radiographer's assistant. Both individuals must maintain constant surveillance of the operations and be capable of providing immediate assistance to prevent unauthorized entry to the restricted area. Operating procedures must comply with the two-man rule for radiographic operations at any locations other than permanent radiographic facilities.

Radiographic personnel are required to maintain continuous direct visual surveillance of operations to protect against unauthorized entry to the high radiation area during radiographic operations. Radiographic personnel should be instructed to keep the perimeter of the restricted area under continuous surveillance to prevent unnecessary exposure of individuals. Operating procedures should specify steps for responding to unauthorized entry to the restricted area. For example, personnel should be instructed to terminate the radiographic exposure immediately, before confronting the person who entered the restricted area.



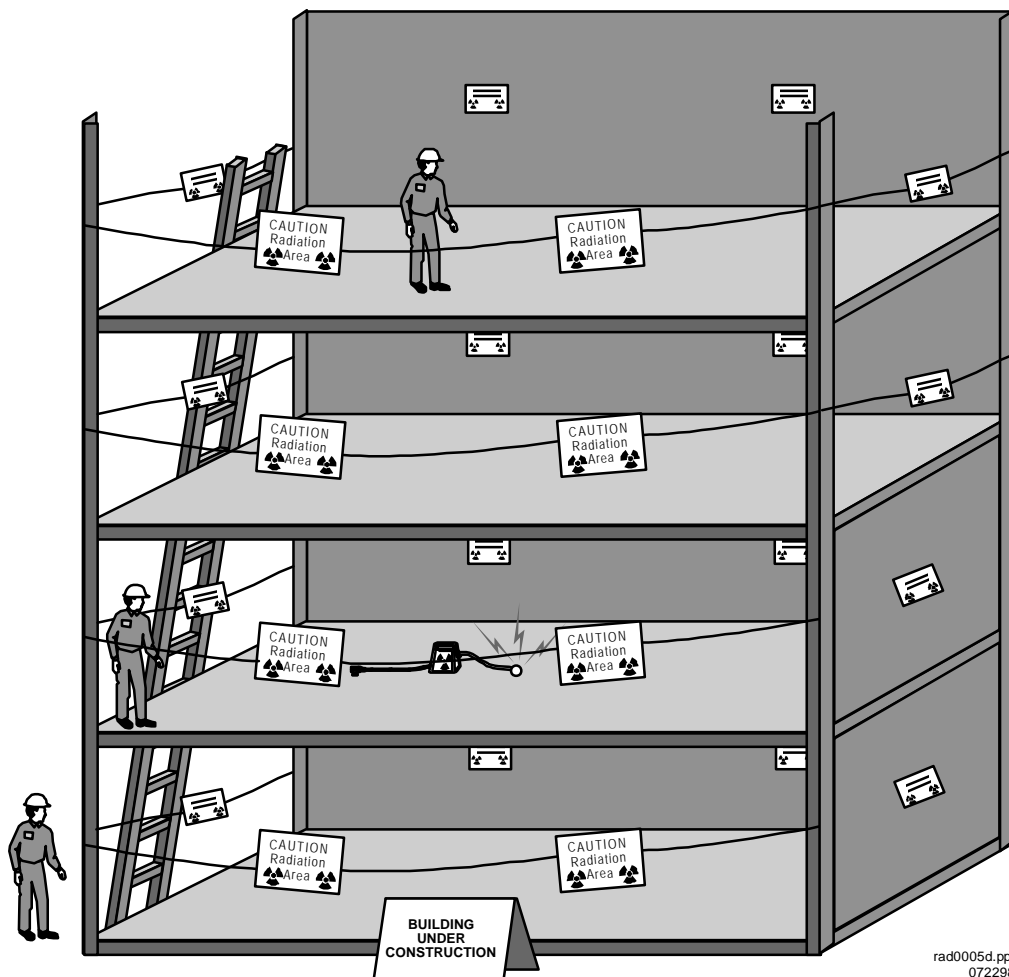
**Figure 8.6 Posting.** A radiographer is likely to use only a single rope barrier. The radiation area and restricted area would be combined into one and located at the 2 mrem in any 1 hour boundary.

All areas where radiographic operations are conducted require posting of the radiation areas and the high radiation areas as shown in Figure 8.6. Specific exemptions listed in 10 CFR 20.1903 do not apply to industrial radiography (10 CFR 34.53). However, it is acceptable to post the

perimeter of the restricted area rather than the perimeter of the radiation area. Personnel should be instructed to post "Caution Radiation Area" signs at the point where radiation levels have been calculated to reach 0.02 mSv (2 mrem) in any one hour. A confirming survey during to the first exposure of the source should be conducted to confirm the location of the boundary and any necessary adjustments should be made.

The perimeter of the high radiation area must be posted with a "Caution (or Danger) High Radiation Area" sign(s) at the point where radiation levels have been calculated to reach 1 mSv (100 mrem) in any one hour. A confirming survey of the high radiation area perimeter should not be conducted, since such a survey could lead to unnecessary exposure of personnel.

Surveillance of the restricted area at facilities with multiple levels and multiple access points, or where members of the public are close to the radiographic operations (e.g., boilers, commercial manufacturing plants, or power plants during outages) can usually be performed only when more than two radiographic personnel are assigned to the job. Figure 8.7 provides one example of such a temporary jobsite. Operating procedures and instruction to personnel should include specific steps for these circumstances to ensure that access into the restricted area is properly controlled. These special instructions may include the use of additional personnel to assist radiographic personnel in controlling access into the restricted area, providing instruction to other workers in the area, or making announcements over the public address system before and during radiographic operations.



**Figure 8.7 Surveillance and Posting at a Temporary Job Site with Multiple Floors and Access Points.** *Adequate control of the restricted area at this type of job site requires several personnel and many postings.*

## Permanent Radiographic Installations

For permanent radiographic installations, instruct personnel about posting each entrance to the facility with a “Caution (or Danger) High Radiation Area” sign(s), and provide procedures to ensure that the visible-audible signal system is operable. The operability of the visible-audible system must be checked daily. The following procedures may be used:

- C Expose a radiation source in the permanent installation with all entrances closed.
- C Determine that each visible signal in and outside the installation is functional.
- C Open the door to each entrance into the installation to activate the audible alarm.

- C Close the entrance and confirm that the alarm stops. If the installation has more than one entrance, only one entrance should be tested at a time.
- C Record results of test.

In the event that an entrance control device or an alarm fails to operate properly at the permanent radiographic installation, the installation may continue to operate for up to 7 days while the defective equipment is fixed, provided that:

- C The entrance control device is labeled as defective;
- C Radiography personnel maintain continuous, direct, visual surveillance of access installation points; and
- C Radiography personnel use an alarming rate meter.
- C The Radiographer must be accompanied by at least one other qualified radiographer or individual who has at a minimum met the requirements of 10 CFR 34.43(c).

## Storage Areas

Radiographic equipment containing licensed materials stored in controlled or unrestricted areas must be secured from unauthorized removal or access. Operating procedures should specify how stored licensed materials should be secured and who is authorized access to licensed material.

A vehicle used to transport licensed material can also be used for storage at locations such as temporary jobsites or overnight lodging. If the applicant plans to use vehicles for storage, there should be procedures and instructions to personnel about proper posting of the vehicle. Vehicles should be posted with a "Caution - Radioactive Material" sign on the entrance to the area of the vehicle where licensed material is stored. A physical survey should be performed to confirm that the area around the storage facility is an unrestricted area. Radiation levels may not exceed 0.02 mSv/hr (2 mrem/hr) at 18 inches (45 cm) from any external surface of the vehicle and the vehicle shall be locked when it is used for storage.

Radiographic equipment stored at temporary jobsites must be secured at a location that prevents access by unauthorized personnel. This usually requires that the equipment be locked in a cabinet or other secure area where key access is controlled by site management and radiographic personnel. It is not acceptable for a device to be chained to a post and left unattended at the place of use during lunch, breaks, or after hours. Storage of exposure devices at a private residence is unacceptable unless it has been identified and approved in a license.

**Note:** All regulatory criteria applying to your normal place of business for conducting industrial radiography operations also apply to the location in which you store at your private residence. You must specify this storage location in your license application.



**Response from Applicant:** Submit the procedures to control access to radiographic operations and storage areas.

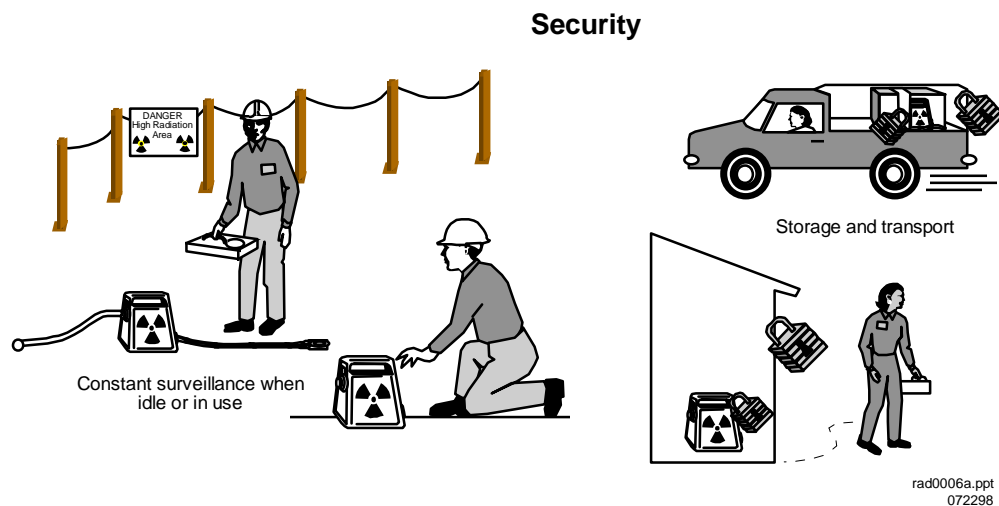
#### 8.10.9.4 METHODS AND OCCASIONS FOR LOCKING AND SECURING RADIOGRAPHIC EXPOSURE DEVICES, STORAGE CONTAINERS, AND SEALED SOURCES

**Regulations:** 10 CFR 34.20, 10 CFR 34.23.

**Criteria:** NRC regulations requires locking and securing radiographic equipment to protect the public and radiographers from an inadvertent exposure to radiation.

**Discussion:** All radiographic devices, i.e., gamma cameras, sealed source storage containers, and source changers are required to have a lock or outer-locked container to maintain the sealed source in its shielded position. During radiographic operations the source must automatically be secured in the shielded position each time the source is returned. Radiographers must not attempt to circumvent the automatic securing features or tamper with the safety features of radiographic devices. As shown in Figure 8.8 radiographers must never leave the exposure device at the temporary jobsite without securing it properly from unauthorized removal or tampering. Radiographers and/or radiographers assistants must ensure that the exposure device and/or storage or source containers are maintained locked (and if key locked, with the key removed at all times) when they are not under the direct supervision of the radiographer or the radiographer's assistant, except at permanent radiographic installations.

**Response from Applicant:** Submit operating and emergency procedures that include procedures for locking and securing radiographic equipment.



**Figure 8.8 Security.** *To avoid lost or stolen devices, licensees must keep the devices under constant surveillance, or secured against unauthorized use or removal.*

### 8.10.9.5 PERSONNEL MONITORING AND THE USE OF PERSONNEL MONITORING EQUIPMENT

**Regulations:** 10 CFR 34.45(a)(5), 10 CFR 34.47.

**Criteria:** Provide procedures for appropriate use of personnel monitoring equipment.

**Discussion:** As shown in Figure 8.9, all radiographers or radiographers' assistants are required to wear:

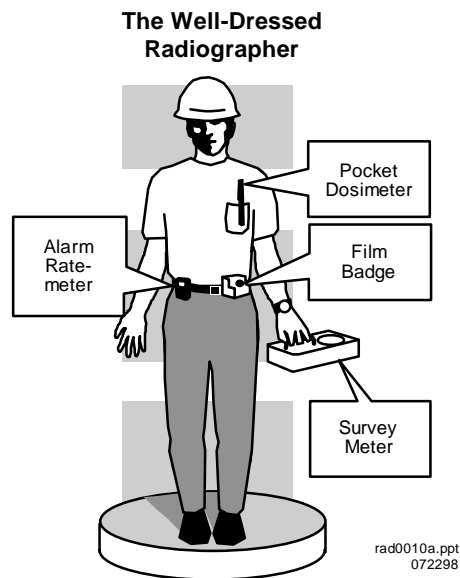
- C Direct-reading dosimeters and either film badges or TLDs.
- C Alarm ratemeters when they are engaged in radiographic operations.

Film badges or TLDs must be assigned to and worn by only one individual. To ensure full-scale reading capability, direct reading dosimeters such as pencil (pocket) dosimeters or electronic personal dosimeters must be recharged or reset at the start of each shift so that the dosimeters will be capable of reading the full scale. Personnel should be instructed that direct reading dosimeters must be read and recorded at the beginning and end of each shift. Proper operation of alarm ratemeters must be checked each day before use to ensure that the alarm functions properly. The manufacturer's recommended procedures should be followed.

Include instructions about how and where dosimetry devices are to be stored when not in use. The storage place should be dry, radiation free, and cool so that the devices will not be affected by adverse environmental conditions.

It is good practice to check the dosimeter reading during the work shift; however, there is no regulatory requirement for the dosimeter to be read during the work shift.

All radiographers or radiographers' assistants are required to wear alarm ratemeters except at permanent radiographic facilities where other appropriate alarm or warning devices (e.g., visible and audible alarms) are in routine use and are operable.



**Figure 8.9 The Well-Dressed Radiographer.** *The radiographer is equipped with the required personnel monitoring devices and survey instrument.*

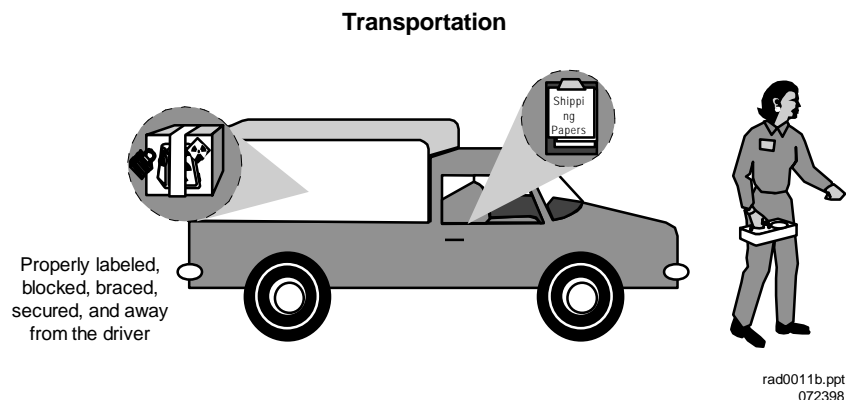
**Response from Applicant:** The operating procedures must include instructions for proper use of personnel monitoring equipment.

#### **8.10.9.6 TRANSPORTING SEALED SOURCES TO FIELD LOCATIONS, SECURING EXPOSURE DEVICES AND STORAGE CONTAINERS IN VEHICLES, POSTING VEHICLES, AND CONTROLLING SEALED SOURCES DURING TRANSPORTATION**

**Regulations:** 10 CFR 71.5, 49 CFR Parts 171-178.

**Criteria:** Licensees must develop, implement, and maintain procedures for transporting radioactive material to ensure compliance with DOT regulations.

**Discussion:** Figure 8.10 illustrates some often overlooked DOT requirements. During an inspection, NRC uses the provisions of 10 CFR 71.5 and a Memorandum of Understanding with DOT to examine and enforce transportation requirements applicable to radiography licensees. Appendix N contains 1) a list of major DOT regulations applicable to transporting radiographic devices; 2) a condensed summary of DOT/NRC transportation requirements; and 3) two sample shipping papers, the second of which may be more useful for multiple-use, temporary jobsite activities.



**Figure 8.10 Transportation.** Licensees often transport their radiographic devices to and from sites and must ensure compliance with Department of Transportation regulations.

Instructions to personnel should not reference DOT requirements. Information should be extracted, paraphrased and placed into the instructions so that personnel know exactly what they are expected to do. The following items should be covered in instructions to personnel:

- C Labeling containers appropriately (i.e., when to use labels Radioactive White I, Radioactive Yellow II, or Radioactive Yellow III).
- C Securing the exposure device or storage container within the transporting vehicle. The instructions should specify how to prevent the package from moving during transport.
- C Preparation of shipping papers. The instructions should specify that the papers must be completed before transporting the licensed material and must be accessible in the driver's compartment at all times. Appendix N contains examples of shipping papers for transporting radiographic exposure devices.
- C Placarding both sides, the front, and the back of the vehicle with "RADIOACTIVE" placards if the package being transported requires a Radioactive Yellow III label. If the vehicle requires placarding and the package radiation levels exceed 2 mSv/hr (200 mrem/hr) or the transport index exceeds 10, exterior surfaces and passenger compartment of the vehicle must be surveyed to ensure that the radiation levels do not exceed 0.02 mSv/hr (2 mrem/hr) from any exterior surface and 0.02 mSv/hr (2 mrem/hr) in the passenger compartment. Include instructions to personnel on the measures to take if the radiation level exceeds 0.02 mSv/hr (2 mrem/hr) in the passenger compartment (e.g., adding more shielding or repositioning the device within the vehicle).
- C If an exposure device is transported in an overpack, the procedures should include instructions that the overpack must be properly marked with the shipping name and identification number, labeled (Radioactive White I or Radioactive Yellow II), and marked when required with a statement that indicates the inner package complies with prescribed specifications.

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Because the licensee may have authorization to possess and use several sealed source/device combinations that are registered by NRC or an Agreement State and meet the safety performance requirements of 10 CFR 34.20, the applicant must, before using a new sealed source/device combination, develop written inspection and maintenance procedures for it and for the corresponding Type B transport package. In addition, the applicant must provide adequate training for radiographic personnel before using a new sealed source/device combination.

**Note:** Before the 1997 revision of 10 CFR Part 34, a licensee who intended to transport a radiographic Type B package was required to submit a quality assurance program to NRC for approval, separate from the license approval. The 1997 revision to 10 CFR Part 34 requires written procedures for inspection and maintenance of radiographic Type B packages (10 CFR 34.31(b)). In conjunction with the revision to 10 CFR Part 34, the NRC also amended 10 CFR 71.101(g) to specifically state that if the applicant's written procedures for inspection and maintenance of radiographic Type B packages are approved, then the applicant also meets NRC quality assurance requirements in Part 71 and does not have to submit or maintain a separate quality assurance program to transport a Type B package. The application's inspection and maintenance procedures for radiographic equipment, which are also used for Type B packages, should ensure that these packages are shipped and maintained in accordance with their COC.

**Response from Applicant:** Submit operating and emergency procedures for transporting sealed sources containing byproduct material, exposure devices, and source changers.

“A Review of Department of Transportation Regulations for Transportation of Radioactive Materials (1983 revision)” can be obtained by calling DOT's Office of Hazardous Material Initiatives and Training at (202) 366-4900. Memorandum of Understanding with DOT on the Transportation of Radioactive Material (signed June 6, 1979) is available from NRC upon request.

