Commonwealth of Virginia
Radiation Protection Regulatory Guide

Guidance for Industrial Radiography Use

ORH-720 B

Virginia Department of Health
Radioactive Materials Program
109 Governor Street, Room 730
Richmond, VA 23219
Phone: (804) 864-8150

EXECUTIVE SUMMARY

Virginia Regulatory Guides (**VAREGS**) are issued to describe and make available to the applicant or licensee, acceptable methods of implementing specific parts of **12VAC5- 481, 'Virginia Radiation Protection Regulations'**, to delineate techniques used by the staff in evaluating past specific problems or postulated accidents, and to provide guidance to applicants or licensees. VAREGS are not substitutes for **12VAC5-481, 'Virginia Radiation Protection Regulations'**; therefore, compliance with them is not required. Methods and solutions different from those set forth in this guide will be acceptable if they provide a basis for the Virginia Department of Health (VDH), Radioactive Materials Program, to determine if a radiation protection program meets the current rule and protects health and safety.

Comments and suggestions for improvements in this VAREG are encouraged at all times and it will be revised, as appropriate, to accommodate comments and to reflect new information or experience. Comments should be sent to: **Virginia Department of Health, Radioactive Materials Program, 109 Governor Street, Room 730, Richmond, VA 23219.**

Requests for single copies of this guide (which may be reproduced) can be made in writing to Virginia Department of Health, Radioactive Materials Program, 109 Governor Street, Room 730, Richmond, VA 23219.

This guide is also available on our website: http://www.vdh.virginia.gov/Epidemiology/RadiologicalHealth/.

This VAREG, 'Guidance for Industrial Radiography Use', has been developed to streamline the application process for an Industrial Radiography license. A copy of the VDH Form, 'Application for a Radioactive Material License Authorizing the Use of Industrial Radiography' is located in **Appendix A** of this guide.

Appendix C through P provide examples, models and additional information that can be used when completing the application.

It typically takes 60-90 days for a license to be processed and issued if the application is complete. When submitting the application be sure to include the appropriate application fee listed in **12VAC5-490**.

In summary, the applicant will need to perform the following to submit an application for an Industrial Radiography license:

- Use this regulatory guide to prepare the VDH Form, 'Application for a Radioactive Material License Authorizing the Use of Industrial Radiography' (**Appendix A**).
- Complete the VDH Form, 'Application for a Radioactive Material License Authorizing the Use of Industrial Radiography' (**Appendix A**). See 'Contents of Application' of the guide for additional information.
- Include any additional attachments.

  All supplemental pages should be on 8 ½" x 11" paper.

  Please identify all attachments with the applicant's name and license number (if a renewal).
- Avoid submitting proprietary information unless it is absolutely necessary. If submitted, proprietary information and other sensitive information should be clearly identified and a request made to withhold from public disclosure.
- Submit an original signed application along with attachments (if any). This submission can be made via scanned copies forwarded via facsimile or electronic mail or via postal mail of the documents.
- Submit the application fee (for new licenses only).
- Retain one copy of the licensee application and attachments (if any) for your future reference. You will need this information because the license will require that radioactive material be possessed and used in accordance with statements, representation, and procedures provided in the application and supporting documentation.

If you have any questions about the application process, please contact this office at (804) 864-8150.

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ABBREVIATIONS

ALARA	as low as reasonably is achievable
ANSI	American National Standards Institute
ALI	annual limit on intake
bkg	background
Bq	Becquerel
cc	centimeter cubed
CDE	Committed Dose Equivalent
CEDE	Committed Effective Dose Equivalent
CFR	Code of Federal Regulations
Ci	Curie
cm	centimeter
cm^2	centimeter squared
cpm	counts per minute
COC	Certificate of Compliance
C/kg	Coulombs/kilogram
DFP	Decommissioning Funding Plan
DIS	Decay-in-storage
DOE	United States Department of Energy
DOT	United States Department of Transportation
dpm	disintegrations per minute
DU	Depleted uranium
EDE	Effective Dose Equivalent
EPA	United States Environmental Protection Agency
FDA	United States Food and Drug Administration
FR	Federal Register
F/A	Financial Assurance
GBq	Gigabecquerel
GM	Geiger-Mueller
GPO	Government Printing Office
hr	hour
IN	Information Notice
LLW	Low Level Waste
MBq	Megabecquerel
mCi	millicuries
mGy	milligray
mR	milliroentgen
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
OSL	optically stimulated luminescence dosimeter
R	Roentgen
RG	Regulatory Guide
RQ	Reportable quantities
RSO	Radiation Safety Officer
SDE	Shallow Dose Equivalent

SI	International System of Units (abbreviated SI from the French Le Systeme Internationale d'Unites)
SSD	Sealed Source and Device
SSDR	Sealed Source and Device Registry
Sv	Sievert
TEDE	Total effective dose equivalent
TI	Transportation Index
TLD	Thermoluminescent dosimeters
T ½	Half-life
VDH	Virginia Department of Health
µCi	microcurie
%	percent

PURPOSE OF GUIDE

This document provides guidance to an applicant in preparing a license application for Industrial Radiography. It also provides guidance on VDH's criteria for evaluating an Industrial Radiography license application. It is not intended to 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. The term 'radiography' as used in this guide means an examination of the structure of materials by nondestructive methods, using ionizing radiation to make radiographic images generally using gamma-emitting radioactive 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 guide identifies the information needed to complete VDH Form, 'Application for a Radioactive Material License Authorizing the Use of Industrial Radiography' (**Appendix A**).

The format for each item number in this guide is as follows:

- **Rule** - references the requirements from **12VAC5-481 'Virginia Radiation Protection Regulations'** applicable to the item;
- **Criteria** - outlines the criteria used to judge the adequacy of the applicant's response;
- **Discussion** - provides additional information on the topic sufficient to meet the needs of most readers.

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

12VAC5-481 'Virginia Radiation Protection Regulations' requires the applicant and/or licensee to develop, document, and implement procedures that will ensure compliance with the rule. The appendices describe radiation protection procedures. Each applicant should read the rule and procedures carefully and then decide if the procedure addresses specific radiation protection program needs at the applicant's facility. Applicants may adopt a procedure included in this VAREG or they may develop their own procedures to comply with the applicable rule.

In this guide, "dose" or "radiation dose" means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent (TEDE). These terms are defined in the **12VAC5-481-10.** Rem and Sievert (Sv), its SI equivalent (1 rem = 0.01 Sv), are used to describe units of radiation exposure or dose. These units are used because **12VAC5-481 'Radiation Protection Regulations', Part IV 'Standards for Protection Against Radiation',** sets dose limits in terms of rem, not rad or roentgen. Furthermore, radioactive materials commonly used in medicine emit beta and photon radiation, for which the quality factor is 1; a useful rule of thumb is an exposure of 1 roentgen is equivalent to an absorbed dose of 1 rad and dose equivalent of 1 rem.

The VAREG provides the latest guidance, shows the requirements in terms of the **12VAC5-481 'Virginia Radiation Protection Regulations'** and provides a user-friendly format to assist with the preparation of a license application.

LICENSES

Applicants should study this document, related guidance, and all applicable regulations carefully before completing the VDH Form ‘Application for a Radioactive Material License Authorizing the Use of Industrial Radiography’. VDH expects licensees to provide requested information on specific aspects of their proposed radiation protection program in attachments to the application. When necessary, VDH may ask the applicant for additional information to gain reasonable assurance that an adequate radiation protection program has been established.

After a license is issued, the licensee must conduct its program in accordance with the following:

- Statements, representations, and procedures contained in the application and in correspondence with VDH;
- Terms and conditions of the license; and
- **12VAC5-481 ‘Virginia Radiation Protection Regulations’**.

THE ‘AS LOW AS IS REASONABLY ACHIEVABLE (ALARA)’ CONCEPT

12VAC5-481-630, Radiation protection programs, states that “*each licensee shall develop, document, and implement a radiation protection program commensurate with the scope and extent of licensed activities*” and “*the licensee shall use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are...ALARA.*” This section also requires that licensees review the content of the radiation protection program and its implementation annually.

Information directly related to radiation protection standards in **12VAC5-481 ‘Virginia Radiation Protection Regulations’, Part IV ‘Standards for Protection Against Radiation’**, is contained in:

- NRC’s NUREG-1736, ‘Consolidated Guidance: 10 CFR Part 20 - Standards for Protection Against Radiation.’

Applicants should consider the ALARA philosophy detailed in these reports when developing plans to work with licensed radioactive materials.

WHO REGULATES FACILITIES IN THE COMMONWEALTH OF VIRGINIA?

In the special situation of work at federally controlled sites in the Commonwealth of Virginia, it is necessary to know the jurisdictional status of the land to determine whether the Nuclear Regulatory Commission (NRC) or VDH has regulatory authority. The NRC has regulatory authority over land determined to be under "exclusive federal jurisdiction", while VDH has jurisdiction over non-exclusive federal jurisdiction land (see **Table 1**). Applicants and licensees are responsible for finding out, in advance, the jurisdictional status of the specific areas where they plan to conduct licensed operations. VDH recommends that applicants and licensees ask their local contacts for the federal agency controlling the site (e.g., contract officer, 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 VDH or NRC regulatory requirements, as appropriate. The following table lists examples of regulatory authority.

Table 1: Who Regulates the Activity?

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

A current list of Agreement States (states that have entered into agreements with the NRC that give them the authority to license and inspect radioactive material used or possessed within their borders), including names, addresses, and telephone numbers of responsible officials are maintained by NRC Office of Federal and State Materials and Environmental Management Programs and is available on their web site http://nrc-stp.ornl.gov/.

MANAGEMENT RESPONSIBILITY

VDH endorses the philosophy that effective radiation protection program management is vital to safe operations that comply with VDH regulatory requirements.

"Management" refers to the chief executive officer or other individual having the authority to manage, direct, or administer the licensee's activities or that person's delegate or delegates.

To ensure adequate management involvement, a management representative (i.e., chief executive officer or delegate) must sign the submitted application acknowledging management's commitments to and responsibility for the following:

- Radiation protection, security, and control of radioactive materials, and compliance with rule;
- Knowledge about the contents of the license application;
- Compliance with current VDH and United Department of Transportation (DOT) regulations and the licensee's operating and emergency procedures;
- Provision of adequate resources (including space, equipment, personnel, time, and, if needed, contractors) to the radiation protection program to ensure that the public and workers are protected from radiation hazards;
- Appointment of a qualified individual who has agreed in writing to work as the RSO;
- 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;
- Ensuring worker audits are conducted at 6-month intervals (may be performed by the RSO);
- Ensuring workers have had adequate training;
- Reporting equipment failures as required under **12VAC5-481-1530**; and
- Ensuring current, up-to-date VDH and DOT rules and regulations are available to all employees.

Management may delegate individuals (i.e., an RSO or other designated individual) to submit amendment requests to VDH. A correspondence delegation letter must be completed, signed by management and submitted to VDH. A sample letter has been included in **Appendix C**.

SAFETY CULTURE

Nuclear safety culture is defined as the core values and behaviors resulting from a collective commitment by leaders and individuals to emphasize safety over competing goals to ensure protection of people and the environment. Individuals and organizations performing regulated activities bear the primary responsibility for safely handling and securing these materials. Experience has shown that certain personal and organizational traits are present in a positive safety culture. A trait, in this case, is a pattern of thinking, feeling, and behaving that emphasizes safety, particularly in goal conflict situations (e.g., production versus safety, schedule versus safety, and cost of the effort versus safety). **Table 2** show traits of a positive nuclear safety culture.

Table 2: Traits of a Positive Nuclear Safety Culture

Trait	Result
Leadership: Safety Values and Actions	Leaders demonstrate a commitment to safety in their decisions and behaviors
Problem Identification and Resolution	Issues potentially impacting safety are promptly identified, fully evaluated, and promptly addressed and corrected commensurate with their significance
Personal Accountability	All individuals take personal responsibility for safety
Evaluating Work Processes	The process of planning and controlling work activities is implemented so that safety is maintained
Continuous Learning	Opportunities to learn about ways to ensure safety are sought out and implemented
Environment for Raising Concerns	A safety conscious work environment is maintained where personnel feel free to raise safety concerns without fear of retaliation, intimidation, harassment, or discrimination
Effective Safety Communications	Communications maintain a focus on safety
Respectful Work Environment	Trust and respect permeate the organization
Questioning Attitude	Individuals avoid complacency and continually challenge existing conditions and activities in order to identify discrepancies that might result in error or inappropriate action

Individuals and organizations performing regulated activities are expected to establish and maintain a positive safety culture commensurate with the safety and security significance of their activities and the nature and complexity of their organizations and functions. This applies to all licensees, holders of quality assurance programs approvals, vendors, and suppliers of safety-related components, and applicants for a license or quality assurance program approval, subject to VDH authority. More information on activities relating to safety culture can be found at: http://www.nrc.gov/about-nrc/regulatory/enforcement/safety-culture.html.

APPLICABLE RULE

It is the applicant's or licensee's responsibility to obtain, read and follow **12VAC5-481 'Virginia Radiation Protection Regulations'**.

The following Parts of **12VAC5-481 'Virginia Radiation Protection Regulations'** contain requirements applicable to Industrial Radiography licensees:

- Part I 'General Provisions'
- Part III 'Licensing of Radioactive Material'
- Part IV 'Standards for Protection Against Radiation'
- Part V 'Radiation Safety Requirements for Industrial Radiographic Operations'
- Part X 'Notices, Instructions and Reports to Workers; Inspections'
- Part XIII 'Transportation of Radioactive Material'

Requests for single copies of the above documents (which may be reproduced) can be made in writing to: Virginia Department of Health, Radioactive Materials Program 109 Governor Street, Room 730, Richmond, VA 23219 or for an electronic copy go to our web site at: http://www.vdh.virginia.gov/Epidemiology/RadiologicalHealth/.

HOW TO FILE

Applicants for a materials license should do the following:

- Be sure to use the current guidance from VDH in preparing an application.
- Complete VDH Form, 'Application for a Radioactive Material License Authorizing the Use of Industrial Radiography' (**Appendix A**).
- For each separate sheet, other than submitted with the application, identify and key it to the item number on the application, or the topic to which it refers.
- Submit all documents, on 8-1/2 x 11 inch paper.
- Avoid submitting proprietary information unless it is absolutely necessary. If submitted, proprietary information and other sensitive information should be clearly identified and a request made to withhold from public disclosure.
- Submit an original, signed application. This submission can be made via scanned copies forwarded via facsimile or electronic mail or via postal mail of the documents.
- Retain one copy of the license application for your future reference.

Deviations from the suggested wording of responses as shown in this VAREG or submission of alternative procedures will require a more detailed review.

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

WHERE TO FILE

Applicants wishing to possess or use radioactive material in the Commonwealth of Virginia are subject to the requirements of **12VAC5-481 'Virginia Radiation Protection Regulations'** and must file a license application with:

Virginia Department of Health
Radioactive Materials Program
109 Governor Street, Room 730
Richmond, VA 23219

LICENSE FEES

The appropriate fee must accompany each application. Refer to **12VAC5-490** to determine the amount of the fee. VDH will not issue the new license prior to fee receipt. Once the technical review has begun, no fees will be refunded. Application fees will be charged regardless of VDH's disposition of an application or the withdrawal of an application.

Licensees are also subject to annual fees; refer to **12VAC5-490.**

Direct all questions about VDH's fees or completion of **Item 12** of VDH Form, 'Application for a Radioactive Material License Authorizing the Use of Industrial Radiography' (**Appendix A**) to: Virginia Department of Health, Radioactive Materials Program, 109 Governor Street, Room 730, Richmond, VA 23219 or (804) 864-8150.

CONTENTS OF APPLICATION

Item 1: Type of Application

Obtain the correct application form for either a new license or a renewal, check the appropriate box and, if appropriate, list the license number for a renewal.

This guide is written to instruct a new licensee in the process of applying for a radioactive material license. Not all discussions will be appropriate to a licensee renewing an existing license.

Item 2: Name and Mailing Address of Applicant

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

Notify the agency of changes in the mailing address.

The licensee must also provide sufficient information for the agency to ensure the proposed corporation or controlling legal entity is a valid entity. Verification of this identity can be accomplished by submitting a copy of the company's license from the NRC or another Agreement State or a government contract or certification, etc.

Note: The agency must be notified immediately in the event of change of ownership or control and bankruptcy proceedings, see below for more details.

Timely Notification of Change of Ownership or Control

Rule: 12VAC5-481-330, 12VAC5-481-450, 12VAC5-481-500

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

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

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

Appendix E identifies the information to be provided about transfer of control.

Notification of Bankruptcy Proceedings

Rule: 12VAC5-481-500

Criteria: 12VAC5-481-500 states: "*Each licensee shall notify the agency in writing immediately following the filing of a voluntary or involuntary petition for bankruptcy under any Chapter of Title 11 (Bankruptcy) of the United States Code by or against: 1. The licensee 2. An entity (as that term is defined in 11 USC §101 (15)) controlling the licensee or listing the license or licensee as property of the estate; or 3. An affiliate (as that term is defined in 11 USC §101 (2)) of the licensee*" and "*…shall indicate the bankruptcy court in which the petition for bankruptcy was filed and the date of filing of the petition*".

Discussion: Even though a licensee may have filed for bankruptcy, the licensee remains responsible for compliance with all regulatory requirements. VDH needs to know when licensees are in bankruptcy proceedings in order to determine whether all licensed material is accounted for and adequately controlled and whether there are any public health and safety concerns (e.g., contaminated facility). VDH shares the results of its determinations with other entities involved (e.g., trustees) so that health and safety issues can be resolved before bankruptcy actions are completed.

Licensees must notify VDH immediately of the filing of a bankruptcy petition.

