

# STATE OF COLORADO

Bill Owens, Governor  
Jane E. Norton, Executive Director

*Dedicated to protecting and improving the health and environment of the people of Colorado*

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Colorado Department  
of Public Health  
and Environment

December 13, 1999

Mr. Paul Lohaus  
Deputy Director, Office of State Programs  
United States Nuclear Regulatory Commission  
Washington, D.C. 20555-0001

Dear Mr. Lohaus,

Attached are the proposed revisions to Part 1 - General Provisions, Part 3 - Licensing of Radioactive Material, and Part 5 - Radiation Safety Requirements for Industrial Radiographic Operations to the *Colorado Rules and Regulations Pertaining to Radiation Control*. These revisions are being made to incorporate current industrial radiography requirements into our regulations. We have adopted the wording and format of Part E of the SSRCR. It is our understanding that incorporation of the SSRCR requirements for industrial radiography will satisfy compatibility requirements between our regulations and 10 CFR Part 34.

Please direct any questions or comments to Jake Jacobi by January 14, 2000. He can be reached at (303)692-3036.

Sincerely,

Robert M. Quillin, Director  
Laboratory and Radiation Services Division

CP

Attachments: as stated

cf: L. McLean

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OSP

**STATEMENT OF BASIS AND PURPOSE  
FOR  
COLORADO RULES AND REGULATIONS  
PERTAINING TO RADIATION CONTROL  
6 CCR 1007**

**Part 1, GENERAL PROVISIONS**

**Part 3, LICENSING OF RADIOACTIVE MATERIAL**

and

**Part 5, RADIATION SAFETY REQUIREMENTS FOR  
INDUSTRIAL RADIOGRAPHIC OPERATIONS**

January 19, 2000

In 1968 the State of Colorado entered into an agreement with the federal government whereby the State assumed the responsibility for the regulation of certain types of radiation and radioactive materials.

The Radiation Control Act, Title 25, Article 11, Colorado Revised Statutes 1989 requires the state Board of Health to formulate, adopt and promulgate rules and regulations pertaining to radiation control which are modeled after the *Suggested State Regulations for Control of Radiation* (SSRCR) as proposed by the Conference of Radiation Control Program Directors, Inc. The Colorado regulations are to be neither more nor less stringent than the SSRCR except when the Board of Health concludes on the basis of detailed findings that a substantial deviation from the SSRCR is warranted. The Department's regulations, in certain areas, must also be compatible with the regulations adopted by the U.S. Nuclear Regulatory Commission (NRC). The revisions are based on the SSRCR which are deemed to be compatible with the NRC regulations.

**PART 1 - General Requirements:**

Part 1 is being modified to 1) reflect the new zip code for the laboratory building; and 2) to reflect the procedure used to provide referenced materials to the State Publications Depository Library and Distribution Center.

**Part 3 - Licensing of Radioactive Material:**

The requirements in Part 3 relating to industrial radiography have been deleted so that all requirements will be in one place.

**Part 5 - Radiation Safety Requirements for Industrial Radiographic Operations:**

Industrial radiography involves the use of x-rays or gamma rays in the evaluation of the structure of solid objects.

This is the first major revision of Part 5 since 1994. It is the result of meetings and workshops which were held, over a period of years, between the NRC, Agreement States, and industry representatives.

Because industrial radiography involves the use of highly radioactive sources, there is a need to have a high assurance that sufficient measures are undertaken to ensure that the source remains in its shielded position when not in use.

The major changes include:

1. A requirement for a two-person crew whenever radiographic operations are being conducted outside a permanent installation, and the second person must meet the requirements of a radiographer's assistant as defined in Part E of the SSRCR;
2. The addition and modification of many definitions;
3. A requirement to provide the location and description of all field stations and permanent radiographic installations;
4. A change in the field inspection of radiographer and radiographer's assistants from a quarterly interval to semiannually;
5. A change in the survey meter calibration interval from three months to six months;
6. A requirement that radiographic exposure devices using depleted uranium, (DU) for shielding be checked for DU contamination annually;
7. Added qualifications and duties of the Radiation Safety Officer;
8. A requirement that radiographers be certified by a certifying entity; and
9. A requirement that pocket dosimeters be checked for accuracy within 20 percent. Many other additions and changes in wording were made for clarification purposes such as moving all record keeping requirements to one location with Part 5.

The following are specific changes that have been made to Part 5. Editorial and clarifying changes are not included.

- RH 5.1 The purpose of this modification is to reflect that the regulations relate to industrial radiography equipment and operations, as well as to persons using the equipment.
- RH 5.2 The scope has been modified to better clarify the applicability of the regulations.
- RH 5.3 Many definitions have been added or modified to clarify the intent of the regulations, and to be compatible with other states' regulations. Terms that are no longer used have been deleted.
- RH 5.4 Exemptions. Certified and certifiable cabinet x-ray systems are exempt from most parts of the regulations in Part 5. Instead of referencing the sections they are not exempt from, the new regulations state what requirements they must meet.

Hand-held light intensified imaging devices, often referred to as lixiscopes, are now exempt only if they meet certain dose limits. The previous version of the regulations assumed that all such devices met the dose limits.

#### RH 5.5 Licensing and Registration Requirements for Industrial Radiography Operations.

A new section has been added. RH 5.5.1 refers the reader to the general requirements of Part 2 or 3, as applicable.

RH 5.5.2 through 5.5.8 are new to Part 5 and replace similar requirements, except as noted, that had been in RH 3.10.5.

RH 5.2 and 5.3 have been added to 1) specify what training information must be submitted, and 2) identify procedures for verifying the certification of radiographers. The submission will be different depending on timing. New training requirements, i.e. certification, will become effective in July 2002. (See below for justification of training requirement.)

RH 5.5.5 requires an evaluation of radiographic personnel every six months. RH 3.10.5.3 in the previous regulations had required evaluations every three months. It is believed that with the new certification requirements (see below), radiographic personnel will be better trained, and therefore the frequency of audits can be reduced.

RH 5.7 requires the submission of the name of the Radiation Safety Officer(s) (RSO). While not previously in the regulations, it has always been part of the license application. The Department must be able to evaluate the qualifications of the individual responsible for radiation safety.

RH 5.5.9, calibration procedures, and 5.5.10, location of use, have always been required to as part of the license application or registration. It is necessary to insure instruments are properly calibrated, as they are used to prevent over exposures. Providing the location of use allows the Department to evaluate shielding designs and to locate the licensee/registrant for inspections.

RH 5.5.11, Location of records is new. Licensees and registrants have always been required to maintain appropriate records. Identification of the locations where they are maintained will permit the Department to conduct inspections more efficiently.

RH 5.5.12, Underwater radiography is also a new section. Special equipment is needed in this environment.

#### RH 5.6 Performance Requirements for Industrial Radiography Equipment

This is similar to the previous RH 5.5. Specific changes are:

- The section now makes it clear that in addition to the exposure device, the source assembly, sealed source, and all associated equipment must meet national standards.
- All equipment must now meet the American National Standard Institute (ANSI) standards. There are no manufacturers of radiographic equipment in Colorado.
- In RH 5.6.2.3, the Department must approve any modification of equipment, rather than letting the licensee make that determination. The Department is aware of sealed sources not being able to be withdrawn into their shielded position due to modifications of equipment. This requirement will help prevent unnecessary exposures.

- The ANSI Standard N432 covers criteria for the design of new devices and for qualifying prototypes to performance standards. This paragraph, Sec. 34.20(c)(5), is included in the rule because ANSI N432-1980 contains crushing and kinking tests that are specific for the control cable and the control cable sheath (tube) only. However, while the crushing tests specified in ANSI N432 should be adequate for the majority of guide tubes in use, the tests specified in ANSI N432 are not sufficient for all cases and that other tests may provide an equal level of safety and may be more appropriate, provided the tests used closely approximate the crushing forces likely to be encountered in normal use.

RH 5.7 Limits on external radiation levels from storage containers and source changers has been changed to be compatible with the requirements of the SSRCR.

RH 5.8 Locking of Sources of Radiation, Storage Containers and Storage Changers has combined RH 5.7 and 5.8 in the previous regulations. Most of the changes are editorial for clarification. The requirements for surveys have been moved to have been moved to RH 5.21.

A new requirement, RH 5.8.3, has been added to clarify the intent of the old RH 5.8.1, which stated "Each source of radiation shall be provided with a lock. . ."

The prohibition from storing radiographic exposure devices in residential locations has been removed. The current limits for exposure to members of the public are sufficiently protective to allow these devices to be stored in a residential area.

The description of a permanent use location has been deleted and replaced with the definition of Field Station in RH 5.3.

RH 5.10 The prohibition against modification of devices in the previous regulation has been moved to RH 5.6.2.3.

RH 5.10.3, leak testing, clarifies that the method of testing, and the analysis of the test must be approved by the Department, the NRC or another Agreement State. The requirement to test a source when received if not accompanied by a certificate from the transferor has been a license condition and is now incorporated into the regulations.

Radiographic exposures devices containing DU shielding in which the source is moved must now be leak tested. The purpose of the leak test is to verify that the "S" tube, through which the cable moves, has not be degraded to a state where the control cable function could be limited.

The requirement in old RH 5.10.6 has been deleted because the Department does not license sealed sources that are not fastened to or contained in a radiographic exposure device.

RH 5.11 This section has been modified to require inventories for radiation machines and devices containing depleted uranium. This has been added due to the potential hazards that could result if these devices were misused.

RH 5.12 Inspection and Maintenance of Radiation Machines, Radiographic Exposure Devices, Transport and Storage Containers, Associated Equipment, Source Changers, and Survey Instruments.

This section has been expanded to specify what must be included in an inspection and maintenance program. The specificity has been added so that an applicant will know the important items they must routinely monitor.

RH 5.13 Permanent Radiographic Installations. The changes to this section are mostly clarifying, except that if an entrance controls is not properly operating, the device may still be used for seven (7) calendar days, provided there is continuous surveillance and an alarming ratemeter is used. The Department believes during this short time period, the facility can operate and provide adequate safety for employees.

RH 5.14 Labeling, Storage and Transportation.

A label is no longer required on a device if it will not be used to store radioactive material.

For clarification, the licensee is referred to Part 17 of the regulations for issues relating to transportation.

Storage requirements that exist in Part 4 of the regulations are reiterated in RH 5.14.4. These requirements have also been applied to radiation machines because if used by unauthorized persons, these machines could cause serious health hazards.

A requirement has been added to lock and physically secure the transport package containing radioactive material in the transporting vehicle. This will help prevent accidental loss, tampering, or unauthorized removal. In Colorado each year there are several radioactive devices which are lost or stolen from the vehicles.

Because of the hazard presented by radiographic devices, a label containing the licensee's or registrant's name and location must be displayed on a vehicle used to transport the device to temporary job sites. This will help authorities in case there is an accident and the radiographer is incapable of providing information about the source of radiation.

RH 5.15 Conducting Industrial Radiographic Operations.

One of the major changes to Part 5 is the requirement for two, qualified individuals to be present during radiography at temporary job sites. This new requirement is based on the recommendations from the radiography industry, including users and manufacturers of radiography equipment, the NRC and Agreement States. Because industrial radiography involves the use of highly radioactive sources, there is a need to have high assurance that sufficient measures are undertaken to ensure the source remains in a safe position when not in use. More overexposures have resulted in the radiography industry than in any other licensed activity, primarily due to inadequate source and equipment handling. By requiring a second qualified individual to be present, there will be greater assurance that radioactive material will be properly used and handled, thus, reducing the potential for additional overexposures.

Texas was the first state to implement a two-man rule. After implementation they reported a significant reduction in exposures and incidents. Based on occupational exposure data submitted to the NRC on an annual basis, the maximum likely benefit from adoption of the two-person rule would be to avoid 1-2 overexposures per year (6-100 rem averted dose); and 2-3 severe extremity or skin overexposures with deterministic effects over a 10-year period.

Requiring Department approval for work at temporary job sites has always been part of the license. This requirement is now incorporated into the regulations.

Collimators are now required. The use of a collimator will reduce radiation exposures in all directions except in the direction needed to conduct the radiography. This will reduce the exposures to the radiographers and to members of the public.

RH 5.16 Qualifications and responsibilities for the Radiation Safety Officer (RSO) have been established. The Department has generally followed nationally accepted guidelines for the necessary qualification of this position. The qualification requirements are now in regulation, and the regulations specify the RSO's responsibilities. A new requirement for the RSO is that they have received formal training in the establishment and maintenance of a radiation protection program. This is necessary because there are many activities in industrial radiography that can lead to overexposures, and the RSO must be trained in order to avoid unnecessary oversights and mistakes.

