

# 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*

4300 Cherry Creek Dr. S.  
Denver, Colorado 80246-1530  
Phone (303) 692-2000  
TDD Line (303) 691-7700  
Located in Glendale, Colorado

Laboratory and Radiation Services Division  
8100 Lowry Blvd.  
Denver CO 80230-6928  
(303) 692-3090

<http://www.cdphe.state.co.us>



Colorado Department  
of Public Health  
and Environment

## MEMORANDUM

TO: Cardelia Maupin

FROM: David A. Butcher, Director <sup>DAB</sup>  
Laboratory and Radiation Services

DATE: June 29, 2000

SUBJECT: Recent final amendments to the Colorado *Rules and Regulations Pertaining to Radiation Control*

Attached are the recent final amendments to the Colorado *Rules and Regulations Pertaining to Radiation Control*. Part 4 was revised and made effective on 12/30/99 due to an amendment to the Clean Air Act. Parts 1, 3, and 5 were revised and made effective on May 30, 2000.

- Statement of Basis and Purpose and final Regulations to Part 4
- Statement of Basis and Purpose and final Regulations to Parts 1, 3, and 5

If you have any questions, please contact Jake Jacobi at (303)692-3036.

DAB/cp

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

**Part 4  
Standards for Protection Against Radiation**

November 17, 1999

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).

Both the U.S. Nuclear Regulatory Commission (US NRC) and the U.S. Environmental Protection Agency (US EPA) have published rules on permissible public radiation doses from releases of radioactive material to the air. These are found in 10 CFR 20.1301 and 40 CFR 61, Subpart I respectively. Congress subsequently enacted an amendment to the Clean Air Act which eliminated the need for the US EPA rule providing the US NRC (or Agreement State) rule provided equal protection. The proposed rule is for Colorado to eliminate dual regulation of Radioactive Material Licensees by implementing the requirements of Environmental Protection Agency's (EPA) 40 CFR Part 61, Subpart I. These regulations are amended to establish a constraint limit for Colorado's licensees. This constraint is set at 0.1 milliSevert (mSv) per year total effective dose equivalent (TEDE) for doses to members of the public from air emissions. This action is necessary to:

- Provide assurance to the EPA that future emissions from Colorado's licensees will not exceed dose levels that EPA has determined will provide an ample margin of safety; and
- Implement the criteria (in cooperation with the NRC and other Agreement States) upon which the EPA has rescinded its Clean Air Act (CAA) regulations for the NRC and Agreement State licensees, thereby relieving these licensees from unnecessary dual regulations.

The EPA promulgated National Emission Standards for Hazardous Air Pollutants (NESHAPs) for radionuclides on October 31, 1989. Under 40 CFR Part 61, Subpart I, emissions of radionuclides must be limited so that no member of the public would receive an effective dose equivalent greater than 0.1 mSv per year. Subpart I of 40 CFR Part 61 was promulgated to implement the CAA and limit doses to members of the public from air emissions of radionuclides (other than Radon-222) from all NRC and Agreement State licensees other than licensees possessing only sealed sources, high-level waste repositories, and uranium mill tailings piles that have been disposed of in accordance with 40 CFR Part 192. Radon-222 emissions from tailings were covered by other sections of 40 CFR Part 61, and by Part 18 of the Colorado Rules and Regulations Pertaining to Radiation Control.

In 1990, Congress enacted amendments to the CAA. Section 112(d)(9) of these amendments to the CAA (the Simpson amendment) states:

No standard for radionuclide emissions from any category or subcategory of facilities licensed by the Nuclear Regulatory Commission (or an Agreement State) is required to be promulgated under this section if the Administrator determines, by rule, and after consultation with the Nuclear Regulatory Commission, that the regulatory program established by the Nuclear Regulatory Commission pursuant to the Atomic Energy Act for such category or subcategory provides an ample margin of safety to protect public health.

EPA conducted two studies of the air emissions from NRC and Agreement State materials licensees. The first was a survey of 367 randomly selected nuclear materials licensees. EPA determined that the highest estimated dose to a member of the public from air emissions from these facilities was 0.08 mSv per year, based on very conservative modeling. In addition, 98 percent of the facilities surveyed were found to have doses to members of the public resulting from air emissions less than 0.01 mSv per year.

The second study evaluated doses from air emissions at 45 additional facilities that were selected because of their potential for air emissions resulting in significant public exposures. EPA found that 75 percent of these licensees had air emissions resulting in an estimated maximum public dose less than 0.01 mSv per year. For the licensees evaluated, none exceeded 0.1 mSv per year.

The regulatory framework that provided the basis for rescission of EPA's Subpart I consists of the requirement to limit doses to members of the public to 1.0 mSv per year for all pathways. In addition, the requirement to constrain doses to members of the public from airborne effluents of radioactive materials to the environment from a single licensed operation to 0.1 mSv per year.

Currently, under RH 4.17, licensees are required to make or cause to be made surveys that may be necessary to comply with the Regulations in Part 4. This data would be made available to inspectors upon request. If the licensee estimates or measures a dose to the nearest resident from air emissions greater than 0.1 mSv per year, the licensee would be required to report the dose to the Department in writing within 30 days. The report would include:

- the circumstances that led to the greater than 0.1 mSv per year dose;
- a description of the corrective steps the licensee had taken or proposed to take to ensure that the constraint is not again exceeded;
- a timetable for implementing the corrective steps; and

- the expected results.

Records of the results of measurements and calculations needed to evaluate the release of radioactive effluents to the environment will still be required pursuant to the current RH 4.42.

Exceeding this constraint will not result in an enforcement action. In the case of the constraint rule, an enforcement action will be issued only if and when: (1) a licensee fails to report an actual or estimated dose from airborne effluent releases from a facility that has exceeded the constraint value; or (2) if a licensee fails to institute agreed upon corrective measures intended to prevent further airborne effluents in excess of those which would result in doses exceeding the constraint level.

The purpose of this rule-making is not to reduce doses because it has already been demonstrated that doses are sufficiently low. The purpose is to ensure that doses are maintained at the low level currently achieved by licensees, eliminate unnecessary dual regulation, and reduce costs associated with the current level of protection. This can be accomplished by implementing the basis upon which EPA found that doses will not increase as a result of rescission of Subpart I.

The specific proposed revisions to these regulations are:

1. A definition of "constraint" has been added, which is the same definition that appears in 10 CFR 20.1003. The definition is necessary to define a level of release above which actions must be taken to reduce exposures but which does not constitute a violation if exceeded.
2. RH 4.5.4 has been added to require licensees to take action if the constraint on air emissions is exceeded. This requirement has been required by EPA in order for EPA to rescind its purview over radionuclides from NRC and Agreement State licensees and thereby eliminate the dual regulation. This requirement is compatible with the rules adopted by other Agreement States and the NRC.
3. RH 4.53.2.2.6 and 4.53.3.1.5.4 have been modified to require the submission and contents of a report to the Department if the constraint limit is exceeded.
4. In addition to the amendments relating to the Clean Air Act, one editorial change has been made. RH 4.53.3.2 is modified to make clear that licensees do not need to report all occupational exposures to the Department, only for those individuals that have been occupationally overexposed.

Effective →  
12/30/99

"Constraint" (dose constraint) means a value above which specified licensee actions are required.

"Critical group" means the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances.

"Declared pregnant woman" means a woman who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception.

"Decommission" means to remove a facility or site safely from service and reduce residual radioactivity to a level that permits: (1) release of the property for unrestricted use and termination of the license; or (2) release of the property under restricted conditions and termination of the license.

"Derived air concentration" (DAC) means the concentration of a given radionuclide in air which, if breathed by the reference man for a working year of 2,000 hours under conditions of light work, results in an intake of one ALI. For purposes of these regulations, the condition of light work is an inhalation rate of 1.2 cubic meters of air per hour for 2,000 hours in a year. DAC values are given in Table I, Column 3, of Appendix B.

"Derived air concentration-hour" (DAC-hour) means the product of the concentration of radioactive material in air, expressed as a fraction or multiple of the derived air concentration for each radionuclide, and the time of exposure to that radionuclide, in hours. A licensee or registrant may take 2,000 DAC-hours to represent one ALI, equivalent to a committed effective dose equivalent of 0.05 Sv (5 rem).