Item 3: Person To Contact Regarding Application

Criteria: Identify the name and title of the individual who can answer questions regarding the application and include their telephone number.

Discussion: This is typically the proposed radiation safety officer or a knowledgeable management official, unless the applicant has named a different person as the contact. The agency will contact this individual if there are any questions about this application.

Notify the agency if the contact person or the contact person's telephone number changes so that the agency can contact the applicant or licensee in the future with questions, concerns, or information. This notice is 'for information only' and does not require a license amendment.

Item 4: Location of Radioactive Material

Rule: 12VAC5-481-450, 12VAC5-481-451, 12VAC5-481-500, 12VAC5-481-590, 12VAC5-481-1200, 12VAC5-481-1530

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

Discussion: Specify the street address, or other descriptive address (such as on Highway460, 5 miles east of the intersection of Highway 58 and State Route 234), city and zip code 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 not acceptable because the agency needs a specific address to allow an inspector to find the use and/or storage location**. If devices will NOT be stored at a dispatch site or field station, indicate this. The applicant should indicate whether a location will be used to perform radiographic operations, storage of sources and devices or used and stored.

The applicant should indicate if a permanent cell is located at the address.

Obtaining a VDH license does not relieve a licensee from complying with other applicable federal, state or local regulations (e.g., local zoning requirements for storage locations).

Note: As discussed later under "Financial Assurance and Record Keeping for Decommissioning," licensees do need to maintain permanent records on where licensed material was used or stored while the license was in force. This is important for making future determinations about the release of these locations for unrestricted use (e.g., before the license is terminated).

Item 5: Radiation Safety Officer (RSO)

Rule: 12VAC5-481-450, 12VAC5-481-451, 12VAC5-481-630, 12VAC5-481-1200, 12VAC5-481-1310

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

Discussion: The person responsible for the radiation protection program is called the RSO. The agency 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 radioactive materials are used in a safe manner. Typical RSO duties are illustrated in **Table 3.**

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 assists 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 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.

VDH requires the name of the RSO on the license to ensure that licensee management has identified a responsible, qualified person and that the named individual knows their designation as RSO. Provide the agency with a copy of an organizational chart showing the RSO and other designated responsible individuals, to demonstrate they have sufficient independence and direct communication with responsible management officials. Also show in the organizational chart the position of the individual who signs **Item 13** of the ‘Application for a Radioactive Material License Authorizing the use of Industrial Radiography’ (**Appendix A**).

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. Hands-on experience means experience in all areas considered to be directly involved in the radiography process, this includes taking radiographs, surveying devices, transporting the radiography equipment to temporary jobsites, posting, work sites, radiation area surveillance, and completing and maintaining records. 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.

The agency 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 on 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.

Table 3: Radiation Safety Officer Duties and Authorities

Radiation Safety Officer Duties and Authorities
1. Develop, distribute, implement, and maintain up-to-date operating, emergency, and ALARA procedures and review them regularly.
2. Oversee and approve the training program for radiographic personnel. Ensure personnel are trained as required and six-month worker audits are performed.
3. Ensure required radiation surveys are performed as required. Ensure survey meter calibrations are performed as required.
4. Ensure personnel monitoring devices are calibrated and used properly, and that records are kept of results and timely notifications are made.
5. Operations are conducted safely and corrective actions are implemented, when necessary, including terminating operations.
6. Perform and document radiation safety program audits annually.
7. Ensure required inventories, leak tests, etc. are conducted as required and records are maintained..
8. Ensure equipment inspection and maintenance is performed as required and records are maintained.
9. Investigate any incidents and respond to any emergencies.
10. Ensure security and control of material is maintained.
11. Preserve accountability of all sources and devices while in field and in the office and maintain utilization logs.
12. Oversee proper disposal of all material including transportation of the material according to VDH and DOT requirements.
13. Ensure that licensed material is transported in accordance with all applicable VDH and DOT requirements.
14. Conduct radiation safety inspections of licensed activities periodically to ensure compliance with te regulations and license conditions.
15. Maintain records as required.
16. Make reports and notifications of incidents to VDH as required.
Above all, the RSO is the key to maintaining the radiation safety of the operations to the workers, the public, and the environment.

Note: It is important to notify the agency 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 agency, 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 VDH rule.

Item 6: Training for Radiographers and Radiographer's Assistants

Rule: 12VAC5-481-450, 12VAC5-481-451, 12VAC5-481-630, 12VAC5-481-840, 12VAC5-481-1200, 12VAC5-481-1320, 12VAC5-481-1470, 12VAC5-481-2260, 12VAC5-481-2270, 12VAC5-481-2280, 12VAC5-481-2310

Criteria: Radiographers and radiographer's assistants must have adequate training and experience as outlined in **12VAC5-481-1320.**

Discussion:

- A radiographer is a person who performs or personally supervises industrial radiography and is responsible for ensuring compliance with VDH rules and the safe use of radioactive materials.
- A certified radiographer is an individual who has been certified by a certifying entity such that he/she has met established radiation safety, testing, and experience criteria.
- A radiographer's assistant is an individual, who under the direct supervision (in the physical presence) of the radiographer uses radiographic equipment in performing industrial radiographic operations.

12VAC5-481-1320 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 radiographer's 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 radiographer's assistants.

Because **12VAC5-481-1320** 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).

An internal inspection program (audit program) of the job performance of each radiographer and radiographer's assistant ensures that VDH's rules, 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.

The applicant shall:

- Submit an outline of the training to be given to prospective radiographer's assistants. Submit your procedures for experienced radiographers who have worked for another licensee.
- 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 radiographer's assistants. The agency 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 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 a 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 **12VAC5-481-1320 E.**

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

Radioactive Material

Item 7: Sealed Source Radioactive Material

Rule: 12VAC5-481-440, 12VAC5-481-450, 12VAC5-481-451, 12VAC5-481-500, 12VAC5-481-1151, 12VAC5-481-1210, 12VAC5-481-1230, 12VAC5-481-1250, 12VAC5-481-1270, 12VAC5-481-1400, 12VAC5-481-1420, 12VAC5-481-1430, 12VAC5-481-1440, 12VAC5-481-1450, 12VAC5-481-1210, 12VAC5-481-1530

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 radioactive material and associated equipment meeting VDH performance requirements and specifically approved or registered by the NRC or another 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: A maximum possession limit, per isotope, is required to be requested; this should reflect the total number of sealed sources and devices containing a particular isotope (i.e., Iriduium-192) that would ever be possessed at any one time, including inactive sources being held for storage and devices awaiting shipment. This should also include sources and devices expected to be purchased at in the future. This limit is isotope specific (i.e., one limit for Iridium-192 and another for Cobalt-60) and not allowed to be exceeded; that is, the total of all sources and devices in the licensee's possession cannot exceed this limit. An amendment request must be made and an amended license received prior to obtaining more sources and devices. Regulated Category 1 or Category 2 sources must be tracked in the National Source Tracking System (NSTS).

Possession limits can be obtained from information provided by the manufacturer; specifically, the activity provided by the manufacturer on the sources and devices the licensee anticipates acquiring. This information will list each isotope with the activity for the source and device. A simple calculation can be performed with this information by totaling the number of each source and device, per isotope, that the licensee expects to possess at any one time. For example; a licensee anticipates possessing three Iridium-192 cameras and 1 Cobalt-60 camera. The manufacturer states that each camera has a maximum quality of 120 Ci for Iridium-192 or 110 Ci of Cobalt-60. The licensee is able to perform the simple calculation (120 multiplied by 3 and 110 multiplied by 1) to request a 360 Ci maximum possession limit for Iridium-192 and a 110 Ci maximum possession limit of Cobalt-60.

Licensees are also required to maintain a limit per device. This is separate from the maximum possession limit; this limit is applied to each source and device itself and is typically determined by the manufacturer's Sealed Source and Device Registration Certificate.

The NRC or another 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 Registration (SSDR) Certificate issued to the manufacturer (or distributor). Therefore, if the source assemblies, exposure devices, or source changers are approved for use by the NRC or another Agreement State, 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.

SSDR Certificates contain sections on "*Conditions of Normal Use*" and "*Limitation and Other Considerations of Use*". These sections may include limitations derived from conditions imposed by the manufacturer or distributor, by particular conditions of use that would reduce radiation safety of the device, or by circumstances unique to the sealed source or device. For example, working life of the device or appropriate temperature and other environmental conditions are specified. Except as specifically approved by VDH, licensees are required to use gauges according to their respective SSDR Certificates. Applicants should obtain a copy of the certificate and review it with the manufacturer, distributor or with the agency, to ensure that they understand and comply with the requirements of the SSDR.

Note*:* If necessary and manufacturer cannot supply the certificate, SSDR certificates are also available by calling the agency at (804) 864-8150.

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 meets the performance requirements in **12VAC5-481-1210** that are equivalent to **10 CFR 34.20**. NRC Regulatory Issue Summary (RIS) 2005-10, 'Performance-Based Approach For Associated Equipment in 10 CFR 34.20' (**Appendix F**) alerts licensees to distinguish between items of equipment that are not. For example, the portion of the connector that is attached to the end of the control cable is actually a component of the source assembly and is subject to the safety evaluation that must be completed by the NRC or another Agreement State before the source assembly may be specifically authorized for use by a licensee. NRC RIS 2005-10 also contains a number of ways that licensees can demonstrate that their associated equipment meets the performance requirements stated in **12VAC5-481-1210**.

Mark all documents that provide specific possession limits of materials or describe security equipment appropriately as sensitive information.

Note: The following tables list several devices with associated radionuclides and amounts:

Table 4: **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	IN Model 32	120 Ci	Amersham 550-SU IN IR-50	120 Ci 120 Ci
Ir-192	IN Model 33	120 Ci	Amersham 550 -SU IN IR-50	120 Ci 120 Ci
Ir-192	Amersham 87703	120 Ci	Amersham 550 -SU Amersham 650L Amersham 820 Amersham 855 IN IR-50	120 Ci 240 Ci 1,000 Ci 960 Ci 120 Ci
Ir-192	Amersham 87704	120 Ci	Amersham 550 -SU Amersham 650 Amersham 820 Amersham 855	120 Ci 240 Ci 1,000 Ci 960 Ci
Ir-192	SPEC G-40F	120 Ci	Amersham 550 -SU SPEC C-1 IN IR-50	120 Ci 150 Ci 120 Ci
Ir-192	SPEC G-40T	120 Ci	Amersham 550 -SU SPEC C-1 IN IR-50	120 Ci 150 Ci 120 Ci

Table 5: **Spec Model 150 Exposure Device Maximum Authorization -- 150 Ci**

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

Table 6: **Amersham Model 680 System Exposure Device Maximum Authorization -- 110 Ci**

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

Table 7: **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
Ir-192	CIS-US 702	120 Ci	Amersham 550 -SU IN IR-50	120 Ci 120 Ci

			SPEC C-1	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: On July 1, 2013, the Model 660 Series device will no longer be an NRC-authorized transportation package. On this date, an approved package other than the Model 660 Series must be used for transport of the 660 Series radiography sources. This applies to the following models: 660, 660E, 660A, 660AE, 660B, and 660BE, see NRC Information Notice 2013-08.

Note: Radiography sources are usually at or above Category 2 quantities. Information submitted with the application including manufacturers, model numbers, and possession limits is sensitive and should be marked accordingly. Regulated Category 1 or Category 2 sources must be tracked in the National Source Tracking System (NSTS).

Item 8: Financial Assurance and Recordkeeping for Decommissioning

Rule: 12VAC5-481-100, 12VAC5-481-450, 12VAC5-481-490, 12VAC5-481-500, 12VAC5-481-510, 12VAC5-481-570, 12VAC5-481-571, 12VAC5-481-1161

Criteria: A licensee authorized to possess licensed material in excess of the limits specified in **12VAC5-481-450 C** must meet the requirements for decommissioning financial assurance.

All licensees are required to maintain, in an identified location, records of information important to decommissioning of the facility until the site, or any area, is released for unrestricted use. Licensees must transfer records important to decommissioning either to the new licensee before licensed activities are transferred or assigned in accordance with **12VAC5-481-500** or to VDH before the license is terminated.

Discussion: VDH wants to ensure that decommissioning will be carried out with minimum impact on public and occupational health and safety and the environment. There are two parts to the rule: financial assurance that applies to SOME licensees, and recordkeeping that applies to ALL licensees.

The requirements for financial assurance are specific to the types and quantities of radioactive 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 radioactive material are 3.7×10^5 Bq (10,000 curies) of cobalt-60 and 3.7×10^6 Bq (100,000 curies) of cesium-137 or radioactive 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 rule also requires that licensees maintain records important to decommissioning in an identified location. All industrial radiography licensees need to maintain records of structures and equipment where radioactive material was used or stored. As-built drawings with modifications of structures and equipment shown as appropriate fulfill this requirement. If drawings are not available, licensees shall substitute appropriate records (e.g., a sketch of the room or building or a narrative description of the area) concerning the specific areas and locations. If no records exist regarding structures and equipment where radioactive materials were used or stored, licensees shall make all reasonable efforts to create such records based upon historical information (e.g. employee recollections). In addition, if radiography licensees have experienced unusual occurrences (e.g., incidents that involve spread of contamination, leaking sources), they also need to maintain records about contamination that remains after cleanup or that may have spread to inaccessible areas.

If financial assurance is required, submit the documentation required under **12VAC5-481-450 C**. NRC NUREG-1757, Vol. 3, 'Consolidated NMSS Decommissioning Guidance: Financial Assurance, Recordkeeping, and Timeliness' contains acceptable wording for each mechanism authorized by the regulation to guarantee or secure funds. This document is available from the NRC website at: www.nrc.gov or the agency upon request.

Item 9: Facilities and Equipment

Rule: 12VAC5-481-450, 12VAC5-481-451, 12VAC5-481-630, 12VAC5-481-640, 12VAC5-481-720, 12VAC5-481-780, 12VAC5-481-840, 12VAC5-481-850, 12VAC5-481-860, 12VAC5-481-880, 12VAC5-481-1200, 12VAC5-481-1270, 12VAC5-481-1280, 12VAC5-481-1290, 12VAC5-481-1420, 12VAC5-481-1450, 12VAC5-481-1460, 12VAC5-481-1520

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

Discussion: A permanent radiographic installation is an enclosed shielded room, cell, or vault, not located at a temporary jobsite, in which radiography is 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 installation, 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 VDH. If licensees need to perform radiography at their place of business outside of a permanent radiographic installation due to unique circumstances (the item to be radiographed is too large for the facility), then VDH must authorize this method of use. In this case, two individuals must be present whenever radiographic operations occur outside of a permanent radiographic 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. In order to ensure this control, a permanent radiographic installation 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 a permanent radiographic installation should qualify as an unrestricted area (i.e., not to exceed 2 mR in one-hour), the rule does not specify radiation limits in order to allow for design flexibility for moving equipment into and out of the permanent radiographic installation, or other considerations. If the roof of the installation 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 entrances into the installation must be interlocked with required control devices as per **12VAC5-481-1280**. Unless all entrances are locked, at least one radiographer must be present at the facility whenever radiography is being performed.

A field station is a facility where licensed material may be stored 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.

A restricted area is an area that licensees limit access for the purpose of protecting individuals from undue risks from exposure to sources of radiation. 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:

- 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.

- Diagram depicting the shielding, layout, and audible-visual alarms. A diagram of the installation is helpful in evaluating the shielding and determining compliance with rules regarding restricted and unrestricted areas, location of access points, and locations of audible-visible signals. **Figure 1** shows an example installation diagram.

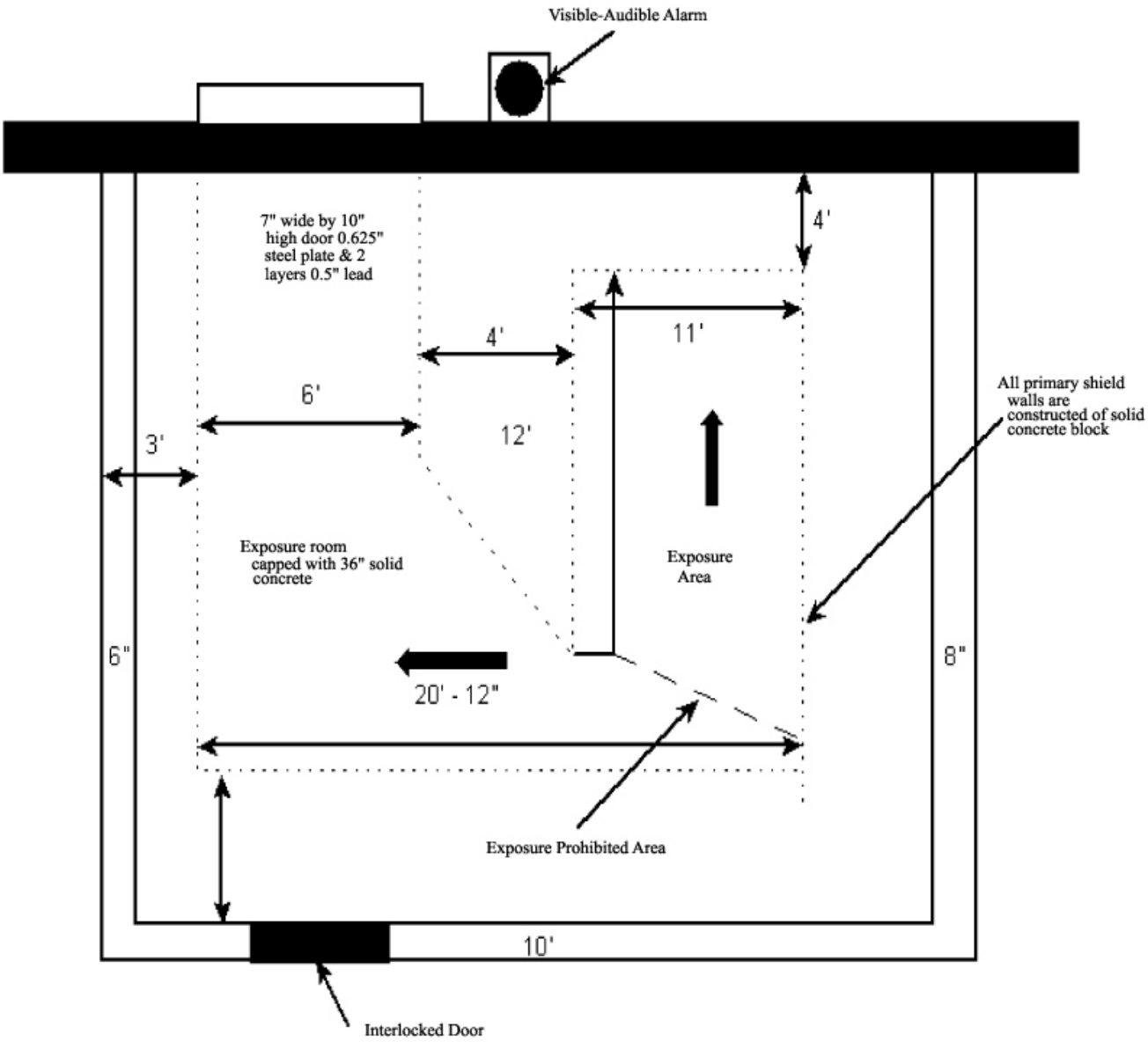

Figure 1: **Diagram of a Permanent Radiographic Installation.**

- 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 doses in all directions around the installation that are below 0.02 mSv (2 mrem) in any one-hour are considered acceptable. If the radiation doses 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 mrem) 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 mrem) 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 mrem) in any one hour or 1 mSv (100 mrem) in a year.