RH 5.17 Training is the second major change to Part 5. Based on a national consensus, there is now a requirement for radiographers to be certified. As stated above, more overexposures have resulted in the radiography industry than in any other licensed activity. By requiring certification, the radiographer will have to demonstrate that they understand the safety requirements of their profession. Certification is required for radiography involving radioactive materials. For operators of x-ray machines in industrial radiography, this requirement is consistent with the SSRCR's. Because there are fewer things that can go wrong with an x-ray machine than using radioactive materials, the training requirements for x-ray users are less. A two-year phase in period is provided.

In regard to the training that has been and continues to be required regarding the specific operations of the license and/or registration, the regulations now specify what subjects must be covered. Licensees and registrants will have one year to comply with the training requirement. It is expected that most companies already provide this training.

The requirements for the radiographer's assistant are essentially equivalent to the previous requirements for a trainee. However, the assistant must now demonstrate understanding of industrial radiography by taking a test, and there is a requirement for annual refresher training. Several sections of the regulations now refer to a radiographer's assistant instead of a radiographer trainee.

The requirement for audits conducted by the RSO have been relaxed from quarterly to semiannually. It is believed that with the increased training and certification requirements, the audit frequency can be relaxed. The regulations now spell out what must be reviewed during the audit.

RH 5.18 The changes to the section on operating and emergency procedures have been modified and clarified. Reference to alarming ratemeters is included. These devices were not commonly in use during the previous revision of Part 5.

- RH 5.19 This section has specified what is meant by the requirement that the assistant be under the personal supervision of the radiographer.
- RH 5.20 Personal Monitoring. Several minor changes have been made to this section. First, two new types of dosimeters can now be used - electronic personal dosimeters and optically stimulated luminescence dosimeters. The second change specifies when non-self reading dosimeters must be processed. This is added so the RSO can be aware of an overexposure, and can take appropriate action. Finally, an alarming ratemeter is required for use of radioactive materials at temporary job sites. Since the NRC incorporated this requirement, overexposures have decreased. Individuals may not use one electronic dosimeter that also has an alarm instead of both a self reading dosimeter and an alarming ratemeter.
- RH 5.21 - 23 These changes are editorial.
- RH 5.24-36 All requirements for the maintenance of records have been moved toward the back of Part 5. The requirements are essentially the same as previous requirements that existed in Part 5 or currently exist in Part 3, except:
- The retention period has been changed from 2 to 3 years. This will allow the inspector to evaluate trends of compliance over a longer period.
  - There is a requirement for the licensee to maintain a copy of the license. Currently, Part 10 of the regulations requires the license to be available for review by radiation workers.
  - New records must be maintained relating to the new certification requirements and the annual refresher training.
  - Records may be maintained in microform or electronic formats.
- RH 5.37 The following additional records must be kept at temporary job sites to demonstrate compliance: Utilization logs; records of equipment problems; records of alarm systems (if applicable); shipping papers (currently required under Part 17); and a copy of the license or registration if operating under reciprocity (currently required by policy). This set of records is the minimum needed to ensure that the licensee or registrant can conduct radiographic operations safely and to demonstrate that they are in compliance with the regulations.
- RH 5.38 Changes have been made to the notification requirements.
- Failures of essential components must be reported in order to quickly evaluate whether the problem could be generic for the equipment, or just an isolated case. The NRC and other Agreement States report these defects to a national data base.
  - If a licensee or registrant operates in a location not on the license or registrant in excess of 180 days, the Department is to be notified so that it can evaluate the shielding and security of the site. Permanent facilities have stricter requirements than temporary job sites.
- RH 5.39 A new section on reciprocity has been added. First, it references the reciprocity requirements in Part 3 of the regulations. Secondly, it specifies the individual(s) must be certified in accordance with the regulation. Finally, as a condition of granting reciprocity, the radiographer and the licensee/registrant can have no escalated enforcement pending with the NRC or any other Agreement State. This will ensure only competent radiographers will be conducting operations in Colorado.



RH 5.26 (old regulations) The prohibition fishpole radiography in the pervious regulations has been deleted because the devices used for this type of radiography do not meet the requirements of current regulations, and can not be licensed.

Appendix A The training requirements in the previous regulations have been replaced with requirements for a certifying entity. This is compatible with the new certification requirements. These requirements apply only to independent certifying agencies. The Department will accept certification by other Agreement States.

**REGULATORY ANALYSIS  
FOR  
COLORADO RULES AND REGULATIONS  
PERTAINING TO RADIATION CONTROL  
6 CCR 1007**

**Part 1, GENERAL PROVISIONS**

**Part 3, LICENSING OF RADIOACTIVE MATERIAL**

and

**Part 5, RADIATION SAFETY REQUIREMENTS FOR  
INDUSTRIAL RADIOGRAPHIC OPERATIONS**

January 19, 2000

The Radiation Control Act, Title 25, Article 11, Colorado Revised Statutes 1989 (Act) requires the Colorado Department of Public Health and Environment (Department) to license radioactive materials, to register the use of radiation producing machines, and to develop and conduct programs for evaluation and control of hazards associated with the use of sources of ionizing radiation.

Section 25-11-104 of the Act requires the state Board of Health to formulate, adopt and promulgate rules and regulations pertaining to radiation control which are modeled after the *Suggested State Regulations for Control of Radiation* (SSRCR) as proposed by the Conference of Radiation Control Program Directors, Inc. The Colorado regulations are to be based on the SSRCR except when the Board of Health concludes on the basis of detailed findings that a substantial deviation from the SSRCR is warranted. The Department's regulations, in certain areas, must also be compatible with the regulations adopted by the U.S. Nuclear Regulatory Commission (NRC). The revisions are based on the SSRCR which have been deemed compatible with the NRC.

This regulatory Analysis provides the background information relative to the revision of the Regulations. This analysis is prepared in fulfillment of section 24-04-103(4.5)(a) of the Colorado Administrative Procedures Act. The analysis of the proposed amendments are compared to the current regulations.

**Overview**

Part 1 is being modified to 1) reflect the new zip code for the laboratory building; and 2) to reflect the procedure used to provide referenced materials to the State Publications Depository Library and Distribution Center.

The requirements in Part 3 relating to industrial radiography have been deleted so that all requirements will be in one place.

The changes to Parts 1 and 3 will have no impact on the state or the regulated community.

The revision specifies requirements for mandatory certification of radiographers, a revised definition for a permanent radiographic installation, new requirements for the designation of and the qualifications for a Radiation Safety Officer, reduced mandatory inspection frequency of radiographers' and radiographers' assistants' performance, additional training for radiographers' assistants, specification of required documents at various radiographic operation sites, additional record keeping and labeling requirements, reduced frequency of survey meter calibrations, and a new requirement for leak testing of radiographic exposure devices. A number of the changes involve a reorganization of the regulations for clarification. The revisions include some new definitions, the defining of some terms and the elimination of terms not used in the new regulations.

### **Regulatory Analysis for Implementation of a Constraint Limit for Air Emissions:**

1. **A description of the classes of persons who will bear the costs and/or benefits from the action.**

Colorado has 8 industrial radiography companies that use radioactive material and 44 registrants that use x-rays for industrial radiography. Of the 44, 31 use cabinet x-ray systems, and they are exempt from Part 5 except for RH 5.4.1.<sup>1</sup> Of the remaining 13 registrants who use x-ray machines, 4 also are licensed to use radioactive materials.

It is estimated that 8 licensees/registrants conduct radiography at temporary job sites, each of which average 5 radiographers. The 9 remaining registrants that conduct radiography without cabinet x-ray systems average 2 employees each that function as radiographers. Hence, the major revisions will impact 17 companies and 58 radiographers and radiography assistants.

In addition to the regulated companies and their employees, the major beneficiaries of these regulations will be the general public which will see a reduction in unnecessary radiation exposures.

2. **A description of the probable quantitative and qualitative impacts of the rule, economic and otherwise, upon the affected classes.**

#### **Quantitative:**

##### **2-Person Rule**

This rule applies only to the 8 companies that conduct radiography at temporary job sites. Colorado regulations have always required licensees to maintain visual surveillance of radiographic operations to protect against unauthorized entry into a high radiation area. In many cases, this requires the presence of more than one qualified individual. Therefore, it is assumed that 80 percent of the job sites already require two or more qualified individuals. The new requirement will affect only those situations in which licensees use only one qualified individual in the performance of radiography.

It is estimated that the new requirement will require each licensee/registrant working at temporary job sites to hire one additional person. The additional cost of implementing this requirement is estimated to be \$24,000 per licensee. (\$12.00 per hour working for 2,000 hours per year).

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<sup>1</sup> RH 5.4.1 is similar to existing regulations.

### Mandatory Certification for Radiographer

As noted above, it is estimated that Colorado has 58 radiographers. It is further estimated that 35 radiographers working at temporary job sites are already certified, because they need this certification to work in other states that currently require certification. The average cost for taking the examination and receiving certification is \$125. Certifications are good for 5 years. Certification exams may be taken in other states, or a professional association can conduct the exam in Colorado. The American Society for Nondestructive Testing stated they will provide the certification testing in as many locations as possible. Therefore, many people may take the test by driving to the exam, without the need for an overnight stay. It is estimated that the average travel costs to take the exam will average \$200. Therefore, the average annual cost is \$65.  $(\$125 + \$200) \div 5 = \$65$  The initial cost to the 23 radiographers that would not otherwise be certified is \$ 1,495 . The average annual cost to all companies would be \$222.  $(58 \text{ radiographers} \times \$65/\text{radiographers}/\text{yr} \div 17 \text{ companies} = \$222/\text{yr}/\text{company})$

### Radiation Safety Officer Training

Previously, the licensing guide for industrial radiography requested the name of the RSO, and said the individual should have at least 1 year actual experience as a radiographer, but did not list the RSO's duties. The new regulations list both the qualifications and the specific duties of the RSO. The new requirement includes in addition experience, 40 hours of training in the establishment and maintenance of a radiation protection program. It is estimated that this will cost each licensee an additional \$1,800 (\$500 for training, \$500 for transportation, \$320 for meals, lodging and expenses while attending the training, and \$480 in salary and benefits)

It is estimated that 4 of Colorado's licensees have already met this requirement so they could work in other states that already have this requirement. Therefore, the cost to Colorado's remaining 13 companies will be \$23,400.

If the average length of employment for an RSO is 5 years, the average annual cost to a licensee/registrant for RSO training would be \$ 360 ( \$1800/course X 1 course/5 yrs)

### Inspection of Radiographers and Radiographers' Assistants During Actual Operations

The frequency of inspections of the job performance of radiographers and radiographers' assistance is changed from quarterly to semiannual, reducing the cost to the licensees and registrants by 50 percent. If there are 58 radiographers, and 25 radiography assistants, 83 persons needed to be audited four times per year under the old regulations, or 332 audits. Under the new regulations, the number of audits is reduced by 166 per year.

If the hourly salary for the auditor is \$30, and each audit takes 3 hours, the cost per each audit will be \$90. The new regulations will result in an annual net savings for the industry of \$14,140. The average annual cost savings to the 17 affected licensees/registrants is approximately \$880.

### Testing for Depleted Uranium (DU)

Radiographic exposures devices containing depleted uranium (DU) shielding in which the source is moved must be leak tested. The purpose of the leak test is to verify that the "S" tube, through which the cable moves, has not be degraded to a state where the control cable function could be limited. This requirement affects 8 radioactive materials licensees. The leak tests are to be conducted at intervals not to exceed 12 months and may be performed by the licensee using an acceptable leak-test kit. If the testing reveals the presence of DU contamination, the exposure device must be removed from use until an evaluation of the wear of the "S" tube has been made. The estimated cost for such a leak-test is estimated to be \$25 if the licensee performs the test himself.

If the 8 licensees average 5 devices needing leak testing, the cost would be \$1,000 ( 8 licensees X 5 devices/licensee X \$25/device = \$1,000.), with an average cost to those licensees per licensee of \$125 per year.

### Documents Required at Various Locations

This requirement will only impact the 8 licensees and registrants that work at temporary job sites. It is estimated that the cost to have these documents available will be \$150 per licensee per year, with the total annual cost to the 8 licensees and registrants being \$1,200. This is based on 15 hours to have the documents available, and a labor cost of \$10 per hour.