"Distinguishable from background" means that the detectable concentration of a radionuclide is statistically different from the background concentration of that radionuclide in the vicinity of the site or, in the case of structures, in similar materials using adequate measurement technology, survey, and statistical techniques.

"Dosimetry processor" means an individual or an organization that processes and evaluates individual monitoring devices in order to determine the radiation dose delivered to the monitoring devices.

"Inhalation class" (see "Class").

"Lung class" (see "Class").

"Nonstochastic effect" means a health effect, the severity of which varies with the dose and for which a threshold is believed to exist. Radiation-induced cataract formation is an example of a nonstochastic effect. For purposes of these regulations, "Deterministic effect" is an equivalent term.

"Planned special exposure" means an infrequent exposure to radiation, separate from and in addition to the annual occupational dose limits.

"Quarter" means a period of time equal to one-fourth of the year observed by the licensee, approximately 13 consecutive weeks, providing that the beginning of the first quarter in a year coincides with the starting date of the year and that no day is omitted or duplicated in consecutive quarters.

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- 4.5.2 The licensee or registrant shall use, to the extent practicable, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and public doses that are as low as is reasonably achievable (ALARA).
- 4.5.3 The licensee or registrant shall, at intervals not to exceed 12 months, review the radiation protection program content and implementation.
- 4.5.4 To implement the ALARA requirements of RH 4.5.2 and notwithstanding the requirements in RH 4.14 of this part, a constraint on air emissions of radioactive material to the environment, excluding radon-222 and its daughters, shall be established by licensees, such that the individual member of the public likely to receive the highest dose will not be expected to receive a total effective dose equivalent in excess of 0.1 millisevert per year from these emissions. If a licensee subject to this requirement exceeds this dose constraint, the licensee shall report the exceedance as provided in RH 4.53.2 and promptly take appropriate corrective action to ensure against recurrence.

### OCCUPATIONAL DOSE LIMITS

#### RH 4.6 Occupational Dose Limits for Adults.

- 4.6.1 The licensee or registrant shall control the occupational dose to individual adults, except for planned special exposures pursuant to RH 4.11, to the following dose limits:
  - 4.6.1.1 An annual limit, which is the more limiting of:
    - 4.6.1.1.1 The total effective dose equivalent being equal to 0.05 Sv (5 rem); or
    - 4.6.1.1.2 The sum of the deep dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 0.5 Sv (50 rem).
  - 4.6.1.2 The annual limits to the lens of the eye, to the skin, and to the extremities which are:
    - 4.6.1.2.1 An eye dose equivalent of 0.15 Sv (15 rem), and
    - 4.6.1.2.2 A shallow dose equivalent of 0.5 Sv (50 rem) to the skin or to any extremity.
- 4.6.2 Doses received in excess of the annual limits, including doses received during accidents, emergencies, and planned special exposures, shall be subtracted from the limits for planned special exposures that the individual may receive during the current year and during the individual's lifetime. See RH 4.11.5.1 and 4.11.5.2.
- 4.6.3 The assigned deep dose equivalent and shallow dose equivalent shall be for the portion of the body receiving the highest exposure determined as follows:

4.53.1.3 The provisions of RH 4.52 do not apply to doses that result from planned special exposures, provided such doses are within the limits for planned special exposures and are reported pursuant to RH 4.54.

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4.53.2 Reports of Exposures, Radiation Levels, and Concentrations of Radioactive Material Exceeding the Constraints or Limits. In addition to the notification required by RH 4.52, each licensee or registrant shall submit a written report to the Department within 30 days after learning of any of the following occurrences:

4.53.2.1 Incidents for which notification is required by RH 4.52; or

4.53.2.2 Doses in excess of any of the following:

4.53.2.2.1 The occupational dose limits for adults in RH 4.6; or

4.53.2.2.2 The occupational dose limits for a minor in RH 4.12; or

4.53.2.2.3 The limits for an embryo/fetus of a declared pregnant woman in RH 4.13; or

4.53.2.2.4 The limits for an individual member of the public in RH 4.14; or

4.53.2.2.5 Any applicable limit in the license or registration; or

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→ 4.53.2.2.6 The ALARA constraints for air emissions established under RH 4.5.4.

4.53.2.3 Levels of radiation or concentrations of radioactive material in:

4.53.2.3.1 A restricted area in excess of applicable limits in the license or registration; or

4.53.2.3.2 An unrestricted area in excess of 10 times the applicable limit set forth in Part 4 or in the license or registration, whether or not involving exposure of any individual in excess of the limits in RH 4.14; or

4.53.2.4 For licensees subject to the provisions of U.S. Environmental Protection Agency's generally applicable environmental radiation standards in 40 CFR 190, levels of radiation or releases of radioactive material in excess of those standards, or of license conditions related to those standards.

4.53.3 Contents of Written Reports.

4.53.3.1 Each report required by RH 4.53.1.2 or 4.53.2 shall include the following, as appropriate:

4.53.3.1.1 A description of the event, including the possible cause and the manufacturer and model number (if applicable) of any equipment that failed or malfunctioned;

4.53.3.1.2 The exact location of the event;

4.53.3.1.3 The isotopes, quantities, and chemical and physical form of the licensed material involved;

- 4.53.3.1.4 Date and time of the event;
- 4.53.3.1.5 The results of any evaluations or assessments, including:
  - 4.53.3.1.5.1 Estimates of each individual's dose;
  - 4.53.3.1.5.2 The levels of radiation and concentrations of radioactive material involved;
  - 4.53.3.1.5.3 The cause of the elevated exposures, dose rates, or concentrations; and
  - 4.53.3.1.5.4 Corrective steps taken or planned to ensure against a recurrence, including the schedule for achieving conformance with applicable limits, ALARA constraints, generally applicable environmental standards, and associated license or registration conditions.

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4.53.3.2 Each report filed pursuant to RH 4.53 shall include for each occupationally overexposed individual exposed: the name, Social Security account number, and date of birth. With respect to the limit for the embryo/fetus in RH 4.13, the identifiers should be those of the declared pregnant woman. The report shall be prepared so that this information is stated in a separate and detachable portion of the report.

RH 4.54 Reports of Planned Special Exposures. The licensee or registrant shall submit a written report to the Department within 30 days following any planned special exposure conducted in accordance with RH 4.11, informing the Department that a planned special exposure was conducted and indicating the date the planned special exposure occurred and the information required by RH 4.45.

RH 4.55 Reserved.

RH 4.56 Reports of Individual Monitoring.

- 4.56.1 This section applies to each person licensed or registered by the Department to:
  - 4.56.1.1 Possess or use sources of radiation for purposes of industrial radiography pursuant to Parts 3 and 5 of these regulations; or
  - 4.56.1.2 Receive radioactive waste from other persons for disposal pursuant to Part 14 of these regulations; or

**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**

April 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 1999 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 was 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.

In addition, the entire Part 1 has been reformatted to improve readability and for uniformity with other parts of the regulations.

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

The requirements in Part 3 relating to industrial radiography were 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.

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 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.

The Department realizes that every temporary job site may not require both individuals to maintain constant direct surveillance of the site during radiography operations. In those specific circumstances where the radiographer can maintain adequate surveillance and control unauthorized entry into the area, the second qualified individual could be in the dark room processing film, provided that this second person is still available to assist the radiographer if needed.

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 previous 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.

## PART 1

### GENERAL PROVISIONS

[This part was revised in its entirety and was effective May 30, 2000, unless otherwise noted in the left hand margin]

- RH 1.1 Authority. Rules and regulations set forth herein are adopted pursuant to the provisions of Section 25-1-107(1)(s) and (1)(t), 25-1-108 and 25-11-104, CRS 1988. Rules and regulations pertaining to land disposal of low-level radioactive waste Parts 14 and 15 are adopted pursuant to the provisions of 24-60-2205.
- RH 1.2 Basis and Purposes. A statement of the basis and purpose of these regulations is incorporated as part of these regulations; a copy may be obtained from the Department.
- RH 1.3 Scope. Except as otherwise specifically provided, these regulations apply to all persons who receive, possess, use, transfer, own, or acquire any source of radiation; provided, however, that nothing in these regulations shall apply to any person to the extent such person is subject to regulation by the U.S. Nuclear Regulatory Commission.<sup>1</sup>
- RH 1.4 Definitions. As used in these regulations, these terms have the definitions set forth below. Additional definitions used only in a certain part will be found in that part.