Provide the following as applicable:

- 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 ½" 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 entranceways 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 4** (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 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 dose 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 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:
  - Procedures for ensuring that no individual is on the roof or could gain access to the roof during radiography;
  - Means of preventing access to the roof;
  - A commitment that the roof will be posted with "*Caution (or Danger) Radiation Area*" signs;
  - Steps taken to minimize radiation on the roof; and
  - 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 doses on the radiography installation roof 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:
  - A commitment that the roof will be posted with "*Caution (or Danger) High Radiation Area*" signs;
  - Evidence of constant surveillance of the roof by closed circuit TV;
  - Fluctuation of the dose rate;
  - 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 accesses the roof; and
  - A description of a control device that activates a visible-audible signal so that both an individual accessing the roof and the radiographer on duty are made aware of the entry.

- Field Stations:
  - Describe the storage location(s) at the address(es) listed in **Item 4** 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.

Mark drawings and diagrams that provide exact location of materials or depict specific locations of safety or security equipment appropriately as sensitive information.

Note: Certain records described in the rule pertaining to radiation safety may need to be on file at these field stations and each temporary jobsite.

Radiation Safety Program

Item 10: Radiation Safety Program

Rule: 12VAC5-481-450, 12VAC5-481-500, 12VAC5-481-630, 12VAC5-481-990, 12VAC5-481-1200

Criteria: A radiation protection program must be established and submitted to the agency 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:

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

Discussion: The specific components of the applicant's radiation safety program are detailed in this guide. 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 VDH requirement.

Item 10.1: Radiation Safety Program Audit

Rule: 12VAC5-481-450, 12VAC5-481-500, 12VAC5-481-630, 12VAC5-481-990

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

- Compliance with VDH and DOT requirements, and the terms and conditions of the license;
- Occupational doses and doses to members of the public that are ALARA; and
- 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 the agency. 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 the agency should contain the following information:

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

It is essential that once identified, problems be corrected in a timely manner. NRC Information Notice (IN) 96-28, 'Suggested Guidance Relating to Development and Implementation of Corrective Action' provides guidance on this subject. The agency 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 agency can exercise discretion and may elect not to cite a violation. The agency's goal is to encourage prompt identification and prompt comprehensive correction of violations and deficiencies.

Item 10.2: Termination of Activities

Rule: 12VAC5-481-100, 12VAC5-481-450, 12VAC5-481-490, 12VAC5-481-500, 12VAC5-481-510, 12VAC5-481-570, 12VAC5-481-571, 12VAC5-481-1161

Criteria: The licensee must do the following:

- Notify the agency, in writing, within 60 days of:
  - The expiration of its license;
  - A decision to permanently cease licensed activity at the entire site or in any separate building or outdoor area if it contains residual radioactivity making it unsuitable for release according to VDH requirements;
  - No principal activities have been conducted at the entire site under the license for a period of 24 months;
  - No principal activities have been conducted for a period of 24 months in any separate building or outdoor area if it contains residual radioactivity making it unsuitable for release according to VDH requirements.
- Submit a decommissioning plan, if required by **12VAC5-481-510;**
- Decommissioning, as required by **12VAC5-481-510 & 12VAC5-481-1161;**
- Submit to the agency, a completed VDH form 'Certificate of Disposition of Materials' (**Appendix B**) and demonstrate that the premises are suitable for release for unrestricted use (e.g. results of final survey); and
- Before a license is terminated, send the records important to decommissioning to the agency as required by **12VAC5-481-571**. If licensed activities are transferred or assigned in accordance with **12VAC5-481-500**, transfer records important to decommissioning to the new licensee.

Discussion: For guidance on the disposition of radioactive material, see **Item 11** 'Waste Management'. For guidance on decommissioning records, see **Item 8** 'Financial Assurance and Record Keeping for Decommissioning'.

Licensees must use the VDH Form, 'Certificate of Disposition of Materials' (**Appendix B**) when submitting for termination of a license.

Item 10.3: Instruments

Rule: 12VAC5-481-450, 12VAC5-481-490, 12VAC5-481-750, 12VAC5-481-900, 12VAC5-481-1000, 12VAC5-481-1240, 12VAC5-481-1260, 12VAC5-481-1270, 12VAC5-481-1330, 12VAC5-481-1410

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.

Discussion: The 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 instrument 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 instrument servicing, except for battery changes. Records of survey instrument calibrations will be retained for a minimum of 3 years. Records are to be made of equipment problems and maintenance performed and these shall be retained for 3 years.

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.

Item 10.4: Material Receipt and Accountability

Rule: 12VAC5-481-100, 12VAC5-481-450, 12VAC5-481-500, 12VAC5-481-570, 12VAC5-481-571, 12VAC5-481-840, 12VAC5-481-900, 12VAC5-481-980, 12VAC5-481-1090, 12VAC5-481-1260, 12VAC5-481-1400, 12VAC5-481-1430, 12VAC5-481-1440, 12VAC5-481-3091, 12VAC5-481-3100

Criteria: Licensees must do the following:

- Maintain records of receipt, transfer, and disposal of sources/devices
- Update transactions in the NSTS, including an annual inventory reconciliation;
- Conduct physical inventories at quarterly intervals (not to exceed 3 months) to account for all sources of radiation and for devices, including devices containing depleted uranium; and
- Maintain utilization logs to account for all sources of radiation and for devices when removed from storage.

Discussion: 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.

Licensees must conduct physical inventories (i.e., locate, verify the presence of the material, and account for it in material transfer record) 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:

- Radionuclide and amount (in units of Bq or curies) of radioactive material in each sealed source;
- Manufacturer's name, model number, and serial number of each sealed source;
- Manufacturer's name, model number, and serial number of each device containing depleted uranium or radioactive material;
- Location of each sealed source and device;
- Date of the inventory; and
- Name of individual performing inventory.

'Cradle to Grave' accountability refers to maintaining the radioactive material from the moment it becomes a part of your organization through performing the physical inventories (ensuring the material's location, etc) until it leaves your organization (through transfer, return to manufacturer/distributor, or disposal to properly licensed facility).

Item 10.5: Leak Tests

Rule: 12VAC5-481-180, 12VAC5-481-740, 12VAC5-481-1010, 12VAC5-481-1150, 12VAC5-481-1200, 12VAC5-481-1250, 12VAC5-481-1420

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

Discussion: Manufacturers, consultants, and other organizations may be authorized by VDH**,** the NRC or another 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 by VDH 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 radioactive material must be leak tested at intervals not to exceed 6 months and DU devices tested at intervals not to exceed 12 months.

Note: Requests for authorization to perform leak testing and sample analysis will be reviewed on a case-by-case basis and, if approved, VDH staff will authorize via a license condition. Alternative procedures will be evaluated against **Appendix K** criteria.

Item 10.6: Occupational Dosimetry

Rule: 12VAC5-481-630, 12VAC5-481-640, 12VAC5-481-690, 12VAC5-481-700, 12VAC5-481-710, 12VAC5-481-750, 12VAC5-481-760, 12VAC5-481-770, 12VAC5-481-1030, 12VAC5-481-1040, 12VAC5-481-1350, 12VAC5-481-2280

Criteria: Licensees must provide to employees dosimetry processing that has been accredited under the National Voluntary Laboratory Accreditation Program (NVLAP) operated by the National Institute of Standards and Technology (NIST).

Table 8: Occupational Dose Limits For Adults

Occupational Dose Limits for Adults (12VAC5-481-640)	
Body Location	Dose (Annual)
Total Effective Dose Equivalent (TEDE)	0.05 Sv (5 Rem)
Dose to the skin of the whole body or any extremity*	0.5 Sv (50 Rem)
Dose to lens of the eyes	0.15 Sv (15 Rem)
**Extremities includes the arms below the elbows and the legs below the knees*	

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 optical stimulated lamination (OSL) or similar approved device. 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. Alarming ratemeters must be preset to give an alarm signal at a dose rate of 5 Sv/hr (500 mrem/hr) and must be calibrated for correct response at intervals not to exceed 12 months.

Film badges, OSLs or similar approved devices must be replaced at frequencies not to exceed 1 month.

Note: 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.

Item 10.7: Public Dose

Rule: 12VAC5-481-630, 12VAC5-481-720, 12VAC5-481-730, 12VAC5-481-840, 12VAC5-481-1050, 12VAC5-481-1230, 12VAC5-481-1280, 12VAC5-481-1330, 12VAC5-481-1370, 12VAC5-481-3080

Criteria: Licensees must do the following:

- 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; and
- Control and maintain constant surveillance over devices that are not in storage and secure stored devices from unauthorized removal or use.

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. An example of a properly stored device would be a locked room a sufficient distance from any individual, especially personnel. Use of area monitors such as an OSL 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 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.

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

Item 10.8: Quarterly Maintenance

Rule: 12VAC5-481-630, 12VAC5-481-1210, 12VAC5-481-1260, 12VAC5-481-1270, 12VAC5-481-1290, 12VAC5-481-1330, 12VAC5-481-1430, 12VAC5-481-1450, 12VAC5-481-3130

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.

Operating and Emergency Procedures

Item 10.9: Operating and Emergency Procedures

Rule: 12VAC5-481-450, 12VAC5-481-630, 12VAC5-481-840, 12VAC5-481-860, 12VAC5-481-880, 12VAC5-481-900, 12VAC5-481-1090, 12VAC5-481-1100, 12VAC5-481-1110, 12VAC5-481-1200, 12VAC5-481-1330, 12VAC5-481-1480, 12VAC5-481-1520, 12VAC5-481-2260

Criteria: Operating and emergency procedures must be established and submitted to the agency 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:

- Instructions for maintaining security during storage and transportation;
- Instructions to keep radiography devices under control and immediate surveillance during use;
- Instructions for appropriate handling and use of sources of radiation;
- Steps to take to keep radiation exposures ALARA;
- Steps to maintain accountability during use;
- Steps to control access to work sites;
- Methods and occasions for conducting radiation surveys;
- Methods for posting and controlling access to radiographic area;
- Use of personnel monitoring and radiation survey equipment;
- Instruction for packaging and transporting licensed material;
- Steps to take and whom to contact when an emergency occurs;
- Steps that must be taken immediately in the event of a pocket dosimeter is found to be off-scale or an alarming ratemeter alarms unexpectedly;
- Instructions for the inspection, maintenance, and operability checks of radiographic devices and associated equipment, survey instruments, and personnel monitoring equipment;
- Instructions for identifying and reporting defects and noncompliance;
- Source recovery procedure; and
- Instructions for maintaining records.

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 agency 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 agency. 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:

- Transport of licensed material;
- Storage facilities for licensed material;
- Methods for restricting access to radiation areas;
- Radiation safety procedures and radiographer responsibilities unique to lay-barge, offshore platform, or underwater radiography;
- Radiographic equipment and radiation safety procedures unique to underwater radiography;
- Methods appropriate for use of equipment in water environments;
- Applicable inspection and maintenance procedures unique to lay-barge, offshore platform, or underwater radiography equipment; and
- Emergency procedures unique to lay-barge, offshore platform, or underwater radiography.

Operating and emergency procedures must be submitted to the agency 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 VDH's authorization for a new sealed source/device combination.

Item 10.9.1: Handling and Use of Sealed Sources and Radiography Exposure Devices

Rule: 12VAC5-481-1210, 12VAC5-481-1330

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 installation. 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.

Note: 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.

Item 10.9.2: Methods and Occasions for Conducting Radiation Surveys

Rule: 12VAC5-481-720, 12VAC5-481-730, 12VAC5-481-900, 12VAC5-481-1210, 12VAC5-481-1220, 12VAC5-481-1240, 12VAC5-481-1250, 12VAC5-481-1360, 12VAC5-481-2980, 12VAC5-481-3080

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 **12VAC5-481-1240**. The following table provides examples of surveys, made during radiographic and associated operations that should be included in the operating and emergency procedures.

Table 9: **Surveys Required for Radiographic Operations**

Type of Radiation Survey	Frequency	Requirement
Boundary of restricted area at temporary jobsite does not exceed 0.02 mSv (2 mrem) in any one hour	During the first exposure for each set up of radiographic device	**12VAC5-481-720**
Unrestricted area in vicinity of permanent radiographic installation or storage area does not exceed 1 mSv (100 mrem) per year	At intervals not to exceed 12 months	**12VAC5-481-730**
External radiation levels when a package is received and opened	Each receipt of package	**12VAC5-481-900**
Exposure rate does not exceed 2 mSv/hr (200 mrem/hr) on surface and 0.1 mSv/hr (10 mrem/hr) at one meter	Each installation of new source in exposure device	**12VAC5-481-1210 A**
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.	Each installation of new source in a storage container or source changer	**12VAC5-481-1220**
Contamination level for leak tests of sealed sources does not exceed 185 Bq (0.005 microcuries)	At intervals not to exceed 6 months	**12VAC5-481-1250 C**
Contamination level for leak test of S tube of exposures device does not exceed 185 Bq (0.005 microcuries)	At intervals not to exceed 12 months	**12VAC5-481-1250 E**
Confirm source has returned to a shielded position	After every radiographic exposure	**12VAC5-481-1360 2**
Confirm source is in shielded position	After every source exchange or exposure device is placed in storage	**12VAC5-481-1360 3**
Exposure rates meet labeling of package (i.e., Yellow II) and determine Transportation Index	Every movement of licensed material on public roads	**12VAC5-481-2980 A**
Exposure rates in and around vehicle do not exceed 0.002 mSv/hr (2 mrem/hr) in	Every movement of a package	**12VAC5-481-3080**

driver's seat, 2 mSv/hr (200 mrem/hr) on surface and 0.1 mSv/hr (10 mrem/hr) at 2 meters from vehicle	labeled Yellow III	

Item 10.9.3: Methods for Controlling Access to Radiographic Areas

Rule: 12VAC5-481-780, 12VAC5-481-840, 12VAC5-481-860, 12VAC5-481-1230, 12VAC5-481-1280, 12VAC5-481-1290, 12VAC5-481-1300, 12VAC5-481-1330, 12VAC5-481-1370, 12VAC5-481-1380, 12VAC5-481-1460, 12VAC5-481-1500

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:

1. Field/Temporary Jobsites

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 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.

All areas where radiographic operations are conducted require posting of the radiation areas and the high radiation areas. 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. Operating procedures and instruction to personnel should include specific steps for these circumstances to ensure that access into the restricted area is properly controlled. Adequate control of the restricted area at with multiple levels would require several personnel and many postings. 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.

2. 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:

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

- The entrance control device is labeled as defective;
- Radiography personnel maintain continuous, direct, visual surveillance of access installation points; and
- Radiography personnel use an alarming rate meter.

3. Storage Areas

Radiographic equipment containing licensed material stored in controlled or unrestricted areas must be secured from unauthorized removal or access. Operating procedures should specify how stored licensed material should be secured and who has 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. 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 45 cm (18 inches) 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.

Item 10.9.4: Methods And Occasions For Locking And Securing Radiographic Exposure Devices, Storage Containers, and Sealed Sources

Rule: 12VAC5-481-840, 12VAC5-481-1210, 12VAC5-481-1230, 12VAC5-481-1360

Criteria: **12VAC5-481-840** and **12VAC5-481-1230** 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. If a radiographer had to leave an exposure device at a temporary jobsite, it would have to be secured against unauthorized removal or tampering by using the lock on the device and then locking it in an available space such as a shed, room, etc. Likewise, while in storage to and from the temporary jobsite, the radiographer would ensure the lock is on the device and then lock the device in the trailer, etc. Radiographers and/or radiographer's 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.

10.9.5: Personnel Monitoring and the Use of Personnel Monitoring Equipment

Rule: 12VAC5-481-630, 12VAC5-481-640, 12VAC5-481-710, 12VAC5-481-750, 12VAC5-481-760, 12VAC5-481-770, 12VAC5-481-1040, 12VAC5-481-1330, 12VAC5-481-1350, 12VAC5-481-1490, 12VAC5-481-2280

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

Discussion: All radiographers or radiographer's assistants are required to wear on the trunk of their body:

- Direct-reading dosimeters;
- Film badges, OSLs or similar devices; and
- Alarm ratemeters when they are engaged in radiographic field operations.