### 8.10.9.7 DAILY INSPECTION AND MAINTENANCE OF RADIOGRAPHIC EQUIPMENT

**Regulations:** 10 CFR 34.31, 10 CFR 34.33, 10 CFR 34.45(a)(7), 10 CFR 34.47, 10 CFR 34.73, 10 CFR 34.83.

**Criteria:** The licensee shall perform visual and operability checks before using radiography equipment on each day it is used.

**Discussion:** Visual and operability checks must be performed on radiographic exposure devices, survey meters, associated equipment, and transport and storage containers before use each day the equipment is used. These checks are intended to ensure that the equipment is in good working condition, that the sources are adequately shielded, and that required labeling is present.

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Licenses must check survey instrument operability using check sources or other appropriate means. The exposure device may be used as a check source.

Inspection records shall contain information about equipment problems found in daily checks and quarterly (not to exceed 3 months) maintenance inspections. Records shall include the date of check or inspection, name of inspector, equipment involved, any problems found, and what repair and/or maintenance, if any, was done.

Instructions to personnel using radiographic equipment must clearly state that inspections are to be made before the equipment is used each day. While not a requirement, good practice would be that if the equipment is used on more than one shift in the day, the equipment should be inspected before the start of each shift.

The procedures should specify the items that are to be checked and the steps that are to be taken if any defects are found. If problems are found, the equipment must be removed from service until it is repaired.

A list of items that should be checked in the daily inspection of radiography equipment can be provided by equipment manufacturers.

Permanent radiographic installation visible and audible alarms must be checked for operability daily before use, and faulty radiographic equipment must be labeled and repaired within 7 days, with compensatory measures taken in the interim. Compensatory measure taken include:

- C Immediately labeled faulty equipment as defective.
- C The Radiographer must be accompanied by at least one other qualified radiographer or individual who has at a minimum met the requirements of 10 CFR 34.43(c).
- C Continuous surveillance requirements are implemented until repairs are completed.
- C Alarm ratemeters shall be worn and checked for alarm function at the beginning of each shift.
- C Records must be maintained of faulty equipment

Direct reading dosimetry devices must be read and the exposures recorded at the beginning and end of each shift. Alarm ratemeters shall be checked for alarm function at the beginning of each shift. Records are to be maintained.

Appendix O provides example instructions for daily inspection of radiographic devices and equipment.

**Response from Applicant:** Submit operating and emergency procedures for daily inspection and maintenance of radiographic equipment.

### **8.10.9.8 RATEMETER ALARMS OR OFF-SCALE DOSIMETER READINGS**

**Regulations:** 10 CFR 34.43(b)(2), 10 CFR 34.45(a)(8), 10 CFR 34.47(d).

**Criteria:** Licensees must instruct personnel in:

- C Appropriate handling and use of sealed radioisotope sources and radiography devices.
- C Methods and occasions for conducting radiation surveys, controlling access to radiation areas and locking, securing, and transporting storage containers, radiographic exposure devices, and sealed radioisotope sources.
- C The licensee's license and operating and emergency procedures.
- C Actions to be taken if a dosimeter shows an off-scale reading or an alarm ratemeter alarms (sounds, etc.) unexpectedly.
- C Procedures to be followed if a film badge or TLD is lost or damaged.
- C Procedures for notifying the proper persons in the event of an accident.

**Discussion:** If an individual's self-reading pocket dosimeter is found to be off scale, an individual's electronic personal dosimeter reads above 2 mSv (200 mrem), or an alarm ratemeter alarms (sounds, etc.) unexpectedly, the RSO or designee must be notified immediately. If radiation exposure cannot be ruled out by the RSO or designee as the root cause, the individual's film badge or TLD must be sent for processing within 24 hours. The affected individual may not resume work with licensed radioactive material until the RSO or designee has determined the individual's radiation exposure.

There are no exceptions to this requirement.

If any of the events described above should occur, personnel should be instructed to do the following at a minimum:

- C Stop work immediately, ensure that the source is in the safe storage position in the exposure device, and vacate the radiation area.
- C If the alarm ratemeter alarms (sounds, etc.), evaluate pocket dosimeter reading.
- C Notify the individual specified in the emergency procedures.
- C Notify the RSO or designee of the problem.
- C If pocket dosimeter is off scale, do not resume operations until authorized by the RSO or designee.

C If the exposure cannot be ruled out by the RSO or designee, then the film badge or TLD must be processed within 24 hours.

**Response from Applicant:** Submit operating and emergency procedures to address ratemeter alarms or off-scale dosimeters.

#### **8.10.9.9 PROCEDURE FOR IDENTIFYING AND REPORTING DEFECTS AND NON-COMPLIANCE AS REQUIRED BY 10 CFR PART 21**

**Regulations:** 10 CFR 21, 10 CFR 30.50, 10 CFR 34.101(a)(3).

**Criteria:** Licensees must notify NRC if defects are found in radiography equipment.

**Discussion:** Equipment defects that could create a substantial safety hazard, or equipment failures involving NRC-regulated activities must be reported to NRC. For example, a failure of a lock box or a failure of the coupling between the source assembly and the control cable are defects that must be reported to NRC. Radiography personnel should be instructed to report any malfunction or defect in radiography equipment to management, so that management can take appropriate action.

**Response from the Applicant:** Submit operating and emergency procedures for notifying management of equipment malfunction or defect.

NRC IN 91-39, "Compliance with 10 CFR Part 21, Reporting of Defects and Noncompliance" is available from NRC upon request.

#### **8.10.9.10 NOTIFICATION OF PROPER PERSONS IN THE EVENT OF AN ACCIDENT**

**Regulations:** 10 CFR 30.50, 10 CFR 34. 45(a)(10), 10 CFR 34.101(a), 10 CFR 20.2201, 10 CFR 20.2202, 10 CFR 20.2203.

**Criteria:** Operating and emergency procedures must ensure that appropriate notifications are made during and after an emergency.

**Discussion:** The emergency procedures should clearly identify the names and telephone numbers of the RSO or other persons who can provide assistance in an emergency or accident. Such



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persons may also include the exposure device manufacturer and state and local agencies. The emergency procedures should always be available to radiography personnel during radiography and must be as up-to-date as possible.

NRC regulations also require immediate notification upon the discovery of certain events. Notify NRC when radiographic devices are lost or stolen or if there is indication of overexposure. Refer to the regulations listed above or to Appendix P for additional guidance in the preparation of emergency procedures. Table 8.6 provides a description of events that require notification and/or reports.

**Table 8.6 Notifications in the Event of an Accident**

<b>Typical NRC Notifications Required for Radiography Licensees</b>			
<b>Event</b>	<b>Telephone Notification</b>	<b>Written Report</b>	<b>Regulatory Requirement</b>
Theft or loss of material	immediate	30 days	10 CFR 20.2201(a)(1)(I)
Whole body dose greater than 0.25 Sv (25 rems)	immediate	30 days	10 CFR 20.2202(a)(1)(I)
Extremity dose greater than 2.5 Sv (250 rems)	immediate	30 days	10 CFR 20.2202(a)(1)(iii)
Whole body dose greater than 0.05 Sv (5 rems) in 24 hours	24 hours	30 days	10 CFR 20.2202(b)(1)(I)
Extremity dose greater than 0.5 Sv (50 rems) in 24 hours	24 hours	30 days	10 CFR 20.2202(b)(1)(iii)
Whole body dose greater than 0.05 Sv (5 rems)	none	30 days	10 CFR 20.2203(a)(2)(I)
Dose to individual member of public greater than 1 mSv (100 mrem)	none	30 days	10 CFR 20.2203(a)(2)(iv)
Defect in equipment that could create a substantial safety hazard	2 days	30 days	10 CFR 21.21(d)(3)(I)
Event that prevents immediate protective actions necessary to avoid exposure to radioactive materials that could exceed regulatory limits	immediate	30 days	10 CFR 30.50(a)
Equipment is disabled or fails to function as designed when required to prevent radiation exposure in excess of regulatory limits	24 hours	30 days	10 CFR 30.50(b)(2)

<b>Typical NRC Notifications Required for Radiography Licensees</b>			
<b>Event</b>	<b>Telephone Notification</b>	<b>Written Report</b>	<b>Regulatory Requirement</b>
Unplanned fire or explosion that affects the integrity of any licensed material or device, container, or equipment with licensed material	24 hours	30 days	10 CFR 30.50(b)(4)
Leak test of sealed source or guide tube greater than 185 Bq (0.005 Ci)	none	5 days	10 CFR 34.27(d)
Unintentional disconnect of source assembly from control cable	none	30 days	10 CFR 34.101(a)(1)
Inability to retract source to a safe shielded position	none	30 days	10 CFR 34.101(a)(2)
Failure of any component to perform its intended function which is critical for safe operation of device	none	30 days	10 CFR 34.101(a)(3)
Use of licensed material at any location not on license for more than 180 days in a calendar year	notify NRC Regional Office	none	10 CFR 34.101(c)

**Note:** Telephone notifications shall be made to the NRC Operations Center at 301- 816-5100 except as noted. The Center is staffed 24 hours a day and accepts collect calls. NRC notification is required when licensed materials are lost or stolen or involved in an incident that may have resulted in doses in excess of NRC limits.

**Response from Applicant:** Submit operating and emergency procedures that include appropriate instructions for notifying the RSO and/or other personnel in the event of an emergency.

### **8.10.9.11 MINIMIZING EXPOSURE OF PERSONS IN THE EVENT OF AN ACCIDENT**

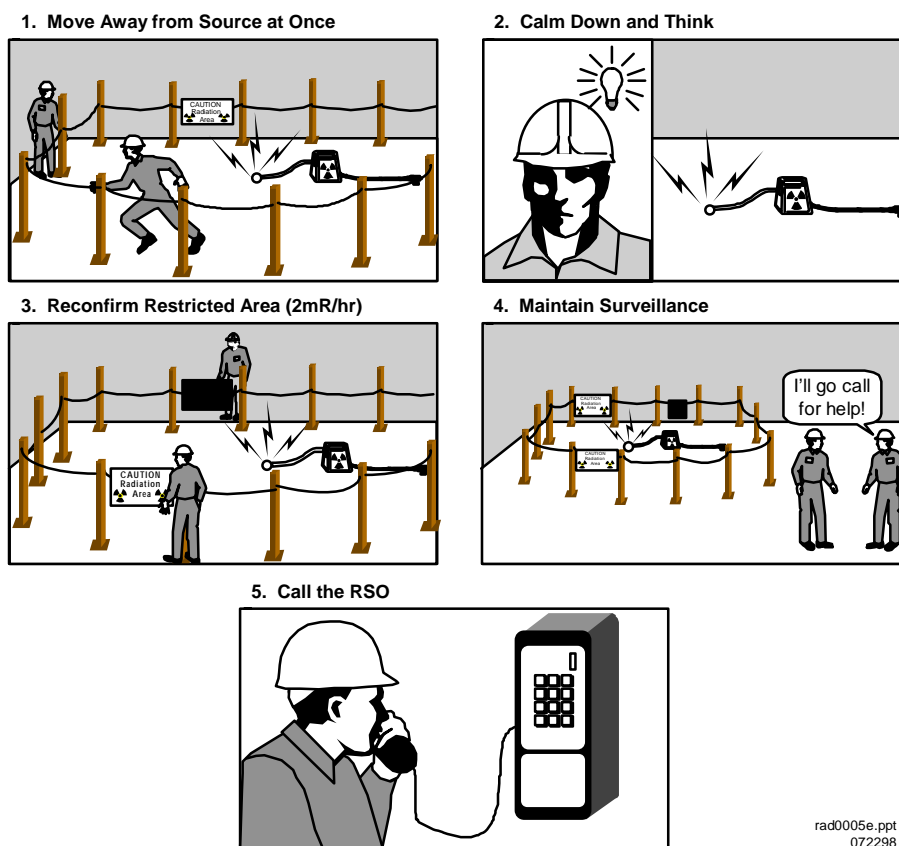
#### **Emergency Procedures**

**Regulations:** 10 CFR 34.45(a)(11).

**Criteria:** To maintain exposures as low as possible in the event of an emergency

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**Discussion:** An emergency situation is considered to exist whenever an abnormal event occurs and/or the source has failed to return to the safe position. Since it is not possible to specify all possible situations that would constitute an emergency, a general instruction is acceptable as shown in Figure 8.11. This general instruction should describe licensee actions to maintain the dose at a minimal level after an abnormal event is identified. The instruction should include routine emergency actions such as posting the restricted area, maintaining surveillance of the restricted area, and notifying the RSO.



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**Figure 8.11 Emergency Procedures.** *These steps provide guidance in an emergency.*

Appendix P provides an example of a routine Emergency Procedure.

**Response from Applicant:** Submit operating and emergency procedures that include instructions for minimizing exposure of persons in the event of an accident.

### 8.10.9.12 SOURCE RETRIEVAL

**Regulations:** 10 CFR 34.45(a)(12), 10 CFR 34.101(a), 10 CFR 34.101(b).

**Criteria:** Each licensee who intends to perform source retrieval operations must have appropriate equipment, training, and procedures.

**Discussion:** Applicants must develop source retrieval procedures if their own radiographic personnel with appropriate training and experience will conduct source retrievals. If procedures are submitted, the NRC will review and approve applicants to perform source retrieval. If source retrieval procedures are not submitted for review, then source retrieval activities must be conducted by an NRC or Agreement State licensee whose license specifically authorizes these activities.

Licensees specifically approved to perform source retrievals will have a specific license condition authorizing these activities. In addition, these individuals would be authorized to perform source retrievals for other licensees.

NRC will review the applicant's procedures for source retrieval with respect to keeping exposures ALARA and controlling exposures to radiation. Since it is not possible to specify all potential exposure situations, a general procedure is acceptable. A retrieval procedure should contain the following elements:

- C Warnings that only specifically authorized individuals, or personnel supervised by such authorized individuals and working in their presence are allowed to perform retrievals.
- C A clear statement that no source or suspected source containing items such as a stuck source in a guide tube will be handled directly.
- C Expedient methods of reducing unintended exposure to staff and the public, such as using lead shot bags, sandbags, steel plates, remote handling devices, and culverts cut lengthwise.
- C Additional dosimetry should be used during source retrievals, for example, pocket dosimeters with a range greater than 2 mSv (200 mrem) or finger badges.
- C Methods of restricting access to the area, including establishing a restricted area and obtaining outside help in controlling access.
- C Appropriate use of survey instruments. The procedure should prohibit using alarming dosimeters or electronic dosimeters as survey instrument substitutes.
- C Criteria for requesting outside assistance.
- C Instructions for reducing the exposure to other personnel and members of the public during recovery operations.
- C Notification of the RSO, RSO-designee, and management.
- C Specific training including practice with special tools, shielding, and additional dosimetry with a dummy source.
- C Notification of the NRC or Agreement State.

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Radiography personnel should not attempt to perform operations involving retrieval or recovery unless they have actual practice in retrieval operations using a dummy source with the appropriate handling tools, survey instruments, and dosimetry.

### **Response from Applicant:**

C Submit the following: “We will not perform source retrievals and will use the services of a person specifically licensed by the NRC or an Agreement State to perform the retrievals of our sources.”

### **OR**

C Submit source retrieval procedures and specific training for NRC review in accordance with the criteria listed above.

## **8.10.9.13 MAINTENANCE OF RECORDS**

**Regulations:** 10 CFR 34.45(a)(13), 10 CFR 34.47, 10 CFR 34.71, 10 CFR 34.73, 10 CFR 34.85, 10 CFR 34.87, 10 CFR 34.89.

**Criteria:** The licensee shall meet NRC record requirements.

**Discussion:** Personnel must generate and maintain certain records when performing radiography, including:

C Utilization logs showing the following:

- Description, including the make, model, and serial number of the device used.
- Identification and signature of the radiographer.
- Where the device is used and dates of use; dates device is removed and returned to storage.

C Records of daily inspection of equipment.

C Pocket dosimeter readings. These readings must be made at the beginning and end of a work shift. Instructions to personnel must specify that the readings be recorded.

C Results of the physical survey to ensure that the sealed source is in its shielded position, when a radiographic exposure device is placed in a storage area (as defined in § 34.3) and if that survey is the last one performed in the workday.

Other operations that may require records include quarterly (not to exceed 3 months) inspection and maintenance, instrument calibration, shipment of packages, etc. Radiography personnel

should also be aware of the records that must be maintained at temporary jobsites. Radiographers performing radiographic duties should be given specific instructions for recordkeeping. These should not include instructions about records that are the responsibility of management and supervision.

**Response from the Applicant:** Submit operating and emergency procedures which ensure proper maintenance of records.

## 8.11 ITEM 11: WASTE MANAGEMENT

### 8.11.1 DISPOSAL OR TRANSFER OF RADIOGRAPHY SEALED SOURCES CONTAINING BYPRODUCT MATERIAL OR DEVICES CONTAINING DEPLETED URANIUM

**Regulations:** 10 CFR 20.2001, 10 CFR 30.41, 10 CFR 30.51.

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

**Discussion:** Licensees who dispose of radiography sealed sources containing byproduct material, or dispose of radiography devices containing depleted uranium, must transfer them to an authorized recipient. Recipients authorized to accept radioactive waste from other persons, or another specific licensee authorized to possess the licensed material, i.e., whose license specifically authorizes the radionuclide and its use are the original manufacturer of the device, or a commercial firm licensed by the NRC or an Agreement State.

Before transferring radioactive material, a licensee must use one of the methods described in 10 CFR 30.41 to verify that the recipient is properly authorized to receive it. In addition, all packages containing radioactive sources must be prepared and shipped in accordance with NRC and DOT regulations. Records of the transfer must be maintained as required by 10 CFR 30.51.

**Response from Applicant:** The applicant does not need to provide a response to this item during the licensing process. However, the applicant should establish and include waste disposal procedures in its radiation safety program.

Because of the difficulties and costs associated with disposal of sealed sources containing byproduct material and devices containing depleted uranium, applicants should preplan the disposal. Applicants may want to consider contractual arrangements with the sealed source and device supplier as part of a purchase agreement.

The next two items on NRC Form 313 should be completed on the form itself.

## **8.12 ITEM 12: LICENSE FEES**

On NRC Form 313, enter the fee category and the amount of the fee enclosed with the application.

## **8.13 ITEM 13: CERTIFICATION**

Individuals acting in a private capacity are required to date and sign NRC Form 313. Otherwise, representatives of the corporation or legal entity filing the application should date and sign NRC Form 313. Representatives signing an application must be authorized to make binding commitments and to sign official documents on behalf of the applicant. As discussed previously in “Management Responsibility,” signing the application acknowledges management's commitment and responsibilities for the radiation protection program. NRC will return all unsigned applications for proper signature.

***Note:***

- C It is a criminal offense to make a willful false statement or representation on applications or correspondence (18 U.S.C. 1001).
- C When the application references commitments, those items become part of the licensing conditions and regulatory requirements.





## 9 AMENDMENTS AND RENEWALS TO A LICENSE

It is the licensee's obligation to keep the license current. If any of the information in the original application changes, the licensee must submit an application for a license amendment to reflect the change before the change takes place. Also, to continue a license after its expiration date, the licensee must submit an application for license renewal at least 30 days before the expiration date (10 CFR 2.109, 10 CFR 30.36(a)).