"A1" means the maximum activity of special form radioactive material permitted in a Type A package. "A2" means the maximum activity of radioactive material, other than special form, low specific activity (LSA) and surface contaminated object (SCO) material, permitted in a Type A package. These values are either listed in Appendix A of Part 17 of these regulations, Table A-1, or may be derived in accordance with the procedure prescribed in Appendix A of Part 17 of these regulations.

"Absorbed dose" means the energy imparted by ionizing radiation per unit mass of irradiated material. The units of absorbed dose are the gray (Gy) and the rad.

"Accelerator" means any machine capable of accelerating electrons, protons, deuterons, or other charged particles in a vacuum and of discharging the resultant particulate or other radiation into a medium at energies usually in excess of 1 MeV. For purposes of this definition, "particle accelerator" is an equivalent term.

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<sup>1</sup> Attention is directed to the fact that regulation by the State of source material, byproduct material, and special nuclear material in quantities not sufficient to form a critical mass is subject to the provisions of the agreement between the State and the U.S. Nuclear Regulatory Commission and to 10 CFR Part 150 of the Commission's regulations.

"Accelerator-produced material" means any material made radioactive by a particle accelerator.

"Act" means Title 25, Article 11, Colorado Revised Statutes 1989 Replacement Volume, as amended.

"Activity" means the rate of disintegration or transformation or decay of radioactive material. The units of activity are the becquerel (Bq) and the curie (Ci).

"Adult" means an individual 18 or more years of age.

"Agreement State" means any State with which the U.S. Nuclear Regulatory Commission or the U.S. Atomic Energy Commission has entered into an effective agreement under subsection 274b. of the Atomic Energy Act of 1954, as amended (73 Stat. 689).

"Airborne radioactive material" means any radioactive material dispersed in the air in the form of dusts, fumes, particulates, mists, vapors, or gases.

"Airborne radioactivity area" means a room, enclosure, or area in which airborne radioactive materials exist in concentrations;

(1) In excess of the derived air concentrations (DACs) specified in Appendix B, Table I of Part 4 of these regulations, or

(2) To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours.

"Authorized nuclear pharmacist" means a pharmacist who is:

(1) Board certified as a Nuclear Pharmacist by the Board of Pharmaceutical Specialties;

(2) Identified as an authorized nuclear pharmacist on a Department, NRC or Agreement State license that authorizes the use of radioactive material in the practice of nuclear pharmacy; or

(3) Identified as an authorized nuclear pharmacist on a permit issued by a Department, NRC or Agreement State specific licensee of broad scope that is authorized to permit the use of radioactive material in the practice of nuclear pharmacy. (See also pharmacist)

"As low as is reasonably achievable" (ALARA) means making every reasonable effort to maintain exposures to radiation as far below the dose limits in these regulations as is practical, consistent with the purpose for which the licensed or registered activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed or registered sources of radiation in the public interest.

"Background radiation" means radiation from cosmic sources; naturally occurring radioactive materials, including radon, except as a decay product of source or special nuclear material; and including global fallout as it exists in the environment from the testing of nuclear explosive devices. "Background radiation" does not include sources of radiation from radioactive materials regulated by the Department.

"Becquerel" (Bq) means the SI unit of activity. One becquerel is equal to 1 disintegration per second or transformation per second (dps or s<sup>-1</sup>).

"Bioassay" means the determination of kinds, quantities or concentrations, and, in some cases, the locations of radioactive material in the human body, whether by direct measurement, *in-vivo* counting, or by analysis and evaluation of materials excreted or removed from the human body. For purposes of these regulations, "radiobioassay" is an equivalent term.

"Brachytherapy" means a method of radiation therapy in which sealed sources are utilized to deliver a radiation dose at a distance of up to a few centimeters, by surface, intracavitary, or interstitial application.

"Byproduct material" means:

(1) Any radioactive material, except special nuclear material, yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material; and

(2) The tailings or wastes produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material content, including discrete surface wastes resulting from uranium or thorium solution extraction processes. Underground ore bodies depleted by these solution extraction operations do not constitute "byproduct material" within this definition.

"Calendar quarter" means not less than 12 consecutive weeks nor more than 14 consecutive weeks. The first calendar quarter of each year shall begin in January and subsequent calendar quarters shall be so arranged such that no day is included in more than one calendar quarter and no day in any one year is omitted from inclusion within a calendar quarter. No licensee or registrant shall change the method observed by him of determining calendar quarters for purposes of these regulations except at the beginning of a year.

"Calibration" means the determination of (1) the response or reading of an instrument relative to a series of known radiation values over the range of the instrument, or (2) the strength of a source of radiation relative to a standard.

"CFR" means Code of Federal Regulations.

"Chelating agent" means amine polycarboxylic acids, hydroxy-carboxylic acids, gluconic acid, and polycarboxylic acids.

"Collective dose" means the sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation.

"Committed dose equivalent" ( $H_{T,50}$ ) means the dose equivalent to organs or tissues of reference (t) that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

"Committed effective dose equivalent" ( $H_{E,50}$ ) is the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to each of these organs or tissues ( $H_{E,50} = \sum W_T H_{T,50}$ ).

"Curie" means a unit of quantity of radioactivity. One curie (Ci) is that quantity of radioactive material which decays at the rate of  $3.7 \times 10^{10}$  transformations per second ( $s^{-1}$ ).

"Deep dose equivalent" ( $H_d$ ), which applies to external whole body exposure, means the dose equivalent at a tissue depth of 1 centimeter ( $1000 \text{ mg/cm}^2$ ).

"Department" means the Colorado Department of Public Health and Environment.

"Depleted uranium" means the source material uranium in which the isotope uranium-235 is less than 0.711 weight percent of the total uranium present. Depleted uranium does not include special nuclear material.

"Dose" is a generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, total organ dose equivalent, or total effective dose equivalent. For purposes of these regulations, "radiation dose" is an equivalent term.

"Dose equivalent ( $H_T$ )" means the product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the sievert (Sv) and rem.

"Dose limits" means the permissible upper bounds of radiation doses established in accordance with these regulations. For purposes of these regulations, "limits" is an equivalent term.

"Effective dose equivalent ( $H_E$ )" means the sum of the products of the dose equivalent to each organ or tissue ( $H_T$ ) and the weighting factor ( $W_T$ ) applicable to each of the body organs or tissues that are irradiated ( $H_E = \sum W_T H_T$ ).

"Embryo/fetus" means the developing human organism from conception until the time of birth.

"Entrance or access point" means any opening through which an individual or extremity of an individual could gain access to radiation areas or to licensed or registered radioactive materials. This includes entry or exit portals of sufficient size to permit human entry, irrespective of their intended use.

"Explosive material" means any chemical compound, mixture, or device which produces a substantial instantaneous release of gas and heat spontaneously or by contact with sparks or flame.

"Exposure" means being exposed to ionizing radiation or to radioactive material.

"Exposure" means the quotient of  $dQ$  by  $dm$  where " $dQ$ " is the absolute value of the total charge of the ions of one sign produced in air when all the electrons (negatrons and positrons) liberated by photons in a volume element of air having mass " $dm$ " are completely stopped in air. The SI unit of exposure is the coulomb per kilogram (C/kg). See RH 1.14 units of exposure and dose for the special unit.<sup>2</sup>

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<sup>2</sup> When not underlined as above (or indicated as "exposure" (X), the term "exposure" has a more general meaning in these Regulations.

"Exposure rate" means the exposure per unit of time, such as roentgen per minute and milliroentgen per hour.

"External dose" means that portion of the dose equivalent received from any source of radiation outside the body.

"Extremity" means hand, elbow, arm below the elbow, foot, knee, and leg below the knee.