### Record keeping, Notification and Labeling

These changes include the addition of required signatures, listing of serial numbers of devices in use in the utilization logs, records of depleted uranium leak-tests performed, and written notification whenever a material will be used or stored for more than 180 days at a location not listed on the license. These new requirements are expected to cost approximately \$200 per licensee/registrant, or a total of \$3,000 for all Colorado industrial radiography companies.

### Reduced Calibration Frequency

The calibration interval for radiation survey instruments is being extended from 3 months to 6 months since it is believed more frequent calibration is not needed, and that any change in instrument response would be detected during the daily operability check for the meter. The cost for calibrations will be reduced by 50 percent. The cost of calibrating a radiation survey instrument is approximately \$125 per instrument.

If it is assumed each of the 8 licensee/registrant that operates at temporary job sites has 7 instruments, and each of the 9 companies that operate at a fixed facility have 1 survey meter, there are a total of 65 meters that must be calibrated. The revised regulations will reduce the number of calibrations by two per meter, or 130 per year. At \$125 per calibration, the total savings per year is \$ 15,625. The average cost per licensee/registrant is \$920.

### Qualitative:

The qualitative impact will be fewer violations and fewer overexposures. The NRC has estimated the benefit to be avoidance of 1-2 overexposures per year (6-100 rem averted dose); and 2-3 severe extremity or skin overexposures with deterministic effects over a 10-year period.

3. **Probable costs to the Department and to local health departments. Anticipated effects on state revenues.**

There will be a slight savings to the department due to 1) new requirements for maintaining records, and 2) fewer violations resulting from the requirements for certification and two-person crews.

4. **A comparison of the probable costs and benefits of the rule and probable costs and benefits of inaction.**

See Item 1 above.

5. **A determination of whether there are less costly or less intrusive means to achieve the purpose of the rule.**

While other alternatives could be chosen (see item 6 below), none would achieve the level of protection that will result from this rule. The changes in the rules were carefully chosen on the basis of recommendations from the radiography industry, including users and manufacturers of radiography equipment, other Agreement States, and the NRC. They are consistent with the SSRCR as required by statute. The revised rules were selected over other alternatives, even though there may be some costs associated with its adoption, on the basis that there will be an overall enhancement in safety. Because industrial radiography involves the use of highly radioactive sources, there is a need to have high assurance that sufficient measures are undertaken to ensure that the sources are used in a safe manner and stored properly when not in use. More overexposures have resulted in the radiography industry than only other licensed activity. The new rules will provide greater assurance that the radioactive sources will be properly handled, thus reducing the potential for additional overexposures.

6. **A description of alternative methods for achieving the purpose of the rule.**

Two alternatives were considered:

A. Adopting the proposed rules without the "two-person" rule.

The consequences of this alternative would be the same as the selected alternative, except that the provision for the "two-person" rule would not be adopted. Based on occupational exposure data submitted to the NRC on an annual basis, the maximum likely benefit, nationally, from adoption of the two-person provision would be to avoid 1-2 over exposures per year, and 2-3 severe extremity or skin overexposures with deterministic effects might be avoided over a 10 year basis. In addition to the dose impacts, the adoption of this alternative would not bring Colorado into uniformity with the other Agreement States, the NRC, or the SSRCR as required by statute. Therefore this alternative was rejected.

B. No action.

This alternative was also rejected for much the same reason as above. Experience has shown that industrial radiography has more overexposures than any other category of licensed or registered activity, and that the adoption of similar rules has reduced the number of overexposures and incidents.

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**PART 1**  
**GENERAL PROVISIONS**

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RH 1.16 Referenced Materials.

1.16.1 These regulations incorporate by reference material originally published elsewhere. Certified copies of the complete text of incorporated materials referenced are available for public inspection during regular business hours at the Laboratory and Radiation Services Division. Copies of referenced material will be provided at cost upon request. Information regarding how the incorporated material may be obtained or examined is available from:

Director, Laboratory and Radiation Services Division  
Colorado Department of Public Health and Environment  
8100 Lowry Blvd.  
Denver, CO 80220-6928 80230-6928

1.16.2 **IN ACCORDANCE WITH 24-4-103 (12.5) ( c) (II) (C), COPIES OF ANY** Any material that has been incorporated by reference may be examined in any State Publications Depository Library **AND DISTRIBUTION CENTER.** ~~Copies of the incorporated materials have been sent to the State Publications Depository and Distribution Center, and are available for interlibrary loan.~~

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PART 3

LICENSING OF RADIOACTIVE MATERIAL

RH 3.10 Additional Requirements for Issuance of Certain Specific Licenses for Radioactive Material.

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~~3.10.5 Use of Sealed Sources in Industrial Radiography.~~

~~In addition to the requirements set forth in RH 3.9, a specific license for use of sealed sources in industrial radiography will be issued if:~~

~~3.10.5.1 the applicant has an adequate program for training radiographers and submits to the department a schedule or description of such program which specifies the:~~

~~3.10.5.1.1 initial training;~~

~~3.10.5.1.2 periodic training;~~

~~3.10.5.1.3 on-the-job training;~~

~~3.10.5.1.4 means to be used by the licensee to determine the radiographer's knowledge and understanding of and ability to comply with department regulations and licensing requirements, and the operating and emergency procedures of the applicant.~~

~~3.10.5.2 the applicant has established and submits to the Department satisfactory written operating and emergency procedures described in RH 5.13 of these regulations;~~

~~3.10.5.3 the applicant will have an internal inspection system adequate to assure that these regulations, license provisions, and the applicant's operating and emergency procedures are followed by radiographers and radiographer's assistants; the inspection system shall include the performance of internal inspections at intervals not to exceed 3 months and the retention of records of such inspections for 2 years;~~

~~3.10.5.4 the applicant submits to the Department a description of his overall organizational structure pertaining to the industrial radiography program, including specified delegations of authority and responsibility for operation of the program;~~

~~3.10.5.5 the applicant who desires to conduct his own leak tests has established adequate procedures to be followed in leak testing sealed sources for possible leakage and contamination and submits to the Department a description of such procedures including:~~



- 1 ~~3.10.5.5.1 instrumentation to be used,~~
- 2 ~~3.10.5.5.2 method of performing tests, and~~
- 3 ~~3.10.5.5.3 pertinent experience of the individual who will perform the test, and~~
- 4 ~~3.10.5.6 the licensee shall conduct a program for inspection and maintenance of radiographic~~  
5 ~~exposure devices and storage containers to assure proper functioning of components~~  
6 ~~important to safety.~~

7 **3.10.5 RESERVED**

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**PART 5**

**RADIATION SAFETY REQUIREMENTS FOR  
INDUSTRIAL RADIOGRAPHIC OPERATIONS**

**RH 5.1 Purpose. This part prescribes requirements for the issuance of licenses or registrations for the industrial use of sources of radiation and radiation safety requirements for persons using these sources of radiation in industrial radiography.**

**RH 5.2 Scope. The provisions and requirements of this Part are in addition to, and not in substitution for, other requirements of these regulations. In particular, the general requirements and provisions of Parts 1, 2, 3, 4, 10, and 17, of these regulations apply to applicants, licensees and registrants subject to this Part. Parts 3 and 17 of these regulations apply to licensing and transportation of radioactive material and Part 2 of these regulations applies to the registration of radiation machines. Except for sections which are applicable only to sealed radioactive sources, radiation machines and sealed radioactive sources are both covered by this Part. This regulation does not apply to medical uses of sources of radiation which are addressed in Parts 6 and 20 of these regulations.**

**RH 5.3 Definitions. As used in this Part, the following definitions apply:**

1           **"Annual refresher safety training" means a review conducted or provided by the licensee**  
2           **or registrant for its employees on radiation safety aspects of industrial radiography. The**  
3           **review shall include, as a minimum, any results of internal inspections, new procedures or**  
4           **equipment, new or revised regulations, and accidents or errors that have been observed.**  
5           **The review shall also provide opportunities for employees to ask safety questions.**

6           **"ANSI" means the American National Standards Institute.**

7           **"Associated equipment" means equipment that is used in conjunction with a radiographic**  
8           **exposure device to make radiographic exposures that drives, guides, or comes in contact**  
9           **with the source ( e.g., guide tube, control tube, control (drive) cable, removable source**  
10           **stop, "J" tube and collimator when used as an exposure head).**

11  
12           **"Cabinet radiography" means industrial radiography conducted in an enclosure or cabinet**  
13           **so shielded that every location on the exterior meets the dose limits for individual**  
14           **members of the public as specified in RH 4.14 of these regulations.**

1       **"Cabinet x-ray system"** means an x-ray system with the x-ray tube installed in an  
2       enclosure, hereinafter termed a cabinet, that is independent of existing architectural  
3       structures except the floor. The cabinet x-ray system is intended to contain at least that  
4       portion of a material being irradiated, provide radiation attenuation, and exclude personnel  
5       from its interior during generation of radiation. This definition includes x-ray systems  
6       designed primarily for the inspection of carry-on baggage at airline, railroad, and bus  
7       terminals, and in similar facilities. An x-ray tube used within a shielded part of a building,  
8       or x-ray equipment that may temporarily or occasionally incorporate portable shielding, is  
9       not considered a cabinet x-ray system.

10       **"Camera"** see "Radiographic exposure device".

11       **"Certifiable cabinet x-ray system"** means an existing uncertified x-ray system that has  
12       been modified to meet the certification requirements specified in 21 CFR 1020.40.

13       **"Certified cabinet x-ray system"** means an x-ray system that has been certified in  
14       accordance with 21 CFR 1010.2 as being manufactured and assembled pursuant to the  
15       provisions of 21 CFR 1020.40.

16       **"Certifying entity"** means an independent certifying organization meeting the requirements  
17       in Appendix A of this Part or a state regulatory program meeting the requirements in  
18       Appendix A, Parts II and III of this Part.

1       **"Collimator" means a radiation shield that is placed on the end of the guide tube or directly**  
2       **onto a radiographic exposure device to restrict the size of the radiation beam when the**  
3       **sealed source is cranked into position to make a radiographic exposure.**

4       **"Control cable" means the cable that is connected to the source assembly and used to**  
5       **drive the source to and from the exposure location.**

6       **"Control drive mechanism" means a device that enables the source assembly to be moved**  
7       **into and out of the exposure device.**

8       **"Control tube" means a protective sheath for guiding the control cable. The control tube**  
9       **connects the control drive mechanism to the radiographic exposure device.**

10       **"Drive cable" see "Control cable".**

11       **"Exposure head" means a device that locates the gamma radiography sealed source in the**  
12       **selected working position.**

13       **"Field station" means a facility from which sources of radiation may be stored or used and**  
14       **from which equipment is dispatched.**

1           **"Guide tube" means a flexible or rigid tube, or "J" tube, for guiding the source assembly**  
2           **and the attached control cable from the exposure device to the exposure head. The guide**  
3           **tube may also include the connections necessary for attachment to the exposure device**  
4           **and to the exposure head.**

5           **"Hands-on experience" means experience in all of those areas considered to be directly**  
6           **involved in the radiography process, and includes taking radiographs, calibration of**  
7           **survey instruments, operational and performance testing of survey instruments and**  
8           **devices, film development, posting of radiation areas, transportation of radiography**  
9           **equipment, posting of records and radiation area surveillance, etc., as applicable.**  
10          **Excessive time spent in only one or two of these areas, such as film development or**  
11          **radiation area surveillance, should not be counted toward the 2000 hours of hands-on**  
12          **experience required for a radiation safety officer in RH 5.16.1.2 or the hands-on experience**  
13          **for a radiographer as required by RH 5.17.1.**

14          **"Independent certifying organization" means an independent organization that meets all of**  
15          **the criteria of Appendix A of this part.**

16          **"Industrial radiography" means an examination of the structure of materials by the**  
17          **nondestructive method of utilizing ionizing radiation to make radiographic images.**

1       **"Lay-barge radiography" means industrial radiography performed on any water vessel**  
2       **used for laying pipe.**

3       **"Offshore platform radiography" means industrial radiography conducted from a platform**  
4       **over a body of water.**

5       **"Permanent radiographic installation" means an enclosed shielded room, cell, or vault, not**  
6       **located at a temporary jobsite, in which radiography is performed.**

7       **"Pigtail" see "Source assembly".**

8       **"Pill" see "Sealed source".**

9       **"Practical examination" means a demonstration through application of the safety rules and**  
10       **principles in industrial radiography including use of all procedures and equipment to be**  
11       **used by radiographic personnel.**