Applications for license amendment, in addition to the following, must include the appropriate fee. For renewal and amendment requests, applicants must do the following:

- C Use the most recent guidance in preparing an amendment or renewal request.
- C Submit in duplicate either an NRC Form 313 or a letter requesting amendment or renewal.
- C Provide the license number.
- C For renewals, provide a complete and up-to-date application if many outdated documents are referenced, or if there have been significant changes in regulatory requirements, NRC's guidance, the licensee's organization, or the licensee's radiation protection program. Alternatively, describe clearly the exact nature of the changes, additions, and deletions.



## 10 APPLICATIONS FOR EXEMPTIONS

Various sections of NRC's regulations address requests for exemptions (e.g., 10 CFR 19.31, 10 CFR 20.2301, 10 CFR 30.11(a), 10 CFR 34.111)). These regulations state that NRC may grant an exemption, acting on its own initiative or on an application from an interested person. Key considerations are whether the exemption is authorized by law, will endanger life or property or the common defense and security, and is otherwise in the public interest.

Until NRC has granted an exemption in writing, NRC expects strict compliance with all applicable regulations.

Exemptions are not intended to revise regulations, are not intended for large classes of licenses, and are generally limited to unique situations and are reviewed on a case-by-case basis. Exemption requests must be accompanied by descriptions of the following:

- C Exemption from which provision in NRC's regulations and the basis for request.
- C Proposed compensatory safety measures intended to provide a level of health and safety equivalent to the regulation for which the exemption is being requested.
- C Alternative methods for complying with the regulation and why they are not feasible.



## 11 TERMINATION OF ACTIVITIES

When terminating licensed activities, pursuant to 10 CFR 30.34(b), 10 CFR 30.35(g), 10 CFR 30.36(d) and (j), and 10 CFR 30.51(f), licensees must do the following:

- C Certify the disposition of licensed materials by submission of NRC Form 314, "Certificate of Disposition of Materials," or equivalent information, available from NRC's Regional or Field Offices (see Figure 2.1 for addresses and telephone numbers).
- C Before a license is terminated, send the records important to decommissioning (as required by 10 CFR 30.35(g)) to the appropriate NRC regional office,

**OR**

- C When transferring a licensed activity to another license at the same location, ensure the records are given to the successor licensee.

For guidance on the disposition of licensed material, see the section on Waste Management - Source or Device Disposal or Transfer. For guidance on decommissioning records, see the section on Radioactive Materials - Financial Assurance and Recordkeeping for Decommissioning.



## **Appendix A**

### **List of Documents Considered in Development of this NUREG**





## List of Documents Considered in Development of this NUREG

### Regulatory Guides (RGs) and Policy and Guidance Directives (PGs)

(\*) Marked items are superseded and are not to be used.

*RG 10.6	Guide for the Preparation of Applications for Use of Sealed Sources and Devices for Performing Industrial Radiography, Rev. 1	12/81
*RG 7.10	Establishing Quality Assurance Programs for Packaging Used in the Transport of Radioactive Material (Combined Draft TP 019-4, published 6/1981, and Draft TP 020-4, published 3/1981), Rev 1	6/86
*FC 401-4	Guide for the Preparation of Applications for the Use of Sealed Sources and Devices for Performing Industrial Radiography	10/84
*FC 84-15	SRP for Applications for Use of Sealed Sources and Devices for Performing Industrial Radiography	10/84
*FC 85-16	Transportation Procedures for Industrial Radiography Licensees	10/85
*PG 2-16	License Exemption for Newly-Manufactured Radiography Equipment	03/95

### Information Notices (INs)

(\*) Marked items are superseded and are not to be used.

*IN 80-17	Potential Hazards Associated with Interchangeable Parts on Radiographic Equipment
*IN 81-02	Transportation of Radiography Devices
IN 83-81	Entry into High Radiation Areas from Areas Which Are Not Under Direct Surveillance
IN 84-25	Recent Serious Violations of NRC Requirements by Radiography Licensees
*IN 85-07	Contaminated Radiography Source Shipments
IN 85-57	Lost Iridium-192 Source Resulting in the Death of Eight Persons in Morocco
IN 87-45	Recent Safety - Related Violations of NRC Requirements by Industrial Radiography Licensees
IN 87-47	Transportation of Radiography Devices
*IN 88-18	Malfunction of Lockbox on Radiography Device
*IN 88-33	Recent Problems Involving the Model Spec 2-T Radiographic Exposure Device

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IN 88-66	Industrial Radiography Inspection and Enforcement
IN 89-25	Unauthorized Transfer of Ownership or Control of Licensed Activities, Rev. 1
IN 90-15	Reciprocity: Notification of Agreement State Radiation Control Directors Before Beginning Work in Agreement States
*IN 90-24	Transportation of Model Spec 2-T Radiographic Exposure Device
IN 91-23	Accidental Radiation Overexposures to Personnel Due to Industrial Radiography Accessory Equipment Malfunctions
*IN 91-49	Enforcement of Safety Requirements for Radiographers
IN 91-60	False Alarm of Alarm Ratemeters Because of Radiofrequency Interference
IN 93-05	Locking of Radiography Exposure Devices
IN 93-69	Radiography Events at Operating Power Reactors
*IN 95-58	10 CFR 34.20; Final Effective Date
IN 95-44	Ensuring Compatible Use of Drive Cables Incorporating Industrial Nuclear Company Ball-type Male Connectors
IN 96-04	Incident Reporting Requirements for Radiography Licensees
IN 96-20	Demonstration of Associated Equipment Compliance with 10 CFR 34.20
IN 96-53	Retrofit to Amersham 660 Posilock Radiography Camera to Correct Inconsistency in 10 CFR Part 34 Compatibility
IN 97-35	Retrofit to Industrial Nuclear Company (INC) IR100 Radiography Camera to Correct Inconsistency in 10 CFR Part 34 Compatibility
IN 97-86	Additional Controls for Transport of the Amersham Model No. 660 Series Radiographic Exposure Devices
IN 97-87	Second Retrofit to Industrial Nuclear Company IR100 Radiography Camera to Correct Inconsistency in 10 CFR Part 34 Compatibility
IN 97-91	Recent Failures of Control Cables Used on Amersham Model 660 Posilock Radiography Systems
IN 98-16	Inadequate Operational Checks of Alarm Ratemeters

**Technical Assistance Requests (TARS)**

1. TAR dated 04/19/96 - Exemption Request from Consumers Power Company to 34.20 for Model 414 Source Changer
2. TAR dated 03/29/96 - Request from Chicago Bridge and Iron Company for Continuation of the Application for Exemption from the Requirements Specified in 10 CFR 34.20(a)
3. TAR dated 03/10/96 - Request from WM. Power Company for Temporary Exemption to 10 CFR 34.20
4. TAR dated 01/29/96 - Northwest Airlines Request for Exemption from Certain Provisions Specified in Section 34.20 of 10 CFR Part 34
5. TAR dated 01/25/96 - Trans World Airlines Request for Exemption from Certain Provisions Specified in Section 34.20 of 10 CFR Part 34
6. TAR dated 01/24/96 - American Airlines Requesting Exemption from Certain Provisions Specified in Section 34.20 of 10 CFR Part 34
7. TAR dated 01/18/96 - Exemption Request from Testing Technology, Inc. from the Requirements of 10 CFR 34.20 until December 31, 1996
8. TAR dated 01/08/96 - Exemption Request from XRI Testing to the Performance Criteria Specified in 10 CFR 34.20(A), (C), (2), and (E)
9. TAR dated 01/05/96 - Request from Waukesha Foundry for Exemption to 10 CFR 34.20
10. TAR dated 01/05/96 - Exemption Request from Wisconsin Centrifugal Inc. to the Performance Criteria Specified in 10 CFR 34.20
11. TAR dated 12/28/95 - Exemption Request Industrial Nuclear Co., Inc. from the January 10, 1996, Implementation Date Specified in Section 34.20(E) of 10 CFR Part 34
12. TAR dated 12/22/95 - Exemption Request from Pitt-Des Moines, Inc. from Certain Provisions Specified in Section 34.20 of 10 CFR 34
13. TAR dated 11/13/95 - Exemption Request from Chicago Bridge and Iron Company for Exemption for the Requirements Specified in 10 CFR 34.20(a)
14. TAR dated - Interpretation of 10 CFR 34.22(A) and 34.20(C)(2), for Requiring Radiographers to Lock the Exposure Device Between each Exposure

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15. TAR dated 09/25/95 - Exemption Request from CTI, Alaska, Inc. To Allow Use of Braided Guide Tubes
16. TAR dated Exemption Request from General Dynamics Corporation to 10 CFR 34.20 in Order to Continue Using a Picker Model 6145A Exposure Device
17. TAR dated 08/21/95 - Exemption Request from Newport News Shipbuilding and Drydock from 10 CFR Part 34 Requirements for Performing Gamma Probing of Shields and Other Materials for Void Detection
18. TAR dated 05/23/95 - Exemption Request from High Steel Structures, Inc. from Provisions of 10 CFR 34.20(A)
19. TAR dated 04/17/95 - Should NRC Review for New NRC Licenses Include Verification that Applicants are a Recognized Company, Corporations, ETC., by the State in Which They Reside
20. TAR dated 02/02/95 - Exemption Request from Empire Steel Castings, Inc from 10 CFR 34.20
21. TAR dated 11/08/94 - Exemption Request from General Motors Corporation, GM Powertrain from Provision Stated in 10 CFR 34.20
22. TAR dated 02/28/94 - Exemption Request from Precision Components to 10 CFR 34.20 Requirements
23. TAR dated 02/04/93 - Proposed License Condition Requiring Radiography Licensee to Report All Anticipated Field Work
24. TAR dated 12/09/92 - Differences Between Training Requirements for Radiographers in the State of Texas and NRC
25. TAR dated 07/13/92 - Exemption Request from Fluor Daniel, Inc. To 10 CFR 34.20 for Use of a Custom Radiography Guide Tube
26. TAR dated 03/18/92 - Pacific Testing Laboratories' Application for a New Industrial Radiography License
27. TAR dated 02/03/92 - Valley Inspection Services Request to Obtain a "Variance" for Its Fixed Radiography Cell
28. TAR dated 09/10/91 - Exemption from 10 CFR 34.33 in Order to Use GE Smith Model GS-15 Personal Alarm's in Lieu of a Device that Satisfies the Criteria of 10 CFR 34.33

29. TAR dated 04/02/91 - Continental Airlines Request for a “Variance” in Radiography Training
30. TAR dated 02/07/91- New Radiography Licensee Requesting Use of Same Facility and Users as an Existing Licensee
31. TAR dated 05/18/90 - Consolidated NDE; Interpretation of Regulations, 10 CFR Parts 20 and 34



## **Appendix B**

### **United States Nuclear Regulatory Commission Form 313**





## **United States Nuclear Regulatory Commission Form 313**

Replace this page with U.S. NRC Form 313.



## **Appendix C**

### **Suggested Format for Providing Information Requested in Items 5 through 11 of NRC Form 313**



### Suggested Format for Providing Information Requested in Items 5 through 11 of NRC Form 313

Item No.	Title and Criteria	Yes	Description Attached
5	<b>RADIOACTIVE MATERIAL</b>  <b>Sealed Sources and Devices</b>  C Identify each radionuclide that will be used for performing radiography. [ ] C Identify the manufacturer (or distributor) and model number of each sealed source. [ ] C Identify the manufacturer (or distributor) and model number of each exposure device. Indicate if a device is only to be used in a permanent radiographic installation. [ ] C Identify the manufacturer (or distributor) and model number of each source changer. [ ] C If depleted uranium is used as shielding material, specify the total amount (in kilograms). [ ] C Confirm that each sealed source, device, and source/device combination possessed is registered as an approved sealed source or device by NRC or an Agreement State and will be possessed and used in accordance with the conditions specified in the registration certificate. [ ] C Confirm that associated equipment is compatible with the exposure devices, source exchangers, and sealed sources containing byproduct material. [ ] C Confirm that only radiographic exposure devices, source assemblies or sealed sources, and associated equipment which meet the requirements specified in 10 CFR 34.20 will be used in radiographic operations. [ ] C Identify each radionuclide and the manufacturer (or distributor) and model number of each sealed source and/or device containing byproduct material that will not be used for performing radiography. [ ]		

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Item No.	Title and Criteria	Yes	Description Attached
5	<p><b>RADIOACTIVE MATERIAL</b></p> <p><b>Financial Assurance and Recordkeeping for Decommissioning</b></p> <p>C Pursuant to 10 CFR 30.35(g), we shall maintain drawings and records important to decommissioning and to transfer these records to a new licensee before licensed activities are transferred, or to assign the records to the appropriate NRC regional office before the license is terminated.</p> <p style="text-align: center;"><b>OR</b></p> <p>C If financial assurance is required, submit evidence.</p>	<input type="checkbox"/>	
6	<p><b>PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED</b></p> <p>Equipment will only be used:</p> <p>C industrial radiography.</p> <p>C underwater radiography</p> <p>C lay-barge radiography</p> <p>C off-shore platform radiography</p> <p>C other than radiography</p>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>

Item No.	Title and Criteria	Yes	Description Attached
7	<p><b>INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING EXPERIENCE</b></p> <p><b>Radiation Safety Officer (RSO)</b></p> <p>C 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.</p> <p style="text-align: center;"><b>AND</b></p> <p>C Demonstrate that the RSO has sufficient independence and direct communication with responsible management officials by providing a copy of an organizational chart by position, demonstrating day-to-day oversight of the radiation safety activities.</p> <p style="text-align: center;"><b>AND EITHER</b></p> <p>C The specific training and experience of the RSO and other potential designees. Include the specific dates of certification and/or training in radiation safety.</p> <p>C Documentation to show that the RSO has a minimum of 2,000 hours of hands-on experience as a qualified radiographer in industrial radiographic operations.</p> <p>C Documentation to show that the RSO has obtained formal training in the establishment and maintenance of a radiation protection program.</p> <p style="text-align: center;"><b>OR</b></p> <p>C Alternative information demonstrating that the proposed RSO is qualified by training and experience.</p> <p>C Documentation to show the RSO has obtained formal training in the establishment and maintenance of a radiation protection program.</p>		<p>[ ]</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p>

APPENDIX C

Item No.	Title and Criteria	Yes	Description Attached
8	<p><b>TRAINING FOR RADIOGRAPHERS AND RADIOGRAPHER'S ASSISTANTS</b></p> <p>C Submit an outline of the training to be given to prospective radiographers and radiographer's assistants. Submit your procedures for experienced radiographers who have worked for another licensee.</p> <p>C Provide a copy of a typical examination and the correct answers to the examination questions. Indicate the passing grade.</p> <p>C Prior to June 27, 1999, you may <b>affirm</b> that all individuals acting as radiographers will be certified in radiation safety in lieu of providing a description of your training and examination program in the topics listed in 10 CFR 34.43(g). (All other training program descriptions must still be submitted.)</p> <p>C Specify the qualifications of your instructors in radiation safety principles and describe their experience with radiography. If training will be conducted by someone outside the applicant's organization, identify the course by title and provide the name and address of the company providing the training.</p> <p>C Describe the field (practical) examination that will be given to prospective radiographers and radiographer's assistants.</p> <p>C Describe the annual refresher training program, including topics to be covered and how the training will be conducted.</p> <p>C Submit your procedures for verifying and documenting the certification status of radiographers and for verifying that their certification remains valid.</p> <p>C Submit a description of your program for inspecting the job performance of each radiographer and radiographers' assistant at intervals not to exceed 6 months as described in 10 CFR 34.43(e).</p>	<p></p> <p></p> <p>[ ]</p> <p></p> <p></p> <p></p> <p></p> <p></p> <p></p>	<p></p> <p></p> <p>[ ]</p> <p></p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p>



Item No.	Title and Criteria	Yes	Description Attached
9	<p><b>FACILITIES AND EQUIPMENT</b></p> <p><b>Permanent Radiography Installations</b></p> <p>Provide the following information for each permanent radiography installation:</p> <p>C An annotated sketch or drawing of the facility and its surroundings. <input type="checkbox"/></p> <p>C The scale to which the sketch or drawing is made. <input type="checkbox"/></p> <p>C The type, thickness and density of shielding materials on all sides, including the floor and the roof. <input type="checkbox"/></p> <p>C The locations of entranceways and other points of access to the facility. <input type="checkbox"/></p> <p>C A description of the areas adjacent to the facility and the distance to these areas. Include information on areas adjacent to, above, and below the facility. <input type="checkbox"/></p> <p>C A description of the general location of each proposed permanent facility listed in Item 3 (e.g., located in an industrial park, an office complex, etc.) and its current use. <input type="checkbox"/></p> <p>C If a proposed permanent facility is a private residence, provide diagrams of the facility that include the building, the proposed restricted area(s), and adjacent areas, including above and below the restricted areas. <input type="checkbox"/></p> <p>C Restricted areas do not include residential quarters. <input type="checkbox"/></p> <p>C Explain how radiation levels in unrestricted areas will be maintained at less than 1 mSv (100 millirem) per year. <input type="checkbox"/></p> <p>C A description of the visible-audible signal system or entrance control system and its locations. <input type="checkbox"/></p> <p>C The results of radiation-level calculations or actual radiation measurements adjacent to, above, and below the facility. <input type="checkbox"/></p>		

Item No.	Title and Criteria	Yes	Description Attached
9	<p><b>FACILITIES AND EQUIPMENT</b></p> <p><b>Permanent Radiography Installations</b></p> <p>Provide the following information to obtain approval for a variance if construction requirements preclude shielding the roof to meet the requirement not to exceed 0.02 mSv (2 mrem) in any one hour:</p> <p>C Means of access to the roof. <span style="float: right;">[ ]</span></p> <p>C Procedures for ensuring that no individual is on the roof or could gain access to the roof during radiography. <span style="float: right;">[ ]</span></p> <p>C A commitment that the roof will be posted with “Caution (or Danger) Radiation Area” sign(s). <span style="float: right;">[ ]</span></p> <p>C Steps taken to minimize radiation on the roof. <span style="float: right;">[ ]</span></p> <p>C Limitations (if needed) on positioning of sources or type (isotope) and amount of radioactive material that may be used in the installation to ensure that areas adjacent to, above, and below the installation will be unrestricted areas during the performance of radiography. <span style="float: right;">[ ]</span></p> <p>Provide the following information to obtain approval for a variance if radiation levels on the radiography installation roof exceed 1.0mSv (100 mrem) in any one hour:</p> <p>C A commitment that the roof will be posted with a “Caution (or Danger) High Radiation Area” sign(s). <span style="float: right;">[ ]</span></p> <p>C Evidence of constant surveillance of the roof by closed-circuit TV. <span style="float: right;">[ ]</span></p> <p>C Fluctuation of the dose rate. <span style="float: right;">[ ]</span></p> <p>C A description of a control device that would automatically reduce the radiation level to 1 mSv (100 mrem) in any one hour at 30 cm from the radiation source if someone enters the roof. <span style="float: right;">[ ]</span></p> <p>C A description of a control device that activates a visible-audible signal so that both an individual entering the roof and the radiographer on duty are made aware of the entry. <span style="float: right;">[ ]</span></p>		