"Eye dose equivalent" means the external dose equivalent to the lens of the eye at a tissue depth of 0.3 Centimeter ( $300 \text{ mg/cm}^2$ ).

"Former U.S. Atomic Energy Commission (AEC) or U.S. Nuclear Regulatory Commission (NRC) licensed facilities" means nuclear reactors, nuclear fuel reprocessing plants, uranium enrichment plants, or critical mass experimental facilities where AEC or NRC licenses have been terminated.

"Generally applicable environmental radiation standards" means standards issued by the U.S. Environmental Protection Agency (EPA) under the authority of the Atomic Energy Act of 1954, as amended, that impose limits on radiation exposures or levels, or concentrations or quantities of radioactive material, in the general environment outside the boundaries of locations under the control of persons possessing or using radioactive material.

"Gray" (Gy) means the SI unit of absorbed dose. One gray is equal to an absorbed dose of 1 joule per kilogram (100 rad).

"Hazardous waste" means those wastes designated as hazardous by U.S. Environmental Protection Department regulations in 40 CFR Part 261.

"Healing arts" means any system, treatment, operation, diagnosis, prescription, or practice for the ascertainment, cure, relief, palliation, adjustment, or correction of any human disease, ailment, deformity, injury or unhealthy or abnormal physical or mental condition.

"High radiation area" means an area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 1 mSv (0.1 rem) in 1 hour at 30 centimeters from any source of radiation or from any surface that the radiation penetrates.

"Human use" means the internal or external administration of radiation or radioactive material to human beings.

"Individual" means any human being.

"Individual monitoring" means the assessment of:

(1) Dose equivalent:

(A) by the use of individual monitoring devices; or

(B) by the use of survey data; or

(2) Committed effective dose equivalent:

(A) by bioassay; or

(B) by determination of the time-weighted air concentrations to which an individual has been exposed, that is, DAC-hours. (See the definition of DAC-hours in Part 4).

"Individual monitoring devices" means devices designed to be worn by a single individual for the assessment of dose equivalent. For purposes of these regulations, "personnel dosimeter" and "dosimeter" are equivalent terms. Examples of individual monitoring devices are film badges, thermoluminescent dosimeters (TLDs), pocket ionization chambers, and personal air sampling devices.

"Inspection" means an official examination or observation including but not limited to, tests, surveys, and monitoring to determine compliance with rules, regulations, orders, license conditions and other requirements of the Department.

"Interlock" means a device arranged or connected such that the occurrence of an event or condition is required before a second event or condition can occur or continue to occur.

"Internal dose" means that portion of the dose equivalent received from radioactive material taken into the body.

"License" means a license issued by the Department in accordance with the regulations adopted by the Department.

"Licensed material" means radioactive material received, possessed, used, transferred or disposed of under a general or specific license issued by the Department.

"Licensee" means any person who is licensed by the Department in accordance with these regulations and the Act.

"Licensing State" means any State with regulations equivalent to the Suggested State Regulations for Control of Radiation relating to, and an effective program for, the regulatory control of NARM and which has been granted final designation by the Conference of Radiation Control Program Directors, Inc.

"Limits" see "dose limits".

"Lost or missing licensed source of radiation" means licensed or registered source(s) of radiation whose location is unknown. This definition includes licensed material that has been shipped but has not reached its planned destination and whose location cannot be readily traced in the transportation system.

"Mammographer" means a person who operates a machine source of ionizing radiation, commonly known as an "x-ray machine", in the conduct of a mammography exam.

"Major processor" means a user processing, handling, or manufacturing radioactive material exceeding Type A quantities as unsealed sources or material, or exceeding 4 times Type B quantities as sealed sources, but does not include nuclear medicine programs, universities, industrial radiographers, or small industrial programs. Type A and B quantities are defined in Part 17 of these regulations.

"Medical use" means the intentional internal or external administration of radioactive material or radiation to humans in the practice of the healing arts.

"Member of the public" means an individual, except when that individual is receiving an occupational dose.

"Minor" means an individual less than 18 years of age.

"Monitoring" means the measurement of radiation, radioactive material concentrations, surface area activities or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses. For purposes of these regulations, "radiation monitoring" and "radiation protection monitoring" are equivalent terms.

"NARM" means any naturally occurring or accelerator-produced radioactive material. It does not include byproduct, source, or special nuclear material.<sup>3</sup>

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<sup>3</sup> For the purpose of meeting the definition of a Licensing State by the Conference of Radiation Control Program Directors, Inc. (CRCPD), NARM refers only to discrete sources of NARM. Diffuse sources of NARM are excluded from consideration by the CRCPD for Licensing State designation purposes.

"Natural radioactivity" means radioactivity of naturally occurring nuclides.

"Natural thorium" means thorium with the naturally occurring distribution of thorium isotopes (essentially 100 weight per cent thorium-232).

"Natural uranium" means uranium containing a mixture of the uranium isotopes 234, 235 and 238 (approximately 0.7 weight percent uranium-235 and the remainder by weight essentially uranium-238), that is neither enriched nor depleted in the isotope uranium 235.

"Normal form radioactive material" means radioactive material that has not been demonstrated to qualify as "special form radioactive material".

"NRC" See "Nuclear Regulatory Commission"

"Nuclear Regulatory Commission" (NRC) means the U.S. Nuclear Regulatory Commission or its duly authorized representatives.

"Occupational dose" means the dose received by an individual in the course of employment in which the individual's assigned duties involve exposure to sources of radiation whether or not the sources of radiation are in the possession of the licensee, registrant or other person. Occupational dose does not include doses received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with RH 7.26, from voluntary participation in medical research programs, or as a member of the public.

"Package" means the packaging together with its radioactive contents as presented for transport.

"Particle accelerator" (see "accelerator").

"Person" means any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, agency, political subdivision of this State, any other State or political subdivision or agency thereof, and any legal successor, representative, agent, or agency of the foregoing.

"Personnel monitoring equipment". [See "Individual monitoring devices"].

"Pharmacist" means an individual licensed by a state or territory of the United States, the District of Columbia or the Commonwealth of Puerto Rico to practice pharmacy. (See also Authorized nuclear pharmacist)

"Physician" means an individual licensed by the State of Colorado to dispense drugs in the practice of medicine.

"Public dose" means the dose received by a member of the public from sources of radiation from licensed or registered operations. Public dose does not include occupational dose, or doses received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with RH 7.26, or from voluntary participation in medical research programs.

"Pyrophoric liquid" means any liquid that ignites spontaneously in dry or moist air at or below 130° F (54.4° C). A pyrophoric solid is any solid material, other than one classed as an explosive, which under normal conditions is liable to cause fires through friction, retained heat from manufacturing or processing, or which can be ignited readily and, when ignited, burns so vigorously and persistently as to create a serious transportation, handling, or disposal hazard. Included are spontaneously combustible and water-reactive materials.

"Qualified expert" means an individual, approved by the Department, having the knowledge and training to measure ionizing radiation, to evaluate safety techniques, and to advise regarding radiation protection needs. The individual shall:

- (1) Be certified in the appropriate field by the American Board of Radiology, the American Board of Health Physics, the American Board of Medical Physics or the American Board of Nuclear Medicine Science; or
- (2) Hold a master's or doctor's degree in physics, biophysics, radiological physics, health physics, or medical physics and have completed 1 year of documented, full time training in the appropriate field and also 1 year of documented, full time work experience under the supervision of a qualified expert in the appropriate field. To meet this requirement, the individual shall have performed the tasks required of a qualified expert during the year of work experience; or
- (3) Receive approval from the Department for specific activities.

"Quality factor" (Q) means the modifying factor, listed in Tables I and II of RH 1.14, that is used to derive dose equivalent from absorbed dose.

"Rad" means the special unit of absorbed dose. One rad is equal to an absorbed dose of 100 erg per gram or 0.01 jule per kilogram (0.01 gray).

"Radiation" means alpha particles, beta particles, gamma rays, x rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. For purposes of these regulations, ionizing radiation is an equivalent term. Radiation, as used in these regulations, does not include non-ionizing radiation, such as radiowaves or microwaves, visible, infrared, or ultraviolet light.