12       **"Projection sheath" see "Guide tube".**

13       **"Projector" see "Radiographic exposure device".**

1       **"Radiation safety officer for industrial radiography" means an individual with the**  
2       **responsibility for the overall radiation safety program on behalf of the licensee or**  
3       **registrant and who meets the requirements of RH 5.16.**

4       **"Radiographer" means any individual who performs or who, in attendance at the site**  
5       **where the sources of radiation are being used, personally supervises industrial**  
6       **radiographic operations and who is responsible to the licensee or registrant for assuring**  
7       **compliance with the requirements of the Department's regulations and the conditions of**  
8       **the license or registration.**

9       **"Radiographer certification" means written approval received from a certifying entity**  
10       **stating that an individual has satisfactorily met the radiation safety, testing, and**  
11       **experience criteria in RH 5.17.**

12       **"Radiographer's assistant" means any individual who under the personal supervision of a**  
13       **radiographer, uses radiographic exposure devices, sources of radiation, related handling**  
14       **tools, or radiation survey instruments in industrial radiography.**

15       **"Radiographic exposure device" means any instrument containing a sealed source**  
16       **fastened or contained therein, in which the sealed source or shielding thereof may be**  
17       **moved, or otherwise changed, from a shielded to unshielded position for purposes of**  
18       **making a radiographic exposure.**



1       **"Radiographic operations" means all activities performed with a radiographic exposure**  
2       **device, or with a radiation machine. Activities include: using; transporting except by**  
3       **common or contract carriers; storing at a temporary job site; performing surveys to**  
4       **confirm the adequacy of boundaries; setting up equipment; and any activity inside**  
5       **restricted area boundaries. Transporting a radiation machine is not considered a**  
6       **radiographic operation.**

7       **"Radiography" see "Industrial radiography."**

8       **"S-tube" means a tube through which the radioactive source travels when inside a**  
9       **radiographic exposure device.**

10       **"Shielded position" means the location within the radiographic exposure device, source**  
11       **changer, or storage container that, by manufacturer's design, is the proper location for**  
12       **storage of the sealed source.**

13  
14       **"Source assembly" means an assembly that consists of the sealed source and a connector**  
15       **that attaches the source to the control cable. The source assembly may include a ballstop**  
16       **to secure the source in the shielded position.**

1           **"Source changer" means a device designed and used for replacement of sealed sources in**  
2           **radiographic exposure devices. They may also be used for transporting and storing**  
3           **sealed sources.**

4           **"Storage area" means any location, facility, or vehicle that is used to store and secure a**  
5           **radiographic exposure device, a radiation machine, or a storage container when it is not**  
6           **used for radiographic operations. Storage areas are locked or have a physical barrier to**  
7           **prevent accidental exposure, tampering, or unauthorized removal of the device, machine,**  
8           **or container.**

9           **"Storage container" means a device in which sealed sources or radiation machines are**  
10           **secured and stored.**

11           **"Temporary jobsite" means a location where radiographic operations are performed and**  
12           **where sources of radiation may be stored other than the location(s) of use authorized on**  
13           **the license or registration.**

14           **"Underwater radiography" means radiographic operations performed when the**  
15           **radiographic exposure device or radiation machine and/or related equipment are beneath**  
16           **the surface of the water.**

17           **RH 5.4 Exemptions.**

1     **5.4.1**       **Uses of certified and certifiable cabinet x-ray systems are exempt from the**  
2                   **requirements of this Part except for the following:**

3     **5.4.1.1**       **For certified and certifiable cabinet x-ray systems, including those designed to**  
4                   **allow admittance of individuals:**

5     **5.4.1.1.1**       **No registrant shall permit any individual to operate a cabinet x-ray system until**  
6                   **the individual has received a copy of and instruction in the operating**  
7                   **procedures for the unit and has demonstrated competence in its use. Records**  
8                   **that demonstrate compliance with this subparagraph shall be maintained for**  
9                   **Department inspection until disposal is authorized by the Department.**

10    **5.4.1.1.2**       **Tests for proper operation of interlocks must be conducted and recorded at**  
11                   **intervals not to exceed six months. Records of these tests shall be maintained**  
12                   **for Department inspection until disposal is authorized by the Department.**

13    **5.4.1.1.3**       **The registrant shall perform an evaluation of the radiation exposure to**  
14                   **determine compliance with RH 4.14.1 and 4.14.3 of these regulations, and 21**  
15                   **CFR 1020.40, *Cabinet X-Ray Systems* (39 Federal Register 12986, April 10,**  
16                   **1974), at intervals not to exceed one year. Records of these evaluations shall**  
17                   **be maintained for Department inspection for two years after the evaluation.**

1     **5.4.1.2**         **Certified cabinet x-ray systems shall be maintained in compliance with 21 CFR**  
2                         **1020.40, *Cabinet X-Ray Systems* (39 Federal Register 12986, April 10, 1974), and no**  
3                         **modification shall be made to the system unless prior Department approval has**  
4                         **been granted.**

5     **5.4.2**         **Industrial uses of hand-held light intensified imaging devices are exempt from the**  
6                         **requirements of this Part if the dose rate 45 cm (18 inches) from the source of radiation**  
7                         **to any individual does not exceed 0.02 millisievert (2 millirem) per hour. Devices which**  
8                         **exceed this limit shall meet the applicable requirements of this Part and the licensing**  
9                         **or registration requirements of Part 2 or Part 3 of these regulations, as applicable.**

10    **RH 5.5 Licensing and Registration Requirements for Industrial Radiography Operations. The**  
11                         **Department will approve an application for a specific license for the use of licensed**  
12                         **material or a registration for use of radiation machines if the applicant meets the following**  
13                         **requirements, as applicable:**

14    **5.5.1**         **The applicant satisfies the general requirements specified in Part 2 for radiation**  
15                         **machine facilities or Part 3 for radioactive material, as applicable, and any special**  
16                         **requirements contained in this Part;**

17    **5.5.2**         **The applicant submits documentation demonstrating an adequate program for training**  
18                         **radiographers and radiographer's assistants that meets the requirements of RH 5.17:**

1     **5.5.2.1**        **After July 1, 2002, the applicant need not describe the initial training and**  
2                           **examination program for radiographers in the subjects outlined in RH 5.17.7.**

3     **5.5.2.2**        **From July 1, 2000 to July 1, 2002, the applicant may affirm that all individuals**  
4                           **acting as industrial radiographers will be certified in radiation safety by a certifying**  
5                           **entity before commencing duty as radiographers. This affirmation substitutes for a**  
6                           **description of its initial training and examination program for radiographers in the**  
7                           **subjects outlined in RH 5.17.7**

8     **5.5.3**         **The applicant submits procedures for verifying and documenting the certification**  
9                           **status of radiographers and for ensuring that the certification of individuals acting as**  
10                          **radiographers remains valid;**

11    **5.5.4**         **The applicant submits written operating and emergency procedures as described in**  
12                          **RH 5.18;**

13    **5.5.5**         **The applicant submits a description of a program for inspections of the job**  
14                          **performance of each radiographer and radiographer's assistant at intervals not to**  
15                          **exceed 6 months as described in RH 5.17.5.;**

- 1     **5.5.6**     **The applicant submits a description of the applicant's overall organizational structure**  
2                   **as it applies to the radiation safety responsibilities in industrial radiography, including**  
3                   **specified delegation of authority and responsibility;**
- 4     **5.5.7**     **The applicant submits the qualifications of the individual(s) designated as the radiation**  
5                   **safety officer as described in RH 5.16.1;**
- 6     **5.5.8**     **If an applicant intends to perform leak testing of sealed sources or exposure devices**  
7                   **containing depleted uranium (DU) shielding, the applicant must describe the**  
8                   **procedures for performing the test. The description must include the:**
- 9     **5.5.8.1**         **Methods of collecting the samples;**
- 10    **5.5.8.2**         **Qualifications of the individual who analyzes the samples;**
- 11    **5.5.8.3**         **Instruments to be used; and**
- 12    **5.5.8.4**         **Methods of analyzing the samples.**

- 1     **5.5.9**     **If the applicant intends to perform calibrations of survey instruments and alarming**  
2                   **ratemeters, the applicant must describe methods to be used and the experience of the**  
3                   **person(s) who will perform the calibrations. All calibrations must be performed**  
4                   **according to the procedures described and at the intervals prescribed in RH 5.9 and**  
5                   **RH 5.20.7.4;**
- 6     **5.5.10**     **The applicant identifies and describes the location(s) of all field stations and**  
7                   **permanent radiographic installations;**
- 8     **5.5.11**     **The applicant identifies the location(s) where all records required by this and other**  
9                   **Parts of these regulations will be maintained;**
- 10    **5.5.12**     **If a license application includes underwater radiography, a description of:**
- 11    **5.5.12.1**     **Radiation safety procedures and radiographer responsibilities unique to the**  
12                   **performance of underwater radiography;**
- 13    **5.5.12.2**     **Radiographic equipment and radiation safety equipment unique to underwater**  
14                   **radiography; and**
- 15    **5.5.12.3**     **Methods for gas-tight encapsulation of equipment; and**

1     **5.5.13**     **If an application includes offshore platform and/or lay-barge radiography, a description**  
2                   **of:**

3     **5.5.13.1**       **Transport procedures for radioactive material to be used in industrial radiographic**  
4                   **operations;**

5     **5.5.13.2**       **Storage facilities for radioactive material; and**

6     **5.5.13.3**       **Methods for restricting access to radiation areas.**

7     **RH 5.6 Performance Requirements for Industrial Radiography Equipment. Equipment used in**  
8                   **industrial radiographic operations must meet the following minimum criteria:**

9     **5.6.1**       **Each radiographic exposure device, source assembly or sealed source, and all**  
10                   **associated equipment must meet the requirements specified in American National**  
11                   **Standard Institute, N432-1980 "Radiological Safety for the Design and Construction of**  
12                   **Apparatus for Gamma Radiography," (published as NBS Handbook 136, issued**  
13                   **January 1981);**

14     **5.6.2**       **In addition to the requirements specified in RH 5.6.1, the following requirements apply**  
15                   **to radiographic exposure devices, source changers, source assemblies and sealed**  
16                   **sources;**



1     **5.6.2.1     The licensee shall ensure that each radiographic exposure device has attached to it**  
2     **a durable, legible, clearly visible label bearing the:**

3     **5.6.2.1.1            Chemical symbol and mass number of the radionuclide in the device;**

4     **5.6.2.1.2            Activity and the date on which this activity was last measured;**

5     **5.6.2.1.3            Model or product code and serial number of the sealed source;**

6     **5.6.2.1.4            Name of the manufacturer of the sealed source; and**

7     **5.6.2.1.5            Licensee's name, address, and telephone number.**

8     **5.6.2.2            Radiographic exposure devices intended for use as Type B packages must meet**  
9     **the applicable transportation requirements of Part 17 of these regulations.**

10    **5.6.2.3            Modification of radiographic exposure devices, source changers, and source**  
11    **assemblies and associated equipment is prohibited, unless approved by the**  
12    **Department another Agreement State, or the NRC.**

1     **5.6.3**     **In addition to the requirements specified in RH 5.6.1 and 2, the following requirements**  
2                   **apply to radiographic exposure devices, source assemblies, and associated equipment**  
3                   **that allow the source to be moved out of the device for radiographic operations or to**  
4                   **source changers;**

5     **5.6.3.1**     **The coupling between the source assembly and the control cable must be**  
6                   **designed in such a manner that the source assembly will not become disconnected**  
7                   **if cranked outside the guide tube. The coupling must be such that it cannot be**  
8                   **unintentionally disconnected under normal and reasonably foreseeable abnormal**  
9                   **conditions.**

10    **5.6.3.2**     **The device must automatically secure the source assembly when it is cranked back**  
11                   **into the fully shielded position within the device. This securing system may only**  
12                   **be released by means of a deliberate operation on the exposure device.**

13    **5.6.3.3**     **The outlet fittings, lock box, and drive cable fittings on each radiographic exposure**  
14                   **device must be equipped with safety plugs or covers which must be installed**  
15                   **during storage and transportation to protect the source assembly from water, mud,**  
16                   **sand or other foreign matter.**

1     **5.6.3.4**     **Each sealed source or source assembly must have attached to it or engraved on it,**  
2                   **a durable, legible, visible label with the words:**