Item No.	Title and Criteria	Yes	Description Attached
9	<b>FACILITIES AND EQUIPMENT</b>  <b>Field Stations</b>  Provide the following information for each field station:  C Describe the storage location(s) at the address(es) listed in Item 3 of the application and submit a diagram showing where the radiography camera will be stored at the field stations. C Indicate whether radiography will be performed at the place of business outside of a permanent facility as if the work was “in the field.” C For radiography performed at the place of business as if the work was “in the field,” provide a diagram of the location where radiography may be performed and its surroundings, including a description of adjacent property.		<div>[ ]</div> <div>[ ]</div> <div>[ ]</div>
10	<b>RADIATION SAFETY PROGRAM</b>  <b>Audit Program</b>  The applicant is <u>not</u> required to, and should not, submit its audit program to the NRC for review during the licensing phase.  <b>Instruments</b> We will possess and use calibrated and operable radiation survey meters.  Calibration will be performed by a NRC or Agreement State licensee specifically authorized to perform instrument calibration.  Calibration is to be performed in-house and the model procedures in Appendix J will be followed.  Calibration is to be performed in-house and alternate procedures will be followed.  Identify the qualifications of the individuals who will perform the calibrations.	<div>Need Not Be Submitted With Application</div> <div>[ ]</div> <div>[ ]</div> <div>[ ]</div> <div>[ ]</div> <div>[ ]</div>	<div>[ ]</div> <div>[ ]</div> <div>[ ]</div>

APPENDIX C

Item No.	Title and Criteria	Yes	Description Attached
10	<b>RADIATION SAFETY PROGRAM</b>		
	<b>Material Receipt And Accountability</b>		
	Physical inventories will be conducted and documented at quarterly intervals (not to exceed 3 months) to account for all sealed sources containing byproduct material and devices containing depleted uranium received and possessed under the license.	<input type="checkbox"/>	
	<b>Minimization Of Contamination</b>		
	The applicant is <i>not</i> required to provide a response to the minimization of contamination if the applicant's responses meet the criteria for the following sections: "Radioactive Material - Sealed Sources and Devices," "Facilities and Equipment," "Radiation Safety Program - Leak Tests," "Radiation Safety Program - Operating and Emergency Procedures," and "Waste Management - Sealed Source / DU Device Transfer and Disposal."		Need Not Be Submitted With Application
	<b>Leak Tests</b>		
	Leak tests will be performed by an organization authorized by 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 NRC or an Agreement State to provide leak test kits and/or services to other licensees and according to the instructions provided in the leak test kit.	<input type="checkbox"/>	
	<b>OR</b>		
	Leak testing will be done by the applicant.	<input type="checkbox"/>	
	C The information in Appendix K supporting a request to perform leak testing and sample analysis is attached.		<input type="checkbox"/>
	C We will follow the model procedures in Appendix K.	<input type="checkbox"/>	
	C We will follow alternate procedures.		<input type="checkbox"/>

Item No.	Title and Criteria	Yes	Description Attached
10	<p><b>RADIATION SAFETY PROGRAM</b></p> <p><b>Occupational Dosimetry</b></p> <p>Film or TLD dosimetry, processed and evaluated by a NVLAP-accredited processor and exchanged at the required frequency, will be worn by radiography personnel.</p> <p>The required personnel monitoring equipment, including 0 to 2 mSv (200 mrem) dosimeters or electronic personal dosimeters, will be worn by radiographic personnel.</p> <p>Alarming ratemeters set to alarm @ <math>\pm 20\%</math> of 500 mrem/hour will be worn by all radiography personnel except those at permanent radiography installations where other appropriate alarming or warning devices are in use.</p> <p>Pocket dosimeters and alarm ratemeters will be checked for correct response at intervals not to exceed 12 months.</p> <p>C If adjustment is necessary, the devices will be returned to the manufacturer.</p> <p>C If adjustment is necessary, in-house procedures for adjustments are described.</p> <p><b>Public Dose</b></p> <p>The applicant is <u>not</u> required to, and should not, submit a response to the public dose section during the licensing phase. This matter will be inspected during an inspection.</p>	<p>[ ]</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p>	<p>[ ]</p> <p>Need Not Be Submitted With Application</p>

APPENDIX C

Item No.	Title and Criteria	Yes	Description Attached
10	<p><b>RADIATION SAFETY PROGRAM</b></p> <p><b>Quarterly Maintenance</b></p> <p>Submit the procedures to NRC for review and approval as Operating and Emergency Procedures and/or as Shipping Package Procedures as needed.</p> <p>Before using a new sealed source/device combination, we will have written inspection and maintenance procedures that address the use of the new equipment as a Type B transport package. In addition, we will provide training to radiographic personnel before using a new sealed source/device combination.</p> <p><b>Operating And Emergency Procedures</b></p> <p><b>Handling And Use Of Sealed Sources And Radiography Exposure Devices</b></p> <p>Submit operating and emergency procedures which provide step-by-step instructions for using each type of radiographic device. Instructions for crankout devices should be separate from those for pipeliner devices.</p> <p>Submit operating and emergency procedures which provide instructions for performing source exchanges.</p> <p><b>Methods And Occasions For Conducting Radiation Surveys</b></p> <p>Submit operating and emergency procedures which, where applicable, include each of the surveys included in Table 8.1</p> <p><b>Methods For Controlling Access To Radiographic Areas</b></p> <p>Submit the procedures to control access to radiographic operations and storage areas.</p>	<p></p> <p>[ ]</p> <p>[ ]</p> <p></p> <p></p> <p></p> <p></p> <p></p> <p></p>	<p></p> <p>[ ]</p> <p></p> <p></p> <p>[ ]</p> <p></p> <p>[ ]</p> <p></p> <p>[ ]</p>

Item No.	Title and Criteria	Yes	Description Attached
10	<p><b>RADIATION SAFETY PROGRAM</b></p> <p><b>Methods And Occasions For Locking And Securing Radiographic Exposure Devices, Storage Containers, And Sealed Sources</b></p> <p>Submit operating and emergency procedures that include procedures for locking and securing radiographic equipment.</p> <p><b>Personnel Monitoring And The Use Of Personnel Monitoring Equipment</b></p> <p>Submit operating procedures that include instructions for proper use of personnel monitoring equipment.</p> <p><b>Transporting Sealed Sources To Field Locations, Securing Exposure Devices And Storage Containers In Vehicles, Posting Vehicles, And Controlling Sealed Sources During Transportation</b></p> <p>Submit operating and emergency procedures for transporting sealed sources containing byproduct material, exposure devices, and source exchangers.</p> <p><b>Daily Inspection And Maintenance Of Radiographic Equipment</b></p> <p>Submit operating and emergency procedures for daily inspection and maintenance of radiographic equipment.</p> <p><b>Ratemeter Alarms Or Off-Scale Dosimeter Readings</b></p> <p>Submit operating and emergency procedures to address ratemeter alarms or off-scale dosimeters.</p> <p><b>Procedure For Identifying And Reporting Defects And Non-Compliance As Required By 10 CFR Part 21</b></p> <p>Submit operating and emergency procedures for notifying management of equipment malfunction or defect.</p>		<p>[ ]</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p>

## APPENDIX C

Item No.	Title and Criteria	Yes	Description Attached
10	<p><b>RADIATION SAFETY PROGRAM</b></p> <p><b>Notification Of Proper Persons In The Event Of An Accident</b></p> <p>Submit operating and emergency procedures that include appropriate instructions for notifying the RSO and/or other personnel in the event of an emergency.</p> <p><b>Minimizing Exposure Of Persons In The Event Of An Accident--Emergency Procedures</b></p> <p>Submit operating and emergency procedures that include instructions for minimizing exposure of persons in the event of an accident.</p> <p><b>Source Retrieval</b></p> <p>We will not perform source retrievals and will use the services of a person specifically licensed by the NRC or an Agreement State to perform the retrievals of our sources.</p> <p>Submit operating and emergency procedures that include instructions for source retrieval procedures and specific training.</p> <p><b>Maintenance Of Records</b></p> <p>Submit operating and emergency procedures which ensure proper maintenance of records.</p>		<p>[ ]</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p>
11	<p><b>WASTE MANAGEMENT</b></p> <p><b>Disposal or Transfer of Radiography Sealed Sources Containing Byproduct Material or Devices Containing Depleted Uranium</b></p> <p>The applicant does not need to provide a response to this item during the licensing process. However, the applicant should establish and include waste disposal procedures in its radiation safety program.</p>		<p>Need Not Be Submitted With Application</p>



## **Appendix D**

### **Sample Radiography License**



## Sample Radiography License

This appendix contains an example of a radiography license that the NRC would issue to an applicant who meets the requirements in the 1997 revision to 10 CFR 34. The sample license includes a matrix of many currently approved source assemblies, exposure devices, and source changers; however, actual licenses should only include the specific items requested by the applicant. The following are descriptions of individual items or conditions as provided in the license:

- Item 2:** The location specified in this section and in Condition 11.A. are assumed to be the location where records are maintained. If this is not the case, then the applicant is required to specify where the records will be maintained.
- Item 6:** Licensed material authorized for sealed sources and devices used for radiography is identified in Condition 10. All other licensed material authorized (both byproduct and source materials) is listed.
- Item 7:** Sealed sources and devices used for other than for radiography are specified by manufacturer and model number.
- Item 8:** If possession limits are not specified, the quantity of licensed material possessed by the licensee cannot exceed that required for financial assurance (in accordance with Condition 14).
- Item 9:** Authorization in A. permits the use of sealed sources, exposure device and source changers in industrial radiography. Note that the authorization in B. is specific for a particular manufacturer and model calibrator for calibrating the licensee's survey instruments.
- Condition 10:** Provides a matrix of many currently approved and compatible sealed sources, exposure devices, and source changers authorized for use.
- Condition 11:** The location specified in A. is only authorized for storage. The address listed in B. identify a permanent radiographic installation, a field Station which is, both a storage location and a use location for field type radiography procedures at the site, and B. also authorizes use of the exposure devices at temporary jobsites.
- Condition 12:** The applicant's training program and 10 CFR Part 34 are both referenced.
- Condition 14:** Limits the quantity of licensed material possessed by the licensee.
- Condition 15:** The authorization for source retrieval is provided by this license condition.
- Condition 16:** The authorization to conduct leak testing is found in this condition of the license. This condition also permits the licensee to not leak test sealed sources for intervals of up to 3 years if the sources are in storage and not being used.
- Condition 19:** Tie-down condition.

## APPENDIX D

**Note:** The authorizations in the sample license do not necessary reflect those normally provided to an applicant. For example, the authorization for source retrieval and leak testing require the applicant to have specific procedures approved by the NRC.

## MATERIALS LICENSE

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 36, 39, 40, and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

Licensee		
1. Mo-Rad, Inc.	3. In accordance with application dated April 1, 1998, License No 08-12345-01 is hereby issued.	
2. 1234 Main Street Anywhere, USA 20000	4. Expiration date June 31, 2008	
5. Docket No. 030-12345 Reference No.		
6. Byproduct, source, and/or special nuclear material	7. Chemical and/or physical form	8. Maximum amount that licensee may possess at any one time under this license
A. See Condition 10	A. Sealed sources	A. See Condition 10
B. Cesium-137	C. Sealed sources (TO Model 77302)	C. Not to Exceed 165 millicuries per source
C. Uranium, Natural or Depleted	D. Shielding material	D. 999 kilograms
9. Authorized Use		
A. For use in industrial radiography and replacement of sources.		
B. For use in TO Model 773 instrument calibrator for calibration of licensee's survey instruments and dosimetry equipment required by 10 CFR Part 34.		
C. For use as shielding in radiography equipment.		

### CONDITIONS

10. Sealed sources, exposure devices, and source changers authorized for use are as follows:

<u>Isotope</u>	<u>Manufacturer &amp; Model No. of Source Assemblies</u>	<u>Maximum Activity per Source</u>	<u>Manufacturer &amp; Model No. of Exposure Devices</u>	<u>Manufacturer &amp; Model No. of Source Changers</u>
A. Ir-192	CIS-US, Inc. Model 702	120 curies	AMSHM Model 660 System, and Models 660A, 660B, 60BE	AMSHM Model 650L*, SPEC Model C-1
B. Ir-192	AMSHM Model A424-9 or A424-22, SPEC Models T-5 or T-5F, IN Model 7	140 curies	AMSHM Model 660 System, and Models 660A, 660AE, 660B, 660BE	AMSHM Models 650L, 820, or 855, SPEC Model C-1, IN Model IR-50
C. Ir-192	AMSHM Model A424-9	240 curies	AMSHM Models 741A, 741AE, 741B, 741BE	AMSHM Models 650L, 820, or 855

**MATERIALS LICENSE  
SUPPLEMENTARY SHEET**

License Number

08-12345-01

Docket or Reference Number

030-12345

Amendment No.

<u>Isotope</u>	<u>Manufacturer &amp; Model No. of Source Assemblies</u>	<u>Maximum Activity per Source</u>	<u>Manufacturer &amp; Model No. of Exposure Devices</u>	<u>Manufacturer &amp; Model No. of Source Changers</u>
D. Co-60	AMSHM Model A424-18	33 curies	AMSHM Models 741A, 741AE, 741B, 741BE	AMSHM Models 770, 771
E. Co-60	AMSHM Models A424-14 or 943	110 curies	AMSHM Models 680A, 680AE, 680B, 680BE	AMSHM Models 770, 771
F. Co-60	AMSHM Model A424-15	11 curies	AMSHM Models 684A, 684AE, 684B, 684BE	AMSHM Models 770, 771
G. Ir-192	AMSHM Model A424-20	240 curies	AMSHM Models 684A, 684AE, 684B, 684BE	AMSHM Models 820, 771
H. Co-60	AMSHM Model A424-13	330 curies	AMSHM Models 676A, 676AE, 676B, 676BE	AMSHM Models 770
I. Ir-192	IN Model 32, AMSHM Models 87703, 89916, SPEC Models G-40F, G-40T	120 curies	IN Model IR-100	IN Model IR-50 AMSHM Model 650L, 820, 855, SPEC Model C-1
J. Ir-192	SPEC Model G-60	150 curies	SPEC Model 150	SPEC Model C-1

**ABBREVIATIONS USED IN LICENSE:**

Amersham (AMSHM), Source Production & Equipment Co. (SPEC), Industrial Nuclear (IN), CIS-US, Inc. formerly RTS

**MATERIALS LICENSE  
SUPPLEMENTARY SHEET**License Number  
08-12345-01Docket or Reference Number  
030-12345

Amendment No.

11. A. Radioactive material shall only be stored at the licensee's facilities located at 9876 Last Street, Anywhere, U.S.A.
- B. Radioactive material shall be stored/used only at the following:
- C Field Station(s): 4321 Last Street, Anywhere, U.S.A.
  - C Permanent Radiographic Installation(s): 1234 Main Street, Anywhere, U.S.A.
  - C Temporary Jobsites: Anywhere in the United States where the U.S. Nuclear Regulatory Commission maintains jurisdiction for regulating licensed material, including areas of exclusive Federal jurisdiction within Agreement States.
- If the jurisdiction status of a Federal facility within an Agreement State is unknown, the licensee should contact the federal agency controlling the jobsite in question to determine whether the proposed jobsite is an area of exclusive Federal jurisdiction. Authorization for use of radioactive materials at jobsites in Agreement States not under exclusive Federal jurisdiction shall be obtained from the appropriate state regulatory agency.
12. Licensed material shall be used by, or under the supervision and in the physical presence of individuals who have been designated in writing by the Radiation Safety Officer and have been trained:
- A. As specified in the application dated April 1, 1997 and the letter dated May 1, 1997; and
  - B. In accordance with the provisions of 10 CFR 34.43.
13. The Radiation Safety Officer for the license is Annette Jones.
14. The licensee shall restrict the possession of licensed material to quantities below the minimum limit specified in 10 CFR 30.35(d), 40.36(b), and 70.25(d) for establishing financial assurance for decommissioning.
15. The licensee is authorized to conduct source retrieval activities in accordance with application dated April 1, 1997, and letter dated May 1, 1997.
16. A. Notwithstanding the periodic leak tests required by 10 CFR 34.27(c)(1) and (e), the requirement does not apply to radiography sources that are stored and not being used. The sources excepted from this test shall be tested for leakage before use or transfer to another person. No sealed source or device containing licensed material shall be stored for a period of more than 3 years without being tested for leakage and/or contamination.
- B. The licensee is authorized to analyze leak test samples in accordance with application dated April 1, 1997, and letter dated May 1, 1997.
17. Sealed sources containing licensed material shall not be opened or sources removed from source holders by the licensee.

**MATERIALS LICENSE  
SUPPLEMENTARY SHEET**

License Number

08-12345-01

Docket or Reference Number

030-12345

Amendment No.

18. The licensee is authorized to transport licensed material in accordance with the provisions of 10 CFR Part 71, "Packaging and Transportation of Radioactive Material."
19. Except as specifically provided otherwise in this license, the licensee shall conduct its program in accordance with the statements, representations, and procedures contained in the documents, including any enclosures, listed below. The Nuclear Regulatory Commission's regulations shall govern unless the statements, representations, and procedures in the licensee's application and correspondence are more restrictive than the regulations.
- A. Application dated April 1, 1998  
B. Letter dated May 1, 1998

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Date: \_\_\_\_\_

By: \_\_\_\_\_

John Q. Reviewer, Health Physicist  
Nuclear Materials Licensing Branch  
NRC Region  
City, State 54321



## **Appendix E**

### **Information Needed for Transfer of Control Application**



## Information Needed for Transfer of Control Application

Licensees must provide full information and obtain NRC's **prior written consent** before transferring control of the license; some licensees refer to this as "transferring the license." Provide the following information concerning changes of 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 transfer of control.
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 transfer of control.
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 10 CFR 30.35(g), 40.36(f), 70.25(g), and 72.30(d); 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 the NRC for license terminations.

## APPENDIX E

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 10 CFR 30.35, 40.36, and 70.25. 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 NRC by the transferor. These include, but are not limited to: maintaining decommissioning records required by 10 CFR 30.35(g); 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 transferring control.

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 NRC before license transfer.

14. Documentation that the transferor and transferee agree to transferring control of the licensed material and activity; documentation of the conditions of transfer; and documentation that 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. Lacking this, the transferee must provide a description of its program, to ensure compliance with the license and regulations.

## **Appendix F**

**Information Notice 96-20,  
“Demonstration of Associated  
Equipment Compliance with  
10 CFR 34.20”**



## **Information Notice 96-20, "Demonstration of Associated Equipment Compliance with 10 CFR 34.20"**

UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS  
WASHINGTON, D.C. 20555

April 4, 1996

NRC INFORMATION NOTICE 96-20: DEMONSTRATION OF ASSOCIATED EQUIPMENT COMPLIANCE WITH 10 CFR 34.20

### **Addressees**

All industrial radiography licensees and radiography equipment manufacturers.

### **Purpose**

The U.S. Nuclear Regulatory Commission is issuing this information notice to inform radiography licensees of acceptable methods to demonstrate that their associated equipment used in radiographic operations meets the regulations in 10 CFR 34.20. It is expected that recipients will review the information for applicability to their facilities and consider appropriate actions. However, this information notice does not contain any new requirements; therefore, no specific action nor written response is required.

### **Description of Circumstances**

Section 34.20 of 10 CFR Part 34 specifies performance requirements for radiography equipment. Paragraph (d) of 10 CFR 34.20 provided that all newly manufactured radiographic exposure devices and associated equipment (manufactured after January 10, 1992) acquired by NRC licensees must meet Section 34.20 requirements. Paragraph (e) of 10 CFR 34.20 provides that all radiographic exposure devices and associated equipment in use by NRC licensees after January 10, 1996, must comply with the requirements specified in 10 CFR 34.20. NRC amended the regulations in 10 CFR 34.20 to permit licensees to use an alternate value of torque for performance testing criteria and to allow licensees to use engineering analysis to demonstrate that a modest change in an already approved design is acceptable without the need to perform prototype testing. The changes were published in the Federal Register as a final rule on May 31, 1995.