"Radiation area" means any area, accessible to individuals, in which Radiation levels could result in an individual receiving a dose equivalent in excess of 0.05 mSv (0.005 rem) in 1 hour at 30 centimeters from the source of radiation or from any surface that the radiation penetrates.

"Radiation dose" (see "dose").

"Radiation machine" means any device capable of producing radiation except, those devices with radioactive material as the only source of radiation.

"Radiation safety officer" means an individual who has the knowledge, responsibility and authority to apply appropriate radiation protection regulations.

"Radioactive material" means any solid, liquid, or gas which emits radiation spontaneously.

"Radioactivity" means the transformation of unstable atomic nuclei by the emission of radiation.

"Radiobioassay" (see "bioassay").

"Registrant" means any person who is registered with the Department and is legally obligated to register with the Department pursuant to these regulations and the Act.

"Registration" means registration with the Department in accordance with the regulations adopted by the Department.

"Regulations of the U.S. Department of Transportation" means the regulations in 49 CFR Parts 100-189 and Parts 390-397.

"Rem" means the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rem is equal to the absorbed dose in rad multiplied by the quality factor (1 rem = 0.01 Sievert).

"Research and development" means (1) theoretical analysis, exploration, or experimentation; or (2) the extension of investigative findings and theories of a scientific or technical nature into practical application for experimental and demonstration purposes, including the experimental production and testing of models, devices, equipment, materials, and processes. Research and development does not include the internal or external administration of radiation or radioactive material to human beings.

"Restricted area" means an area, access to which is limited by the licensee or registrant for the purpose of protecting individuals against undue risks from exposure to sources of radiation. Restricted area does not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area.

"Roentgen" means the special unit of exposure. One roentgen (R) equals  $2.58 \times 10^{-4}$  coulombs/kilogram of air (see "Exposure").

"Sealed source" means radioactive material that is permanently bonded or fixed in a capsule or matrix designed to prevent release and dispersal of the radioactive material under the most severe conditions which are likely to be encountered in normal use and handling.

"Shallow dose equivalent" ( $H_s$ ), which applies to the external exposure of the skin or an extremity, means the dose equivalent at a tissue depth of 0.007 Centimeter ( $7 \text{ mg/cm}^2$ ) averaged over an area of 1 square centimeter.

"SI" means the abbreviation for the international system of units.

"Sievert" means the SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sievert is equal to the absorbed dose in gray multiplied by the quality factor ( $1 \text{ Sv} = 100 \text{ rem}$ ).

"Site boundary" means that line beyond which the land or property is not owned, leased, or otherwise controlled by the licensee or registrant.

"Source material" means material, in any physical or chemical form, including ores, that contain by weight one-twentieth of 1 percent (0.05 percent) or more of uranium, thorium or any combination thereof. Source material does not include special nuclear material.

"Source material milling" means any activity that results in the production of byproduct material as defined by definition (2) of byproduct material.

"Source of radiation" means any radioactive material or any device or equipment emitting, or capable of producing, radiation.

"Special form radioactive material" means radioactive material that satisfies the following conditions:

- (1) It is either a single solid piece or is contained in a sealed capsule that can be opened only by destroying the capsule;
- (2) The piece or capsule has at least one dimension not less than 5 millimeters (0.2 inch); and
- (3) It satisfies the test requirements specified by the Nuclear Regulatory Commission. A special form encapsulation designed in accordance with the Nuclear Regulatory Commission requirements in effect on June 30, 1983, and constructed prior to July 1, 1985, may continue to be used. A special form encapsulation designed in accordance with the Nuclear Regulatory Commission requirements in effect on March 31, 1996, and constructed prior to April 1, 1998, may continue to be used. A special form encapsulation either designed or constructed after April 1, 1998, must meet requirements of this definition applicable at the time of its design or construction.

"Special nuclear material" means:

- (1) plutonium, uranium-233, uranium enriched in the isotope 233 or in the isotope 235, and any other material that the U.S. Nuclear Regulatory Commission, pursuant to the provisions of Section 51 of the Atomic Energy Act of 1954, as amended, determines to be special nuclear material, but does not include source material; or
- (2) any material artificially enriched by any of the foregoing but does not include source material.

"Special nuclear material in quantities not sufficient to form a critical mass" means uranium enriched in the isotope U-235 in quantities not exceeding 350 grams of contained U-235; uranium-233 in quantities not exceeding 200 grams; plutonium in quantities not exceeding 200 grams; or any combination of them in accordance with the following formula: For each kind of special nuclear material, determine the ratio between the quantity of that special nuclear material and the quantity specified above for the same kind of special nuclear material. The sum of such ratios for all of the kinds of special nuclear material in combination shall not exceed 1. For example, the following quantities in combination would not exceed the limitation and are within the formula:

$$\frac{175 \text{ (grams contained } ^{235}\text{U)}}{350} + \frac{50 \text{ (grams contained } ^{233}\text{U)}}{200} + \frac{50 \text{ (grams Pu)}}{200} \# 1$$

"Specific activity of a radionuclide" means the radioactivity of the radionuclide per unit mass of that nuclide. The specific activity of a material in which the radionuclide is essentially uniformly distributed is the radioactivity per unit mass of the material.

"Survey" means an evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of sources of radiation. When appropriate, such evaluation includes, but is not limited to, tests, physical examinations, and measurements of levels of radiation or concentrations of radioactive material present.

"Test" means the process of verifying compliance with an applicable regulation.

"These regulations" mean all parts of the Colorado Rules and Regulations Pertaining to Radiation Control.

"Total effective dose equivalent" (TEDE) means the sum of the deep dose equivalent for external exposures and the committed effective dose equivalent for internal exposures.

"Total organ dose equivalent" means the sum of the deep dose equivalent and the committed dose equivalent to the organ receiving the highest dose.

"U.S. Department of Energy" means the Department of Energy established by Public Law 95-91, August 4, 1977, 91 Stat. 565, 42 U.S.C. 7101 et seq., to the extent that the Department exercises functions formerly vested in the U.S. Atomic Energy Commission, its Chairman, members, officers and components and transferred to the U.S. Energy Research and Development Administration and to the Administrator thereof pursuant to sections 104(b), (c) and (d) of the Energy Reorganization Act of 1974 (Public Law 93-438, October 11, 1974, 88 Stat. 1233 at 1237 42 U.S.C. 5814, effective January 19, 1975) and retransferred to the Secretary of Energy pursuant to section 301(a) of the Department of Energy Organization Act (Public Law 95-91, August 4, 1977, 91 Stat. 565 at 577-578, 42 U.S.C. 7151, effective October 1, 1977).

"Unrefined and unprocessed ore" means ore in its natural form prior to any processing, such as grinding, roasting, beneficiating, or refining.

"Unrestricted area" means an area, access to which is neither limited nor controlled by the licensee or registrant. For purposes of these regulations, "uncontrolled area" is an equivalent term.

"Uranium - depleted, enriched"

- (1) "Depleted uranium" means uranium containing less uranium-235 than the naturally occurring distribution of uranium isotopes.
- (2) "Enriched uranium" means uranium containing more uranium-235 than the naturally occurring distribution of uranium isotopes.

"Waste" means those low-level radioactive wastes that are acceptable for disposal in a land disposal facility. For the purposes of this definition, low-level waste has the same meaning as in the Low-Level Radioactive Waste Policy Act, P.L. 96-573, as amended by P.L. 99-240, effective January 15, 1986; that is, radioactive waste (a) not classified as high-level radioactive waste, spent nuclear fuel, or byproduct material as defined in Section 11e.(2) of the Atomic Energy Act (uranium or thorium tailings and waste) and (b) classified as low-level radioactive waste consistent with existing law and in accordance with (a) by the U.S. Nuclear Regulatory Commission.

"Waste handling licensees" means persons licensed to receive and store radioactive wastes prior to disposal and/or persons licensed to dispose of radioactive waste.

"Week" means 7 consecutive days starting on Sunday.

"Whole body" means, for purposes of external exposure, head, trunk including male gonads, arms above the elbow, or legs above the knee.