Film badges, OSLs or similar devices 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.

All radiographers or radiographer's 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.

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.

Note: It is good practice to check the dosimeter during the work shift.

Item 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

Rule: **12VAC5-481-630, 12VAC5-481-1210, 12VAC5-481-2980, 12VAC5-481-3070, 12VAC5-481-3080, 12VAC5-481-3091, 12VAC5-481-3100, 12VAC5-481-3130, 49 CFR Parts 171-178**

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

Discussion: During an inspection, the agency uses the provisions of **12VAC5-481-2980** which incorporates the requirements of **49 CFR**, 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 VDH/DOT requirements; and 3) two sample shipping papers, the second of which may be more useful for multiple-use, temporary jobsite activities.

Instructions to personnel should not reference VDH/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:

- Labeling containers appropriately (i.e., when to use labels Radioactive White I, Radioactive Yellow II, or Radioactive Yellow III);
- Securing the exposure device or storage container within the transporting vehicle. The instructions should specify how to prevent the package from moving during transport;
- 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;
- 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);
- Ensure that the licensees name and city/town is prominently displayed as a label on both sides of the vehicle; and
- 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.

Because the licensee may have authorization to possess and use several sealed source/device combinations that are registered by the NRC or another Agreement State and meet the safety performance requirements of **12VAC5-481-1210**, 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.

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 Certificate of Compliance (COC).

Note: 'A Review of Department of Transportation Regulations for Transportation of Radioactive Materials' can be obtained by calling DOT's Office of Hazardous Material Initiatives and Training at (800) 467-4922.

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 **10 CFR 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.

Item 10.9.7: Daily Inspection and Maintenance of Radiography Equipment

Rule: 12VAC5-481-1210, 12VAC5-481-1240, 12VAC5-481-1260, 12VAC5-481-1270, 12VAC5-481-1280, 12VAC5-481-1290, 12VAC5-481-1330, 12VAC5-481-1350, 12VAC5-481-1360, 12VAC5-481-1410, 12VAC5-481-1430, 12VAC5-481-1450, 12VAC5-481-1460, 12VAC5-481-1490

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. Licensees must check survey instrument operability using check sources or other appropriate means.

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 obtained by contacting the 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 measures taken include:

- Immediately label faulty equipment as defective;
- The radiographer must be accompanied by at least one other radiographer or radiographer's assistant;
- Continuous surveillance requirements are implemented until repairs are completed;
- Alarming ratemeters shall be worn and checked for alarm function at the beginning of each shift; and
- Records must be maintained of faulty equipment.

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

Note: Direct reading dosimetry devices must be recharged at the start of each shift 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 per **12VAC5-481-1490.**

Item 10.9.8: Ratemeter Alarms or Off-Scale Dosimeter Readings

Rule: 12VAC5-481-1320, 12VAC5-481-1330, 12VAC5-481-1350 D

Criteria: Licensees must instruct personnel in:

- Appropriate handling and use of sealed radioisotope sources and radiography devices;
- 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;
- The operating and emergency procedures;
- Actions to be taken if a dosimeter shows an off-scale reading or an alarm ratemeter alarms (sounds, etc.) unexpectedly;
- Procedures to be followed if a film badge, OSL, or similar device is lost or damaged;
- Steps that must be taken immediately in the event of a pocket dosimeter is found to be off-scale or an alarming ratemeter alarms unexpectedly; and
- 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 a 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, OSL or similar approved device must be sent for processing within 24 hours. The affected individual may not resume work with radioactive material until the RSO or designee has determined the individual's radiation exposure. **There are no exemptions to this requirement**.

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

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

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

Item 10.9.9: Procedure For Identifying And Reporting Defects And Non-Compliance

Rule: 12VAC5-481-1090, 12VAC5-481-1100, 12VAC5-481-1150, 12VAC5-481-1330, 12VAC5-481-1530

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

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

Note: See NRC IN 91-39 'Compliance with 10 CFR part 21, Reporting of Defects and Non-compliance'. This is available from the NRC website at www.nrc.gov.

Item 10.9.10: Required Notifications

Rule: 12VAC5-481-1090, 12VAC5-481-1100, 12VAC5-481-1110, 12VAC5-481-1150, 12VAC5-481-1250, 12VAC5-481-1330, 12VAC5-481-1520, 12VAC5-481-1530

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 persons may also include the exposure device manufacturer and the agency. The emergency procedures shall always be available to radiography personnel during radiography and up-to-date.

VDH rules also require immediate notification upon the discovery of certain events. Notify the agency when radiographic devices are lost or stolen or if there is indication of overexposure. Refer to the rule stated above or to **Appendix P** for additional guidance in the preparation of emergency procedures. **Table 10** below provides a description of events that require notification and/or reports.

Table 10: Required Notifications

EVENT	TEL. NOTIFICATION	WRITTEN REPORT	RULE
Fire, explosion or toxic gas release	Immediate	30 days	**12VAC5-481-1100**
Unplanned contamination event	24 hours	30 days	**12VAC5-481-1100**
Equipment is disabled or fails to function as designed	24 hours	30 days	**12VAC5-481-1100**
Theft or loss of material	Immediate	30 days	**12VAC5-481-1090**
Whole body dose greater than 0.25 Sv (25 rems)	Immediate	30 days	**12VAC5-481-1100**
Extremity dose greater than 2.5 Sv	Immediate	30 days	**12VAC5-481-1100**

(250 rems)			
Whole body dose greater than 0.05 Sv (5 rems) in 24 hours	24 hours	30 days	**12VAC5-481-1100**
Extremity dose greater than 0.5 Sv (50 rems) in 24 hours	24 hours	30 days	**12VAC5-481-1100**
Whole body dose greater than 0.05 Sv (5 rems)	None	30 days	**12VAC5-481-1110**
Dose to minor greater than 5mSv (500 mrem)	None	30 days	**12VAC5-481-1110**
Dose to embryo or fetus of a declared pregnant woman greater than 5 msv (500 mrem)	None	30 days	**12VAC5-481-1110**
Dose to individual member of public greater than 1 mSv (100 mrems)	None	30 days	**12VAC5-481-1110**
Any applicable limit in the license or registration	None	30 days	**12VAC5-481-1110**
Leak test of sealed source or guide tube greater than 185 Bq (0.005 Ci)	None	5 days	**12VAC5-481-1250 D**
Unintentional disconnection of the source assembly from the control cable	None	30 days	**12VAC5-481-1530 A**
Inability to retract the source assembly to its fully shielded position and secure it in its retracted position	None	30 days	**12VAC5-481-1530 A**
Failure of any component which is critical to safe operation of the device to properly perform its intended function	None	30 days	**12VAC5-481-1530 A**
An indicator on radiation machine fails to show that radiation is being produced, and exposure switch fails to terminate production of radiation when turned to the off position or a safety interlock fails to terminate x-ray production	None	30 days	**12VAC5-481-1530 A**
Use of licensed material at any location not on license for more than 180 days in a calendar year	Notify the agency prior to exceeding 180 days	None	**12VAC5-481-1530 C**

Note: Telephone notifications shall be made to the agency at (804) 864-8150 during normal business hours (8 a.m. – 4:30 p.m.) For immediate notifications after normal business hours, the 24 hour emergency telephone number is (804) 674-2400 or (800) 468-8892. Identify the emergency as radiological.

Item 10.9.11: Minimizing Exposure Of Persons In The Event Of An Accident

Rule: 12VAC5-481-630, 12VAC5-481-1330

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

Discussion: Since it is not possible to specify all possible situations that would constitute an emergency, a general instruction is acceptable. 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.

General instructions that give a basic idea of how to react when something unexpected happens should include such direction as immediately move away from the source, while at a safe distance from the source and maintaining a low exposure, calm down and begin to survey to verify the boundary of the restricted area (2 mR/hr boundary). Remain at this boundary, but maintain visual surveillance of source. Contact RSO or designee; however, do not leave where you cannot maintain surveillance of source, send someone to the phone if necessary.

Item 10.9.12: Source Retrieval

Rule: 12VAC5-481-1330, 12VAC5-481-1530

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 agency 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 a licensee whose is specifically authorized for these activities by VDH, NRC or another Agreement State.

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

The agency 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:

- Warnings that only specifically authorized individuals, or personnel supervised by such authorized individuals and working in their presence are allowed to perform retrievals;
- A clear statement that no source or suspected source containing items such as a stuck source in a guide tube will be handled directly;
- 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;
- Additional dosimetry should be used during source retrievals, for example, pocket dosimeters with a range greater than 2 mSv (200 mrems) or finger badges;
- Methods of restricting access to the area, including establishing a restricted area and obtaining outside help in controlling access;
- Appropriate use of survey instruments. The procedure should prohibit using alarming dosimeters or electronic dosimeters as survey instrument substitutes;
- Criteria for requesting outside assistance;

- Instructions for reducing the exposure to other personnel and members of the public during recovery operations;
- Notification of the RSO/RSO-designee, and management;
- Specific training including practice with special tools, shielding, and additional dosimetry with a dummy source; and
- Notification to the agency.

Note: Radiography personnel should not attempt to perform operations involving retrieval or recovery unless they have actual training in retrieval operations using a dummy source with the appropriate handling tools, survey instruments, and dosimetry. Source retrieval must be specifically authorized on the license.

Item 10.9.13: Maintenance Of Records

Rule: 12VAC5-481-10, 12VAC5-481-100, 12VAC5-481-451, 12VAC5-481-571, 12VAC5-481-980, 12VAC5-481-1330, 12VAC5-481-1350, 12VAC5-481-1360, 12VAC5-481-1390, 12VAC5-481-1430, 12VAC5-481-1440, 12VAC5-481-1450, 12VAC5-481-1480, 12VAC5-481-1490, 12VAC5-481-1500, 12VAC5-481-1520

Criteria: The licensee shall meet VDH record requirements.

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

- 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.
- Records of daily inspection of equipment;
- 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; and
- Results of the physical survey to ensure that the sealed source is in the shielded position, when a radiographic exposure device is placed in a storage area (as defined in **12VAC5-481-10**) and if that survey is the last one performed in the workday.

Operations requiring records include inspections and maintenance at intervals not to exceed 3 months. Other examples include instrument calibration and shipment of packages. Radiography personnel should also be aware of the records that must be maintained at temporary jobsites listed in **12VAC5-481-1520 B**. 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.

Item 10.10: Minimization of Contamination

Rule: **12VAC5-481-450, 12VAC5-481-1200, 12VAC5-481-1250**

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.

Discussion: All applicants for new licenses need to consider the importance of designing and operating their facilities 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 source and devices that are approved by the NRC or another Agreement State and located and used according to their respective SSDR Certificates usually pose little risk of contamination. Leak tests performed as specified in **12VAC5-481-1250** should identify defective sources. Leaking sources must be withdrawn from use and decontaminated, repaired, or disposed of according to **12VAC5-481, 'Virginia Radiation Protection Regulations'**. 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.

Note: The applicant does not need to provide a response to this item. The agency will consider that the above Criteria have been met if the applicant's responses meet the criteria for the following items: 'Sealed Sources and Devices', 'Facilities and Equipment', 'Leak Tests', 'Operating and Emergency Procedures', and 'Waste Management'.

Item 11: Waste Management

Rule: 12VAC5-481-100, 12VAC5-481-500, 12VAC5-481-570, 12VAC5-481-571, 12VAC5-481-910, 12VAC5-481-980, 12VAC5-481-2980, 12VAC5-481-3100

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

Discussion: Licensees who dispose of radiography sealed sources, or dispose of radiography devices containing depleted uranium, must transfer them to an authorized recipient. Recipients authorized to accept radioactive material are the original manufacturer of the device, or a commercial firm licensed by VDH, the NRC or another Agreement State.

Before transferring radioactive material, a licensee must use one of the methods described in **12VAC5-481-570 D** 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 VDH/DOT requirements. Records of the transfer must be maintained as required by **12VAC5-481-571**.

If the source activity exceeds activities listed in **12VAC5-481-451** or **12VAC5-481-1151**, the transfer transaction must be conducted and reported in compliance with the specific regulation.

Note: Because of the difficulties and costs associated with disposal of sealed sources containing radioactive 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.

Item 12 License Fees

For a listing of application fees, please see **12VAC5-481-490**. On VDH form, 'Application for a Radioactive Material License Authorizing the Use of Industrial Radiography' (**Appendix A**), enter the fee category and the amount of the fee enclosed with the application.

Item 13: Certification

Individuals acting in a private capacity are required to sign and date VDH Form, 'Application for a Radioactive Material License Authorizing the Use of Industrial Radiography' (**Appendix A**). Otherwise, senior representatives of a corporation or legal entity must sign and date VDH Form, 'Application for a Radioactive Material License Authorizing the use of Industrial Radiography' (**Appendix A**). **Representatives signing an application must be authorized to make binding commitments and sign official documents on behalf of the applicant.** The agency will return all unsigned applications for proper signature**.**

Note:

- It is a violation of **12VAC5-481-30** to make a willful false statement or representation on applications or correspondence.
- When the application references commitments, those items become part of the licensing conditions and regulatory requirements

Security Program

Rule: 12VAC5-481-451, 12VAC5-481-840, 12VAC5-481-1151

Criteria: Licensees must ensure the security and control of licensed material.

Discussion: 12VAC5-481-840 requires licensees to secure radioactive materials from unauthorized removal or access while in storage and to control and maintain constant surveillance over licensed material that is not in storage.

12VAC5-481-1151 requires that each licensee who manufacturers, transfers, receives, disassembles, or disposes of a nationally tracked source complete and submit a National Source Tracking Transaction Report. The NSTS is a secure, accessible, and easy-to-use computer system that tracks high –risk radioactive sources from the time they are manufactured or imported through the time of their disposal or export, or until they decay enough to no longer be of concern.

12VAC5-481-451 requires licensees to implement enhanced security to control access to Category 1 and Category 2 quantities of radioactive material and to protect sensitive security related information. The regulation also requires fingerprinting and criminal history checks for all individuals with unescorted access to Category 1 and Category 2 quantities radioactive materials. The specific radionuclides and associated thresholds were based on the Category 1 and Category 2 quantities described in International Atomic Energy Agency's "*Code of Conduct on the Safety and Security of Radioactive Sources*."

Refer to Appendix Q for additional guidance on implementing a security plan for physical protection of category 1 and category 2 quantities of radioactive material.

Appendix A

VDH Form
‘Application for a Radioactive Material License Authorizing the Use of Industrial Radiography’

The Form is located at:

http://www.vdh.state.va.us/epidemiology/radiologicalhealth/Materials/

Attachment A
Industrial Radiography Applicant's Checklist

Yes	No	Item	Material Needed
		Application	Used the correct form (New for new licensees or Renewal for renewing licensees)
		Application	Checked at least one box and filled in all the required information, as needed, for all Items
		Item 5	Attached training information, as needed
		Item 6	Attached information for training of radiographers and radiographer's assistants
		Item 9	Attached facility diagram
		Item 10.3	Checked box or attached alternate procedures
		Item 10.5	Checked at least one box and, if needed, attached alternate procedures including analysis instrumentation information
		Item 10.6	Checked at least one box and, if needed, attached alternate procedures for dosimetry equipment adjustment
		Item 10.8	Attached procedures for quarterly maintenance (notate if included in Item 10.9 material)
		Item 10.9 (Items 10.9.1 through 10.9.13)	Attached operating and emergency procedures, including all topics from Items 10.9.1 through 10.9.13

Appendix B

VDH Form
‘Certificate of Disposition of Material’

Virginia Department of Health
Radioactive Materials Program
(804) 864-8150

CERTIFICATE OF DISPOSITION OF MATERIALS

Completion of this form is required to complete termination of a Radioactive Material License as outlined in **12VAC5-481-500**. Failure to provide information will result in this request for termination of a specific license not being processed.

Instructions – Complete all items. Retain one copy and submit original to Virginia Department of Health, Radioactive Materials Program, 109 Governor Street, Room 730, Richmond, VA 23219.

CONTACT INFORMATION

Item 1 Name and Mailing Address of Applicant:	**Item 2 Virginia Radioactive Material License Number**
	Item 3 Contact Person – Name
	Contact Person - Telephone Number (Include area code) ( ) - x

TERMINATION AND DISPOSITION INFORMATION

The following information is provided in accordance with **12VAC5-481-510.** (Check all that apply)

☐ **Item 4** All use of radioactive material authorized under the above referenced license has been terminated.

☐ **Item 5** Radioactive contamination has been removed to the levels outlined in **12VAC5-481-1161 B.**

☐ **Item 6** All radioactive material previously procured and/or possessed under the authorization granted by the above referenced license has been disposed of as follows. (Check all that apply)

☐ Transferred to: Name Address

Who is (are) authorized to possess such material under Licensed Number: _____

Issued by (Licensing Agency): _____

☐ Decayed, surveyed and disposed of as non-radioactive waste.

☐ No radioactive material has ever been procured and/or possessed by the licensee under the authorization granted by the above referenced license.

☐ Other (Attach additional pages)

☐ **Item 7** Attached are radiation surveys or equivalent as specified in **12VAC5-481-510 L**. Specify the survey instrument(s) used and certify that each instrument is properly calibrated as required in **12VAC5-481-510 K**.

☐ **Item 8** Records required to be maintained for the license termination requested are available at the following location(s):

Name:

Address:

Contact Person Telephone Number:

Additional remarks (Attach additional pages if necessary.)

CERTIFICATION (To be completed by an individual authorized to make binding commitments on behalf of the applicant.)

Item 10.