NRC Information Notice (IN) 95-58: "10 CFR 34.20; Final Effective Date," issued on December 18, 1995, to all radiography licensees, reminded licensees of the final effective date implementing the regulations in 10 CFR 34.20. IN 95-58 also reminded licensees that associated

## APPENDIX F

equipment used with radiography cameras (i.e., source assemblies, drive cables, guide tubes, control tubes, source stops, etc.) were subject to 10 CFR 34.20 requirements. IN 95-58 went on to explain that, previously, certain associated equipment had not been independently registered and/or evaluated by the NRC or the Agreement States (AS). This includes drive cables, guide tubes, and source stops. Most new camera models and their basic associated equipment were registered as part of the gamma radiography system as described in the American National Standard N432-1980, "Radiological Safety for the Design and Construction of Apparatus for Gamma Radiography." Therefore, information concerning certain associated equipment to be used with the devices was included as part of the overall system evaluation and registration process. Some manufacturers have also been labeling their equipment with an identifier, such as the manufacturer's logo, to indicate that the equipment meets the requirements of 10 CFR 34.20. IN 95-58 went on to remind licensees that 10 CFR 34.20 makes the licensee responsible for ensuring that equipment meets regulatory requirements.

NRC and AS review and evaluate radiography-associated equipment (guide tubes, exposure heads, and collimators) as well as sealed sources, radiographic exposure devices (cameras) and source changers for compliance with 10 CFR Part 34. On completion of this evaluation, acceptable components are identified on a registration certificate. Information is also included in a National Registry System maintained by NRC. Regulatory authorities use this information in their licensing and inspection activities.

### Discussion

The regulation on performance requirements for radiography equipment—Section 34.20—requires that the radiographic exposure device and all associated equipment must meet the requirements of ANSI N432-1980, and other specific requirements listed in 10 CFR 34.20. Associated equipment includes source assemblies, drive cables, guide tubes, control tubes, cranks, "J" tubes, collimators, exposure heads, and source stops.

In particular for guide tubes, 10 CFR 34.20(c)(5) states, "The guide tube must have passed the crushing tests for the control tube as specified in ANSI N432 and a kinking resistance test that closely approximates the kinking forces likely to be encountered during use." In addition, 10 CFR 34.20(c)(8) requires that the connection between the guide tube and exposure head be able to withstand the tensile test for control units specified in ANSI N432. Since Section 8.9 of ANSI N432-1980 specifies that radiography systems must withstand the endurance test described in that section, licensees must demonstrate that guide tubes and exposure heads will withstand the endurance test.

Recently some questions were raised concerning what constitutes an exposure head vs. a guide tube. Exposure heads may be a separate or integral part of a guide tube. NRC's analysis of associated equipment (i.e., collimators, guide tubes, exposure heads) has shown that there is little risk of obstruction of source travel for equipment that guides a source assembly a distance less than 10 times the length of the source capsule. NRC's analysis included a review of equipment designs and incidents involving source travel obstructions. Based on these findings, NRC's policy



is that associated equipment that guides a source assembly a distance greater than 10 times the length of the source capsule (i.e., exposure heads, “J” tubes, jet engine probes, source stops) is considered a guide tube and must meet the testing requirements for guide tubes. In addition, NRC's policy is that only associated equipment that comes in contact with the source (e.g., collimators that slip over the end stop) must meet the applicable testing requirements.

The NRC has identified several ways licensees can demonstrate that their radiography equipment meets 10 CFR 34.20 requirements. First, the most direct method would be that the equipment that has been labeled by the manufacturer pursuant to a registration certificate. (If the label has worn off, you should contact the manufacturer or have support information as described below.) Alternatively, licensees can make this demonstration if they can provide a document trail to registered associated equipment. The equipment will be considered to meet the requirements, if the licensee has in its possession one of the following for each piece of equipment:

- C A purchase order(s) listing the radiography equipment that can be tied-back to a registration certificate; or,
- C Documentation from the manufacturer verifying that the equipment the licensee is using was approved and registered with the NRC or AS. The documentation must clearly identify which equipment meets the requirements; or,
- C A signed NRC or AS recognized checklist(s) certifying that the licensee has evaluated its equipment, and that it meets the specifications of the checklist. In order for the checklist to be recognized, it must have been provided by the manufacturer of the equipment and approved by the NRC or AS. As of this date, only one checklist has been approved. See Attachment 1 for the recognized checklist.

If a licensee possesses and intends to use radiography equipment that is not labeled by the manufacturer, or that the licensee cannot demonstrate that it meets 10 CFR 34.20 requirements, then the licensee must submit an application for a custom evaluation. Attachment 2 includes information on how to file an application for custom evaluation. Equipment cannot be used in radiographic operations until it has been approved for use by NRC or an AS.

This information notice requires no specific action nor written response. If you have any questions about the information in this notice, please contact the technical contact listed below or the appropriate regional office.

Signed by

---

Donald A. Cool, Director  
Division of Industrial and Medical Nuclear Safety  
Office of Nuclear Material Safety and Safeguards

## APPENDIX F

### Attachments:

1. Recognized Checklist for Associated Equipment
2. Custom Evaluation of Associated Equipment
3. List of Recently Issued NMSS Information Notices
4. List of Recently Issued NRC Information Notices

Contact: Thomas W. Rich, NMSS  
(301) 415-7893

Attachment 1  
IN 96-20  
April 4, 1996  
Page 1 of 2

### Checklist for Amersham's Model 591 Controls

To assure the associated equipment you are using are approved Amersham-manufactured accessories, please perform a side-by-side comparison against a known (i.e., flying A is legible or POs are available) Amersham-manufactured piece. Perform a detailed mechanical and visual inspection of your equipment against the following checklist. If you have any questions, please call Amersham for assistance.

#### Amersham Controls:

1. All controls have a yellow polyvinyl housing with a 9/16 inch outer diameter.
2. The fittings are 3 inches long (including the hex nut).
3. The hex nut is 11/16 inch.
4. Check the fittings for swage marks, the fittings will have 3 single swage marks 1/8 inch wide and 1/2 inch apart or 4 single swage marks 1/8 inch wide and 1/2 inch apart.
5. The first swage mark is typically 3/8 inch from the end.
6. The thread pattern for the control connector is 5/8"-18.
7. The 661 connector assembly will have an indentation 1/2 inch wide band behind the jaws; for newer units this will be covered with a red stripe, but this stripe may have worn off on the older models.

To the best of my knowledge the piece of equipment identified below (the equipment must be uniquely identifiable, either by labeling, marking, or tagging, or other means to signify which piece of equipment is certified as meeting the conditions of this checklist) has been manufactured after 1964, meets the conditions of this checklist, and is the same design as a similar piece of equipment that has been registered and approved by the NRC.

Specify Equipment (i.e., Guide Tube)  
Include Identifier/Labeling

Signature  
Printed or Typed Name

**Amersham Model 402, 489, and 676 Guide Tubes**

To assure the associated equipment you are using are approved Amersham-manufactured accessories, please perform a side by side comparison against a known (i.e., flying A is legible or POs are available) Amersham-manufactured piece. Perform a detailed mechanical and visual inspection of your equipment against the following checklist. If you have any questions, please call Amersham for assistance.

**Amersham Guide Tubes:**

1. Housing should be yellow polyvinyl with either a 5/8 inch or 3/4 inch outer diameter.
2. The fittings are yellow iridited steel, the threaded fittings consist of 1 inch 18 thread.
3. The fittings for both the threaded fitting and the source stop fitting will have 2 single swage marks approximately 1/4 inch apart.
4. The Amersham standard source stops are made from aluminum and are 2 1/2 inches long.

To the best of my knowledge the piece of equipment identified below (the equipment must be uniquely identifiable, either by labeling, marking, or tagging, or other means to signify which piece of equipment is certified as meeting the conditions of this checklist) has been manufactured after 1964, meets the conditions of this checklist, and is the same design as a similar piece of equipment that has been registered and approved by the NRC.

Specify Equipment (i.e., Guide Tube)  
Include Identifier/Labeling

Signature  
Printed or Typed Name

## **Custom Evaluation of Associated Equipment**

The information provided below applies to custom registration of associated equipment.

### **Product Registration**

Either the manufacturer, distributor, or user of the radiographic equipment can submit the information outlined in 10 CFR 32.210 for evaluation.

If the applicant is located within the jurisdiction of the U.S. Nuclear Regulatory Commission, the application should be sent to the following address:

U.S. Nuclear Regulatory Commission  
Sealed Source Safety Section  
Mail Stop T-8-F-5  
Washington, DC 20555

Otherwise, the applicant should submit the information to the appropriate Agreement State.

### **Application Contents**

General:

Licensees are required to use only radiography equipment, including exposure heads and source guide tubes, that meets the requirements specified in 10 CFR 34.20. The regulations require that the exposure device and all associated equipment must meet the requirements in American National Standard N432-1980, "Radiological Safety for the Design and Construction of Apparatus for Gamma Radiography," and other specific requirements listed in 10 CFR 34.20. The standard defines the requirements for the design and method of qualifying (testing) prototypes of gamma radiography systems.

Refer to Regulatory Guide 10.10, "Guide for the Preparation of Applications for Radiation Safety Evaluation and Registration of Devices Containing Byproduct Material" for information on what types of information needs to be included in your application.

**Specific:**

Applications for registration for the equipment must, at a minimum, include the following documentation:

- C A demonstration, either by testing or by engineering analysis, that prototypes of the associated equipment meets the appropriate tests listed below;
- C A list of all radiographic exposure equipment with which the associated equipment will be used, and an explanation of how the associated equipment is compatible with each piece of radiographic exposure equipment;
- C Details of how the associated equipment will be identified, such as by labeling, marking, or tagging, as meeting the requirements of Section 34.20;
- C Complete specifications, including materials, details of construction, and complete dimensions of each component of the equipment; and
- C Likely environments (i.e., temperature, pressure, vibration, humidity, impact) and conditions of use of the equipment.

**Prototype Tests**

Each associated equipment design (e.g., source guide tube, collimator, exposure head) must either pass the appropriate tests listed below, or demonstrate by engineering analysis that the designs would likely meet the test requirements.

NRC's policy is that associated equipment that guides a source assembly a distance greater than 10 times the length of the source capsule (i.e., exposure heads, "J" tubes, jet engine probes, source stops) is considered a guide tube and must meet the testing requirements for guide tubes.

**Source Guide Tube Tests**

Source guide tubes are required to meet the following:

- C The crushing test specified in Section 8.6 of ANSI N432-1980;
- C A kinking resistance test that closely approximates the kinking forces likely to be encountered during use;
- C The endurance test specified in Section 8.9 of ANSI N432-1980; and
- C The tensile tests specified in Section 8.7 of ANSI 432-1980 for control units.

## **Exposure Head and Collimator Tests**

Exposure heads and collimators that are not considered guide tubes, need only meet the tests listed in item c, and d above.

## **Engineering Analysis**

Engineering analysis will be considered in lieu of actual testing if the analysis is based on a similar design that has been tested in accordance with the standard and has been approved by the NRC or Agreement State. The engineering analysis, at a minimum, must compare the tested design against the associated equipment you want evaluated and address the effects of the materials of construction (i.e., wear resistance, strength, corrosion properties); the wall thickness; the length (i.e., resistance); any bends, bend angles and the minimum bend radii over which the bends will be produced (curvature); and any other properties that would have an effect on the outcome of the endurance test.





## **Appendix G**

### **Radiographer and Assistant Radiographer Training**



## Radiographer and Assistant Radiographer Training

**Table G.1 10 CFR Part 34 Radiographer and Assistant Radiographer Training Requirements**

Requirement		Training Criteria
34.43(a)(1)		Radiographer
A.	Receive Training in 10 CFR 34.43(g) Topics  (Classroom Training — Approximately 40 hours in Length)	<p>Topics in 10 CFR 34.43(g)</p> <p>Fundamentals of Radiation Safety</p> <p>C Characteristics of gamma radiation</p> <p>C Units of radiation dose and quantity of radioactivity</p> <p>C Hazards of exposure to radiation</p> <p>C Levels of radiation from licensed material</p> <p>C Methods of controlling radiation dose (time, distance, and shielding)</p> <p>Radiation Detection Instruments</p> <p>C Use, operation, calibration and limitations</p> <p>C Survey techniques</p> <p>C Personnel monitoring equipment</p> <p>Equipment to be Used</p> <p>C Operation and control of radiographic exposure equipment,, remote handling equipment, storage containers and pictures or models of source assemblies (pigtailed)</p> <p>C Storage, control and disposal of licensed material</p> <p>C Inspection and maintenance of equipment</p> <p>Requirements of Pertinent Federal Regulations</p> <p>Case Histories of Accidents in Radiography</p>
B.	On-the-Job Training — 2 months or 320 hours	Under the supervision of a qualified radiographer

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Requirement		Training Criteria
C.	Certification by a Certifying Entity	<u>Radiographer Certification</u> is required by June 27, 1999. In lieu of submitting a description of the training program to meet 10 CFR 34.43(g) <b>above</b> , you may indicate that only certified radiographers will be employed. However, the licensee must ensure training on the subjects listed in 34.43(g) has been conducted.
<b>34.43(a)(2)</b>		<b>Radiographer</b>
D.	Completion of a Written Examination	Until June 27, 1999, individuals may complete a written examination submitted and approved by NRC.
<b>34.43(b)</b>		<b>Radiographer</b>
E.	Must Receive Copies of and Instruction in:  (Classroom Training — Approximately 8 hours in Length)	NRC Regulations  10 CFR Part 34  C 10 CFR 30.7, 10 CFR 30.9, and 10 CFR 30.10 C Applicable Parts of 10 CFR Parts 19 and 20 C Applicable DOT Regulations and 10 CFR Part 71  The NRC License The Licensee's Operating & Emergency Procedures
F.	Pass Written or Oral Examination on Licensee's Operating & Emergency Procedures	C 50 questions C Passing Grade 80%
G.	Receive Equipment Training  (Approximately 4 hours in Length)	Training includes:  C Exposure devices C Sealed sources C Associated equipment C Survey meters C Daily inspection
H.	Demonstrate Understanding in Use of Equipment by Passing Practical Exam	Questions on topics determined by the licensee. Use the Six-Month Radiographer/Radiographer's Assistant Inspection Checklist as a potential source of questions.

Requirement		Training Criteria
I.	Annual Refresher Training	<p>Review the following:</p> <ul style="list-style-type: none"> <li>C Radiation Safety review</li> <li>C New procedures or equipment</li> <li>C New regulations</li> <li>C Observations and deficiencies during audits and discussion of any significant incidents or accidents involving radiography</li> <li>C Employee questions</li> </ul>
J.	Records	To be maintained in accordance with 10 CFR 34.79.
<b>34.43(c)</b>		<b>Assistant Radiographer</b>
A.	<p>Must Receive Copies of and Instruction in:</p> <p>(Classroom Training — Approximately 8 hours in Length)</p>	<p>NRC Regulations:</p> <ul style="list-style-type: none"> <li>C 10 CFR Part 34</li> <li>C 10 CFR 30.7, 10 CFR 30.9, and 10 CFR 30.10</li> <li>C Applicable Parts of 10 CFR Parts 19 and 20</li> <li>C Applicable DOT Regulations and 10 CFR Part 71</li> </ul> <p>The NRC License The Licensee's Operating &amp; Emergency Procedures</p>
B.	Pass Written Exam	<ul style="list-style-type: none"> <li>C 25 - 50 questions</li> <li>C Closed Book</li> <li>C Passing Grade 80%</li> </ul>
C.	<p>Receive Equipment Training</p> <p>(Approximately 4 hours in Length)</p>	<p>Training under the supervision of a qualified radiographer that includes:</p> <ul style="list-style-type: none"> <li>C Exposure devices</li> <li>C Sealed sources</li> <li>C Associated equipment</li> <li>C Survey meters</li> <li>C Daily inspection</li> </ul>
D.	Demonstrate Understanding in Use of Equipment by Passing Practical Exam	25 - 50 questions on topics determined by the licensee. NRC suggests using the Semiannual Radiographer Audit Checklist for a potential source of questions

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Requirement		Training Criteria
E.	Annual Refresher Training	<p>Review the following:</p> <ul style="list-style-type: none"> <li>C Any Significant item identified in the annual review of the Radiation Safety Program</li> <li>C New procedures or equipment</li> <li>C New regulations</li> <li>C Observations and deficiencies during audits and discussion of any significant incidents or accidents involving radiography</li> <li>C Employee questions</li> </ul>
F.	Records	To be maintained in accordance with 10 CFR 34.79.

## **Appendix H**

### **Six-Month Radiographer/Radiographer's Assistant Inspection Checklist**





## Six-Month Radiographer/Radiographer's Assistant Inspection Checklist

Date: \_\_\_\_\_ Time: \_\_\_\_\_

Radiographic Location: \_\_\_\_\_

Radiographer/Radiographer Assistant: \_\_\_\_\_

Device Model No.: \_\_\_\_\_ Serial No.: \_\_\_\_\_

Survey Meter Functionality: Yes \_\_\_\_\_ No \_\_\_\_\_

Calibrated: Yes \_\_\_\_\_ No \_\_\_\_\_ Daily/Source For Operation: Yes \_\_\_\_\_ No \_\_\_\_\_

Dosimetry: TLD/Film Badge Pocket/Dosimeter: Yes \_\_\_\_\_ No \_\_\_\_\_

Calibrated: Yes \_\_\_\_\_ No \_\_\_\_\_

Alarming Dosimeter: Yes \_\_\_\_\_ No \_\_\_\_\_ Calibrated Yes \_\_\_\_\_ No \_\_\_\_\_

- G** Were other individuals working within the restricted area wearing film badges/TLDs, dosimeters and alarm dosimeters?
- G** Was the restricted area posted with a "CAUTION (or DANGER) RADIATION AREA" sign(s)?
- G** Was the restricted area properly controlled to prevent unauthorized entry?
- G** Was the high-radiation area posted with a "CAUTION (OR DANGER) HIGH RADIATION AREA" sign(s)?
- G** Was the utilization log properly filled out?
- G** Did the radiographer/radiographer assistant have sufficient knowledge of safety rules? (Ascertained by oral questions)
- G** Was the radiographer working with properly inspected and operable equipment?
- G** Did the radiographer/radiographer assistant properly survey the source projector?
- G** Did the radiographer properly supervise the radiographer assistant?

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- G** Was the source projector properly locked and secured to prevent unauthorized removal?
- G** Was the restricted area properly controlled?
- G** Was the high radiation area under continuous direct observation except where entry had been prevented?
- G** Were radioactive isotopes stored properly and kept locked to prevent removal?
- G** Was the storage area posted with a “CAUTION (or DANGER) RADIOACTIVE MATERIAL” sign(s)?
- G** Did the radiographer/radiographer assistant possess and use a copy of the operating and emergency procedures and (State or NRC) rules and regulations for protection against radiation?
- G** Were there any other safety items found to be lacking? If yes, explain in Remarks.