3                                   **"DANGER -- RADIOACTIVE."**

4                   **The label may not interfere with the safe operation of the exposure device or**  
5                   **associated equipment.**

6     **5.6.3.5**     **The guide tube must be able to withstand a crushing test that closely approximates**  
7                   **the crushing forces that are likely to be encountered during use, and be able to**  
8                   **withstand a kinking resistance test that closely approximates the kinking forces**  
9                   **that are likely to be encountered during use.**

10    **5.6.3.6**     **Guide tubes must be used when moving the source out of the device.**

11    **5.6.3.7**     **An exposure head or similar device designed to prevent the source assembly from**  
12                   **passing out of the end of the guide tube must be attached to the outermost end of**  
13                   **the guide tube during industrial radiography operations.**

14    **5.6.3.8**     **The guide tube exposure head connection must be able to withstand the tensile**  
15                   **test for control units specified in ANSI N432-1980.**

1     **5.6.3.9**         **Source changers must provide a system for ensuring that the source will not be**  
2                             **accidentally withdrawn from the changer when connecting or disconnecting the**  
3                             **drive cable to or from a source assembly.**

4     **5.6.4**         **All radiographic exposure devices and associated equipment in use after January 10,**  
5                             **1996, must comply with the requirements of this section; and**

6     **5.6.5**         **As an exception to RH 5.6.1, equipment used in industrial radiographic operations**  
7                             **need not comply with § 8.9.2(c) of the Endurance Test in American National Standards**  
8                             **Institute N432-1980, if the prototype equipment has been tested using a torque value**  
9                             **representative of the torque that an individual using the radiography equipment can**  
10                            **reasonably exert on the lever or crankshaft of the drive mechanism.**

11    **RH 5.7 Limits on External Radiation Levels From Storage Containers and Source Changers. The**  
12                            **maximum exposure rate limits for storage containers and source changers are 2**  
13                            **millisieverts (200 mrem) per hour at any exterior surface, and 0.1 millisieverts (10 mrem)**  
14                            **per hour at 1 meter from any exterior surface with the sealed source in the shielded**  
15                            **position.**

16    **RH 5.8 Locking of Sources of Radiation, Storage Containers and Source Changers.**

1     **5.8.1**     Each radiographic exposure device must have a lock or outer locked container  
2                   designed to prevent unauthorized or accidental removal of the sealed source from its  
3                   shielded position. The exposure device and/or its container must be kept locked<sup>1</sup>  
4                   when not under the direct surveillance of a radiographer or a radiographer's assistant  
5                   except at permanent radiographic installations as stated in RH 5.22. In addition, during  
6                   radiographic operations the sealed source assembly must be secured in the shielded  
7                   position each time the source is returned to that position.

8     **5.8.2**     Each sealed source storage container and source changer must have a lock or outer  
9                   locked container designed to prevent unauthorized or accidental removal of the sealed  
10                  source from its shielded position. Storage containers and source changers must be  
11                  kept locked<sup>1</sup> when containing sealed sources except when under the direct  
12                  surveillance of a radiographer or a radiographer's assistant.

13    **5.8.3**     The control panel of each radiation machine shall be equipped with a lock that will  
14                  prevent the unauthorized use of an x-ray system or the accidental production of  
15                  radiation. The radiation machine shall be kept locked and the key removed at all times  
16                  except when under the direct visual surveillance of a radiographer or a radiographer's  
17                  assistant.

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<sup>1</sup>If a keyed lock, the key must be removed at all times.

1 **RH 5.9 Radiation Survey Instruments.**

2 **5.9.1 The licensee or registrant shall keep sufficient calibrated and operable radiation survey**  
3 **instruments at each location where sources of radiation are present to make the**  
4 **radiation surveys required by this Part and by Part 4 of these regulations.**  
5 **Instrumentation required by this section must be capable of measuring a range from**  
6 **0.02 millisieverts (2 mrem) per hour through 0.01 sievert (1 rem) per hour.**

7 **5.9.2 The licensee or registrant shall have each radiation survey instrument required under**  
8 **RH 5.9.1 calibrated:**

9 **5.9.2.1 At energies appropriate for use and at intervals not to exceed 6 months and after**  
10 **instrument servicing, except for battery changes;**

11 **5.9.2.2 For linear scale instruments, at two points located approximately one-third and**  
12 **two-thirds of full-scale on each scale; for logarithmic scale instruments, at mid-**  
13 **range of each decade, and at two points of at least one decade; and for digital**  
14 **instruments, at 3 points between 0.02 and 10 millisieverts (2 and 1000 mrem) per**  
15 **hour; and**

16 **5.9.2.3 So that an accuracy within plus or minus 20 percent of the true radiation dose rate**  
17 **can be demonstrated at each point checked.**

1     **5.9.3**        The licensee or registrant shall maintain records of the results of the instrument  
2                    calibrations in accordance with RH 5.26.

3     **RH 5.10 Leak Testing and Replacement of Sealed Sources.**

4     **5.10.1**        The replacement of any sealed source fastened to or contained in a radiographic  
5                    exposure device and the leak testing of any sealed source must be performed by  
6                    persons authorized to do so by the Department, the Nuclear Regulatory Commission,  
7                    or another Agreement State.

8     **5.10.2**        The opening, repair, or modification of any sealed source must be performed by  
9                    persons specifically authorized to do so by the Department, the Nuclear Regulatory  
10                   Commission, or another Agreement State.

11    **5.10.3**        Testing and recordkeeping requirements.

12    **5.10.3.1**       Each licensee who uses a sealed source shall have the source tested for leakage at  
13                    intervals not to exceed 6 months. The leak testing of the source must be  
14                    performed using a method approved by the Department, the Nuclear Regulatory  
15                    Commission, or by another Agreement State. The wipe sample should be taken  
16                    from the nearest accessible point to the sealed source where contamination might  
17                    accumulate. The wipe sample must be analyzed for radioactive contamination.

1           **The analysis must be capable of detecting the presence of 185 bequerel (0.005 µCi)**  
2           **of radioactive material on the test sample and must be performed by a person**  
3           **specifically authorized by the Department, the Nuclear Regulatory Commission, or**  
4           **another Agreement State to perform the analysis.**

5           **5.10.3.2       The licensee shall maintain records of the leak tests in accordance with RH5.27.**

6           **5.10.3.3       Unless a sealed source is accompanied by a certificate from the transferor that**  
7           **shows that it has been leak tested within 6 months before the transfer, it may not**  
8           **be used by the licensee until tested for leakage. Sealed sources that are in storage**  
9           **and not in use do not require leak testing, but must be tested before use or transfer**  
10           **to another person if the interval of storage exceeds 6 months.**

11           **5.10.4       Any test conducted pursuant to RH 5.10.2 and 5.10.3. that reveals the presence of 185**  
12           **becquerel (0.005 µCi) or more of removable radioactive material must be considered**  
13           **evidence that the sealed source is leaking. The licensee shall immediately withdraw**  
14           **the equipment involved from use and shall have it decontaminated and repaired or**  
15           **disposed of in accordance with Department regulations. A report must be filed with**  
16           **the Department within 5 days of any test with results that exceed the threshold in this**  
17           **paragraph, describing the equipment involved, the test results, and the corrective**  
18           **action taken.**



1     **5.10.5**     Each exposure device using depleted uranium (DU) shielding and an "S" tube  
2                   configuration must be tested for DU contamination at intervals not to exceed 12  
3                   months. The analysis must be capable of detecting the presence of 185 becquerel  
4                   (0.005  $\mu$ Ci) of radioactive material on the test sample and must be performed by a  
5                   person specifically authorized by the Department, the Nuclear Regulatory Commission,  
6                   or another Agreement State to perform the analysis. Should such testing reveal the  
7                   presence of DU contamination, the exposure device must be removed from use until an  
8                   evaluation of the wear of the S-tube has been made. Should the evaluation reveal that  
9                   the S-tube is worn through, the device may not be used again. DU shielded devices do  
10                  not have to be tested for DU contamination while not in use and in storage. Before  
11                  using or transferring such a device, however, the device must be tested for DU  
12                  contamination, if the interval of storage exceeds 12 months. A record of the DU leak-  
13                  test must be made in accordance with RH 5.27.

14     **RH 5.11 Quarterly Inventory.**

15     **5.11.1**     Each licensee or registrant shall conduct a quarterly physical inventory to account for  
16                   all sources of radiation, and for devices containing depleted uranium received and  
17                   possessed under the license.

18     **5.11.2**     The licensee or registrant shall maintain records of the quarterly inventory in  
19                   accordance with RH 5.28.

1 **RH 5.12 Inspection and Maintenance of Radiation Machines, Radiographic Exposure Devices,**  
2 **Transport and Storage Containers, Associated Equipment, Source Changers, and Survey**  
3 **Instruments.**

4 **5.12.1 The licensee or registrant shall perform visual and operability checks on survey**  
5 **meters, radiation machines, radiographic exposure devices, transport and storage**  
6 **containers, associated equipment and source changers before each day's use, or work**  
7 **shift, to ensure that:**

8 **5.12.1.1 The equipment is in good working condition;**

9 **5.12.1.2 The sources are adequately shielded; and**

10 **5.12.1.3 Required labeling is present.**

11 **5.12.2 Survey instrument operability must be performed using check sources or other**  
12 **appropriate means.**

13 **5.12.3 If equipment problems are found, the equipment must be removed from service until**  
14 **repaired.**

1     **5.12.4**     Each licensee or registrant shall have written procedures for, and perform inspection  
2                   and routine maintenance of, radiation machines, radiographic exposure devices,  
3                   source changers, associated equipment, transport and storage containers, and survey  
4                   instruments. The inspection and maintenance must be performed at intervals not to  
5                   exceed 3 months, or before the first use thereafter, to ensure the proper functioning of  
6                   components important to safety. If equipment problems are found, the equipment must  
7                   be removed from service until repaired.

8     **5.12.5**     The licensee's inspection and maintenance program must include procedures to  
9                   assure that Type B packages are shipped and maintained in accordance with the  
10                  certificate of compliance or other approval.

11    **5.12.6**     Records of equipment problems and of any maintenance performed under RH 5.12  
12                  must be made in accordance with RH 5.30.

13    **RH 5.13 Permanent Radiographic Installations.**

14    **5.13.1**     Each entrance that is used for personnel access to the high radiation area in a  
15                  permanent radiographic installation must have either:

16    **5.13.1.1**    An entrance control of the type described in RH 4.19 of these regulations that  
17                  causes the radiation level upon entry into the area to be reduced; or

1       **5.13.1.2**       Both conspicuous visible and audible warning signals to warn of the presence of  
2                           radiation. The visible signal must be actuated by radiation whenever the source is  
3                           exposed or the machine is energized. The audible signal must be actuated when  
4                           an attempt is made to enter the installation while the source is exposed or the  
5                           machine is energized.

6       **5.13.2**       The alarm system must be tested for proper operation with a radiation source each day  
7                           before the installation is used for radiographic operations. The test must include a  
8                           check of both the visible and audible signals. Entrance control devices that reduce the  
9                           radiation level upon entry as designated in RH 5.13.1 must be tested monthly.

10      **5.13.3**       If an entrance control device or an alarm is operating improperly, it must be  
11                          immediately labeled as defective and repaired within 7 calendar days. The facility may  
12                          continue to be used during this 7-day period, provided the licensee or registrant  
13                          implements the continuous surveillance requirements of RH 5.22 and uses an alarming  
14                          ratemeter. Test records for entrance controls and audible and visual alarms must be  
15                          maintained in accordance with RH 5.31.

16      **RH 5.14 Labeling, Storage, and Transportation.**

1     **5.14.1**     **The licensee may not use a source changer or a container to store radioactive material**  
2                   **unless the source changer or the storage container has securely attached to it a**  
3                    **durable, legible, and clearly visible label bearing the standard trefoil radiation caution**  
4                    **symbol conventional colors, i.e., magenta, purple or black on a yellow background,**  
5                    **having a minimum diameter of 25 mm, and the wording:**

6                                   **CAUTION \***

7                                   **RADIOACTIVE MATERIAL**

8                                   **NOTIFY CIVIL AUTHORITIES [or " NAME OF COMPANY"]**

9                                   **\* --- or "DANGER"**

10    **5.14.2**     **The licensee may not transport radioactive material unless the material is packaged,**  
11                    **and the package is labeled, marked, and accompanied with appropriate shipping**  
12                    **papers in accordance with regulations set out in Part 17.**

13    **5.14.3**     **Radiographic exposure devices, source changers, storage containers, and radiation**  
14                    **machines, must be physically secured to prevent tampering or removal by**  
15                    **unauthorized personnel. The licensee shall store radioactive material in a manner that**  
16                    **will minimize danger from explosion or fire.**

1     **5.14.4**     The licensee shall lock and physically secure the transport package containing  
2                   radioactive material in the transporting vehicle to prevent accidental loss, tampering,  
3                   or unauthorized removal.