The undersigned, on behalf of the licensee, hereby certifies that licensable quantities of radioactive material under the jurisdiction of the Virginia Department of Health are not possessed by the licensee. It is therefore requested that the above referenced radioactive material license be terminated.

SIGNATURE - Applicant or Authorized Individual	**Date signed**
Print Name and Title of above signatory	

Appendix C

Sample Correspondence Delegation Letter

SAMPLE CORRESPONDENCE DELEGATION LETTER

[*date*]

[*name and address*]

Virginia Department of Health
Radioactive Materials Program
109 Governor Street, Room 730
Richmond, VA 23219

To Director Radioactive Materials Program:

As [*job title*] of [*name of licensee*], I have delegated authority for all matters pertaining to our Radioactive Material License to [*name of designee*]. [*Name of designee*] has management approval to sign and submit amendment requests to the Virginia Department of Health on behalf of [*name of licensee*]. I understand that license renewals must still be signed by a representative of upper management.

[This document must be signed by a management representative who has independent authority to reassign job duties and/or provide finances, if necessary, to support an effective radiation safety program.]

_____	_____	_____
Signature	Title	Date

_____

Print Name

Appendix D

Reserved

Appendix E

Information Needed for Transfer of Control Application

Information Needed for Transfer of Control Application

Licensees must provide full information and obtain VDH'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.

Control: Control of a license is in the hands of the person or persons who are empowered to decide when and how that license will be used. That control is to be found in the person or persons who, because of ownership or authority explicitly delegated by the owners, possess the power to determine corporate policy and thus the direction of the activities under the license.

Transferee: A transferee is an entity that proposes to purchase or otherwise gain control of a VDH-licensed operation.

Transferor: A transferor is a VDH licensee selling or otherwise giving up control of a licensed operation.

1. Provide a complete description of the transaction (transfer of stocks or assets, or merger). Indicate whether the name has changed and include the new name. Include the name and telephone number of a licensee contact who the agency may contact if more information is needed.

2. Describe any changes in personnel or duties that relate to the licensed program. Include training and experience for new personnel.

3. Describe any changes in the organization, location, facilities, equipment or procedures that relate to the licensed program.

4. Describe the status of the surveillance program (surveys, wipe tests, quality control) at the present time and the expected status at the time that control is to be transferred.

5. Confirm that all records concerning the safe and effective decommissioning of the facility will be transferred to the transferee or to VDH, as appropriate. These records include documentation of surveys of ambient radiation levels and fixed and/or removable contamination, including methods and sensitivity.

6. Confirm that the transferee will abide by all constraints, conditions, requirements and commitments of the transferor or that the transferee will submit a complete description of the proposed licensed program.

References: The information above is derived from Information Notice 89-25, Revision 1, "*Unauthorized Transfer of Ownership or Control of Licensed Activities*," which is available at the NRC's webpage at http://www.nrc.gov.

Appendix F

NRC Regulatory Issue Summary 2005-10 ‘Performance-Based Approach for Associated Equipment in 10 CFR 34.20’

ADDRESSEES

All industrial radiography licensees and manufacturers and distributors of industrial radiography equipment.

INTENT

The U.S. Nuclear Regulatory Commission (NRC) is issuing this regulatory issue summary (RIS) to explain the performance-based approach NRC has decided to take regarding the requirements in **10 CFR 34.20**, "*Performance requirements for industrial radiography equipment*", which addresses the regulation of associated equipment used in an industrial radiography system. This RIS supersedes and replaces Information Notice 96-20, "Demonstration *of Associated Equipment Compliance with 10 CFR 34.20*". No specific action or written response is required.

BACKGROUND

In the *Federal Register* notice (68 FR 41757, July 15, 2003), NRC announced its denial of the petitioner's request for rulemaking to remove from **10 CFR 34.20** the term "*associated equipment*". The notice also explained that NRC's practice of registering associated equipment under **10 CFR 32.210**, "*Registration of product information*", which was previously described in Information Notice 96-20, had been discontinued. This RIS supersedes and replaces Information Notice 96-20.

SUMMARY OF ISSUE

To maintain safety, each licensee must take special care to ensure that all associated equipment (including modified or customized associated equipment) meets the minimum performance criteria required in **10 CFR 34.20**. A licensee that modifies associated equipment is required to demonstrate by actual testing or an alternative analysis that the performance of the radiographic system and individual items of associated equipment meet the criteria in **10 CFR 34.20**. The results of actual testing or analysis must demonstrate that the replacement component will not compromise the design safety features of the industrial radiography system. Compliance with the performance criteria prevents a licensee from using substandard associated equipment.

PERFORMANCE REQUIREMENTS FOR ASSOCIATED EQUIPMENT

The performance requirements for associated equipment are set forth in the paragraphs of **10 CFR 34.20**, described below:

- paragraph (a)(1), incorporates by reference the American National Standards Institute (ANSI) N432–1980, "*Radiological Safety for the Design and Construction of Apparatus for Gamma Radiography*", (ANSI N432) which specifies the design and method of qualifying (testing) industrial radiography equipment, including equipment that NRC has defined as "*associated equipment*";
- paragraph (a)(2), provides for an engineering analysis as an alternative to actual testing, to demonstrate the performance of individual radiography equipment components;
- paragraph (b)(3), allows associated equipment to be modified unless the replacement component would compromise the design safety features of the industrial radiography system;
- paragraph (c)(5) and (8), respectively address crushing and kinking tests for a guide tube and the standard test for tensile strength of an exposure head;
- paragraph (e), allows a licensee or vendor to apply a realistic torque to the drive mechanism during the life cycle test.

The regulations require a licensee to use industrial radiography equipment that has been manufactured and tested to meet radiation safety performance criteria under **10 CFR 34.20**.

The life cycle test in ANSI N432 is an evaluation of the endurance of a source or device. To test the life cycle of an industrial radiography source or exposure device, all components of the industrial radiography system (including the associated equipment) must be assembled and operated for the duration of the test. This

requirement, NRC determined, is sufficient to maintain safety and a separate regulatory approval for associated equipment is not needed as long as the associated equipment meets the minimum criteria in **10 CFR 34.20**.

Attachment 1 to this RIS contains additional information about definitions and applicable requirements, certificates of registration for a sealed source or device, custom-built items of associated equipment, acceptable methods to demonstrate compliance, inspection and licensing guidance, and inspection and maintenance procedures. Attachment 2 indicates the availability of reference documents that are cited in this RIS and Attachment 1.

ENFORCEMENT POLICY

The NRC Enforcement Policy, Supplement VI, provides examples of violations in each of the four severity levels as guidance in determining the appropriate severity level for violations in the area of fuel cycle and materials operations, including industrial radiographic operations. An example of an activity that would normally result in the NRC issuing a Severity Level III Notice of Violation is possession or use of unauthorized equipment or materials in the conduct of licensee activities that degrades safety. Based on this example, enforcement action would be considered for a licensee that used associated equipment that had not been tested or analyzed to meet the performance requirements or that used modified associated equipment that compromised the design safety features of an industrial radiography system and threatened or did not protect the health and safety of workers or members of the public.

AGREEMENT STATE COMPATIBILITY

NRC has determined that the information provided in this RIS does not change the level of compatibility of the Agreement State regulations to the existing NRC requirements. Use of the information in this RIS continues to provide Agreement States with the flexibility to revise their policy and guidance to meet unique situations and local conditions and to ensure an orderly, uniform implementation of the performance-based approach for associated equipment.

FEDERAL REGISTER NOTIFICATION

A notice of opportunity for public comment on this RIS was not published in the *Federal Register* because it is informational, and does not represent a departure from current regulatory requirements.

SMALL BUSINESS REGULATORY ENFORCEMENT FAIRNESS ACT

NRC has determined that this action is not subject to the Small Business Regulatory Enforcement Fairness Act of 1996.

PAPERWORK REDUCTION ACT STATEMENT

This RIS requires no specific action or written response. If you have any questions about this summary, please contact one of the individuals listed below or the appropriate regional office.

/RA/ Thomas Essig for
Patricia K. Holahan, Acting Director
Division of Industrial and
Medical Nuclear Safety
Office of Nuclear Material Safety
and Safeguards

Technical Contacts:	J. Bruce Carrico, NMSS 301-415-7826 E-mail: jbc@nrc.gov	Thomas Young, NMSS 301-415-5795 E-mail: tfy@nrc.gov

Note: NRC generic communications may be found on the NRC public Web site, http://www.nrc.gov, under Electronic Reading Room/Document Collections.

Attachments: 1. Additional Information and Applicable Requirements Regarding Associated Equipment
2. Availability of Reference Documents

Attachment 1

ADDITIONAL INFORMATION AND APPLICABLE REQUIREMENTS REGARDING ASSOCIATED EQUIPMENT

Definitions

10 CFR 34.3, "*Definitions*", defines associated equipment as equipment that is used in conjunction with a radiographic exposure device to make radiographic exposures that drives, guides, or comes in contact with the source [e.g., guide tube, control tube, control (drive) cable, removable source stop, 'J' tube, and collimator when it is used as an exposure head]. **10 CFR 34.3** defines the following items of associated equipment: collimator, control (drive) cable, control (drive) mechanism, control tube, exposure head (source stop), and guide tube. **10 CFR 34.3** defines the following radiographic equipment and related terms: radiographic exposure device, s-tube, sealed source, source assembly, source changer, and storage container.

Licensees should be aware of the specific meaning of the terms indicated above. The requirements applicable to items of equipment depend on how the equipment is defined in **10 CFR 34.3**. It is important to distinguish between items of equipment that are considered to be associated equipment and items of equipment that are not. In some cases, there may be no regulatory requirements that apply to an item of equipment; in other cases, an item of equipment may be a component of a source or device that is required to be specifically authorized for use. Following are two examples that illustrate important distinctions which determine regulatory requirements for an item of equipment.

The first example distinguishes certain types of collimators that are not associated equipment and are not required to meet the performance criteria in ANSI N432. Various types of collimators are used as radiation safety devices for industrial radiographic operations. In many cases, the exposure head at the end of the guide tube is inserted into a collimator. This type of collimator is not an item of associated equipment because the source does not come in contact with the collimator. This type of collimator is not subject to the performance requirements in **10 CFR 34.20** or the evaluation process in **10 CFR 32.210**. However, if a collimator does come in contact with the source because it also acts as a source stop (exposure head), then it falls within the scope of the definition of associated equipment that is subject to the performance requirements in **10 CFR 34.20**.

The second example distinguishes the connector that is located between the sealed source and the control (drive) cable. **10 CFR 34.3** defines the source assembly to include the connector, stating, "*Source assembly means an assembly that consists of the sealed source and a connector that attaches the source to the control cable*". The connector is a component of the source assembly and is, therefore, not an item of associated equipment. The source assembly is subject to the requirements in **10 CFR 30.32**, "*Application for a specific license*". **10 CFR 30.32(g)** indicates that an application for a specific license to use byproduct material in the form of a sealed source or in a device that contains a sealed source must either identify the sealed source or the device as registered under **10 CFR 32.210** or with an Agreement State or must include the information identified in **10 CFR 32.210(c)**. The manufacturing processes used to attach the connector to the source cable and to the control (drive) cable are also subject to evaluation by NRC or an Agreement State under these requirements.

Portable industrial radiographic systems typically include a two-piece connector (swivel coupling design) to attach the source assembly to the control (drive) cable in order to operate the system. The performance-based requirement in **10 CFR 34.20(c)(1)** indicates that the coupling must be designed such that it cannot be unintentionally disconnected under normal and reasonably foreseeable abnormal conditions. The Statements of Consideration at 55 FR 843 (January 10, 1990) include a response to comments received for **10 CFR**

34.20(c)(1). The response indicates, "*NRC's source and device registration process will ensure compliance with this performance requirement by requiring NRC approval before the newly designed connectors could be used*". The sealed source or device evaluation process ensures compliance with the performance criteria in the rule. Both pieces of the two-piece connector are subject to evaluation under **10 CFR 30.32(g)** or **32.210(c)**.

Sealed Source and Device (SS&D) Certificate of Registration

NRC determined that the previous practice of registering associated equipment under **10 CFR 32.210** was not only not required, but was a regulatory practice that imposed an unnecessary burden on licensees and for NRC and the Agreement States which are authorized to evaluate SS&Ds. Therefore, this practice has been discontinued. NRC does not intend to independently revise current SS&D certificates of registration only to remove references to associated equipment. If it becomes necessary to amend a current SS&D certificate of registration, the applicant may remove or update the information about associated equipment in the application.

As a matter of convenience, an SS&D applicant under **10 CFR 32.210** may describe the associated equipment that was used in the life cycle test for the radiographic source or device that is being registered; however, there is no requirement to do so. If an applicant wants the associated equipment to be included on the certificate of registration, the application which describes associated equipment must include sufficient information to demonstrate that the performance criteria were met for associated equipment under **10 CFR 34.20**. If a certificate of registration does not identify the associated equipment that was used in the system along with the source or device, then each end-user (licensee) must demonstrate that the items of associated equipment which the licensee uses in the system meet the performance criteria under **10 CFR 34.20** and do not compromise the design safety features of the system.

NUREG-1556, Volume 3, Revision 1, "*Consolidated Guidance About Materials Licenses–Applications for Sealed Source and Device Evaluation and Registration*", (Final Report, April 2004), Section 4.6, "*Radiography Equipment*", indicates that there is no requirement to identify associated equipment for an SS&D certificate of registration. **Note**–In Section 15, "*Glossary*", the definition of "*associated equipment*" was intended to be removed and should be disregarded because it has been superceded by Section 4.6.

Custom-Built or Unique Items of Associated Equipment

Associated equipment specifically designed and constructed to the order of a single licensee must comply with the performance criteria in **10 CFR 34.20**. There is no requirement to register custom-built or unique items of associated equipment. However, when modified or custom-built associated equipment introduces components or fabrication methods that differ from those that were used in the endurance test for a source assembly or exposure device that was previously registered, the licensee must demonstrate compliance with the requirements in **10 CFR 34.20** before the equipment can be used for industrial radiographic operations. For example, licensees must obtain information demonstrating that modified guide tubes and exposure heads will withstand tests that demonstrate the equipment will maintain its integrity in normal use and likely accident conditions.

Acceptable Methods to Demonstrate that Associated Equipment Complies with 10 CFR 34.20

The performance-based approach that NRC has decided to take for associated equipment recognizes that a licensee has latitude to use modified components, unless the design of any replacement component would compromise the design safety features of the system. Further guidance about testing or an alternative analysis to testing is described in NUREG-1556, Volume 3, Revision 1, Section 10.5, "*Prototype Testing*". The NUREG addresses appropriate methods a licensee may use to demonstrate the ability of a modified industrial radiography system to maintain its integrity when subjected to conditions of normal use and likely accident conditions.

For example, information about an equivalent system that was previously registered may be used to demonstrate safety and integrity of the modified system, if the design of the modified system and its intended normal and

likely accident conditions of use are identical or similar to the previously registered system. In some cases, an engineering analysis or operational history with supporting documentation may be sufficient for a licensee to justify the use of a modified system without repeating, e.g., an endurance test. However, when an appropriate comparison to the previously registered system is not possible because a licensee is unable to obtain appropriate information about previous prototype testing, engineering analysis, or operational history for the previously registered system or item of associated equipment, then the licensee must complete actual testing of the modified system and the individual items of associated equipment to demonstrate compliance with **10 CFR 34.20**.

NRC contracted a testing laboratory to complete actual testing of three industrial radiography systems from three manufacturers. The contractor developed procedures to test the systems and individual items of associated equipment to meet the performance criteria in **10 CFR 34.20**. In a similar manner, a licensee could contract a testing laboratory or manufacturer of industrial radiography equipment to test or analyze a modified system or component that will be used in a system that was previously licensed or registered.

If a licensee needs to modify associated equipment, the licensee should adopt and implement a suitable engineering procedure or plan to ensure that a modified component will not compromise the design safety features of the industrial radiographic system. Implementation of such a procedure or plan should demonstrate that modifications to the equipment: (1) will not create material incompatibility that may degrade a sealed source or device over the expected useful life time; (2) will not diminish the performance of the system in expected use environments and in likely accident conditions over the expected life time of the various system components; (3) will not allow a source to inadvertently exit the system; and (4) will not initiate or propagate equipment failures resulting in a "source disconnect." An endurance test for a modified system should indicate that the modified component does not interfere with the performance of the components of the system that were previously registered.

Examples of the performance-based approach that NRC has decided to use for **10 CFR 34.20** are included in the following paragraphs to illustrate situations when a licensee must complete testing or analysis of associated equipment to demonstrate that the associated equipment meets the performance criteria in **10 CFR 34.20** and does not compromise the design safety features of the system.

It is acceptable for a licensee to assume that no further testing is needed for associated equipment which is listed along with the source or device as an entire system on the certificate of registration because the associated equipment has already been verified to meet the performance criteria in **10 CFR 34.20** when the associated equipment is used with the source or device. However, a licensee that substitutes associated equipment into an industrial radiography system that was registered as an entire system which specified the associated equipment must demonstrate that the reconfigured system meets the performance criteria under **10 CFR 34.20**.

It is acceptable for a licensee to assume that associated equipment that is used as the manufacturer intended as described in the SS&D certificate of registration meets the performance criteria under **10 CFR 34.20**. The SS&D certificate of registration indicates the principal use, normal conditions of use, and the limitations on use for the source or device. However, a licensee that uses associated equipment in a manner that was not intended by the manufacturer as described in the SS&D certificate of registration for the source or device must describe the conditions of use for the equipment and obtain information about performance of the equipment under these conditions of use to demonstrate compliance with **10 CFR 34.20**. Conditions of use include, for example, extremely hot or cold operating temperature, excessive vibration or shock, high concentrations of corrosive materials, and underwater usage.