Remarks:

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## **Appendix I**

# **Radiation Safety Program Audit**



## Radiation Safety Program Audit

### Annual Radiation Protection Industrial Radiography Audit

Date of this Audit \_\_\_\_\_ Date of Last Audit \_\_\_\_\_

Next Audit Date \_\_\_\_\_

Auditor \_\_\_\_\_ Date \_\_\_\_\_  
(Signature)

Management Review \_\_\_\_\_ Date \_\_\_\_\_  
(Signature)

**Note:** Except where noted, references are to Title 10, Code of Federal Regulations (10 CFR)

### Organization and Scope of Program

#### A. Organizational structure (specify any changes)

1. Matches license requirements [L/C]
2. Multiple authorized locations of use and/or field sites authorized
3. List of location(s) inspected - attached or reference
4. Brief description of scope of activities, including types of equipment, types and quantities of use involving byproduct material, frequency of use, staff size, etc.

#### B. Radiation Safety Officer

1. Named on license [L/C]
2. Fulfills duties as RSO [34.42(c)]
3. Meets requirements [34.42]

#### C. Radiographers and radiographer's assistants named in documents [34.43, 34.79; L/C]

### Training, Retraining, and Instructions to Workers

#### A. Instructions to workers [19.12]

- B. Parts 19, 20, 21, 34; the license; and Operating and Emergency Procedures are furnished to all radiographers and radiographer's assistants [34.43(b)(1), (c)(1)]

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- C. Training program description the same as that submitted with license application or as amended? [34.13(b); L/C]
  - 1. Written tests completed by all radiographers and radiographer's assistants.
  - 2. Oral tests
  - 3. All radiographers completed on-the-job training
  - 4. Periodic training program implemented
  - 5. Records maintained [34.79]
- D. Revised Part 2. Workers cognizant of requirements for:
  - 1. Radiation safety program [20.1101]
    - a. Occupational exposure annual limits [20.1201; 20.1202]
    - b. Public annual dose limits [20.1301; 20.1302]
  - 2. New NRC Forms 4 and 5
  - 3. 10% monitoring threshold [20.1502]
  - 4. Dose limits to embryo/fetus and declared pregnant worker [20.1208]
  - 5. Procedures for opening packages [20.1906]

### **Operating and Emergency Procedures**

- A. Procedures current? [34.45; 34.81; 34.89]
- B. Procedures contain information specified
- C. Procedures submitted to NRC [34.13(d)]

### **Internal Audits or Inspections**

- A. Audits/inspections of each radiographer and radiographer's assistants conducted at 6-month intervals or after as appropriate [34.111(e); 34.42(e); L/C]
- B. Equipment check before use each day [34.31(a)]
- C. Equipment inspection and maintenance performed at 3-month intervals [34.31(b)]
- D. Records maintained [34.73]

### **Facilities**

- A. Permanent radiographic installation [34.3; 34.33]
  - 1. High Radiation Area posted [20.1601(a); 20.2902(b)]
  - 2. Entrance controls are as described [20.1601(a); L/C]
    - a. Visible and audible radiation signals
    - b. Visible signal actuates if entry is attempted when source is exposed
    - c. Audible signal actuates if entry is attempted when source is exposed
    - d. System tested daily with radiation source
    - e. Records maintained for 3 years [34.75]
- B. Temporary High Radiation Area Entry Controlled [20.1601(b); 34.31]
- C. Storage Area
  - 1. Storage Facilities as Described in license [L/C]
  - 2. Sources Locked in Devices [34.23]
  - 3. Devices secured to prevent tampering or unauthorized removal [34.23; 20.1801; 20.2803]
- D. Field” Radiography Conducted at Location Identified on License [L/C]

## **Equipment**

- A. Radiography devices, source assemblies and source changers in use meet requirements [34.20]
- B. Associated equipment in use complies with requirements [34.20]
- C. Awareness that associated equipment must comply with 34.20
- D. Source changers and storage containers meet radiation level limits [34.21]
- E. Equipment exempted by specific license condition is used in accordance with license commitments and authorization

## **Materials**

- A. Isotope, chemical/physical form, quantity and use as authorized [L/C]
- B. All sealed sources not fastened to or contained in an exposure device are tagged [34.20(b)(4)(I)]
- C. During radiographic operations, sources are secured in shielded position each time source is returned to that position [34.49(b)]

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### D. Leakage and contamination tests

1. Sealed sources
  - a. Leak test method approved [34.27(c)]
  - b. Leak tests performed at 6 month intervals [34.27]
  - c. Leakage is less than 185 becquerels (Bq) (0.005 microcuries)
2. Depleted uranium (DU) shielding with S-tubes
  - a. Test every 12 months [34.27]
  - b. DU is less than 185 Bq (0.005 microcuries)
3. Records maintained for 3 years [34.67] Inventories

### E. Inventories

1. Conducted quarterly (not to exceed 3 months) [34.29]
2. Contain all required information [34.69]
3. Most recent inventory conducted on \_\_\_\_\_

### F. Utilization Logs

1. Utilization logs maintained [34.71]
2. Contain all required information [34.71]

## Instrumentation

### A. Describe the survey instruments possessed:

Model No. \_\_\_\_\_ Quantity \_\_\_\_\_

- B. Capable of measuring 0.02 mSv (2 mrem)/hr through 0.01 Sv (1 rem)/hr [34.25]
- C. Operable and calibrated survey instruments available and used on each job [34.25(a)]
- D. Calibration performed at intervals not to exceed six months or after servicing [34.25(a)]
- E. Records maintained for 3 years [34.65]



## Radiation Surveys

- A. Area or facility surveys conducted to show compliance with 20.1301 and 20.1302(a) [20.1501(a)]
- B. Records maintained [20.2103]
- C. Survey after each exposure, including device, guide tube, ensuring source has returned to the shielded position [34.49(b)]
- D. Survey of device when place in storage to ensure source is in shielded position [34.49(c)]
- E. Protection of members of the public [20.1301]
  - 1. Adequate surveys made to demonstrate
    - a. the TEDE to the individual likely to receive the highest dose does not exceed 0.1 mSv (100 mrem) in a year, or
    - b. that if an individual were continuously present in an unrestricted area, the external dose would not exceed 0.02 mSv (2 mrem) in any hour and 1 mSv (100 mrem) in a year [20.1301(a)(1); 20.1302(b)]
  - 2. Unrestricted area radiation levels do not exceed 0.02 mSv (2 mrem) in any 1 hour [20.1301(a)(2)]
  - 3. Records maintained [20.2103, 20.2107]

## Personnel Radiation Protection

- A. Dosimetry
  - 1. Workers monitored as required [20.1502; 34.47(a); L/C]
  - 2. Exchange Frequency \_\_\_\_\_ Supplier \_\_\_\_\_
  - 3. Verify supplier is NVLAP-approved [20.1501(c)]
  - 4. Dosimeters exchanged at required frequency [L/C]
  - 5. Dosimetry records maintained [20.2106; 34.83(c)]
- B. Pocket Dosimeters and Electronic Personal Dosimeters
  - 1. Model No. \_\_\_\_\_ Range \_\_\_\_\_  
 Model No. \_\_\_\_\_ Range \_\_\_\_\_
  - 2. Read and recorded at start of each shift [34.47(b)]
  - 3. Daily readings recorded [34.47(b)]

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4. Dosimeters checked for response ( $\pm 20\%$ ) at intervals not to exceed 12 months
5. Off-scale dosimeter procedure and records [34.47; 34.87(d)]

### C. Alarm Ratemeters

1. Model No. \_\_\_\_\_ Range \_\_\_\_\_
2. Checked that alarm functions properly at start of each shift [34.47(g)(1)]
3. Preset at 5 mSv (500 mrem)/hr [34.47(g)(2)]
4. Calibrated to  $\pm 20\%$  at intervals not to exceed 12 months [34.47(g)(4)]
5. Records maintained [34.83(b)]

### D. Dosimetry Reports

1. Reviewed by \_\_\_\_\_ Frequency \_\_\_\_\_.
2. Reviewed personnel monitoring records for interval (from \_\_\_\_\_ to \_\_\_\_\_)
3. Maximum exposures: TEDE \_\_\_\_\_ extremity  
other \_\_\_\_\_
4. NRC Forms (or equivalent) [20.2104(d); .2106(c)]
  - a. NRC-4 an occupational exposure history
  - b. NRC-5 current occupational exposure
5. Maximum exposures in compliance with annual limits [20.1201]
6. Fetal and Pregnant worker exposure [20.1206; 20.2106(e)]
  - a. Worker declared pregnancy in writing during the audit interval.
  - b. If yes, licensee in compliance? Records maintained?
7. Dosimetry records maintained [34.83]

### E. Radiation Protection Program

1. Program includes provisions for keeping dose ALARA [20.1101]
2. Procedures and engineering controls used to achieve ALARA [20.1101(b)]
3. Content and implementation reviewed annually by licensee [20.101(c)]
4. Records of program reviews maintained [20.2102(a)(2)]

## F. Planned Special Exposures (PSEs) [20.1206]

1. PSEs performed? \_\_\_\_\_
2. If so, when, where and why? \_\_\_\_\_
3. Records maintained [20.2105; 20.2106; 20.2204]

**Receipt and Transfer of Radioactive Material**

## A. Procedures established and followed for picking up, receiving and opening packages [20.1906(e)]

## B. Incoming packages surveyed [20.1906(b)(2); L/C]

## C. Shipment of sources since last inspection

1. Used container authorized by license or Certificate of Compliance (COC) [L/C; COC]
2. Transfers [30.41]
3. All sources surveyed before shipment and transfer [20.1501(a); 49 CFR 173.475(I); L/C]

## D. Records of surveys and receipt/transfer maintained [20.2103(a); 30.51; 34.63]

**Transportation (10 CFR 71.5(a) and 49 CFR 170-189)**

## A. Shipments are:

- G** Delivered to common carriers
- G** Transported in company's private vehicle
- G** Both
- G** No shipments since last audit

## B. HAZMAT training [49 CFR 172.700- 172.704]

## C. Packages:

1. Authorized packages used [49 CFR 173.415; 173.416]
2. Performance test records on file
  - a. Special form sources [49 CFR 173.476(a)]
  - b. DOT-7A packages [49 CFR 173.415(a)]

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3. COC's on file with NRC for Type B [71.12(c)(1)]
4. Two labels with Transport Index, Nuclide, Hazard Class [49 CFR 172.403; 172.441]
5. Properly marked (Shipping name, UN number, Package type, RQ, Name and address of consignee [49 CFR 172.301; 172.310; 172.324; 172.101 ]
6. Closed and sealed during transport [49 CFR 173.475(f)]

### D. Shipping papers

1. Prepared and used [49 CFR 172.200(a)]
2. Proper (Shipping name, Hazard class, UN number, Quantity, Package type, Nuclide, RQ, Radioactive material, Physical and chemical form, Category of label, TI, Shipper's name, Certification and signature, Emergency response phone number, "Limited Quantity""Cargo Aircraft Only" if applicable) [49 CFR 172.200 - 172.204; 175.700]
3. Readily accessible during transport

### E. Vehicles

1. Placarded [49 CFR 172.504]
2. Cargo blocked and braced [49 CFR 177.842(d)]
3. Proper overpacks (shipping name, UN number label, statement of inner packaging complies with specification packaging) [49 CFR 171.15; 171.16]

- F. Any transportation incidents reported to DOT National Response Center [49 CFR 171.15; 171.16]

## Auditor's Independent Measurements

### A. Survey Instrument

Serial No.

Last Calibration

- B. Auditor's measurements were compared with audited person's measurement
- C. Describe the type, location, and results of measurements, attach a diagram/survey sheet and refer to this section

## Notifications and Reports

- A. Reports to individuals, public and occupational, monitored to show compliance with Part 20 [19.13; 30.50]

- B. Theft or loss [20.2201; 30.50]
- C. Incidents [20.2202; 30.50; 34.101]
- D. Overexposures and high radiation levels [20.2203; 30.50]
- E. Annual reports furnished to NRC [20.2206(b), (c)]
- F. Reporting of defects and non-compliance [21.21]

### **Posting and Labeling**

- A. Radiation areas [20.1902(a)]
- B. High radiation areas [20.1902(b)]
- C. Use or storage areas [20.1902(e)]
- D. Containers or devices labeled [20.1904(a)]
- E. NRC Form 3 [19.11]
- F. Parts 19, 20, 21 (section 206 of Energy Reorganization Act), OR notification of location of required documents [19.11; 21.6]
- G. Other posting and labeling [20.1902; 20.1904]

### **Recordkeeping for Decommissioning**

- A. Records in independent and identifiable location [30.35(g)]
- B. Records include all required data [30.35(g)]

### **Bulletins and Information Notices**

- A. Communications received and reviewed
- B. Appropriate response to Bulletin, Generic Letters, etc.

### **Special License Conditions or Issues**

Evaluate special license conditions for data, actions

### **Performance Evaluation Factors**

These indicators may provide an indication of the status of the Radiation Safety Program as perceived by management.

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- A. Lack of senior management involvement with the radiation safety program and/or RSO oversight
- B. RSO too busy with assignments other than radiation safety
- C. Insufficient staffing
- D. Radiation Safety Committee fails to meet or functions inadequately
- E. Inadequate consulting service or inadequate audits

## **Appendix J**

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





## Model Procedure for Calibrating Survey Instruments

1. Sealed source(s) used for calibrating survey instruments should:
  - C Approximate a point source
  - C Have its exposure rate at a given distance traceable by documented measurements to a standard certified to be within  $\pm 5\%$  accuracy by NIST
  - C Approximate the same photon energy (Ir-192, Co-60) as the source to be used in the radiography device.
  - C Be of sufficient strength to give an exposure rate of about 0.3 mSv/hr (30 mrem/hr) at 100 cm. (85 millicuries of Cs-137 or 21 millicuries of Co-60).
2. Use the inverse square and radioactive decay law to correct changes in exposure rate due to source decay or different distances from the source.
3. Record survey meter calibration data and maintain written records for each instrument being used to satisfy regulatory requirements. Survey meter calibration reports should indicate the procedure used and the data obtained. Calibration records should contain the following information and must be maintained 3 years from date of calibration of each instrument:
  - C Owner or user identification, including name, address, and person to be contacted
  - C Instrument description that includes manufacturer, model number, serial number, and type of detector
  - C Calibration source description that includes exposure rate, indicated exposure rate at a specified distance on a specified date, and the calibration procedure
  - C Each calibration point identifying the calculated exposure rate, the indicated exposure rate, the deduced correction factor, and the scale selected on the instrument.
  - C Exposure reading indicated with the instrument in the "battery check" mode, if available
  - C Angle between the radiation flux field and the detector (parallel, perpendicular).

**Note:** Internal detectors should specify angle between radiation flux field and a specified surface of the instrument.

- C For detectors with removable shielding, note whether the shielding was in place or removed during the calibration procedure.
- C Include person's name who performed the calibration and the date on which the calibration was performed

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4. A single point on a survey meter scale can be considered satisfactorily calibrated if the indicated exposure rate differs from the calculated exposure rate by less than 10%.

**Note:** Three kinds of scales are frequently used on radiation survey meters:

- C Linear Scale: Meters on which the user selects a linear scale must be calibrated at no less than two points on each scale. The points should be at approximately 1/3 and 2/3 of the decade.
  - C Multidecade Logarithmic Scale: Meters that have a multidecade logarithmic scale must be calibrated at no less than one point on each decade and no less than two points on one of the decades. Those points should be approximately 1/3 and 2/3 of the decade.
  - C Automatically Ranging Digital Display: Meters that have a device for indicating rates must be calibrated at no less than one point on each decade and at no less than two points on one of the decades. Those points should be at approximately 1/3 and 2/3 of the decade.
5. Scales in excess of 10 mSv/hr (1,000 mrem/hr) need not be calibrated. However, such scales should be checked for operation and approximately correct response.
  6. The following information should be attached to the instrument as a calibration sticker or tag:
    - C Source that was used to calibrate the instrument
    - C A calibration chart or graph for each scale or decade of a survey meter that is greater than  $\pm 20\%$  of the actual values identifying the average correction factor, or a note indicating that scale was checked only for function or is inoperative.
    - C Date of calibration
    - C Date survey instrument is due calibration
    - C Name or initials of individual calibrating instrument.

**Note:** Detailed information about survey instrument calibration may be obtained by referring to ANSI N323-1978, "Radiation Protection Instrumentation Test and Calibration." Copies may be obtained from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

**Draft Regulatory Guide FC 413-4**, "Guide for the Preparation of Applications for Licenses for the Use of Radioactive Materials in Calibrating Radiation Survey and Monitoring Instruments," is available from NRC's Regional Offices, whose addresses are listed in Section 2, "Filing an Application."





## **Appendix K**

# **Requests to Perform Leak Testing and Sample Analysis**



## Requests to Perform Leak Testing and Sample Analysis

- C Identify the individual who will make the analysis and provide his or her qualifications to make quantitative measurements of radioactivity.
- C Specify how and where test samples will be taken on the radiography device. Describe materials used and methods of handling samples to prevent or minimize exposure to personnel.
- C Specify the type of instrument(s) that will be used for measurement, the counting efficiency, and minimum levels of detection for each radionuclide to be measured.

**Note:** An instrument capable of making quantitative measurements should be used; hand-held survey meters will not normally be considered adequate for measurements.

- C Specify the standard sources used to calibrate the instrument; for each, specify the radionuclide, quantity, accuracy, and traceability to primary radiation standards.

**Note:** Accuracy of standards should be within  $\pm 5\%$  of the stated value and traceable to a primary radiation standard such as those maintained by the National Institutes of Standards and Technology (NIST).

Draft Regulatory Guide FC 412-4, "Guide for the Preparation of Applications for the Use of Radioactive Materials in Leak-Testing Services," is available from NRC upon request.

- C Include a sample calculation for conversion of the measurement data to Bq(or microcuries).
- C Provide instructions on actions to take and persons to be notified if sources are found to be leaking.

## Model Procedure for Performing Leak Testing and Analysis

- C For each source to be tested, list identifying information such as radiography device serial number, radionuclide, activity.
- C If available, use a survey meter to monitor exposure.
- C Prepare a separate wipe sample (e.g., cotton swab or filter paper) for each source.
- C Number each wipe to correlate with identifying information for each source.
- C Wipe the most accessible area where contamination would accumulate if the sealed source were leaking.
- C Using the instrument identified to, and approved by, NRC, count and record background count rate.

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- C Check the instrument's counting efficiency using standard source of the same radionuclide as the source being tested or one with similar energy characteristics.
- C Calculate efficiency.
- C Count each wipe sample; determine net count rate.
- C For each sample, calculate and record estimated activity in Bq (or microcuries).
- C Sign and date the list of sources, data and calculations.
- C 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 NRC.

<b>Sampling and Analysis for Depleted Uranium as a Result of S-tube Breakthrough</b>
--

**Note:** As an ALARA and safety measure, the source should be transferred to a source changer before the S-tube is tested for breakthrough.

The wipe test sample should be obtained from the areas of the tube where wear is likely to be most severe, at the first curve nearest the ends of the radiography device. The sample should be analyzed for alpha contamination. Alpha contamination present indicates that wear has broken through the S-tube to expose the depleted uranium.

Alpha counting sensitivity should be able to detect 185 Bq (0.005 microcuries) of contamination.

A worn S-tube could create equipment operating difficulties. Upon verification of the presence of alpha-particle emitting uranium, the radiographic exposure device should be removed from use until an evaluation of the wear of the S-tube has been made. Should the evaluation reveal that the S-tube is worn through, the device may not be used again. No user repairs are permitted.