"Worker" means an individual engaged in work under a license or registration issued by the Department and controlled by a licensee or registrant.

"Working level" (WL) means any combination of short-lived radon daughters in 1 liter of air that will result in the ultimate emission of  $1.3E+5$  MeV of potential alpha particle energy. The short-lived radon daughters are -- for radon-222: polonium-218, lead-214, bismuth-214, and polonium-214; and for radon-220: polonium-216, lead-212, bismuth-212, and polonium-212.

"Working level month" (WLM) means an exposure to 1 working level for 170 hours -- 2,000 working hours per year divided by 12 months per year is approximately equal to 170 hours per month.

"Year" means the period of time beginning in January used to determine compliance with the provisions of these regulations. The licensee or registrant may change the starting date of the year used to determine compliance by the licensee or registrant provided that the change is made at the beginning of the year and that no day is omitted or duplicated in consecutive years.

### **Exemptions from the Regulatory Requirements**

#### **RH 1.5 Exemptions.**

- 1.5.1 **General Provision.** The Department may, upon application or upon its own initiative, grant such exemptions or exceptions from the requirements of these regulations as it determines are authorized by law and will not result in undue hazard to public health and safety or property.
- 1.5.2 **U.S. Department of Energy Contractors and U.S. Nuclear Regulatory Commission Contractors.** Any U.S. Department of Energy contractor or subcontractor and any U.S. Nuclear Regulatory Commission contractor or subcontractor of the following categories operating within this State is exempt from these regulations to the extent that such contractor or subcontractor under his contract receives, possesses, uses, transfers or acquires sources of radiation:
  - 1.5.2.1 prime contractors performing work for the U.S. Department of Energy at U.S. Government-owned or -controlled sites, including the transportation of sources of radiation to or from such sites and the performance of contract services during temporary interruptions of such transportation;
  - 1.5.2.2 prime contractors of the U.S. Department of Energy performing research in, or development, manufacture, storage, testing, or transportation of, atomic weapons or components thereof;
  - 1.5.2.3 prime contractors of the U.S. Department of Energy using or operating nuclear reactors or other nuclear devices in a United States Government-owned vehicle or vessel; and
  - 1.5.2.4 any other prime contractor or subcontractor of the U.S. Department of Energy or of the U.S. Nuclear Regulatory Commission when the State and the U.S. Nuclear Regulatory Commission jointly determine:
    - 1.5.2.4.1 that the exemption of the prime contractor or subcontractor is authorized by law; and

- 1.5.2.4.2 that, under the terms of the contract or subcontract, there is adequate assurance that the work thereunder can be accomplished without undue risk to the public health and safety.

### **General Regulatory Requirements**

RH 1.6 Records. Each licensee and registrant shall maintain records showing the receipt, transfer, and disposal of all sources of radiation. Additional record requirements are specified elsewhere in these regulations.

RH 1.7 Inspections.

1.7.1 Each licensee and registrant shall afford the Department at all reasonable times opportunity to inspect sources of radiation and the premises and facilities wherein such sources of radiation are used or stored.

1.7.2 Each licensee and registrant shall make available to the Department for inspection, upon reasonable notice, records maintained pursuant to these regulations.

RH 1.8 Tests. Each licensee and registrant shall perform upon instructions from the Department, or shall permit the Department to perform, such reasonable tests as the Department deems appropriate or necessary including, but not limited to, tests of:

1.8.1 sources of radiation;

1.8.2 facilities wherein sources of radiation are used or stored;

1.8.3 radiation detection and monitoring instruments; and

1.8.4 other equipment and devices used in connection with utilization or storage of licensed or registered sources of radiation.

### **Additional Regulatory Requirements**

RH 1.9 Additional Requirements. The Department may, by rule, regulation, or order, impose upon any licensee or registrant such requirements in addition to those established in these regulations as it deems appropriate or necessary to minimize danger to public health and safety or property.

## Enforcement Requirements

RH 1.10 Violations. An injunction or other court order may be obtained prohibiting any violation of any provision of the Act or any regulation or order issued thereunder. Any person who willfully violates any provision of the Act or any regulation or order issued thereunder may be guilty of a misdemeanor and, upon conviction, may be punished by fine or imprisonment or both, as provided by law. Additionally, any person who violates any provision of the Act or any regulation may be subject to a civil penalty as provided for in Part 13 or these regulations.

RH 1.11 Impounding. Sources of radiation shall be subject to impounding pursuant to the Act.

RH 1.12 Prohibited Uses.

1.12.1 A hand-held fluoroscopic screen shall not be used with x-ray equipment unless it has been listed in the registry of sealed source and devices or accepted for certification by the U.S. Food and Drug Administration, Center for Devices and Radiological Health.

1.12.2 A shoe-fitting fluoroscopic device shall not be used.

## Communications

RH 1.13 Communications. All communications and reports concerning these regulations, and applications filed thereunder, should be addressed to the Department.

## Informational Provisions

RH 1.14 The International System of Units (SI).

1.14.1 Exposure. As used in these regulations, the unit of exposure is the coulomb per kilogram (C/kg) of air. One roentgen is equal to  $2.58 \times 10^{-4}$  coulomb per kilogram.

1.14.2 As used in these regulations, the units of dose are:

1.14.2.1 Gray (Gy) is the SI unit of absorbed dose. One gray is equal to an absorbed dose of 1 joule per kilogram (100 rad).

1.14.2.2 Rad is the special unit of absorbed dose. One rad is equal to an absorbed dose of 100 erg per gram or 0.01 Joule per kilogram (0.01 Gy).

- 1.14.2.3 Rem is the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rem is equal to the absorbed dose in rad multiplied by the quality factor (1 rem = 0.01 Sv).
- 1.14.2.4 Sievert is the SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sievert is equal to the absorbed dose in gray multiplied by the quality factor (1 Sv = 100 rem).
- 1.14.3 As used in these regulations, the quality factors for converting absorbed dose to dose equivalent are shown in Table I.

TABLE I  
QUALITY FACTORS AND ABSORBED DOSE EQUIVALENCIES

Type of radiation	Quality factor (Q)	Absorbed dose equal to a unit dose equivalent <sup>a</sup>
X, gamma, or beta radiation and high-speed electrons	1	1
Alpha particles, multiple-charged particles, fission fragments and heavy particles of unknown charge	20	0.05
Neutrons of unknown energy	10	0.1
High-energy protons	10	0.1

<sup>a</sup>Absorbed dose in gray equal to 1 Sv or the absorbed dose in rad equal to 1 rem.

1.14.4 If it is more convenient to measure the neutron fluence rate than to determine the neutron dose equivalent rate in sievert per hour or rem per hour, as provided in RH 1.14.3, 0.01 Sv (1 rem) of neutron radiation of unknown energies may, for purposes of these regulations, be assumed to result from a total fluence of 25 million neutrons per square centimeter incident upon the body. If sufficient information exists to estimate the approximate energy distribution of the neutrons, the licensee or registrant may use the fluence rate per unit dose equivalent or the appropriate Q value from Table II to convert a measured tissue dose in gray or rad to dose equivalent in sievert or rem.

**TABLE II**  
**MEAN QUALITY FACTORS, Q, AND FLUENCE PER UNIT DOSE**  
**EQUIVALENT FOR MONOENERGETIC NEUTRONS**

	Neutron energy (MeV)	Quality factor <sup>a</sup> (Q)	Fluence per unit dose equivalent <sup>b</sup> (neutrons cm <sup>-2</sup> rem <sup>-1</sup> )	Fluence per unit dose equivalent <sup>b</sup> (neutrons cm <sup>-2</sup> Sv <sup>-1</sup> )
(thermal)	2.5 E-8	2	980 E+6	980 E+8
	1 E-7	2	980 E+6	980 E+8
	1 E-6	2	810 E+6	810 E+8
	1 E-5	2	810 E+6	810 E+8
	1 E-4	2	840 E+6	840 E+8
	1 E-3	2	980 E+6	980 E+8
	1 E-2	2.5	1010 E+6	1010 E+8
	1 E-1	7.5	170 E+6	170 E+8
	5 E-1	11	39 E+6	39 E+8
	1	11	27 E+6	27 E+8
	2.5	9	29 E+6	29 E+8
	5	8	23 E+6	23 E+8
	7	7	24 E+6	24 E+8
	10	6.5	24 E+6	24 E+8
	14	7.5	17 E+6	17 E+8
	20	8	16 E+6	16 E+8
	40	7	14 E+6	14 E+8
	60	5.5	16 E+6	16 E+8
	1 E+2	4	20 E+6	20 E+8
	2 E+2	3.5	19 E+6	19 E+8
	3 E+2	3.5	16 E+6	16 E+8
	4 E+2	3.5	14 E+6	14 E+8

<sup>A</sup> Value of quality factor (Q) at the point where the dose equivalent is maximum in a 30-centimeter diameter cylinder tissue-equivalent phantom.