Inspection and Licensing Guidance

NRC is revising inspection and licensing guidance to incorporate the explanation provided by this RIS. Inspection Procedure 87121, "*Industrial Radiography Programs*", directs an inspector to follow a performance-

based approach to examine available associated equipment, observe work in progress that involves use of associated equipment, and interview workers about the inspection and maintenance procedures and the worker's awareness that associated equipment must comply with the performance criteria in **10 CFR 34.20**.

If the associated equipment appears to be modified or defective, the inspector should verify whether or not the licensee had developed and implemented a testing program to demonstrate that modified components meet the performance criteria in **10 CFR 34.20**. The inspector should alert the inspection supervisor who may extend the inspection and request an SS&D reviewer to evaluate the licensee's modification of the equipment. The expectation is that the design safety features of the industrial radiography system were not compromised by a replacement component of associated equipment that was modified by the licensee. Before using the modified system, the licensee is required to demonstrate that the replacement component meets the performance criteria in **10 CFR 34.20**.

NUREG-1556, Volume 2, "*Consolidated Guidance about Materials Licensees–Program-Specific Guidance about Industrial Radiography Licenses*" (Final Report, August 1998) is being amended to remove statements that indicate associated equipment must be specifically approved or registered by NRC or an Agreement State. Instead, the guidance will state that vendors or distributors of industrial radiography equipment may voluntarily include the items of associated equipment that were used in the system with their SS&Ds that are registered under **10 CFR 32.210**. To include associated equipment in the certificate of registration, the vendor's application must include information that demonstrates the associated equipment meets the minimum criteria in **10 CFR 34.20**. Also, copies of this RIS will be inserted into Appendix F to replace Information Notice 96-20.

Inspection and Maintenance Procedures

NRC completed a generic assessment and special team inspection which was published in NUREG-1631, "*Source Disconnects Resulting from Radiography Drive Cable Failures*" (June 1998). The inspection team observed that, in general, radiography exposure devices appeared to be in good working order, showing no evidence of damage, abuse, or lack of maintenance. By contrast, the associated equipment (i.e., control mechanisms, including drive cables) often appeared to be damaged, in disrepair, and lacking maintenance.

NUREG-1631 emphasized the importance of a licensee's understanding and commitment to the operating and use conditions specified by a vendor (manufacturer or distributor) of an industrial radiography system which, if exceeded, could compromise the safety and reliability of the system. This is particularly true of items of associated equipment, including drive cables. A licensee should be vigilant to inspect and maintain associated equipment in order to avoid component failures that could result in unnecessary radiation exposures to workers and members of the public.

A licensee's equipment inspection and maintenance program should prevent particular equipment problems that may develop from excessive uses where harsh or abusive conditions exist that may cause a component to fail. **10 CFR 34.31**, "*Inspection and maintenance of radiographic exposure devices, transport and storage containers, associated equipment, source changers, and survey instruments*", requires a licensee to perform visual and operability checks on associated equipment before use on each day the equipment is to be used to ensure that the equipment is in good working condition. If equipment problems are found, the equipment must be removed from service until repaired. In addition, the licensee is required to have written procedures for inspection and routine maintenance of associated equipment at intervals not to exceed three months or before the first use thereafter to ensure the proper functioning of components important to safety. Replacement components shall meet design specifications. If problems are found, the equipment must be removed from service until repaired. Records are required for equipment problems and any maintenance performed.

AVAILABILITY OF REFERENCE DOCUMENTS

Below are the titles of the reference documents along with the URLs and the ADAMS accession numbers (e.g., MLxxxxxxxxx)., if available. The URLs link directly to the documents that are posted on the NRC's public web site. For documents without an URL, NRC maintains an Agencywide Document Access and Management System (ADAMS), which provides text and image files of NRC's public documents. These documents may be accessed through the NRC's Public Electronic Reading Room on the Internet at http://www.nrc.gov/reading-rm/adams.html. If you do not have access to ADAMS or if there are problems in accessing the documents located in ADAMS, contact the NRC Public Document Room (PDR) Reference staff at 1-800- 397-4209, 301-415- 4737, or by e-mail to pdr@nrc.gov. If no URL or ADAMS accession number is indicated for the document then send a written request for a single, paper copy of the document to the Office of Administration, Distribution and Mail Services Section, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; or contact the PDR noted above.

1. Federal Register notice (68 FR 41757, July 15, 2003), Denial of a petition for rulemaking [Docket No. PRM-34-5, Amersham Corporation] ML050620568

2. 10 CFR Part 32, Specific domestic licenses to manufacture or transfer certain items containing byproduct material http://www.nrc.gov/reading-rm/doc-collections/cfr/part032/

3. 10 CFR Part 34, Licenses for Industrial Radiography and Radiation Safety Requirements for Industrial Radiographic Operations http://www.nrc.gov/reading-rm/doc-collections/cfr/part034/

4. American National Standards Institute (ANSI) N432–1980, Radiological Safety for the Design and Construction of Apparatus for Gamma Radiography, (ANSI N432) ML050840139

5. NRC Enforcement Policy http://www.nrc.gov/what-we-do/regulatory/enforcement/enforc-pol.pdf

6. NUREG-1556, Volume 3, Revision 1, Consolidated Guidance About Materials Licenses–Applications for Sealed Source and Device Evaluation and Registration, ML041340618 http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1556/v3/r1/

7. Inspection Procedure 87121, Industrial Radiography Programs, http://www.nrc.gov/reading-rm/doc-collections/insp-manual/inspection-procedure/ip87121.pdf

8. NUREG-1556, Volume 2, Consolidated Guidance about Materials Licensees–Program-Specific Guidance about Industrial Radiography Licenses http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1556/v2/

9. NUREG-1631, Source Disconnects Resulting from Radiography Drive Cable Failures (June 1998)

Appendix G

Radiographer and Radiographer's Assistant Training

Radiographer's Training

REFERENCE	REQUIREMENT	TRAINING CRITERIA
12VAC5-481-1320	Training Classroom Training – 40 hours in Length	Topics in **12VAC5-481-1320 A & B** Fundamentals of Radiation Safety • Characteristics of gamma radiation • Units of radiation dose and quantity of radioactivity • Hazards of exposure to radiation • Levels of radiation from licensed material • Methods of controlling radiation dose (time, distance, and shielding) Radiation Detection Instruments • Use, operation, calibration and limitations • Survey techniques • Personnel monitoring equipment Equipment to be Used • Operation and control of radiographic exposure equipment, remote handling equipment, storage containers and pictures or models of source assemblies (pigtails) • Storage, control and disposal of licensed material • Inspection and maintenance of equipment Requirements of **12VAC5-481, 'Virginia Radiation Protection Regulations'** Case Histories of Accidents in Radiography
	On-the-Job Training- 2 months or 320 hours	Under the supervision of a qualified radiographer
	Certification by a Certifying Entity	Certified through a radiographer certification program meeting the requirements of **10 CFR 34 Appendix A**

12VAC5-481-1320	Must Receive Copies of and Instruction in:	**12VAC5-481 Parts**: • IV • V • X • XIII **12VAC5-481-30** The License The Licensee's Operating & Emergency Procedures
	Written Examination of items listed above	Successful completion
12VAC5-481-1320 B	Receive Equipment Training	Training includes: • Exposure devices • Sealed sources • Associated equipment • Survey meters • Daily inspection
	Demonstrate Understanding in Use of Equipment by Practical Exam	Successful completion
12VAC5-481-1320 D	Annual Refresher Training	Review the following: • Radiation Safety review • New procedures or equipment • New rule requirements • Observations and deficiencies during audits and discussion of any significant incidents or accidents involving radiography • Employee questions
12VAC5-481-1470	Records of Training and Certification	Maintained in accordance with rule

Radiographer's Assistant Training

REFERENCE	REQUIREMENT	TRAINING CRITERIA
12VAC5-481-1320 C	Must Receive Copies of and Instruction in:	**12VAC5-481 Parts**: • IV • V • X • XIII **12VAC5-481-30** The License The Licensee's Operating & Emergency Procedures
	Written Examination of items listed above	Successful completion
12VAC5-481-1320 C	Receive Equipment Training	Training under the supervision of a qualified radiographer that includes: • Exposure devices • Sealed sources • Associated equipment • Survey meters • Daily inspection
	Demonstrate Understanding in Use of Equipment by Practical Exam	Successful completion
12VAC5-481-1320 D	Annual Refresher Training	Review the following: • Radiation Safety review • New procedures or equipment • New rule requirements • Observations and deficiencies during audits and discussion of any significant incidents or accidents involving radiography • Employee questions
12VAC5-481-1470	Records of Training and Certification	Maintained in accordance with rule

Appendix H

Six-Month Radiographer/Radiographer's Assistant Inspection Checklist

Six-Month Radiographer/Radiographer's Assistant

Inspection Checklist

Date: _____ Time: _____

Radiographic Location: _____

Radiographer/Radiographer's Assistant:_____

Device Model No.: _____ Serial No.: _____

Survey Meter Functionality: ☐ Yes ☐ No

Calibrated: ☐ Yes ☐ No Daily Source Check: ☐ Yes ☐ No

Dosimetry: OSL, Film Badge, Or Similar Device and Pocket Dosimeter: ☐ Yes ☐ No

Pocket Dosimeter Calibrated: ☐ Yes ☐ No

Alarming Dosimeter: ☐ Yes ☐ No

Calibrated: ☐ Yes ☐ No

Daily Operational Check Performed: ☐ Yes ☐ No

Were other individuals working within the restricted area wearing film badges, OSLs or similar devices, dosimeters and alarm dosimeters?	☐ Yes ☐ No
Was the restricted area posted with a "*CAUTION (or DANGER) RADIATION AREA*" sign(s)?	☐ Yes ☐ No
Was the restricted area properly controlled to prevent unauthorized entry?	☐ Yes ☐ No
Was the high-radiation area posted with a "*CAUTION (OR DANGER) HIGH RADIATION AREA*" sign(s)?	☐ Yes ☐ No
Was the utilization log properly filled out?	☐ Yes ☐ No
Did the radiographer/radiographer's assistant have sufficient knowledge of safety rules?	☐ Yes ☐ No
Was the radiographer working with properly inspected and operable equipment?	☐ Yes ☐ No
Did the radiographer/radiographer's assistant properly survey the camera?	☐ Yes ☐ No
Did the radiographer properly supervise the radiographer's assistant?	☐ Yes ☐ No
Was the camera properly locked and secured to prevent unauthorized removal?	☐ Yes ☐ No
Was the restricted area properly controlled?	☐ Yes ☐ No
Were calculations or surveys performed to determine the restricted area boundary?	☐ Yes ☐ No
Was the high radiation area under continuous direct observation except where entry had been prevented?	☐ Yes ☐ No
Were radioactive isotopes stored properly and kept locked to prevent removal?	☐ Yes ☐ No
Was the storage area posted with a "*CAUTION (or DANGER) RADIOACTIVE MATERIAL*" sign(s)?	☐ Yes ☐ No
Did the radiographer/radiographer's assistant possess and use a copy of the operating and emergency procedures and VDH rules for protection against radiation?	☐ Yes ☐ No
Were there any other safety items found to be lacking? If yes, explain in Remarks.	☐ Yes ☐ No

Remarks/Comments:

_____

_____

_____

_____

Appendix I

Radiation Protection Program Audit

Radiation Protection Program Audit

Date of this Audit:_____ Date of Last Audit:_____
Next Audit Date:_____

Auditor_____ Date_____
(Signature)

Management Review_____ Date_____
(Signature)

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 radioactive material, frequency of use, staff size, etc.

B. Radiation Safety Officer.
1. Named on license. **[L/C]**
2. Fulfills duties as RSO. **[12VAC5-481-1310 A & D]**
3. Meets requirements. **[12VAC5-481-1310 B & C]**

C. Radiographers and radiographer's assistants named in documents. **[L/C]**

D. Commensurate security program implemented.

Training, Retraining, and Instructions to Workers

A. Instructions to workers. **[12VAC5-481-2270]**

B. **12VAC5-481-30** and Parts: III, V, X, and XII; the license; and operating and emergency procedures are furnished to all radiographers and radiographer's assistants. **[12VAC5-481-1320]**

C. Training program description the same as that submitted with license application or as amended? **[12VAC5-481-1200 A]**
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 **[12VAC5-481-1470].**

D. Workers cognizant of requirements for:
1. Radiation safety program. **[12VAC5-481-630]**
   a. Occupational exposure annual limits. **[12VAC5-481-640]**
   b. Public annual dose limits. **[12VAC5-481-720]**

2. 10% monitoring threshold. **[12VAC5-481-760]**
3. Dose limits to embryo/fetus and declared pregnant worker. **[12VAC5-481-710]**
4. Procedures for opening packages. **[12VAC5-481-900]**

Operating and Emergency Procedures

A. Procedures current? **[12VAC5-481-1520 B]**

B. Procedures contain information specified. **[12VAC5-481-1330 A]**

C. Procedures submitted to the agency. **[L/C]**

Internal Audits or Inspections

A. Audits/inspections of each radiographer and radiographer's assistants conducted at 6-month intervals or after as appropriate. **[12VAC5-481-1320 E]**

B. Equipment check before use each day. **[12VAC5-481-1270]**

C. Equipment inspection and maintenance performed at 3-month intervals. **[12VAC5-481-1270 D]**

D. Records maintained. **[12VAC5-481-1390, 12VAC5-481-1410, 12VAC5-481-1420, 12VAC5-481-1430, 12VAC5-481-1440, 12VAC5-481-1450, 12VAC5-481-1460, 12VAC5-481-1490, 12VAC5-481-1500, 12VAC5-481-1510, 12VAC5-481-1520]**

Facilities

A. Permanent radiographic installation. **[12VAC5-481-1280]**
1. High Radiation Area posted. **[12VAC5-481-860]**
2. Entrance controls are as described. **[12VAC5-481-1280 A]**
   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. **[12VAC5-481-1460]**

B. Temporary High Radiation Area Entry Controlled. **[12VAC5-481-1370]**

C. Storage Area
1. Storage Facilities as Described in license. **[L/C]**
2. Sources Locked in Devices. **[12VAC5-481-1230 A]**
3. Devices secured to prevent tampering or unauthorized removal. **[12VAC5-481-1290 C]**
4. Storage locations comply with the appropriate security program measures [**12VAC5-481-451**].

Equipment

A. Radiography devices, source assemblies and source changers in use meet requirements. **[12VAC5-481-1210]**

B. Associated equipment in use complies with requirements. **[12VAC5-481-1210 C]** and individuals are aware

that associated equipment must comply with **12VAC5-481-1210.**

C. Source changers and storage containers meet radiation level limits. **[12VAC5-481-1220]**

D. 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 on the license. **[L/C]**

B. All sealed sources not fastened to or contained in an exposure device are tagged. **[12VAC5-481-1210 C]**

C. Leakage and contamination tests.
1. Sealed sources.
   a. Leak test method approved. **[12VAC5-481-1250 C]**
   b. Leak tests performed at 6 month intervals. **[12VAC5-481-740, 12VAC5-481-1250 C]**
   c. Leakage is less than 185 becquerels (Bq) (0.005 microcuries).
2. Depleted uranium (DU) shielding with S-tubes.
   a. Test every 12 months. **[12VAC5-481-1250 E]**
   b. DU is less than 185 Bq (0.005 microcuries).
3. Records maintained for 3 years. **[12VAC5-481-1420]**

D. Inventories
1. Conducted quarterly (not to exceed 3 months). **[12VAC5-481-1260]**
2. Contain all required information. **[12VAC5-481-1430 B]**
3. Records maintained for 3 years. [**12VAC5-481-1430 A]**
   a. Most recent inventory conducted on _____

E. Utilization Logs
1. Utilization logs maintained. **[12VAC5-481-1440]**
2. Contain all required information. **[12VAC5-481-1440]**

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. **[12VAC5-481-1240 A]**

C. Operable and calibrated survey instruments available and used on each job. **[12VAC5-481-1240]**

D. Calibration performed at intervals not to exceed six months or after servicing. **[12VAC5-481-1240 B]**

E. Records maintained for 3 years. **[12VAC5-481-1410]**

Radiation Surveys

A. Area or facility surveys conducted to show compliance with **12VAC5-481-720** and **12VAC5-481-730. [12VAC5-481-750]**

B. Records maintained. **[12VAC5-481-1000]**

C. Survey after each exposure, including device, guide tube, ensuring source has returned to the shielded position. **[12VAC5-481-1360]**

D. Survey of device when place in storage to ensure source is in shielded position. **[12VAC5-481-1360]**

E. Protection of members of the public **[12VAC5-481-720]**

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 1 mSv (100 mrem) in a year. **[12VAC5-481-730]**
2. Unrestricted area radiation levels do not exceed 0.02 mSv (2 mrem) in any 1 hour. **[12VAC5-481-720]**
3. Records maintained. **[12VAC5-481-1050]**

Personnel Radiation Protection

A. Dosimetry

1. Workers monitored as required. **[12VAC5-481-1350]**
2. Exchange Frequency _____ Supplier_____
3. Verify supplier is NVLAP-approved. **[12VAC5-481-750]**
4. Dosimetry exchanged at required frequency. **[12VAC5-481-1350 A]**
5. Dosimetry records maintained. **[12VAC5-481-1490]**

B. Pocket Dosimeters and Electronic Personal Dosimeters **[12VAC5-481-1350]**

1. Model No. _____ Range _____
   Model No. _____ Range _____
2. Recharged, read, and recorded at start of each shift.
3. Daily readings recorded.
4. Dosimeters checked for response (± 20%) at intervals not to exceed 12 months.
5. Off-scale dosimeter procedure and records.

C. Alarm Ratemeters **[12VAC5-481-1350]**

1. Model No._____ Range _____
2. Checked that alarm functions properly at start of each shift.
3. Preset at 5 mSv (500 mrem)/hr.
4. Calibrated to ±20% at intervals not to exceed 12 months.
5. Records maintained.