## **Appendix L**

### **Guidance for Demonstrating That Individual Members of the Public Will Not Receive Doses Exceeding the Allowable Limits**



## Guidance for Demonstrating That Individual Members of the Public Will Not Receive Doses Exceeding the Allowable Limits

Licensees must ensure that:

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

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

- C The radiation dose in unrestricted areas does not exceed 0.02 mSv (2 mrem) in any one hour.
- C Typical unrestricted areas may include offices, shops, laboratories, areas outside buildings, property, and nonradioactive 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.
- C Licensees must show compliance with both portions of the regulation. Radiographic operations at temporary jobsites must be demonstrated to have doses to the public in unrestricted areas that do not exceed 0.02 mSv (2 mrem) in any one hour. For storage areas and permanent radiographic facilities, calculations or a combination of calculations and measurements (e.g., using an environmental TLD) are often used to prove compliance with levels of 0.02 mSv (2 mrem) in any one hour and 1 mSv (100 mrem) in a calendar year.

### Calculational Method

For ease of use by most industrial radiography licensees, the examples in this Appendix use conventional units. The conversions to SI units are as follows: 1 foot (ft) = 0.305 meter (m); 1 mrem = 0.01 mSv.

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 device is a point source, (2) typical radiation levels encountered when the source is in the shielded position are taken from either the Sealed Source & Device (SSD) Registration Sheet, the maximum dose levels allowed for a transport package (exposure device) labeled YELLOW III, or the manufacturer's literature, and (3) no credit is taken for any shielding found between the devices and the unrestricted areas.

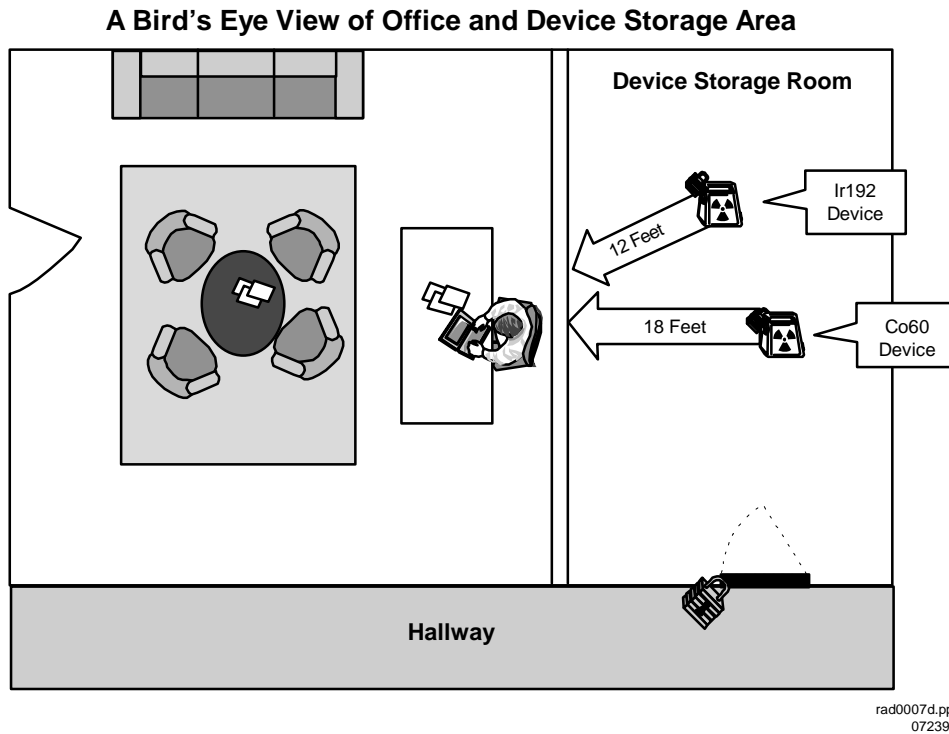
## APPENDIX L

Part 1 of the calculational method is simple but conservative. It assumes that a member of the public is present 24 hours a day, and it uses only the inverse square law to determine if the distance between the device 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 a member of the public is actually in the area under consideration. Part 3 considers distance and the portion of time that both the device and the affected member of the public are present. Part 4 considers the distance, the portion of time that both the device and the affected member of the public are present and the shielding provided by the structural materials or shielding materials specifically added by the licensee. 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. 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, Mo-Rad, Inc., a hypothetical radiography licensee, is demonstrated. Yesterday, the company's president noted that the new device storage area is close to his secretary's desk and he asked Joe, the Radiation Safety Officer (RSO), to determine if the company is complying with NRC's regulations.

The secretary's desk is near the wall separating the reception area from the designated, locked device storage area, where the company is storing its two devices. Joe measures the distances from each device to the wall and assumes that each device would have the maximum dose rate allowed under NRC or DOT regulations: 2 mSv/hr (200 mrem/hr) on the surface and 0.1 mSv/hr (10 mrem/hr) at one meter. Figure M.1 is Joe's sketch of the areas in question, and Table M.1 summarizes the information Joe has on each device.



**Figure L.1 Diagram of Office and Device Storage Area.** *This sketch shows the areas described in Examples 1 and 2.*

**Table L.1 Information Known about Each Device**

Description of Known Information	Device 1	Device 2
How device is stored	Ir-192 exposure device (Type B container)	Co-60 exposure device (Type B container)
Dose rate in mrem/hr encountered at specified distance from the device	10 mrem/hr at 1 meter (3.3 ft)	10 mrem/hr at 1 meter (3.3 ft)
Distance in ft to secretary's chair	12 ft	18 ft

### Example 1: Part 1

Joe's first thought is that the distance between the devices and the secretary's chair may be sufficient to show compliance with the regulation in 10 CFR 20.1301. So, taking a worst case approach, he assumes: 1) the devices are constantly present (i.e., 24 hr/d), 2) both devices 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 device, as shown in Tables M.2, and M.3 below.

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**Table L.2      Calculational Method, Part 1: Hourly and Annual Dose Received from Device 1**

Step No.	Description	Device 1 Input Data	Results
1	Dose received in an hour at known distance from device (e.g., from manufacturers data), in mrem/hr	10	10
2	Square of the distance (ft) at which the Step 1 rate was measured, in ft <sup>2</sup>	(3.3) 2	10.9
3	Square of the distance (ft) from the device the secretary's desk in an unrestricted area, in ft <sup>2</sup>	(12) 2	144
4	Multiply the results of Step 1 by the results of Step 2 (this is an intermediate result)	10 x 10.9 = 109	
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 DEVICE 1</b> , in mrem in an hour.	109/144 = <b>0.76</b>	
6	Multiply the result of Step 5 by 24 hr/d x 365 d/yr = <b>MAXIMUM ANNUAL DOSE RECEIVED FROM DEVICE 1</b> , in mrem in a year.	0.76 x 24 x 365 = 0.76 x 8760 = <b>6,630</b>	

**Table L.3      Calculational Method, Part 1: Hourly and Annual Dose Received from Device 2**

Step No.	Description	Device 2 Input Data	Results
1	Dose received in an hour at known distance from device (e.g., from manufacturers data), in mrem/hr	10	10
2	Square of the distance (ft) at which the Step 1 rate was measured, in ft <sup>2</sup>	(3.3) 2	10.9
3	Square of the distance (ft) from the device to the secretary's desk in an unrestricted area, in ft <sup>2</sup>	(18) 2	324
4	Multiply the results of Step 1 by the results of Step 2 (this is an intermediate result)	10 x 10.9 = 109	
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 DEVICE 2</b> , in mrem in an hour	109/324 = <b>0.34</b>	

Step No.	Description	Device 2 Input Data	Results
6	Multiply the result of Step 5 by 24 hr/d x 365 d/yr = <b>MAXIMUM ANNUAL DOSE RECEIVED FROM DEVICE 2</b> , in mrem in a year	$0.34 \times 24 \times 365 =$ $0.34 \times 8760 = \mathbf{2950}$	

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

**Table L.4      Calculational Method, Part 1: Total Hourly and Annual Dose Received from Devices 1 and 2**

Step No.	Description	Device 1	Device 2	Sum
7	<b>TOTAL HOURLY DOSE RECEIVED</b> from Step 5 of Tables I-3, and I-4, in mrem in an hour	0.76	0.34	$0.76 + 0.34 =$ <b>1.1</b>
8	<b>TOTAL ANNUAL DOSE RECEIVED</b> from Step 6 of Tables I-3, and I-4, in mrem in a year	6630	2950	$6630 + 2950 =$ <b>9580</b>

**Note:** The Sum in Step 7 demonstrates compliance with the limit of 2 mrem in any one hour. 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 1.1 mrem in an hour, but notes that an individual could receive a dose of 9,580 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 devices are constantly present (i.e., 24 hr/d), both devices remain in storage with no other use). He then recalculates the annual dose received.

**Table L.5      Calculational Method, Part 2: Annual Dose Received from Devices 1 and 2**

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Step No.	Description	Results
9	<p>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.)</p> <p>B. Average number of days per week in area (e.g., secretary is part time and works 3 days/week)</p> <p>C. Average number of weeks per year in area (e.g., secretary works all year )</p>	<p>5</p> <p>3</p> <p>52</p>
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 DEVICES CONSIDERING REALISTIC ESTIMATE OF TIME SPENT IN AREA OF CONCERN</b> , in mrem in a year	$1.1 \times 780 = \mathbf{860}$

**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 devices are not always in storage when the secretary is seated at the desk. As he examines the situation, he realizes he must consider each device individually.



**Table L.6      Calculational Method, Part 3: Summary of Information**

<b>Summary</b>	
<b>Information on When Devices Are Present in the Storage Area:</b>	
<b>C Device 1:</b>	an Ir-192 Exposure Device Located in the Storage Area Overnight; it Is Used Every Day at Temporary Jobsites All Year and Returned to the Storage Location at the End of Each Day. The Device Is Usually Present During the Secretary's First and Last Hours of Work Each Day.
<b>C Device 2:</b>	a Co-60 Exposure Device Located in the Storage Area Continuously (24 Hr/d) for 8 Months of the Year; for the Remaining 4 Months of the Year, it Is at Temporary Jobsites
<b>Information from Example 1, Part 2 on When the Secretary Is Sitting at the Desk:</b>	
C	5 Days per Week
C	3 Days per Week
C	52 Weeks per Year

**Table L.7      Calculational Method, Part 3: Annual Dose Received from Devices 1 and 2**

<b>Step No.</b>	<b>Description</b>	<b>Device 1</b>	<b>Device 2</b>
12	Average number of <b>hours per day</b> device is in storage while secretary is present	<b>2</b>	<b>5</b>
13	Average number of <b>days per week</b> device is in storage while secretary is present	<b>3</b>	<b>3</b>
14	Average number of <b>weeks per year</b> device is in storage while secretary is present	<b>52</b>	<b>32</b>
15	Multiply the results of Step 12 by the results of Step 13 by the results of Step 14 = <b>TOTAL HOURS EACH DEVICE IS STORED PER YEAR WHILE SECRETARY IS PRESENT</b>	$2 \times 3 \times 52 = \mathbf{312}$	$5 \times 3 \times 32 = \mathbf{480}$
16	Multiply the results of Step 15 by the results of Step 7 = <b>ANNUAL DOSE RECEIVED FROM EACH DEVICE</b> , in mrem in a year	$312 \times 0.76 = \mathbf{237}$	$480 \times 0.34 = \mathbf{163}$

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Step No.	Description	Device 1	Device 2
17	Sum the results of Step 16 for each device = <b>TOTAL ANNUAL DOSE RECEIVED CONSIDERING REALISTIC ESTIMATE OF TIME SPENT IN AREA OF CONCERN AND TIME DEVICE IS IN STORAGE</b> , in mrem in a year	237+ 163 = <b>400</b>	

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

Joe notes that the result in Step 17 does not show compliance with the 100 mrem/yr limit. Since the result in Step 17 is higher than 100 mrem/yr, then Joe has to consider one or more of the following:

- C Consider whether the assumptions used to determine occupancy and the time each device is in storage are accurate, revise the assumptions as needed, and recalculate using the new assumptions.
- C Calculate the effect of any shielding located between the device storage area and the secretarial workstation. Listed below are typical half-value layers (HVL) for Ir-192 and Co-60.

**Table L.8 Half Value Layers (HVL) for Typical Shielding Materials**

	Steel	HVL (inches) Lead	Concrete
Ir-192	0.5	0.25	1.7
Co-60	0.8	0.5	2.1

- C Take corrective action (e.g., move devices within storage area, move the storage area, move the secretarial workstation) and perform new calculations to demonstrate compliance
- C 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 10 CFR 19.12.

### Example 1, Part 4

Joe decides to take into account the amount of shielding provided by the wall between the secretary's desk and the storage area where the two devices are located. The wall between the secretary's office and the storage area is a 4 inch thick concrete fire wall.

**Table L.9      Calculational Method, Part 4: Annual Dose Received from Devices 1 and 2**

Step No.	Description	Device 1	Device 2
18	Annual dose received from each device from Step 15	<b>237</b>	<b>163</b>
19	Number of HVLs (Thickness of shielding material/Thickness for one HVL); If more than one shielding material, need to evaluate each shielding material separately by <i>type of radionuclide</i> .	<b>4.0/1.7 = 2.35</b>	<b>4.0/2.1 = 1.9</b>
20	Fraction of radiation dose transmitted through shield: 0.5 (Total Number of HVLs); If more than one shielding material, then sum the number results from Step 19 <i>by radionuclide</i> .	<b>0.5(2.35) = 0.2</b>	<b>0.5(1.9) = 0.27</b>
21	Multiply the results of Step 20 by the results of Step 18 = <b>ANNUAL DOSE RECEIVED FROM EACH DEVICE</b> , in mrem in a year	<b>0.2 x 237 = 47</b>	<b>0.27 x 163 = 44</b>
22	Sum the results of Step 21 for each device = <b>TOTAL ANNUAL DOSE RECEIVED CONSIDERING REALISTIC ESTIMATE OF TIME SPENT IN AREA OF CONCERN, TIME DEVICE IS IN STORAGE AND SHIELDING OF STRUCTURAL MATERIALS</b> , in mrem in a year	<b>47 + 44 = 91</b>	

**Note:** If the result in Step 22 is greater than 100 mrem/yr, the licensee must take corrective actions.

Joe is glad to see that the results in Step 22 show compliance with the 100 mrem in a calendar year limit.

Note that in the example, Joe evaluated the unrestricted area outside only one wall of the device 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 devices closer to the secretarial workstation, adding a device 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:** 10 CFR 20.2107 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 device 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 device. 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 an interval 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. 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 CaF<sub>2</sub> that are used for environmental monitoring. in unrestricted areas next to the device 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.

### Example 2

As in Example 1, Joe is the RSO for Mo-Rad, Inc., a radiography licensee. The company has two devices stored in a designated, locked storage area that adjoins an unrestricted area where a secretarial work station is located. See Figure M.1 and Table M.1 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 devices were in storage, Joe placed an environmental TLD badge in the secretarial work space for 30 days. Joe chose a winter month so he did not have to keep track of the number of hours that each device was in the storage area. The TLD processor sent Joe a report indicating the TLD received 100 mrem.

Parts 2 and 3 are the calculated the same as Example 1.

**Table L.10 Combination Measurement - Calculational Method**

Step No.	Description	Input Data and Results
<b>Part 1</b>		
1	<b>Dose</b> received by TLD, in mrem	<b>100</b>
2	<b>Total hours</b> TLD exposed	24 hr/d x 30 d/month = <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 DEVICES</b> , in mrem in a year	365 x 24 x 0.14 = 8760 x 0.14 = <b>1226</b>
<b>Part 2</b>		
<b>Part 3</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 regulations.

In Step 2, 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.

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 devices are actually in storage as in Part 3 of Example 1. (Recall that the TLD measurement was made while all the devices were in storage — i.e., 24 hr/d for the 30 days that the TLD was in place.)

## APPENDIX L

## **Appendix M**

### **Information for Applicants to Consider When Developing Procedures for Operating Radiography Equipment**





## **Information for Applicants to Consider When Developing Procedures for Operating Radiography Equipment**

### **Crank-out Device**

- C Locate the source shield at the desired distance from the object to be radiographed.
- C Mount the source tip firmly, using jigs or other attachments, with the tip in the exact exposure position.
- C Locate the control unit at the maximum distance (25 feet or 7.6 meters) from the source shield with the control tubes laid out as straight as possible.
- C Join the control cable to the unit following the manufacturer's instructions.
- C Establish and post the restricted area and high radiation area.
- C Unlock the device.
- C Turn the hand crank steadily to move the source out of the source shield to the exposure position.
- C Survey the perimeter of the restricted area to be sure that radiation levels do not exceed 0.02 mSv (2 mrem) in any one hour.
- C Maintain continuous surveillance over the restricted area during an exposure, keeping all persons from entering.
- C After completing the exposure, retract the source by turning the crank until the "safe" position is indicated.
- C Survey the entire circumference of the device and the guide tube to determine that the source is in a shielded position.
- C Lock the device and remove the key.

### **Pipeliners Device**

- C Establish and post the restricted area and high radiation area.
- C Unlock the device.
- C Stand as far away as possible and out of the direction of the beam and expose the source (e.g., use the "stretch technique").
- C Survey the perimeter of the restricted area to be sure that the radiation levels do not exceed 0.02 mSv (2 mrem) in any one hour.
- C Maintain continuous surveillance over the restricted area during an exposure, keeping all persons from entering.

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C After completing the exposure, return the source to the shielded position.

C Survey the device to determine that the source is in a shielded position.

C Lock the device.

**Note:** The NRC considers the following very important: surveys of the restricted area, continuous surveillance of the restricted area during an exposure, the survey of the device and guide tube, and locking the device.

### Source Exchange

#### Removing the Old Source

**Caution:** Always use a calibrated, operable survey meter while performing a source exchange!

1. Survey the shipping container upon receipt with a survey meter. Note that the surface reading should not exceed 2 mSv/hr (200 mem/hr).
2. Attach the end of the source guide tube to the exposure device.
3. Connect the other end of the source guide tube to the empty side of the source changer.
4. Unlock the empty side of the source changer.
5. Unlock the camera and crank out the source from the camera into the source changer.
6. Survey the source changer and guide tube to verify that the source is in the safe position.
7. Lock the source changer.
8. Disconnect the source guide tube and drive cable to the source pigtail. Replace the dust cap on the source changer.
9. Remove the source identification plate from the exposure device and affix the plate to the side of the source changer loaded with the old source.

#### Installing the New Source

1. Remove the dust cap on the source changer lock body identified with the new source tag.
2. Align the camera and source guide tube with the source changer.

3. Connect the new source to the drive cable.
4. Connect the source guide tube to the source changer.
5. Unlock the source changer and retract the new source into the exposure device.
6. Survey the exposure device and guide tube to assure that the source is in the safe position.
7. Lock the exposure device.
8. Disconnect the source guide tube and drive accessories.
9. Affix the new source identification plate on the exposure device.