<sup>B</sup> Monoenergetic neutrons incident normally on a 30-centimeter diameter cylinder tissue-equivalent phantom.

1.14.5 Units of activity. For purposes of these regulations, activity is expressed in the SI unit of becquerel (Bq) or in the special unit of curie (Ci), or their multiples, or disintegrations or transformations per unit of time.

1.14.5.1 One becquerel (Bq) = 1 disintegration per second or transformation per second (dps or s<sup>-1</sup>).

1.14.5.2 One curie (Ci) = 3.7 E+10 disintegrations per second or transformations per second (dps or s<sup>-1</sup>) = 3.7 E+10 becquerel (Bq) = 2.22 E+12 disintegrations per minute (dpm).

RH 1.15 Severability. The provisions of this regulation are severable, and if any provisions or the application of the provisions to any circumstances is held invalid, the application of such provision to other circumstances, and the remainder of this regulation shall not be affected thereby.

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 80230-6928

1.16.2 In accordance with 24-4-103 (12.5) ( c) (II) (C), copies of any material that has been incorporated by reference may be examined in any State Publications Depository Library and Distribution Center.

1.16.3 Material referenced in these regulations does not include amendments to or revised editions of the material published later than the effective date of the relevant regulation.

- 3.9.11.3.13 Hazardous chemicals. A certification that the applicant has met its responsibilities under the Emergency Planning and Community Right-To-Know Act of 1986, Title III, Pub. L. 99-499, if applicable to the applicant's activities at the proposed place of use of the radioactive material.
- 3.9.11.4 The licensee shall allow the offsite response organizations expected to respond in case of an accident 60 days to comment on the licensee's emergency plan before submitting it to the Department. The licensee shall provide any comments received within 60 days to the Department with the emergency plan.

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

3.10.1 Use of Unsealed Radioactive Materials.  
 In addition to the requirements set forth in RH 3.9, applicants for licenses authorizing the possession and use of unsealed radioactive materials shall include in the application a description of the facility and procedures for operation which (1) minimize to the extent practicable, contamination of the facility and environment, and the generation of radioactive waste; and (2) facilitate eventual decommissioning.

3.10.2 Reserved.

3.10.3 Reserved.

3.10.4 Reserved.

Effective →  
5/30/00

3.10.5 Reserved.

3.10.6 Reserved.

RH 3.11 Special Requirements for Specific Licenses of Broad Scope. This section prescribes requirements for the issuance of specific licenses of broad scope for radioactive material and certain regulations governing holders of such licenses.<sup>8/</sup>

3.11.1 The different types of broad scope licenses are set forth below:

3.11.1.1 A "Type A specific license of broad scope" is a specific license authorizing receipt, acquisition, ownership, possession, use and transfer of any chemical or physical form of the radioactive material specified in the license, but not exceeding quantities specified in the license, for any authorized purpose. The quantities specified are usually in the multicurie range.

<sup>8/</sup> Authority to transfer possession or control by the manufacturer, processor, or producer of any equipment, device, commodity, or other product containing byproduct material whose subsequent possession, use, transfer, and disposal by all other persons are exempted from regulatory requirements may be obtained only from the U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

## PART 5

### RADIATION SAFETY REQUIREMENTS FOR INDUSTRIAL RADIOGRAPHIC OPERATIONS

[This part was revised in its entirety and was effective May 30, 2000, unless otherwise noted in the left hand margin]

- 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:
- "Annual refresher safety training" means a review conducted or provided by the licensee or registrant for its employees on radiation safety aspects of industrial radiography. The review shall include, as a minimum, any results of internal inspections, new procedures or equipment, new or revised regulations, and accidents or errors that have been observed. The review shall also provide opportunities for employees to ask safety questions.
- "ANSI" means the American National Standards Institute.
- "Associated equipment" means equipment that is used in conjunction with a radiographic exposure device to make radiographic exposures that drives, guides, or comes in contact with the source ( e.g., guide tube, control tube, control (drive) cable, removable source stop, "J" tube and collimator when used as an exposure head).
- "Cabinet radiography" means industrial radiography conducted in an enclosure or cabinet so shielded that every location on the exterior meets the dose limits for individual members of the public as specified in RH 4.14 of these regulations.

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

"Camera" see "Radiographic exposure device".

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

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

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

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

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

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

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

"Drive cable" see "Control cable".

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

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

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

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

"Independent certifying organization" means an independent organization that meets all of the criteria of Appendix A of this Part.

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

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

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

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

"Pigtail" see "Source assembly".

"Pill" see "Sealed source".

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

"Projection sheath" see "Guide tube".

"Projector" see "Radiographic exposure device".

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

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

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

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

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

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

"Radiography" see "Industrial radiography."

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

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

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

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

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

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

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

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

#### **RH 5.4 Exemptions.**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

- 5.5.6 The applicant submits a description of the applicant's overall organizational structure as it applies to the radiation safety responsibilities in industrial radiography, including specified delegation of authority and responsibility;
- 5.5.7 The applicant submits the qualifications of the individual(s) designated as the radiation safety officer as described in RH 5.16.1;
- 5.5.8 If an applicant intends to perform leak testing of sealed sources or exposure devices containing depleted uranium (DU) shielding, the applicant must describe the procedures for performing the test. The description must include the:
  - 5.5.8.1 Methods of collecting the samples;
  - 5.5.8.2 Qualifications of the individual who analyzes the samples;
  - 5.5.8.3 Instruments to be used; and
  - 5.5.8.4 Methods of analyzing the samples.
- 5.5.9 If the applicant intends to perform calibrations of survey instruments and alarming ratemeters, the applicant must describe methods to be used and the experience of the person(s) who will perform the calibrations. All calibrations must be performed according to the procedures described and at the intervals prescribed in RH 5.9 and RH 5.20.7.4;
- 5.5.10 The applicant identifies and describes the location(s) of all field stations and permanent radiographic installations;
- 5.5.11 The applicant identifies the location(s) where all records required by this and other Parts of these regulations will be maintained;
- 5.5.12 If a license application includes underwater radiography, a description of:
  - 5.5.12.1 Radiation safety procedures and radiographer responsibilities unique to the performance of underwater radiography;
  - 5.5.12.2 Radiographic equipment and radiation safety equipment unique to underwater radiography; and
  - 5.5.12.3 Methods for gas-tight encapsulation of equipment; and

- 5.5.13 If an application includes offshore platform and/or lay-barge radiography, a description of:
  - 5.5.13.1 Transport procedures for radioactive material to be used in industrial radiographic operations;
  - 5.5.13.2 Storage facilities for radioactive material; and
  - 5.5.13.3 Methods for restricting access to radiation areas.