4     **5.14.5**     The licensee's or registrant's name and city or town where the main business office is  
5                   located shall be prominently displayed with a durable, clearly visible label(s) on both  
6                   sides of all vehicles used to transport radioactive material or radiation machines for  
7                   temporary job site use.

8     **RH 5.15 Conducting Industrial Radiographic Operations.**

9     **5.15.1**     Whenever radiography is performed at a location other than a permanent radiographic  
10                  installation, the radiographer must be accompanied by at least one other qualified  
11                  radiographer or an individual who has at a minimum met the requirements of  
12                  RH 5.17.3. The additional qualified individual shall observe the operations and be  
13                  capable of providing immediate assistance to prevent unauthorized entry.  
14                  Radiography may not be performed if only one qualified individual is present.

15  
16     **5.15.2**     All radiographic operations must be conducted in a permanent radiographic  
17                  installation unless otherwise specifically authorized by the Department.

1     **5.15.3**     **Except when physically impossible, collimators shall be used in industrial radiographic**  
2                   **operations that use radiographic exposure devices that allow the source to be moved**  
3                   **out of the device.**

4     **5.15.4**     **A licensee or registrant may conduct lay-barge, offshore platform, or underwater**  
5                   **radiography only if procedures have been approved by the Department, the Nuclear**  
6                   **Regulatory Commission, or by another Agreement State.**

7     **RH 5.16 Radiation Safety Officer. The radiation safety officer shall ensure that radiation safety**  
8                   **activities are being performed in accordance with approved procedures and regulatory**  
9                   **requirements in the daily operation of the licensee's or registrant's program.**

10    **5.16.1**     **The minimum qualifications, training, and experience for radiation safety officers for**  
11                   **industrial radiography are as follows:**

12    **5.16.1.1**     **Completion of the training and testing requirements of RH 5.17.1;**

13    **5.16.1.2**     **2000 hours of hands-on experience as a qualified radiographer in industrial**  
14                   **radiographic operations; and**

15    **5.16.1.3**     **Formal training in the establishment and maintenance of a radiation protection**  
16                   **program.**

1     **5.16.2**     **The Department will consider alternatives to RH 5.16.1 when the radiation safety officer**  
2                   **has appropriate training and experience in the field of ionizing radiation, and in**  
3                   **addition, has adequate formal training with respect to the establishment and**  
4                   **maintenance of a radiation safety protection program.**

5     **5.16.3**     **The specific duties and authorities of the radiation safety officer include:**

6     **5.16.3.1**     **Establishing and overseeing all operating, emergency, and ALARA procedures as**  
7                   **required by Part 4 of these regulations and reviewing them regularly to ensure that**  
8                   **they conform to Department regulations and to the license or registration**  
9                   **conditions;**

10    **5.16.3.2**     **Overseeing and approving the training program for radiographic personnel to**  
11                   **ensure that appropriate and effective radiation protection practices are taught;**

12    **5.16.3.3**     **Ensuring that required radiation surveys and leak tests are performed and**  
13                   **documented in accordance with the regulations, including any corrective measures**  
14                   **when levels of radiation exceed established limits;**

15    **5.16.3.4**     **Ensuring that personnel monitoring devices are calibrated, if applicable, and used**  
16                   **properly; that records are kept of the monitoring results; and that timely**  
17                   **notifications are made as required by Part 4 of these regulations; and**



1      **5.16.3.5      Ensuring that operations are conducted safely and for implementing corrective**  
2                               **actions including terminating operations.**

3      **5.16.4      Licensees and registrants will have until July 1, 2002 to meet the requirements of**  
4                               **RH 5.16.1. and 2.**

5      **RH 5.17 Training.**

6      **5.17.1      The licensee or registrant may not permit any individual to act as a radiographer until**  
7                               **the individual:**

8      **5.17.1.1      Has received at least 40 hours of training in the subjects outlined in RH 5.17.7, in**  
9                               **addition to on the job training consisting of hands-on experience under the**  
10                              **supervision of a radiographer and is certified through a radiographer certification**  
11                              **program by a certifying entity in accordance with the criteria specified in Appendix**  
12                              **A of this Part<sup>2</sup>. The on the job training shall include a minimum of 2 months (320**  
13                              **hours) of active participation in the performance of industrial radiography utilizing**  
14                              **radioactive material and/or 1 month (160 hours) of active participation in the**  
15                              **performance of industrial radiography utilizing radiation machines. Individuals**  
16                              **performing industrial radiography utilizing radioactive materials and radiation**

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<sup>2</sup> Certification which has been suspended or revoked by the certifying entity is not considered valid.

1                   **machines must complete both segments of the on the job training (3 months or 480**  
2                   **hours); or**

3       **5.17.1.2           The licensee or registrant may, until July 1, 2002, allow an individual who has not**  
4                   **met the requirements of RH 5.17.1.1, to act as a radiographer after the individual**  
5                   **has received:**

6       **5.17.1.2.1           At least 40 hours of training in the subjects outlined in RH 5.17.7 and**  
7                   **demonstrated an understanding of these subjects by successful completion of**  
8                   **a written examination that was previously submitted to, and approved by, the**  
9                   **Department, the Nuclear Regulatory Commission, or another Agreement State;**  
10                  **and**

11       **5.17.1.2.2           On the job training consisting of hands-on experience under the supervision of**  
12                   **a radiographer. The on the job training shall include a minimum of 2 months**  
13                   **(320 hours) of active participation in the performance of industrial radiography**  
14                   **utilizing radioactive material and/or 1 month (160 hours) of active participation**  
15                   **in the performance of industrial radiography utilizing radiation machines.**  
16                   **Individuals performing industrial radiography utilizing radioactive materials**  
17                   **and radiation machines must complete both segments of the on the job**  
18                   **training (3 months or 480 hours).**

1       **5.17.2**       **In addition, the licensee or registrant may not permit any individual to act as a**  
2                       **radiographer until the individual:**

3       **5.17.2.1**       **Has received copies of and instruction in the requirements described in the**  
4                       **regulations contained in this Part, and applicable sections of Parts 4, 10 and 17 of**  
5                       **these regulations; in the license or registration under which the radiographer will**  
6                       **perform industrial radiography; and the licensee's or registrant's operating and**  
7                       **emergency procedures;**

8       **5.17.2.2**       **Has demonstrated an understanding of items in RH 5.17.2.1 by successful**  
9                       **completion of a written or oral examination;**

10       **5.17.2.3**       **Has received training in the use of the registrant's radiation machines, or the**  
11                       **licensee's radiographic exposure devices, sealed sources, in the daily inspection**  
12                       **of devices and associated equipment, and in the use of radiation survey**  
13                       **instruments; and**

14       **5.17.2.4**       **Has demonstrated understanding of the use of the equipment described in**  
15                       **RH 5.17.2.3 by successful completion of a practical examination.**

16       **5.17.3**       **The licensee or registrant may not permit any individual to act as a radiographer's**  
17                       **assistant until the individual:**

- 1     **5.17.3.1**     **Has received copies of and instruction in the requirements described in the**  
2                   **regulations contained in this Part, and applicable sections of Parts 4, 10, and 10 of**  
3                   **these regulation, in the license or registration under which the radiographer's**  
4                   **assistant will perform industrial radiography, and the licensee's or registrant's**  
5                   **operating and emergency procedures;**
- 6     **5.17.3.2**     **Has demonstrated an understanding of items in RH 5.17.3.1 by successful**  
7                   **completion of a written or oral examination;**
- 8     **5.17.3.3**     **Under the personal supervision of a radiographer, has received training in the use**  
9                   **of the registrant's radiation machines, or the licensee's radiographic exposure**  
10                  **devices and sealed sources, in the daily inspection of devices and associated**  
11                  **equipment, and in the use of radiation survey instruments; and**
- 12    **5.17.3.4**     **Has demonstrated understanding of the use of the equipment described in**  
13                   **RH 5.17.3.3 by successful completion of a practical examination.**
- 14    **5.17.4**     **The licensee or registrant shall provide annual refresher safety training for each**  
15                   **radiographer and radiographer's assistant at intervals not to exceed 12 months.**  
16

1     **5.17.5**     **Except as provided in RH 5.17.5.4, the radiation safety officer or designee shall**  
2                   **conduct an inspection program of the job performance of each radiographer and**  
3                   **radiographer's assistant to ensure that the Department's regulations, license or**  
4                   **registration requirements, and operating and emergency procedures are followed. The**  
5                   **inspection program must:**

6     **5.17.5.1**     **Include observation of the performance of each radiographer and radiographer's**  
7                   **assistant during an actual industrial radiographic operation, at intervals not to**  
8                   **exceed 6 months; and**

9     **5.17.5.2**     **If a radiographer or a radiographer's assistant has not participated in an industrial**  
10                   **radiographic operation for more than 6 months since the last inspection, the**  
11                   **radiographer must demonstrate knowledge of the training requirements of RH**  
12                   **5.17.2.3. and the radiographer's assistant must demonstrate knowledge of the**  
13                   **training requirements of 5.17.3.3 by a practical examination before these**  
14                   **individuals can next participate in a radiographic operation.**

15     **5.17.5.3**     **The Department may consider alternatives in those situations where the individual**  
16                   **serves as both radiographer and radiation safety officer.**

1     **5.17.5.4**     **In those operations where a single individual serves as both radiographer and**  
2                    **radiation safety officer, and performs all radiography operations, an inspection**  
3                    **program is not required.**

4     **5.17.6**     **The licensee or registrant shall maintain records of the above training to include**  
5                    **certification documents, written, oral and practical examinations, refresher safety**  
6                    **training and inspections of job performance in accordance with RH 5.32.**

7     **5.17.7**     **The licensee or registrant shall include the following subjects required in RH 5.17.1:**

8     **5.17.7.1**     **Fundamentals of radiation safety including:**

9     **5.17.7.1.1**     **Characteristics of gamma and x-radiation;**

10    **5.17.7.1.2**     **Units of radiation dose and quantity of radioactivity;**

11    **5.17.7.1.3**     **Hazards of exposure to radiation;**

12    **5.17.7.1.4**     **Levels of radiation from sources of radiation; and**

13    **5.17.7.1.5**     **Methods of controlling radiation dose (time, distance, and shielding);**

- 1     **5.17.7.2     Radiation detection instruments including:**
- 2     **5.17.7.2.1        Use, operation, calibration, and limitations of radiation survey instruments;**
- 3     **5.17.7.2.2        Survey techniques; and**
- 4     **5.17.7.2.3        Use of personnel monitoring equipment;**
- 5     **5.17.7.3     Equipment to be used including:**
- 6     **5.17.7.3.1        Operation and control of radiographic exposure equipment, remote handling**  
7     **equipment, and storage containers, including pictures or models of source**  
8     **assemblies (pigtailed);**
- 9     **5.17.7.3.2        Operation and control of radiation machines;**
- 10    **5.17.7.3.3        Storage, control, and disposal of sources of radiation; and**
- 11    **5.17.7.3.4        Inspection and maintenance of equipment.**
- 12    **5.17.7.4     The requirements of pertinent state and federal regulations; and**

1       **5.17.7.5       Case histories of accidents in radiography.**

2       **5.17.8       Licensees and registrants will have until July 1, 2001 to comply with the additional**  
3       **training requirements specified in RH 5.17.2.1 and 5.17.3.1.**

4       **RH 5.18 Operating and Emergency Procedures.**

5       **5.18.1       Operating and emergency procedures must include, as a minimum, instructions in the**  
6       **following:**

7       **5.18.1.1       Appropriate handling and use of sources of radiation so that no person is likely to**  
8       **be exposed to radiation doses in excess of the limits established in Part 4 of these**  
9       **regulations;**

10      **5.18.1.2       Methods and occasions for conducting radiation surveys;**

11      **5.18.1.3       Methods for posting and controlling access to radiographic areas;**

12      **5.18.1.4       Methods and occasions for locking and securing sources of radiation;**

13      **5.18.1.5       Personnel monitoring and the use of personnel monitoring equipment;**