# **Appendix N**

## **Transportation**



## Transportation

The following are the major areas in DOT regulations most relevant for transporting radiographic exposure devices and source exchangers that are shipped as Type B quantities are:

A. Table of Hazardous Materials and Special Provisions - 49 CFR 172.101

1. 49 CFR 172.101 - Hazardous Materials Table [proper shipping name, hazard class, identification number]
2. Table 2, Appendix A, 49 CFR 172.101 - List of Hazardous Substances and Reportable Quantities [for radionuclides]

B. Shipping Papers - 49 CFR 172.200

1. 49 CFR 172.201 - General entries [on shipping papers]
2. 49 CFR 172.202 - Description of hazardous material on shipping papers
3. 49 CFR 172.203 - Additional description requirements
4. 49 CFR 172.204 - Shipper's certification [if applicable]

C. Package Markings - 49 CFR 172.300

1. 49 CFR 172.301 - General marking requirements for non-bulk packaging
2. 49 CFR 172.304 - Marking requirements
3. 49 CFR 172.310 - Radioactive material [Type B]
4. 49 CFR 172.324 - Hazardous substances in non-bulk packaging [designation of "reportable quantities" with the letters "RQ"]

D. Package Labeling - 49 CFR 172.400

1. 49 CFR 172.400(a) - General labeling requirements
2. 49 CFR 172.403 - Radioactive materials [types and contents of labels]
3. 49 CFR 172.406 - Placement of labels

E. Placarding of Vehicles - 49 CFR 172.500

1. 49 CFR 172.504 - General placarding requirements
2. 49 CFR 172.516 - Visibility and display of placards
3. 49 CFR 172.556 - RADIOACTIVE placard

F. Emergency Response Information - Subpart G

1. 49 CFR 172.600 - Applicability and general requirements
2. 49 CFR 172.602 - Emergency response information
3. 49 CFR 172.604 - Emergency response telephone number

G. Training - Subpart H

1. 49 CFR 172.702 - Applicability and responsibility for training and testing [for HAZMAT employees]
2. 49 CFR 172.702 - Training requirements (includes types of training, when it must be conducted, need for refresher training every 3 years, recordkeeping)

H. Shippers - General Requirements for Shipments and Packaging - 49 CFR 173

1. 49 CFR 173.25 - Requirements for use and labeling of overpacks
2. 49 CFR 173.403 - Definitions
3. 49 CFR 173.411 - General design requirements
4. 49 CFR 173.413 - Additional design requirements for Type B packages
5. 49 CFR 173.416 - Authorized Type B packages [includes packaging certification requirements]
6. 49 CFR 173.441 - Radiation levels
7. 49 CFR 173.471 - Additional requirements for Type B packages approved by NRC
8. 49 CFR 173.476 - Approval of special form radioactive materials [includes requirement for documentation of special form status]

I. Carriage by Public Highway - 49 CFR 177

1. 49 CFR 177.817 - Shipping paper [location of shipping papers during transport]
2. 49 CFR 177.842 - Class 7 (radioactive) material [includes requirement for blocking and bracing during transport]



# 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 <b>emergency response telephone number</b></li> <li>! Name of <b>shipper</b></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 Radionuclides</b> (95% 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> </ul> </li> <li>! Shipper's <b>certification</b> (not required of private carriers)</li> </ul>	<p><u>Materials-Based Requirements:</u></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><u>Package-Based Requirements:</u></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><u>Administrative-Based Requirements:</u></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 parenthesis 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>

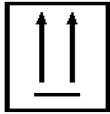

### Some Special Considerations/Exceptions for Shipping Paper Requirements

- ! 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 person entering 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><u>Non-Bulk Packages</u></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>- highway only and no motor carrier transfers, <i>or</i></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>	<p><u>Materials-Based Requirements:</u></p> <ul style="list-style-type: none"> <li>! If in excess of 110 lbs (50 kg), Gross Weight</li> <li>! If non-bulk <u>liquid</u> 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><u>Package-Based Requirements:</u></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><u>Administrative-Based Requirements:</u></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>
<p><u>Bulk Packages</u> (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>		

## 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><i>Sides:</i> ≥ 100 mm (3.9 in.)</p> <p><i>Border:</i> 5-6.3 mm (0.2-0.25 in.)</p>				
	49 CFR 172.436	49 CFR 172.438	49 CFR 172.440	49 CFR 172.450
<b>Label</b>	<b>WHITE-I</b>	<b>YELLOW-II</b>	<b>YELLOW-III</b>	<b>EMPTY LABEL</b>
<b><u>Required when:</u></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 <b>§173.428</b> . It must cover any previous labels, or they must be removed or obliterated.
	<b><u>Or:</u></b>	<b>TI = 0</b> [1 meter dose rate < 0.0005 mSv/hr (0.05 mrem/hr)]	<b>TI ≤ 1</b> [1 meter dose rate < 0.01 mSv/hr (1 mrem/hr)]	
<b><u>Notes:</u></b>	<p>! Any package containing a Highway Route Controlled Quantity (HRCQ) <b>must bear YELLOW-III label</b></p> <p>! Although radiation level transport indices (TIs) are shown above, <b>for fissile material</b>, the TI is typically determined on the basis of criticality control</p>			

### Content on Radioactive Labels

- ! RADIOACTIVE Label must contain (entered using a durable, weather-resistant means):
  - (1) The **radionuclides** in the package (with consideration of available space). Symbols (e.g., Co-60) are acceptable
  - (2) 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.
  - (3) 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 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 any vehicle containing 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>	 <p>49 CFR 172.556</p> <p><b>RADIOACTIVE PLACARD (Domestic)</b></p> <p><i>Base of yellow solid area:</i> 29 ± 5 mm (1.1 ± 0.2 in.) above horizontal centerline</p>	 <p>IAEA SS 6 (1985) paras. 443-444</p> <p><b>RADIOACTIVE PLACARD (International)</b></p>	 <p>See 49 CFR 172.527 AND 556</p> <p><b>RADIOACTIVE PLACARD FOR HIGHWAY ROUTE CONTROLLED QUANTITY</b> (either domestic or international placard could be in middle)</p>
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### 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)

### 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**

<b>Quantity:</b>	< 70 Bq/g ( < 0.002 :Ci/g)	Limited Quantity (§173.421)	A <sub>1</sub> /A <sub>2</sub> value (§173.435)	1 rem/hr at 3 m, unshielded (§173.427)
<b>Non-LSA/SCO:</b>	<b>Excepted</b>	<b>Type A</b>	<b>Type B <sup>3</sup></b>	
<b>Domestic or International LSA/SCO:</b> LSA-I solid, (liquid) <sup>1</sup> SCO-I	<b>Excepted</b>	<b>IP-I</b>	<b>Type B <sup>3</sup></b>	
LSA-I Liquid LSA-II Solid, (liquid or gas) <sup>1</sup> (LSA-III) <sup>1</sup> SCO-II		<b>IP-II</b>	<b>Type B <sup>3</sup></b>	
LSA-II Liquid or Gas LSA-III		<b>IP-III</b>	<b>Type B <sup>3</sup></b>	
<b>Domestic (only) LSA/SCO:</b> LSA-I, II, III; SCO-I, II	<b>Excepted</b>	<b>Strong-tight <sup>2</sup></b>	<b>DOT Spec. 7A Type A</b>	<b>Type B <sup>3</sup></b>
				<b>NRC Type A LSA <sup>3,4</sup></b>

- 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**

<i>Transport Vehicle Use:</i>	Non-Exclusive	Exclusive		
<i>Transport Vehicle Type:</i>	Open or Closed	Open (flat-bed)	Open w/Enclosure <sup>B</sup>	Closed
<b>Package (or freight container) Limits:</b>				
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		
<b>Roadway or Railway Vehicle (or freight container) Limits:</b>				
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>		

A. The limits in this table do not apply to excepted packages - see 49 CFR 173.421-426

B. Securely attached (to vehicle), access-limiting enclosure; package personnel barriers are considered as enclosures

C. 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

D. No dose limit is specified, but separation distances apply to Radioactive Yellow-II or Radioactive Yellow-III labeled packages

E. Does not apply to private carrier wearing dosimetry if under radiation protection program satisfying 10 CFR 20 or 49 CFR 172 Subpart I

F. Some fissile shipments may have combined conveyance TI limit of 100 - see 10 CFR 71.59 and 49 CFR 173.457



### 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

&( 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)**

&( : 0.4 Bq/cm<sup>2</sup> = 40 Bq/100 cm<sup>2</sup> = 1x10<sup>-5</sup> :Ci/cm<sup>2</sup> = 2200 dpm/100 cm<sup>2</sup>

" : 0.04 Bq/cm<sup>2</sup> = 4 Bq/100 cm<sup>2</sup> = 1x10<sup>-6</sup> :Ci/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 <b>exclusive use shipment, during transport</b> including end of transport. Conditions include: (1) Contamination levels at beginning of transport must be below the basic limits. (2) 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.
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: (1) 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). (2) Exterior of vehicle must be conspicuously stenciled, <b>"For Radioactive Materials Use Only"</b> in letters at least 76 mm (3 inches) high, on both sides. (3) Vehicle must be kept closed except when loading and unloading.
100 times the basic limits	173.428	<b>Internal</b> contamination limit for <b>excepted package-empty packaging</b> , Class 7 (Radioactive) Material, shipped in accordance with 49 CFR 173.428. Conditions include: (1) The basic contamination limits (above) apply to <b>external</b> surfaces of package. (2) Radiation level must be ≤ 0.005 mSv/hr (0.5 mrem/hr) at any external surface. (3) Notice in §173.422(a)(4) must accompany shipment. (4) Package is in unimpaired condition & securely closed to prevent leakage. (5) Labels are removed, obliterated, or covered, and the "empty" label (§172.450) is affixed to the package.

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 offer or at the earliest practicable moment after incident.

Replace this page with Straight Bill of Lading

<b>HAZARDOUS MATERIAL SHIPPING CERTIFICATION</b> FOR COMPANY VEHICLE TRANSPORTING IRIIDIUM 192 SEALED SOURCES				
<b>SHIPPER*</b> Mo-Rad, Inc. 1234 Main Street Anywhere, USA 20000		<b>CONSIGNEE*</b> Mo-Rad, Inc. 1234 Main Street Anywhere, USA 20000		
<b>DATE*</b>		<b>NUMBER OF TERABEQUERELS (CURIES)</b>	<b>TRANSPORT* INDEX (MR/HR @ 39 37")</b>	<b>CERTIFYING* SIGNATURE</b>
5/01/98	Metal Fabricators 4321 Broad Street Somewhere, USA	1.9 (50)	0.4	John Jones
<b>DESCRIPTION OF PIECES AND CONTENTS</b>  RQ RADIOACTIVE MATERIAL - SPECIAL FORM N.O.S. - UN 2974 - CLASS 7 IRIIDIUM 192: 110 CURIES MAXIMUM TYPE B CONTAINER - YELLOW LABEL II - TRANSPORT INDEX NOT TO EXCEED 1.0				
AMERSHAM MODEL 660 SERIES	AMERSHAM SHIP/CON MODEL 650L	SPEC MODEL 150	SPEC SHIP/CON MODEL C-1	
<b>G</b> USA/9033/B(U)	<b>G</b> USA/9269/B(U)	<b>G</b> USA/9263/B(U)	<b>G</b> USA/9036/B(U)	
<i>This is to certify that the above named materials are properly classified, described, packaged, marked, labeled and are in proper condition for transportation according to the applicable regulations of the DEPARTMENT OF TRANSPORTATION. (See certifying signature above)</i>				
<b>INSTRUCTIONS</b> "Radioactive Yellow II Label" - 0.5 to 50 mR/hr on the surface of package and not over 1.0 mR/hr at 39.37" from container. Yellow II label does not require vehicle placards. NOTE: Do not transport if surface of container is over 50 mR/hr and/or over 1 mR/hr at 39.37" from container.  Shipping papers must be within reach of the driver when wearing a seat belt. Should the driver leave the vehicle, the shipping papers are to be left on the front seat of the driver's side or in a box on the driver's side of the vehicle.  If a motor vehicle accident occurs, it is required that an accident report be filed with the DOT within 15 days. Give no information regarding radioactive material to anyone present at the scene except police or DOT or NRC officials. Other information is to be obtained from the Radiation Safety Officer				
<b>EMERGENCY TELEPHONE NUMBER - 1-800-000-0000</b>				

\* Substitute appropriate information for your device and shipment.



## **Appendix O**

### **Daily Maintenance Check of Radiographic Equipment**



## Daily Maintenance Check of Radiographic Equipment

The radiographer or radiographer assistant shall perform a daily maintenance check of the exposure device and related radiographic equipment. This inspection will be performed before using the equipment on each day the equipment is to be used. Report defective equipment to the RSO immediately. Do **not** attempt to use defective equipment. After the inspection, document the results of the inspection.

1. Inspect the survey meter for battery check, zero and operation. If batteries are low, replace, then check for operability. If not able to correct a problem with the survey meter, obtain another meter and start over.
2. Check survey meter with a check source (which should give a reading of \_\_\_\_ millirem) (or check with camera \_\_\_\_ which should give a reading of \_\_\_\_ millirem) as indicated on the survey meter. If reading is not acceptable, obtain another meter and start again.

**Note:** RSO or calibration vendor should determine the acceptable meter reading for each survey meter and post the expected reading on each instrument. This reading shall be obtained and noted at the time of calibration.

3. Inspect the remote-control radiographic equipment as follows:
  - C Inspect the cables for cuts, breaks, and broken fittings.
  - C Carefully inspect approximately one foot of the drive cable immediately next to the male connector. Take care not to introduce any dirt or dust on the drive cable during this inspection. In addition to the previously mentioned items, the examination of the cable should look for any of the following:
    - excessive or uneven wearing
    - fraying
    - unraveling
    - nicks
    - kinks or bends
    - loss of flexibility (abnormal stiffness)
    - excessive grit or dirt
    - stretching
    - Inspect the crank unit for damage and loose hardware.
    - Check operation of the control for freedom of drive cable movement.

## APPENDIX O

- Inspect the guide tube for cuts, crimps, and broken fittings.
  - Survey for radiation levels and record readings. The radiation levels should be about the same as those in the previous day's inspection, unless there has been a source change.
  - Check that all safety plugs are in place.
  - Inspect the exposure device for damage to fittings, lock, fasteners, and labels.
  - Check for any impairment of the locking mechanism.
4. Record the results of the daily inspection.

## **Appendix P**

### **Suggested Example of a Routine Emergency Procedure**



## Suggested Example of a Routine Emergency Procedure

### Emergency Procedure

If the source fails to return to the shielded position or if any other emergency or unusual situation arises (e.g., vehicle accident, off-scale dosimeter, etc.)

- C Immediately secure the area and post the restricted area at the 0.02 mSv/hr (2 mrem/hr) radiation level; maintain continuous surveillance and restrict access to the restricted area.
- C Notify the RSO and/or Management Personnel.
- C Take no further actions until instructions are received from the RSO.
- C Do **not** attempt source retrieval until the situation has been discussed with the RSO or other knowledgeable personnel.
- C Don't panic. Source retrieval can be performed with very little exposure when properly planned by trained personnel.
- C Notify the persons listed below of the situation, in the order shown.

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 Radiation Safety Officer (RSO), or other knowledgeable licensee staff, licensee's consultant, device manufacturer) to be contacted in case of emergency.

Follow the directions provided by the person contacted above.

### RSO and Licensee Management

Discuss emergency operating procedures, and ensure no operations are conducted until the situation has been discussed with and approved by the RSO or other knowledgeable staff, consultants, or device manufacture. Management should have access to emergency equipment to keep doses to radiographers as low as reasonably achievable. Emergency equipment may include high range dosimeters, extra lead shielding, remote tongs, etc.

Notify local authorities as well as the NRC as required. (Even if notification is not required, ANY incident may be reported to NRC by calling NRC's Emergency Operations Center at (301) 816-5100, which is staffed 24 hours a day and accepts collect calls.) NRC notification is required

## APPENDIX P

when sources or devices containing licensed material are lost or stolen and when radiographic sources or equipment are involved in incidents that may have caused or threatens to cause an exposure in excess of 10 CFR 20.2202 limits. Reports to the NRC must be made within the reporting time frames specified by the regulations. Notification and reporting requirements are found in 10 CFR 20.2201-2203, 10 CFR Part 21.21, 10 CFR 34.101, and 10 CFR 30.50.



## **Appendix Q**

### **Summary of Comments Received on Draft NUREG-1556, Vol. 2**



## Summary of Comments Received on Draft NUREG-1556, Vol. 2

On September 17, 1997, NRC announced in the *Federal Register* (62 FR 48904) that draft NUREG-1556, Vol. 2 was available for comment. NRC requested that comments be submitted by November 17, 1997. NRC also mailed copies of the document to its radiography licensees.

NRC received three comments, two from licensees and the other from an industry consultant. The comments, two letters and an e-mail message, are available for inspection in NRC's Public Document Room.

### Letters

**Issue 1:** The writer objects to the new provision in 10 CFR 34.43(a), which requires individuals acting as radiographers to be certified by a certifying entity. The writer believes that licensees with good radiation safety program should be allowed to certify their radiographers.

**Response to Issue 1:** This comment is outside the scope of NUREG-1556, Vol. 2, similar comments were considered as part of the rule making process when Part 34 was revised.

**Issue 2:** The writer objects to the new provision in 10 CFR 34.41(a), which requires at least two individuals to be present, both of whom must be observing the operations, whenever radiography is performed at a location other than a permanent radiographic installation. The writer believes that, in some instances, it should be acceptable to "assign the other individual to work in the darkroom to process film."

**Response to Issue 2:** This comment is outside the scope of NUREG-1556, Vol. 2, similar comments were considered as part of the rule making process when Part 34 was revised.

**Issue 3:** The writer refers to the appendix concerning transportation and questions the need for certain Department of Transportation requirements related to shipping papers and package labeling.

**Response to Issue 3:** This comment is outside the scope of NUREG-1556, Vol. 2.

**Issue 4:** The writer suggests that section 8.32, Item 10, "Maintenance of records" needs to make clearer which records need to be maintained or be available at field stations and temporary jobsites and, in some instances, what constitutes an acceptable record.

**Response to Issue 4:** The writer appears to have misunderstood the purpose of this section of the guide. This section provides further information to licensees on developing operating procedures which provide radiography personnel with specific guidance on the records the workers will generate when conducting radiographic operations. The records that workers might be expected to generate are already clearly identified in this section or in 10 CFR Part 34.

## **E-Mail Messages**

**Issue 1:** The writer noted the need for a correction in Item 10, “Transportation” which indicated that when a vehicle is placarded, the exterior surfaces and passenger compartment must be surveyed to ensure radiation levels do not exceed 2 mrem/hr. The writer pointed out that there is no such regulatory requirement except under exclusive use requirements.

**Response to Issue 1:** The section was revised to reflect this correction.

**Issue 2:** The writer noted that Sample 2 of Appendix N was incorrect in stating “Exclusive Use” on the sample form.

**Response to Issue 2:** The sample form was revised to reflect this correction.

**Issue 3:** The writer had several comments concerning corrections to the content of Appendix N, pages N-3 and N-8.

**Response to Issue 3:** These pages of Appendix N are copies of previously published documents and can not be modified at this time. However, the writer’s comments will be considered when the documents are next revised and updated.

## **Summary of Other Changes**

The writing team made other changes to the text in addition to those discussed above. These changes encompass the following:

- C Editorial changes based on reviews of other volumes in the NUREG-1556 series
- C More comprehensive listing of abbreviations
- C Improved consistency in the use of abbreviations and URL addresses
- C Editorial changes based on management review