D. Dosimetry Reports

1. Reviewed by _____ Frequency _____.
2. Reviewed personnel monitoring records for interval (from _____ to _____).
3. Maximum exposures: TEDE _____ extremity, other _____.
4. VDH Forms (or equivalent). **[12VAC5-481-1000, 12VAC5-481-1040]**
5. Maximum exposures in compliance with annual limits. **[12VAC5-481-640]**
6. Fetal and Pregnant worker exposure. **[12VAC5-481-710]**
   a. Worker declared pregnancy in writing during the audit interval.

b. If yes, licensee in compliance? Records maintained?
7. Dosimetry records maintained. **[12VAC5-481-1490]**
8. Annual exposure reports given to workers who receive > 100 mrem per year? **[12VAC5-481-2280]**

E. Radiation Protection Program **[12VAC5-481-630]**
1. Program includes provisions for keeping dose ALARA.
2. Procedures and engineering controls used to achieve ALARA.
3. Content and implementation reviewed annually by licensee.
4. Records of program reviews maintained.

F. Planned Special Exposures (PSEs) **[12VAC5-481-690]**
1. PSEs performed? _____
2. If so, when, where and why? _____
3. Records maintained.

Receipt and Transfer of Radioactive Material [12VAC5-481-570, 12VAC5-481-571, 12VAC5-481-900, 12VAC5-481-1400]

A. Procedures established and followed for picking up, receiving, and opening packages.

B. Incoming packages surveyed.

C. Shipment of sources since last inspection.
1. Used container authorized by license or Certificate of Compliance (COC).
2. Transfers.
3. All sources surveyed before shipment and transfer.

D. Records of surveys and receipt/transfer maintained. **[12VAC5-481-1400]**

E. Transactions entered into the National Source Tracking System, including annual reconciliation. [**12VAC5-481-1151**]

Transportation [12VAC5-481-2980 and 49 CFR 170-189]

A. Shipments are:
- ☐ Delivered to common carriers.
- ☐ Transported in company's private vehicle.
- ☐ Both.
- ☐ 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)]**
3. COC's on file with NRC for Type B. **[10 CFR 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 **[12VAC5-481-1030, 12VAC5-481-1040, 12VAC5-481-1050, 12VAC5-481-1120, 12VAC5-481-1130, 12VAC5-481-2280]**

B. Theft or loss **[12VAC5-481-1090]**

C. Incidents **[12VAC5-481-1100]**

D. Overexposures and high radiation levels **[12VAC5-481-1110]**

E. Annual reports furnished to the agency

F. Reporting of defects and non-compliance **[12VAC5-481-1530]**

Posting and Labeling

A. Radiation areas **[12VAC5-481-860]**

B. High radiation areas **[12VAC5-481-860]**

C. Use or storage areas **[12VAC5-481-860]**

D. Containers or devices labeled **[12VAC5-481-880, 12VAC5-481-1290]**

E. Notice to employee form **[12VAC5-481-2260 C]**

F. Applicable regulations and Parts of 12VAC5-481 or notification of location or required documents [**12VAC5-481-2260**].

G. Other posting and labeling

Recordkeeping for Decommissioning [12VAC5-481-450 C]

A. Records in independent and identifiable location

B. Records include all required data

Bulletins and Information Notices

A. Communications received and reviewed

B. Appropriate response to Information Notices

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.

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

Procedure for Calibrating Survey Instruments

Procedure for Calibrating Survey Instruments

A. Sealed source(s) used for calibrating survey instruments should:

1. Approximate a point source
2. Have its exposure rate at a given distance traceable by documented measurements to a standard certified to be within +/- 5% accuracy by NIST
3. Approximate the same photon energy (Ir-192, Co-60) as the source to be used in the radiography device.
4. Be of sufficient strength to give an exposure rate of about 0.3 mSv/hr (30 mrem/hr) at 100 cm (85 mCi of Cs-137 or 21 mCi of Co-60).

B. Use the inverse square and radioactive decay law to correct changes in exposure rate due to source decay or different distances from the source.

C. 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:

1. Owner or user identification, including name, address, and person to be contacted;
2. Instrument description that includes manufacturer, model number, serial number, and type of detector;
3. Calibration source description that includes exposure rate, indicated exposure rate at a specified distance on a specified date, and the calibration procedure;
4. Each calibration point identifying the calculated exposure rate, the indicated exposure rate, the deduced correction factor, and the scale selected on the instrument;
5. Exposure reading indicated with the instrument in the ‘battery check’ mode, if available;
6. 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
7. For detectors with removable shielding, note whether the shielding was in place or removed during the calibration procedure;
8. Include person's name who performed the calibration and the date on which the calibration was performed;

D. 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:

1. Linear Scale: Meters on which the user selects a linear scale must be calibrated at no less that two points on each scale. The points should be at approximately 1/3 and 2/3 of the decade.
2. Multidecade Logarithmic Scale: Meters that have a multidecade logarithmic scale must be calibrated at no less that 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.
3. 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.

E. 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.

F. The efficiency of surface contamination measurement instruments must be determined by using radiation

sources with energies and types of radiation similar to those that the instrument will be used to measure. Each scale has a calibration potentiometer, the reading shall be adjusted to read the conventional true value at approximately 80% of full scale, and the reading at approximately 20% full scale. If only one potentiometer is available, the reading shall be adjusted at midscale on one of the scales. Readings shall be within 20% of the true value.

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.

Calibration Records

A. The following information shall be attached to the instrument as a calibration sticker or tag:
1. Source that was used to calibrate the instrument
2. A calibration chart or graph for each scale or decade of a survey meter that is greater than +/ 20% of the actual values identifying the average correction factor, or a note indicating that scale was checked only for function or is inoperative.
3. Date of calibration
4. Date survey instrument is due calibration
5. Name or initials of individual calibrating instrument.

B. The following information shall be created and maintained in appropriate documentation:
1. The owner of the instrument
2. A description of the instrument, including manufacturer's name, model number, serial number, and type of detector.
3. Source used to perform calibration, including the exposure rate at a specified distance or activity on a specified date
4. For each calibration point, the calculated exposure/count rate, the indicated exposure/count rate, the deduced correction factor (calculated rate divided by indicated rate), and the scale selected.
5. For instruments with external detectors, the angle between the radiation flux field and the detector (i.e., parallel or perpendicular). For instruments with internal detectors, the angle between the radiation flux field and a specified surface of the instrument.
6. For detectors with removable shielding, an indication of whether the shielding was in place or removed
7. The exposure/count rate from a check source
8. The name of the person who performed the calibration and date it was performed.

Training

Before allowing an individual to perform survey instrument calibration, the RSO will ensure that s/he has sufficient training and experience to perform the calibration. This training may be in the form of lecture, videotape, online, or self-study and will cover the following areas:

A. Principles and practices of radiation protection
B. Radioactivity measurements, monitoring techniques, and instrument use
C. Mathematics and calculations basic to using and measuring radioactivity
D. Biological effects of radiation.

In addition, appropriate on-the-job training will consist of the following:
A. Observing authorized personnel performing survey instrument calibrations
B. Conducing calibrations under the supervision and in the physical presence of an authorized and

experienced individual.

Facilities and Equipment

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

NUREG 1556, Volume 18 'Program-Specific Guidance About Service Provider Licenses' is available from the NRC website at www.nrc.gov.

Appendix K

Requests to Perform Leak Testing and Sample Analysis

Requests to Perform Leak Testing and Sample Analysis

A. Requests to Perform Leak Testing and Sample Analysis

1. Identify the individual who will make the analysis and provide his or her qualifications to make quantitative measurements of radioactivity.

2. 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.

3. 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.

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

Note: Accuracy of standards should be within ±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).

NUREG 1556, Volume 18 'Program-Specific Guidance About Service Provider Licenses' is available at the NRC website: www.nrc.gov, or from DHFS upon request.

5. Include a sample calculation for conversion of the measurement data to Bq (or microcuries).

6. Provide instructions on actions to take and persons to be notified if sources are found to be leaking.

B. Procedure for Performing Leak Testing and Analysis

1. For each source to be tested, list identifying information such as radiography device serial number, radionuclide, activity.

2. If available, use a survey meter to monitor exposure.

3. Prepare a separate wipe sample (e.g., cotton swab or filter paper) for each source.

4. Number each wipe to correlate with identifying information for each source.

5. Wipe the most accessible area where contamination would accumulate if the sealed source were leaking.

6. Using the instrument identified to and approved by VDH, count and record background count rate.

7. Check the instrument's counting efficiency using standard source of the same radionuclide as the source being tested or one with similar energy characteristics.

8. Calculate efficiency.

9. Count each wipe sample; determine net count rate.

10. For each sample, calculate and record estimated activity in Bq (or microcuries).

11. Sign and date the list of sources, data and calculations.

12. 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 the agency.

C. Sampling and Analysis for Depleted Uranium as a Result of S-tube Breakthrough

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

1. 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.

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

3. 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

A. Licensees must ensure that:

1. The radiation dose received by individual members of the public resulting from the licensee's 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.

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

   Typical unrestricted areas may include offices, shops, laboratories, areas outside buildings, property, and 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.

3. Licensees must show compliance with both portions of the rule. 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 1mSv (100 mrem) in a calendar year.

B. Calculation Method

1. 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.

2. The calculation 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.

3. Part 1 of the calculation 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 calculation 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.

C. Example 1

1. To better understand the calculation 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 VDH regulations.

2. 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 VDH rule or DOT regulations: 2 mSv/hr (200 mrem/hr) on the surface and 0.1 mSv/hr (10 mrem/hr) at one meter.

D. Findings

1. Upon his inspection, Joe found that there were two sources in the room. One Ir 192 device (Type B container) had a reading of 10 mrem/hr at 1 meter (3.3 ft) and was 12 ft from the secretary's chair. The other was a Co-60 device (Type B container) had a reading of 10 mrem/hr at 1 meter (3.3 ft) and was 18 ft from the secretary's chair.

E. Example 1: Part 1

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 11** and **12** below.

F. Table 11: Calculation 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^2	$(3.3)^2$	10.9
3	Square of the distance (ft) from the device the secretary's desk in an unrestricted area, in ft^2	$(12)^2$	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, HOURLY DOSE RECEIVED FROM DEVICE 1, in mrem in an hour.	109/144	0.76
6	Multiply the result of Step 5 by 24 hr/d x 365 d/yr = MAXIMUM ANNUAL DOSE RECEIVED FROM DEVICE 1, in mrem in a year.	0.76 x 24 x 365	6,630

G. Table 12: **Calculation Method, Part 1: Hourly and Annual Dose Received from Device 2**

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^2	$(3.3)^2$	10.9
3	Square of the distance (ft) from the device the secretary's desk in an unrestricted area, in ft^2	$(18)^2$	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 the dose received by an individual at the secretary's desk, HOURLY DOSE RECEIVED FROM DEVICE 2, in mrem in an hour.	109/324	0.34
6	Multiply the result of Step 5 by 24 hr/d x 365 d/yr = MAXIMUM ANNUAL DOSE RECEIVED FROM DEVICE 2, in mrem in a year.	0.34 x 24 x 365	2,950

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

Table 13: **Calculation Method, Part 1: Total Hourly and Annual Dose Received from Devices 1 and 2**

Step No.	Description	Device 1	Device 2	Sum
7	TOTAL HOURLY DOSE RECEIVED from Step 5 of **Tables 9** and **10**, in mrem in an hour	0.76	0.34	0.76 + 0.34 = 1.1
8	TOTAL ANNUAL DOSE RECEIVED from Step 6 of **Tables 10** and **11**, in mrem in a year	6,630	2,950	9,580

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.

I. Example 1: Part 2

1. 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.

2. Table 14: **Calculation Method, Part 2: Annual Dose Received from Devices 1 and 2**

Step No.	Description	Results
9	A. Average number of hours per day that individual spends in area of concern (e.g., secretary sits at desk 5 hr/day; the remainder of the day the secretary is away from the desk area copying, filing, etc.) B. Average number of days per week in area (e.g., secretary is part time and works 3 days/week) C. Average number of weeks per year in area (e.g., secretary works all year)	5 3 52
10	Multiply the results of Step 9.A. by the results of Step 9.B. by the results of Step 9.C. = AVERAGE NUMBER OF HOURS IN AREA OF CONCERN PER YEAR	5 x 3x 52 = **780**
11	Multiply the sum in Step 7 by the results of Step 10 = ANNUAL DOSE RECEIVED FROM DEVICES CONSIDERING REALISTIC ESTIMATE OF TIME SPENT IN AREA OF CONCERN, in mrem in a year	1.1 x 780 = **860**

Note: If Step 11 exceeds 100 mrem in a year, proceed to Part 3 of the calculation method.

3. 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.

J. Example 1, Part 3

1. 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.

2. Summary of Information: Device #1 (Ir-192 Exposure Device) is located in the storage area overnight and used every day at temporary jobsites all year long; it is returned to the storage location at the end of each day meaning it is only present for the secretary's first and last hours of work each day. Device #2 (Co-60 Exposure Device) is in the storage area continuously (24 hr/d) for 8 months of the year and at a temporary jobsite for the remaining 4 months. The secretary is sitting at the desk 5 hours/day, 3 days/week and 52 weeks/year.

3. **Table 15**: **Calculation Method, Part 3: Annual Dose Received from Devices 1 and 2**

Step No.	Description	Device 1	Device 2
12	Average number of hours per day device is in storage while secretary is present	2	5
13	Average number of days per week device is in storage while secretary is present	3	3
14	Average number of weeks per year device is in storage while secretary is present	52	32
15	Multiply the results of Step 12 by the results of Step 13 by the results of Step 14 = TOTAL HOURS EACH DEVICE IS STORED PER YEAR WHILE SECRETARY IS PRESENT	2x3x52 = 312	5x3x32=480
16	Multiply the results of Step 15 by the results of Step 7 = ANNUAL DOSE RECEIVED FROM EACH DEVICE, in mrem in a year	312x0.76=237	480x0.34=163
17	Sum the results of Step 16 for each device = TOTAL ANNUAL DOSE RECEIVED CONSIDERING REALISTIC ESTIMATE OF TIME SPENT IN AREA OF CONCERN AND TIME DEVICE IS IN STORAGE, in mrem in a year	237+163=**400**	

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

4. 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:
   - 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.
   - 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.

5. **Table 16**: **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

   - 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.
   - 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.

K. Example 1, Part 4

1. 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.

2. **Table 17**: **Calculation 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	237	163
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 type of radionuclide	4.0/1.7 = 2.35	4.0/2.1 = 1.9
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 by radionuclide	0.5(2.35) = 0.2	0.5(1.9) = 0.27
21	Multiply the results of Step 20 by the results of Step 18 = ANNUAL DOSE RECEIVED FROM EACH DEVICE, in mrem in a year	0.2 x 237 = 47	0.27 x 163 = 44
22	Sum the results of Step 21 for each device = TOTAL ANNUAL DOSE RECEIVED CONSIDERING REALISTIC ESTIMATE OF TIME SPENT IN AREA OF CONCERN, TIME DEVICE IS IN STORAGE AND SHIELDING OF STRUCTURAL MATERIALS, in mrem in a Year	47 + 44 = **91**	

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

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

4. 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 principal, 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: **12VAC5-481-1050** requires licensees to maintain records demonstrating compliance with the dose limits for individual members of the public.

L. Combination Measurement - Calculation Method

1. 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.

2. 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.

3. 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_2 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.

M. Example 2

1. 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 workstation is located. See **D** for information. Joe wants to see if the company complies with the public dose limits at the secretarial station.

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

3. **Table 18**: **Combination Measurement - Calculation Method**

Step No.	Description	Input Data and Results
Part 1		
1	Dose received by OSL, in mrem	100
2	Total hours OSL exposed	224 hr/d x 30 d/month = 720
3	Divide the results of Step 1 by the results of Step 2 to determine HOURLY DOSE RECEIVED, in mrem in an hour	0.14
4	Multiply the results of Step 3 by 365 d/yr x 24 hr/d = 8760 hours in one year = MAXIMUM ANNUAL DOSE RECEIVED FROM DEVICES, in mrem in a year	365 x 24 x 0.14 = 8760 x 0.14 = 1226
Part 2		
Adjust for realistic estimates of the time the secretary spends in the area as in Part 2 of Example 1.		
Part 3		
Adjust for realistic estimates of time devices spend in area of concern as in Part 3 of Example 1.		

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

4. 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.

5. 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 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

A. Crank-out Device

1. Locate the source shield at the desired distance from the object to be radiographed.
2. Mount the source tip firmly, using jigs or other attachments, with the tip in the exact exposure position.
3. 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.
4. Join the control cable to the unit following the manufacturer's instructions.
5. Establish and post the restricted area and high radiation area.
6. Unlock the device.
7. Turn the hand crank steadily to move the source out of the source shield to the exposure position.
8. 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.
9. Maintain continuous surveillance over the restricted area during an exposure, keeping all persons from entering.
10. After completing the exposure, retract the source by turning the crank until the "safe" position is indicated.
11. Survey the entire circumference of the device and the guide tube to determine that the source is in a shielded position.
12. Lock the device and remove the key.

B. Pipeliner Device

1. Establish and post the restricted area and high radiation area.
2. Unlock the device.
3. Stand as far away as possible and out of the direction of the beam and expose the source
4. 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.
5. Maintain continuous surveillance over the restricted area during an exposure, keeping all persons from entering.
6. After completing the exposure, return the source to the shielded position.
7. Survey the device to determine that the source is in a shielded position.
8. Lock the device.

Note: The agency 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.