- 1     **5.18.1.6**     **Transporting equipment to field locations, including packing of radiographic**  
2                   **exposure devices and storage containers in the vehicles, placarding of vehicles**  
3                   **when required, and control of the equipment during transportation as described in**  
4                   **Part 17 of these regulations;**
  
- 5     **5.18.1.7**     **The inspection, maintenance, and operability checks of radiographic exposure**  
6                   **devices, radiation machines, survey instruments, alarming ratemeters, transport**  
7                   **containers, and storage containers;**
  
- 8     **5.18.1.8**     **Steps that must be taken immediately by radiography personnel in the event a**  
9                   **pocket dosimeter is found to be off-scale or an alarming ratemeter alarms**  
10                  **unexpectedly;**
  
- 11    **5.18.1.9**     **The procedure(s) for identifying and reporting defects and noncompliance, as**  
12                  **required by RH 5.38;**
  
- 13    **5.18.1.10**    **The procedure for notifying proper persons in the event of an accident or incident;**
  
- 14    **5.18.1.11**    **Minimizing exposure of persons in the event of an accident or incident, including a**  
15                  **source disconnect, a transport accident, or loss of a source of radiation;**

1     **5.18.1.12       Source recovery procedure if licensee will perform source recoveries; and**

2

3     **5.18.1.13       Maintenance of records.**

4     **5.18.2        The licensee or registrant shall maintain copies of current operating and emergency**  
5                   **procedures in accordance with RH 5.33 and 5.37.**

6     **RH 5.19 Supervision of Radiographer's Assistants. The radiographer's assistant shall be under**  
7                   **the personal supervision of a radiographer when using radiographic exposure devices,**  
8                   **associated equipment, or a sealed source, or while conducting radiation surveys required**  
9                   **by RH 5.21.2 to determine that the sealed source has returned to the shielded position or**  
10                  **the radiation machine is off after an exposure. The personal supervision must include:**

11    **5.19.1        The radiographer's physical presence at the site where the sources of radiation are**  
12                  **being used;**

13    **5.19.2        The availability of the radiographer to give immediate assistance if required; and**

14    **5.19.3        The radiographer's direct observation of the assistant's performance of the operations**  
15                  **referred to in this section.**

1     **RH 5.20 Personnel Monitoring.**

2     **5.20.1     The licensee or registrant shall not permit any individual to act as a radiographer or a**  
3                   **radiographer's assistant unless, at all times during radiographic operations, each**  
4                   **individual wears, on the trunk of the body, a combination of direct reading dosimeter,**  
5                   **an alarming ratemeter, and a film badge, a TLD or an optically stimulated luminescence**  
6                   **(OSL) dosimeter. At permanent radiographic installations where other appropriate**  
7                   **alarming or warning devices are in routine use, or during radiographic operations**  
8                   **using radiation machines, the use of an alarming ratemeter is not required.**

9     **5.20.1.1     Pocket dosimeters must have a range from zero to 2 millisieverts (200 mrem) and**  
10                   **must be recharged at the start of each shift. Electronic personal dosimeters may**  
11                   **only be used in place of ion-chamber pocket dosimeters.**

12    **5.20.1.2     Each film badge, TLD or OSL dosimeter must be assigned to and worn by only one**  
13                   **individual.**

14    **5.20.1.3     Film badges, TLD's or OSL dosimeters must be exchanged at periods not to**  
15                   **exceed one month.**

1     **5.20.1.4**     **After replacement, each film badge, TLD or OSL dosimeter must be returned to the**  
2                   **supplier for processing within 14 calendar days of the end of the monitoring**  
3                   **period, or as soon as practicable. In circumstances that make it impossible to**  
4                   **return each personnel monitoring device in 14 calendar days, such circumstances**  
5                   **must be documented and available for review by the Department.**

6     **5.20.2**     **Direct reading dosimeters such as pocket dosimeters or electronic personal**  
7                   **dosimeters, must be read and the exposures recorded at the beginning and end of**  
8                   **each shift, and records must be maintained in accordance with RH 5.34.**

9     **5.20.3**     **Pocket dosimeters, or electronic personal dosimeters, must be checked at periods not**  
10                  **to exceed 12 months for correct response to radiation, and records must be**  
11                  **maintained in accordance with RH 5.34. Acceptable dosimeters must read within plus**  
12                  **or minus 20 percent of the true radiation exposure.**

1     **5.20.4**     **If an individual's pocket dosimeter is found to be off-scale, or the electronic personal**  
2                   **dosimeter reads greater than 2 millisieverts (200 mrem), the individual's film badge,**  
3                   **TLD or OSL dosimeter must be sent for processing within 24 hours. In addition, the**  
4                   **individual may not resume work associated with the use of sources of radiation until a**  
5                   **determination of the individual's radiation exposure has been made. This**  
6                   **determination must be made by the radiation safety officer or the radiation safety**  
7                   **officer's designee. The results of this determination must be included in the records**  
8                   **maintained in accordance with RH 5.34.**

9     **5.20.5**     **If a film badge, TLD or OSL dosimeter is lost or damaged, the worker shall cease work**  
10                  **immediately until a replacement film badge, TLD or OSL dosimeter is provided and the**  
11                  **exposure is calculated for the time period from issuance to loss or damage of the film**  
12                  **badge, TLD or OSL dosimeter. The results of the calculated exposure and the time**  
13                  **period for which the film badge, TLD, or OSL dosimeter was lost or damaged must be**  
14                  **included in the records maintained in accordance with RH 5.34.**

15     **5.20.6**     **Reports received from the film badge, TLD or OSL dosimeter processor must be**  
16                  **retained in accordance with RH 5.34.**

17     **5.20.7**     **Each alarming ratemeter must:**

1     **5.20.7.1**     **Be checked to ensure that the alarm functions properly before using at the start of**  
2                    **each shift;**

3     **5.20.7.2**     **Be set to give an audible alarm signal at a preset dose rate of 5 millisieverts (500**  
4                    **mrem) per hour; with an accuracy of plus or minus 20 percent of the true radiation**  
5                    **dose rate;**

6     **5.20.7.3**     **Require special means to change the preset alarm function; and**

7     **5.20.7.4**     **Be calibrated at periods not to exceed 12 months for correct response to radiation.**  
8                    **The licensee shall maintain records of alarming ratemeter calibrations in**  
9                    **accordance with RH 5.34**

10    **RH 5.21 Radiation Surveys. The licensee or registrant shall:**

11    **5.21.1**     **Conduct all surveys with a calibrated and operable radiation survey instrument that**  
12                    **meets the requirements of RH 5.9;**

1     **5.21.2**     **Conduct a survey of the radiographic exposure device and the guide tube after each**  
2                   **exposure when approaching the device or the guide tube. The survey must determine**  
3                   **that the sealed source has returned to its shielded position before exchanging films,**  
4                   **repositioning the exposure head, or dismantling equipment. Radiation machines shall**  
5                   **be surveyed after each exposure to determine that the machine is off;**

6     **5.21.3**     **Conduct a survey of the radiographic exposure device whenever the source is**  
7                   **exchanged and whenever a radiographic exposure device is placed in a storage area**  
8                   **as defined in RH 5.3, to ensure that the sealed source is in its shielded position; and**

9     **5.21.4**     **Maintain records in accordance with RH 5.35.**

10    **RH 5.22 Surveillance.** **During each radiographic operation, the radiographer shall ensure**  
11                   **continuous direct visual surveillance of the operation to protect against unauthorized**  
12                   **entry into a radiation area or a high radiation area, as defined in Part 1 of these**  
13                   **regulations, except at permanent radiographic installations where all entryways are**  
14                   **locked and the requirements of RH 5.13 are met.**

15    **RH 5.23 Posting.** **All areas in which industrial radiography is being performed must be**  
16                   **conspicuously posted as required by RH 4.28 of these regulations. The exceptions listed**  
17                   **in RH 4.29 of these regulation do not apply to industrial radiographic operations.**

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**Recordkeeping Requirements**

2 **RH 5.24 Records for Industrial Radiography.** Each licensee or registrant shall maintain a copy of  
3 its license or registration, documents incorporated by reference, and amendments to  
4 each of these items until superseded by new documents approved by the Department, or  
5 until the Department terminates the license or registration.

6 **RH 5.25 Records of Receipt and Transfer of Sources of Radiation.**

7

8 **5.25.1** Each licensee or registrant shall maintain records showing the receipts and transfers  
9 of sealed sources, devices using DU for shielding, and radiation machines, and retain  
10 each record for 3 years after it is made.

11 **5.25.2** These records must include the date, the name of the individual making the record,  
12 radionuclide, number of becquerels (curies) or mass (for DU), and manufacturer,  
13 model, and serial number of each source of radiation and/or device, as appropriate.

14 **RH 5.26 Records of Radiation Survey Instruments.** Each licensee or registrant shall maintain  
15 records of the calibrations of its radiation survey instruments that are required under RH  
16 5.9 and retain each record for 3 years after it is made.



1 **RH 5.27 Records of Leak Testing of Sealed Sources and Devices Containing DU.** Each licensee  
2 shall maintain records of leak test results for sealed sources and for devices containing  
3 DU. The results must be stated in units of becquerels ( $\mu\text{Ci}$ ). The licensee shall retain  
4 each record for 3 years after it is made or until the source in storage is removed.

5 **RH 5.28 Records of Quarterly Inventory.**

6 **5.28.1** Each licensee or registrant shall maintain records of the quarterly inventory of sources  
7 of radiation, including devices containing depleted uranium as required by RH 5.11,  
8 and retain each record for 3 years.

9 **5.28.2** The record must include the date of the inventory, name of the individual conducting  
10 the inventory, radionuclide, number of becquerels (curies) or mass (for DU) in each  
11 device, location of sources of radiation and/or devices, and manufacturer, model, and  
12 serial number of each source of radiation and/or device, as appropriate.

13 **RH 5.29 Utilization Logs.**

14 **5.29.1** Each licensee or registrant shall maintain utilization logs showing for each source of  
15 radiation the following information:

1     **5.29.1.1**     **A description, including the make, model, and serial number of the radiation**  
2                    **machine or the radiographic exposure device, transport, or storage container in**  
3                    **which the sealed source is located;**

4     **5.29.1.2**     **The identity and signature of the radiographer to whom assigned;**

5     **5.29.1.3**     **The location and dates of use, including the dates removed and returned to**  
6                    **storage; and**

7     **5.29.1.4**     **For permanent radiographic installations, the dates each radiation machine is**  
8                    **energized.**

9     **5.29.2**       **The licensee or registrant shall retain the logs required by RH 5.29.1. for 3 years.**

10    **RH 5.30 Records of Inspection and Maintenance of Radiation Machines, Radiographic Exposure**  
11                    **Devices, Transport and Storage Containers, Associated Equipment, Source Changers,**  
12                    **and Survey Instruments.**

1     **5.30.1**     **Each licensee or registrant shall maintain records specified in RH 5.12 of equipment**  
2                   **problems found in daily checks and quarterly inspections of radiation machines,**  
3                   **radiographic exposure devices, transport and storage containers, associated**  
4                   **equipment, source changers, and survey instruments; and retain each record for 3**  
5                   **years after it is made.**

6     **5.30.2**     **The record must include the date of check or inspection, name of inspector, equipment**  
7                   **involved, any problems found, and what repair and/or maintenance, if any, was**  
8                   **performed.**

9     **RH 5.31 Records of Alarm System and Entrance Control Checks at Permanent Radiographic**  
10                   **Installations. Each licensee or registrant shall maintain records of alarm system and**  
11                   **entrance control device tests required by RH 5.13 and retain each record for 3 years after**  
12                   **it is made.**

13     **RH 5.32 Records Of Training and Certification. Each licensee or registrant shall maintain the**  
14                   **following records for 3 years:**

1     **5.32.1**     **Records of training of each radiographer and each radiographer's assistant. The**  
2                   **record must include radiographer certification documents and verification of**  
3                   **certification status, copies of written tests, dates of oral and practical examinations,**  
4                   **the names of individuals conducting and receiving the oral and practical examinations,**  
5                   **and a list of items tested and the results of the oral and practical examinations; and**

6     **5.32.2**     **Records of annual refresher safety training and semi-annual inspections of job**  
7                   **performance for each radiographer and each radiographer's assistant. The records**  
8                   **must list the topics discussed during the refresher safety training, the dates the annual**  
9                   **refresher safety training was conducted, and names of the instructors and attendees.**  
10                  **For inspections of job performance, the records must also include a list showing the**  
11                  **items checked and any non-compliance observed by the radiation safety officer or**  
12                  **designee.**