C. Source Exchange

1. Removing the Old Source

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

a. Survey the shipping container upon receipt with a survey meter. Note that the surface reading should not exceed 2 mSv/hr (200 mem/hr).
b. Attach the end of the source guide tube to the exposure device.
c. Connect the other end of the source guide tube to the empty side of the source changer.
d. Unlock the empty side of the source changer.
e. Unlock the camera and crank out the source from the camera into the source changer.
f. Survey the source changer and guide tube to verify that the source is in the safe position.

g. Lock the source changer.
h. Disconnect the source guide tube and drive cable to the source pigtail. Replace the dust cap on the source changer.
i. 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.

2. Installing the New Source
   a. Remove the dust cap on the source changer lock body identified with the new source tag.
   b. Align the camera and source guide tube with the source changer.
   c. Connect the new source to the drive cable.
   d. Connect the source guide tube to the source changer.
   e. Unlock the source changer and retract the new source into the exposure device.
   f. Survey the exposure device and guide tube to assure that the source is in the safe position.
   g. Lock the exposure device.
   h. Disconnect the source guide tube and drive accessories.
   i. 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. Security Plans – **49 CFR 172**

1. **49 CFR 172.800, 49 CFR 172.802**: Purpose and applicability, components of a security plan;

I. 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]

J. 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]

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.			
• Labeling is required to be: (1) placed near the required marking of the proper shipping name, (2) printed or affixed to the package surface, (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. • Two labels are required on opposite sides of the package, excluding the bottom.			
Determination of Required Label			
Size: *Sides:* ≥ 100 mm *Border:* 5-6.3 mm	 49 CFR 172.436	 49 CFR 172.438	 49 CFR 172.440
	WHITE-I	YELLOW-II	YELLOW-III
Required when:	Surface radiation level ≤ 0.005 mSv/hour (0.5 mrem/hour)	0.005 mSv/hour (0.5 mrem/hour) < surface radiation level ≤ 0.5 mSv/hour (50 mrem/hour)	0.5 mSv/hour (50 mrem/hour) < surface radiation level ≤ 2 mSv/hour (200 mrem/hour)
Or:	TI = 0 [1 meter dose rate < 0.5 mrem/hour]	TI ≤ 1 [1 meter dose rate ≤ 1 mrem/hour]	1 < TI ≤ 10 [1 meter dose rate ≤ 10 mrem/hour]
Content on Radioactive Labels			
RADIOACTIVE label must contain (entered using a durable, weather-resistant means): (1) The radionuclides in the package. Symbols (e.g., Ir-192) 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. (3) The Transport Index (TI) in the supplied box. The TI is entered only on YELLOW-II and YELLOW-III labels.			
Some Special Considerations for Labeling Requirements			
• Radioactive material, excepted packages (e.g., Limited Quantity, Radioactive Instrument and Article) are excepted from labeling. • The "Cargo Aircraft Only" label is typically required for radioactive materials packages shipped by air [§172.402(c)]			

Marking Packages (49 CFR 172.300-308) 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.		
Always Required, Unless Excepted	**Sometimes Required**	**Optional**
• Proper shipping name • U.N. Identification Number • Name and address of consignor or consignee, unless: -Highway only and no motor carrier transfers, or -Part of truckload lot and entire contents of freight container are shipped from one consignor to one consignee (§172.301(d))	• If in excess of 50 kg, Gross Weight • If hazardous substance, "RQ" in association with the proper shipping name • The package type if Type A or Type B (1/2" or greater letters) • The specification-required markings (see §178.350-353) • For approved packages, the certificate ID number	• Both the name and address of consignor and consignee are recommended. • Other markings (e.g., advertising) are permitted, but must be sufficiently away from markings and labeling
Some Special Considerations 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 packages (§173.421) must bear the marking "radioactive" on the outside of the inner package, or the outer package itself, and are excepted from other marking. • Empty (§173.428) and Radioactive Instrument and Article (§173.424) packages are excepted from marking.		

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.	
Always Required, Unless Excepted	**Sometimes Required**
• The basic desription, in sequence Proper shipping name Hazard Class (7) U.N. Identification Number • 24 hour emergency response telephone number • Name of shipper • Proper page numbering (Page 1 of 4) • The total quantity (mass), in appropriate units • The name of each radionuclide 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). • For each labeled package: - The category of label used - The transport index of each package with a Yellow-II or Yellow-III label - Shipper's certification (not required of private carriers)	• If hazardous substance, "RQ" as part of the basic description **Optional** • The type of packaging (e.g., Type B) • Other information is permitted (e.g., functional description of product), provided it does not confuse or detract from the proper shipping name or other required information • Emergency response hazards and guidance information (§§172.600-604) may be entered on the shipping papers, or may be carried with the shipping papers
Some Special Considerations/Exceptions for Shipping Paper Requirements	
• Shipments of Radioactive Material, excepted packages, under UN2908-UN2911 (e.g., Limited Quantity, Empty, or 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. • Shipping papers must be in the pocket on the left door, or readily visible to a person entering the driver's compartment and within arm's reach of the driver. • For shipments of multiple cargo types, any HAZMAT entries must appear as the first entries on the shipping papers, be designated by an "X" (or "RQ") in the hazardous material column, or be highlighted in a contrasting color.	

SHIPPER'S DECLARATION FOR DANGEROUS GOODS (Provide at least two copies to the airline.)

Shipper YOUR COMPANY NAME
YOUR STREET ADDRESS
CITY & STATE & ZIP CODE

Air Waybill No.
Page 01 of 01 Pages
Shipper's Reference Number (optional) RETURN

Consignee AEA TECHNOLOGY QSA
40 North Avenue
Burlington MA 01803
U.S.A.

Two completed and signed copies of this Declaration must be handed to the operator

WARNING

Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties. This Declaration must not, in any circumstances, be completed and/or signed by a consolidator, a forwarder or an IATA cargo agent.

TRANSPORT DETAILS

This shipment is within the limitations prescribed for: *(delete non-applicable)*

~~PASSENGER AND CARGO AIRCRAFT~~ | CARGO AIRCRAFT ONLY

Airport of Departure

Airport of Destination:

Shipment type: *(delete non-applicable)*

~~NON-RADIOACTIVE~~ | RADIOACTIVE

NATURE AND QUANTITY OF DANGEROUS GOODS

Dangerous Goods Identification							
Proper Shipping Name	Class or Division	UN or ID No.	Packing Group	Subsidiary Risk	Quantity and Type of packing	Packing Inst.	Authorization
RQ, RADIOACTIVE MATERIAL, TYPE B(U) PACKAGE,	7	UN2916			IR-192, Special Form 1 Type B(U) Package 1 X 925.0 GBq	II YELLOW T.I. 0.5 DIMS 26x22x34 CMS	Special Form Cert USA/0335/B ATTACHED PACKAGE Cert. USA/9269/B(U)-96 ATTACHED

Additional Handling Information This shipment may be carried on passenger aircraft outside US jurisdiction.

" ICAO/IATA REGS USED"

24 hr. Emergency Contact Tel. No. YOUR 24 HR. NUMBER

I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

Name/Title of Signatory
YOUR NAME& TITLE

Place and Date
CITY & DATE

Signature
(see warning above)

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ATTENTION SHIPPERS! FREIGHT CHARGES ARE PREPAID ON THIS BILL OF LADING UNLESS MARKED COLLECT.

STRAIGHT BILL OF LADING

ORIGINAL—NOT NEGOTIABLE

Shipper No. _____

Carrier No. _____

Date 6/23/03

Page 01 of 01

_____ (Name of carrier) (SCAC)

On Collect on Delivery shipments, the letters "COD" must appear before consignee's name or as otherwise provided in Item 430, Sec. 1.

TO: Consignee: AEA TECHNOLOGY QSA

Street: 40 NORTH AVENUE

City: BURLINGTON State: MA Zip Code: 01803

FROM: Shipper: YOUR COMPANY NAME

Street: YOUR STREET ADDRESS

City: CITY State: STATE Zip Code: ZIP CODE

24 hr. Emergency Contact Tel. No.: YOUR 24 HOUR EMERGENCY NUMBER

Route

Vehicle Number

No. of Units & Container Type	HM	BASIC DESCRIPTION Proper Shipping Name, Hazard Class, Identification Number (UN or NA), Packing Group, per 172.101, 172.202, 172.203	TOTAL QUANTITY (Weight, Volume, Gallons, etc.)	WEIGHT (Subject to Correction)	RATE	CHARGES (For Carrier Use Only)
01		MODEL 650L CONTAINING:	01	80 LBS	CL100	
	XXX	RQ RADIOACTIVE MATERIAL				
		TYPE B(U) PACKAGE,				
		CLASS 7, UN2916				
		Special Form,				
		IR-192				
		925.0 GBq T.I. 0.5				
		USA/9269/B(U)-96 TYPE B				
		Yellow II Labels Attached				

PLACARDS TENDERED: YES ☐ NO ☒

Note – (1) Where the rate is dependent on value, shippeers are required to state specifically in writing the agreed or declared value of the property, as follows: "The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding _____ per _____."
(2) Where the applicable tariff provisions specify a limitation of the carrier's liability absent a release or a value declaration by the shipper and the shipper does not release the carrier's liability or declare a value, the carrier's liability shall be limited to the extent provided by such provisions. See NMFC Item 172.
(3)Commodities requiring special or additional care or attention in handling or stowing must be so marked and packaged as to ensure safe transportation. See section 2(e) of item 360, Bills of Lading, Freight Bills and Statements of Charges and Section 1(a) of the Contract Terms and Conditions for a list of such articles.

I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name and are classified, packed, marked and labelled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

_____ Signature

REMIT C.O.D. TO: ADDRESS

COD Amt: $

C.O.D. FEE: PREPAID ☐ COLLECT ☐ $

Subject to Section 7 of the conditions, if this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement:
The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.

(Signature of Consignor)

TOTAL CHARGES: $

FREIGHT CHARGES

FREIGHT PREPAID except when box at right is checked — Check box if charges are to be collect ☐

RECEIVED, subject to classifications and tariffs in effect on the date of the issue of this Bill of Lading, the property described above in apparent good order, except as noted (contents and condition of contents of packages unknown), marked consigned, and destined as indicated above which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under contract) agrees to carry to its usual place of delivery at said destination, if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed as to each carrier of all or any of, said property over all or any portion of said route to destination and as to each party at any time interested in all or any said property, that every service to be performed hereunder shall be subject to all the bill of lading terms and conditions in the governing classification on the date of shipment.
Shipper hereby certifies that he is familiar with all the bill of lading terms and conditions in the governing classification and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

SHIPPER: YOUR COMPANY NAME

PER: YOUR NAME & TITLE

CARRIER

PER

DATE

1

Permanent post-office address of shipper

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Sample 2

HAZARDOUS MATERIAL SHIPPING CERTIFICATION

FOR COMPANY VEHICLE TRANSPORTING IRIDIUM 192 SEALED SOURCES

SHIPPER*	CONSIGNEE*
Mo-Rad, Inc. 1234 Main Street Anywhere, USA 20000	Mo-Rad, Inc. 1234 Main Street Anywhere, USA 20000

DATE*		NUMBER OF TERABEQUERELS (CURIES)	TRANSPORT* INDEX (MR/HR @ 39 37")	CERTIFYING* SIGNATURE
5/01/98	Metal Fabricators 4321 Broad Street Somewhere, USA	1.9 (50)	0.4	John Jones

DESCRIPTION OF PIECES AND CONTENTS

RQ RADIOACTIVE MATERIAL - SPECIAL FORM N.O.S. - UN 2974 - CLASS 7
IRIDIUM 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
☐ USA/9033/B(U)	☐ USA/9269/B(U)	☐ USA/9263/B(U)	☐ USA/9036/B(U)

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)

INSTRUCTIONS

"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

EMERGENCY TELEPHONE NUMBER - 1-800-000-0000

* Substitute appropriate information for your device and shipment.

Appendix O

Daily Maintenance Check of Radiographic Equipment

Daily Maintenance Check of Radiographic Equipment

A. The radiographer or radiographer's 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:
   - Inspect the cables for cuts, breaks, and broken fittings.
   - 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;
     - 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; and
     - Check for any impairment of the locking mechanism.
     - Use the go/no-go tool to determine if the locking ball will function as intended.

4. Record the results of the daily inspection.

Appendix P

Model Emergency Procedure

Model 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.)

- 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.
- Notify the RSO and/or Management Personnel.
- Take no further actions until instructions are received from the RSO.
- Do not attempt source retrieval until the situation has been discussed with the RSO or other knowledgeable personnel.
- Don't panic. Source retrieval can be performed with very little exposure when properly planned by trained personnel.
- 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. Update information as necessary.

- 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 ALARA. Emergency equipment may include high range dosimeters, extra lead shielding, remote tongs, etc.

Notify local authorities as well as the agency as required. The agency notification is required when sources or devices containing licensed material are lost or stolen and when radiographic sources or equipment are involved in incidents that may have cause or threatens to cause an exposure in excess of **12VAC5-481-1100** limits. Reports to the agency must be made within the reporting time frames specified by **12VAC5-481-1090, 12VAC5-481-1100, 12VAC5-481-1110,** and **12VAC5-481-1120**.

Telephone notifications shall be made to the agency at (804) 864-8150 during normal business hours (8 a.m. – 4:30 p.m.). For immediate notifications after normal business hours, the agency's 24 hour emergency telephone number is (804) 674-2400 or (800) 468-8892. Identify the emergency as radiological.

Appendix Q

12VAC5-481-451: Physical Protection of Category 1 and C 2 Quantities of Radioactive Material; and 12VAC5-481-1151: Reports of Transactions Involving Nationally Tracked Sources

12VAC5-481-451

This appendix provides guidance to a licensee or applicant for the implementation of **12VAC5-481-451**, "Physical Protection of Category 1 and Category 2 Quantities of Radioactive Material." **12VAC5-481-451** was revised in order to make it compatible with NRC's 10 CFR Part 37. NRC revised Part 37 in March of 2013 and the Agreement States were required to implement compatible requirements by March of 2016.

12VAC5-481-451 became effective on March 8, 2016. New definitions such as reviewing official, security zone, safe heaven, telemetric position monitoring system, movement control center, etc., are included in the revised regulation. The requirements under this regulation provide reasonable assurance of the security of category 1 or category 2 quantities of radioactive material by protecting these materials from theft or diversion.

The table below lists the Category 1 and Category 2 quantities of radioactive materials:

Radionuclide			Category 1 (TBq)1,2	Category 1 (Ci)1,2	Category 2 (TBq)1,2	Category 2 (Ci)1,2
Am-241			60	1,620	0.6	16.2
Am-241/Be			60	1,620	0.6	16.2
Cf-252			20	540	0.2	5.4
Cm-244			50	1,350	0.5	13.5
Co-60			30	810	0.3	8.1
Cs-137			100	2,700	1	27
Gd-153			1,000	27,000	10	270
Ir-192			80	2,160	0.8	21.6
Pm-147			40,000	1,080,000	400	10,800
Pu-238			60	1,620	0.6	16.2
Pu-239/Be			60	1,620	0.6	16.2
Ra-226			40	1,080	0.4	10.8
Se-75			200	5,400	2	54
Sr-90 (Y-90)			1,000	27,000	10	270
Tm-170			20,000	540,000	200	5,400
Yb-169			300	8,100	3	81
Combinations of radioactive materials listed above3					See footnote4 below	

1The aggregate activity of multiple, collocated sources of the same radionuclides should be included when the total activity equals or exceeds the Category 1 or Category 2 threshold.

2The primary values used for compliance are TBq. The curie (Ci) values are rounded to two significant figures for informational purposes only.[3]Radioactive materials are to be considered aggregated or collocated if breaching a common physical barrier (e.g., a locked door at the entrance to a storage room) would allow access to the radioactive material or devices containing the radioactive material.

[4]If several radionuclides are aggregated, the sum of the ratios of the activity of each source, i of radionuclide, n, A (i,n), to the Category 1 or Category 2 threshold for radionuclide n, Q_n, listed for that radionuclide equals or exceeds one. [(aggregated source activity for radionuclide A) / (quantities of concern for radionuclide A)] + [(aggregated source activity for radionuclide B) / (quantities of concern for radionuclide B)] + etc…. ≥ 1

12VAC5-481-451 has the following four Subsections:

Subsection A, requires licensee to establish a physical protection program.

Subsection B, requires licensees to establish background investigation and an access authorization program to ensure that individuals who have unescorted access to Category 1 and 2 quantities of radioactive material and reviewing officials are trustworthy and reliable.

Subsection C, requires licensees to establish, implement, and maintain a security program that is designed to monitor and, without delay, detect, assess, and respond to any actual or attempted unauthorized access to Category 1 or Category 2 quantities of radioactive material in use or storage.

Subsection D, requires licensees to provide for physical protection of Category 1 or Category 2 quantity of radioactive materials in transit. These requirements apply to a person delivering material to a carrier for transport, as well as cases in which the person transports material. If licensees intend to transfer category 1 or category 2 quantities of radioactive material to a licensee of the agency, the NRC, or another agreement state, then prior to conducting such transfer they are required to verify with the NRC's license verification system or the license-issuing authority that the transferee's license authorizes the receipt of the type, form, and quantity of radioactive material to be transferred.

NRC Guidance Documents

Licensees or applicants should refer to NRC NUREG 2155 and NUREG 2166 for detailed guidance in implementing the physical protection requirements set forth under 12VAC5-481-451.

NUREG 2155 and NUREG 2166 can be found on the following NRC webpage:
http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/**12VAC5-481-1151: Reports of Transactions Involving Nationally Tracked Sources**

Nationally tracked source is a sealed source containing a quantity equal to or greater than category 1 or category 2 levels of any radioactive materials listed in **12VAC5-481-3780**.
The regulations in **12VAC5-481-1151** require that each licensee that manufactures, transfers, receives, disassembles, or disposes of a nationally tracked source shall complete and submit an NSTS report