13     **RH 5.33 Copies of Operating and Emergency Procedures. Each licensee or registrant shall**  
14                   **maintain a copy of current operating and emergency procedures until the Department**  
15                   **terminates the license or registration. Superseded material must be retained for 3 years**  
16                   **after the change is made.**

17     **RH 5.34 Records of Personnel Monitoring. Each licensee or registrant shall maintain the following**  
18                   **exposure records specified in RH 5.20:**

1     **5.34.1     Direct reading dosimeter readings and yearly operability checks required by RH 5.20.2**  
2                   **and 20.3 for 3 years after the record is made;**

3     **5.34.2     Records of alarming ratemeter calibrations for 3 years after the record is made;**

4     **5.34.3     Reports received from the film badge, TLD or OSL dosimeter processor until the**  
5                   **Department terminates the license or registration; and**

6     **5.34.4     Records of estimates of exposures as a result of off-scale personal direct reading**  
7                   **dosimeters, or lost or damaged film badges or TLD's, until the Department terminates**  
8                   **the license or registration.**

9     **RH 5.35 Records of Radiation Surveys. Each licensee shall maintain a record of each exposure**  
10                   **device survey conducted before the device is placed in storage as specified in RH 5.21.3.**  
11                   **Each record must be maintained for 3 years after it is made.**

12     **RH 5.36 Form of Records. Each record required by this Part must be legible throughout the**  
13                   **specified retention period. The record may be the original or a reproduced copy or a**  
14                   **microform provided that the copy or microform is authenticated by authorized personnel**  
15                   **and that the microform is capable of reproducing a clear copy throughout the required**  
16                   **retention period. The record may also be stored in electronic media with the capability for**  
17                   **producing legible, accurate, and complete records during the required retention period.**

1           **Records, such as letters, drawings, and specifications, must include all pertinent**  
2           **information, such as stamps, initials, and signatures. The licensee or registrant shall**  
3           **maintain adequate safeguards against tampering with and loss of records.**

4       **RH 5.37 Location Of Documents and Records.**

5       **5.37.1       Each licensee or registrant shall maintain copies of records required by this Part and**  
6           **other applicable Parts of these regulations at the location specified in RH 5.5.11.**

7       **5.37.2       Each licensee or registrant shall also maintain current copies of the following**  
8           **documents and records sufficient to demonstrate compliance at each applicable field**  
9           **station and each temporary jobsite;**

10      **5.37.2.1       The license or registration authorizing the use of sources of radiation;**

11      **5.37.2.2       A copy of Parts 1, 4, 5 & 10 of these regulations;**

12      **5.37.2.3       Utilization logs for each source of radiation dispatched from that location as**  
13           **required by RH 5.29;**

14  
15      **5.37.2.4       Records of equipment problems identified in daily checks of equipment as required**  
16           **by RH 5.30.1;**

- 1      **5.37.2.5      Records of alarm system and entrance control checks required by RH 5.31, if**  
2                   **applicable;**
- 3      **5.37.2.6      Records of dosimeter readings as required by RH 5.34;**
- 4      **5.37.2.7      Operating and emergency procedures as required by RH 5.33;**
- 5      **5.37.2.8      Evidence of the latest calibration of the radiation survey instruments in use at the**  
6                   **site, as required by RH 5.26;**
- 7      **5.37.2.9      Evidence of the latest calibrations of alarming ratemeters and operability checks of**  
8                   **dosimeters as required by RH 5.34;**
- 9      **5.37.2.10     Survey records as required by RH 5.35 and RH 4.42 of these regulations as**  
10                  **applicable, for the period of operation at the site;**
- 11     **5.37.2.11     The shipping papers for the transportation of radioactive materials required by Part**  
12                  **17 of these regulations; and**
- 13     **5.37.2.12     When operating under reciprocity pursuant to Part 3 of these regulations, a copy of**  
14                  **the applicable State license or registration, or Nuclear Regulatory Commission**  
15                  **license authorizing the use of sources of radiation.**

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**Notifications**

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**RH 5.38 Notifications.**

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**5.38.1 In addition to the reporting requirements specified in RH 4.52 of these regulations, each licensee or registrant shall provide a written report to the Department within 30 days of the occurrence of any of the following incidents involving radiographic equipment:**

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**5.38.1.1 Unintentional disconnection of the source assembly from the control cable;**

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**5.38.1.2 Inability to retract the source assembly to its fully shielded position and secure it in this position;**

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**5.38.1.3 Failure of any component, which is critical to safe operation of the device, to properly perform its intended function; or**

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**5.38.1.4 An indicator on a radiation machine fails to show that radiation is being produced, an exposure switch fails to terminate production of radiation when turned to the off position, or a safety interlock fails to terminate x-ray production.**

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1     **5.38.2**     **The licensee or registrant shall include the following information in each report**  
2                   **submitted under RH 5.38.1, and in each report of overexposure submitted under RH**  
3                   **4.53.2 of these regulations which involves failure of safety components of radiography**  
4                   **equipment:**

5     **5.38.2.1**     **Description of the equipment problem;**

6     **5.38.2.2**     **Cause of each incident, if known;**

7     **5.38.2.3**     **Name of the manufacturer and model number of equipment involved in the**  
8                   **incident;**

9     **5.38.2.4**     **Place, date, and time of the incident;**

10    **5.38.2.5**     **Actions taken to establish normal operations;**

11    **5.38.2.6**     **Corrective actions taken or planned to prevent recurrence; and**

12    **5.38.2.7**     **Names and qualifications of personnel involved in the incident.**

1     **5.38.3**     **Any licensee or registrant conducting radiographic operations or storing sources of**  
2                   **radiation at any location not listed on the license or registration for a period in excess**  
3                   **of 90 days in a calendar year, shall notify the Department prior to exceeding the 90**  
4                   **days.**

5     **RH 5.39 Reciprocity.**

6     **5.39.1**     **All reciprocal recognition of licenses and registrations by the Department will be**  
7                   **granted in accordance with Part 3 of these regulations.**

8     **5.39.2**     **Reciprocal recognition by the Department of an individual radiographer certification**  
9                   **will be granted provided that:**

10    **5.39.2.1**    **The individual holds a valid certification in the appropriate category issued by a**  
11                   **certifying entity, as defined in RH 5.3;**

12    **5.39.2.2**    **The requirements and procedures of the certifying entity issuing the certification**  
13                   **affords the same or comparable certification standards as those afforded by**  
14                   **RH 5.17.1;**

15    **5.39.2.3**    **The applicant presents the certification to the Department prior to entry into the**  
16                   **state; and**

1     **5.39.2.4**        **No escalated enforcement action is pending with the Nuclear Regulatory**  
2                            **Commission or in any other state.**

3     **5.39.3**         **Certified individuals who are granted reciprocity by the Department shall maintain the**  
4                            **certification upon which the reciprocal recognition was granted, or prior to the**  
5                            **expiration of such certification, shall meet the requirements of RH 5.17.1.**

6     **RH 5.40 Specific Requirements for Radiographic Personnel Performing Industrial Radiography.**

7     **5.40.1**        **At a job site, the following shall be supplied by the licensee or registrant:**

8     **5.40.1.1**      **At least one operable, calibrated survey instrument for each exposure device or**  
9                            **radiation machine in use;**

10    **5.40.1.2**      **A current whole body personnel monitor (OSL dosimeter, TLD or film badge) for**  
11                            **each person performing radiographic operations;**

12    **5.40.1.3**      **An operable, calibrated pocket dosimeter with a range of zero to 2 millisieverts (200**  
13                            **milliroentgens) for each person performing radiographic operations ;**

14    **5.40.1.4**      **An operable, calibrated, alarming ratemeter for each person performing**  
15                            **radiographic operations using a radiographic exposure device; and**

- 1       **5.40.1.5**        The appropriate barrier ropes and signs.
- 2       **5.40.2**        Each radiographer at a job site shall have on their person a valid certification ID card  
3       issued by a certifying entity.
- 4       **5.40.3**        Industrial radiographic operations shall not be performed if any of the items in  
5       RH 5.40.1 and 5.40.2 are not available at the job site or are inoperable.
- 6       **5.40.4**        During an inspection, the Department may terminate an operation if any of the items in  
7       RH 5.40.1. and 2 are not available or operable, or if the required number of radiographic  
8       personnel are not present. Operations shall not be resumed until all required  
9       conditions are met.

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**PART 5**

**APPENDIX A**

**I. Requirements for an Independent Certifying Organization.**

**An independent certifying organization shall:**

- 1. Be an organization such as a society or association, whose members participate in, or have an interest in, the field of industrial radiography;**
- 2. Make its membership available to the general public nationwide. Membership shall not be restricted because of race, color, religion, sex, age, national origin or disability;**
- 3. Have a certification program open to nonmembers, as well as members;**
- 4. Be an incorporated, nationally recognized organization, that is involved in setting national standards of practice within its fields of expertise;**
- 5. Have an adequate staff, a viable system for financing its operations, and a policy and decision-making review board;**

1       **6. Have a set of written organizational by-laws and policies that provide adequate assurance**  
2       **of lack of conflict of interest and a system for monitoring and enforcing those by-laws and**  
3       **policies;**

4       **7. Have a committee, whose members can carry out their responsibilities impartially, to**  
5       **review and approve the certification guidelines and procedures, and to advise the**  
6       **organization's staff in implementing the certification program;**

7       **8. Have a committee, whose members can carry out their responsibilities impartially, to**  
8       **review complaints against certified individuals and to determine appropriate sanctions;**

9       **9. Have written procedures describing all aspects of its certification program, maintain**  
10       **records of the current status of each individual's certification and the administration of its**  
11       **certification program;**

12       **10. Have procedures to ensure that certified individuals are provided due process with**  
13       **respect to the administration of its certification program, including the process of becoming**  
14       **certified and any sanctions imposed against certified individuals;**

1       **11. Have procedures for proctoring examinations, including qualifications for proctors. These**  
2       **procedures must ensure that the individuals proctoring each examination are not employed by**  
3       **the same company or corporation (or a wholly-owned subsidiary of such company or**  
4       **corporation) as any of the examinees;**

5       **12. Exchange information about certified individuals with the Nuclear Regulatory Commission**  
6       **and other independent certifying organizations and/or Agreement States and allow periodic**  
7       **review of its certification program and related records; and**

8       **13. Provide a description to the Nuclear Regulatory Commission of its procedures for**  
9       **choosing examination sites and for providing an appropriate examination environment.**

10       **II. Requirements for Certification Programs.**

11       **All certification programs must:**

12           **1. Require applicants for certification to (a) receive training in the topics set forth in RH 5.17.7.**  
13           **or equivalent State or Nuclear Regulatory Commission regulations, and (b) satisfactorily**  
14           **complete a written examination covering these topics;**

15           **2. Require applicants for certification to provide documentation that demonstrates that the**  
16           **applicant has:**

- 1           **(a) received training in the topics set forth in RH 5.17.7 or equivalent State or Nuclear**  
2           **Regulatory Commission regulations;**
- 3           **(b) satisfactorily completed a minimum period of on-the-job training as specified in RH 5.17.1;**  
4           **and**
- 5           **(c) received verification by a State licensee or registrant or a Nuclear Regulatory Commission**  
6           **licensee that the applicant has demonstrated the capability of independently working as**  
7           **a radiographer.**
- 8           **3. Include procedures to ensure that all examination questions are protected from disclosure;**
- 9           **4. Include procedures for denying an application and revoking, suspending, and reinstating a**  
10           **certification;**
- 11           **5. Provide a certification period of not less than 3 years nor more than 5 years;**
- 12           **6. Include procedures for renewing certifications and, if the procedures allow renewals without**  
13           **examination, require evidence of recent full-time employment and annual refresher training;**  
14           **and**



- 1           **7. Provide a timely response to inquiries, by telephone or letter, from members of the public,**  
2           **about an individual's certification status.**

3           **III. Requirements for Written Examinations**

4           **All examinations must be:**

- 5           **1. Designed to test an individual's knowledge and understanding of the topics listed in RH 5.17.7**  
6           **or equivalent State or Nuclear Regulatory Commission requirements;**
- 7           **2. Written in a multiple-choice format;**
- 8           **3. Have test items drawn from a question bank containing psychometrically valid questions**  
9           **based on the material in RH 5.17.7.**