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

- 5.6.1 Each radiographic exposure device, source assembly or sealed source, and all associated equipment must meet the requirements specified in American National Standard Institute, N432-1980 "Radiological Safety for the Design and Construction of Apparatus for Gamma Radiography," (published as NBS Handbook 136, issued January 1981);
- 5.6.2 In addition to the requirements specified in RH 5.6.1, the following requirements apply to radiographic exposure devices, source changers, source assemblies and sealed sources:
  - 5.6.2.1 The licensee shall ensure that each radiographic exposure device has attached to it a durable, legible, clearly visible label bearing the:
    - 5.6.2.1.1 Chemical symbol and mass number of the radionuclide in the device;
    - 5.6.2.1.2 Activity and the date on which this activity was last measured;
    - 5.6.2.1.3 Model or product code and serial number of the sealed source;
    - 5.6.2.1.4 Name of the manufacturer of the sealed source; and
    - 5.6.2.1.5 Licensee's name, address, and telephone number.
  - 5.6.2.2 Radiographic exposure devices intended for use as Type B packages must meet the applicable transportation requirements of Part 17 of these regulations.
  - 5.6.2.3 Modification of radiographic exposure devices, source changers, and source assemblies and associated equipment is prohibited, unless approved by the Department another Agreement State, or the NRC.
- 5.6.3 In addition to the requirements specified in RH 5.6.1 and 2, the following requirements apply to radiographic exposure devices, source assemblies, and associated equipment that allow the source to be moved out of the device for radiographic operations or to source changers:

- 5.6.3.1 The coupling between the source assembly and the control cable must be designed in such a manner that the source assembly will not become disconnected if cranked outside the guide tube. The coupling must be such that it cannot be unintentionally disconnected under normal and reasonably foreseeable abnormal conditions.
- 5.6.3.2 The device must automatically secure the source assembly when it is cranked back into the fully shielded position within the device. This securing system may only be released by means of a deliberate operation on the exposure device.
- 5.6.3.3 The outlet fittings, lock box, and drive cable fittings on each radiographic exposure device must be equipped with safety plugs or covers which must be installed during storage and transportation to protect the source assembly from water, mud, sand or other foreign matter.
- 5.6.3.4 Each sealed source or source assembly must have attached to it or engraved on it, a durable, legible, visible label with the words:
- "DANGER -- RADIOACTIVE."
- The label may not interfere with the safe operation of the exposure device or associated equipment.
- 5.6.3.5 The guide tube must be able to withstand a crushing test that closely approximates the crushing forces that are likely to be encountered during use, and be able to withstand a kinking resistance test that closely approximates the kinking forces that are likely to be encountered during use.
- 5.6.3.6 Guide tubes must be used when moving the source out of the device.
- 5.6.3.7 An exposure head or similar device designed to prevent the source assembly from passing out of the end of the guide tube must be attached to the outermost end of the guide tube during industrial radiography operations.
- 5.6.3.8 The guide tube exposure head connection must be able to withstand the tensile test for control units specified in ANSI N432-1980.

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

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

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

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

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

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

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

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

RH 5.9 Radiation Survey Instruments.

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

- 5.9.1 The licensee or registrant shall keep sufficient calibrated and operable radiation survey instruments at each location where sources of radiation are present to make the radiation surveys required by this Part and by Part 4 of these regulations. Instrumentation required by this section must be capable of measuring a range from 0.02 millisieverts (2 mrem) per hour through 0.01 sievert (1 rem) per hour.
- 5.9.2 The licensee or registrant shall have each radiation survey instrument required under RH 5.9.1 calibrated:
  - 5.9.2.1 At energies appropriate for use and at intervals not to exceed 6 months and after instrument servicing, except for battery changes;
  - 5.9.2.2 For linear scale instruments, at two points located approximately one-third and two-thirds of full-scale on each scale; for logarithmic scale instruments, at mid-range of each decade, and at two points of at least one decade; and for digital instruments, at 3 points between 0.02 and 10 millisieverts (2 and 1000 mrem) per hour; and
  - 5.9.2.3 So that an accuracy within plus or minus 20 percent of the true radiation dose rate can be demonstrated at each point checked.
- 5.9.3 The licensee or registrant shall maintain records of the results of the instrument calibrations in accordance with RH 5.26.

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

- 5.10.1 The replacement of any sealed source fastened to or contained in a radiographic exposure device and the leak testing of any sealed source must be performed by persons authorized to do so by the Department, the Nuclear Regulatory Commission, or another Agreement State.
- 5.10.2 The opening, repair, or modification of any sealed source must be performed by persons specifically authorized to do so by the Department, the Nuclear Regulatory Commission, or another Agreement State.
- 5.10.3 Testing and recordkeeping requirements.

- 5.10.3.1 Each licensee who uses a sealed source shall have the source tested for leakage at intervals not to exceed 6 months. The leak testing of the source must be performed using a method approved by the Department, the Nuclear Regulatory Commission, or by another Agreement State. The wipe sample should be taken from the nearest accessible point to the sealed source where contamination might accumulate. The wipe sample must be analyzed for radioactive contamination. The analysis must be capable of detecting the presence of 185 becquerel (0.005  $\mu$ Ci) of radioactive material on the test sample and must be performed by a person specifically authorized by the Department, the Nuclear Regulatory Commission, or another Agreement State to perform the analysis.
- 5.10.3.2 The licensee shall maintain records of the leak tests in accordance with RH 5.27.
- 5.10.3.3 Unless a sealed source is accompanied by a certificate from the transferor that shows that it has been leak tested within 6 months before the transfer, it may not be used by the licensee until tested for leakage. Sealed sources that are in storage and not in use do not require leak testing, but must be tested before use or transfer to another person if the interval of storage exceeds 6 months.
- 5.10.4 Any test conducted pursuant to RH 5.10.2 and 5.10.3. that reveals the presence of 185 becquerel (0.005  $\mu$ Ci) or more of removable radioactive material must be considered evidence that the sealed source is leaking. The licensee shall immediately withdraw the equipment involved from use and shall have it decontaminated and repaired or disposed of in accordance with Department regulations. A report must be filed with the Department within 5 days of any test with results that exceed the threshold in this paragraph, describing the equipment involved, the test results, and the corrective action taken.
- 5.10.5 Each exposure device using depleted uranium (DU) shielding and an "S" tube configuration must be tested for DU contamination at intervals not to exceed 12 months. The analysis must be capable of detecting the presence of 185 becquerel (0.005  $\mu$ Ci) of radioactive material on the test sample and must be performed by a person specifically authorized by the Department, the Nuclear Regulatory Commission, or another Agreement State to perform the analysis. Should such testing reveal 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. Should the evaluation reveal that the S-tube is worn through, the device may not be used again. DU shielded devices do not have to be tested for DU contamination while not in use and in storage. Before using or transferring such a device, however, the device must be tested for DU contamination, if the interval of storage exceeds 12 months. A record of the DU leak-test must be made in accordance with RH 5.27.

RH 5.11 Quarterly Inventory.

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

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

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

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

5.12.1.1 The equipment is in good working condition;

5.12.1.2 The sources are adequately shielded; and

5.12.1.3 Required labeling is present.

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

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

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

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

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

RH 5.13 Permanent Radiographic Installations.

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

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

- 5.13.1.2 Both conspicuous visible and audible warning signals to warn of the presence of radiation. The visible signal must be actuated by radiation whenever the source is exposed or the machine is energized. The audible signal must be actuated when an attempt is made to enter the installation while the source is exposed or the machine is energized.
- 5.13.2 The alarm system must be tested for proper operation with a radiation source each day before the installation is used for radiographic operations. The test must include a check of both the visible and audible signals. Entrance control devices that reduce the radiation level upon entry as designated in RH 5.13.1 must be tested monthly.
- 5.13.3 If an entrance control device or an alarm is operating improperly, it must be immediately labeled as defective and repaired within 7 calendar days. The facility may continue to be used during this 7-day period, provided the licensee or registrant implements the continuous surveillance requirements of RH 5.22 and uses an alarming ratemeter. Test records for entrance controls and audible and visual alarms must be maintained in accordance with RH 5.31.

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

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

CAUTION \*  
 RADIOACTIVE MATERIAL  
 NOTIFY CIVIL AUTHORITIES [or " NAME OF COMPANY"]

\* --- or "DANGER"

- 5.14.2 The licensee may not transport radioactive material unless the material is packaged, and the package is labeled, marked, and accompanied with appropriate shipping papers in accordance with regulations set out in Part 17.
- 5.14.3 Radiographic exposure devices, source changers, storage containers, and radiation machines, must be physically secured to prevent tampering or removal by unauthorized personnel. The licensee shall store radioactive material in a manner that will minimize danger from explosion or fire.
- 5.14.4 The licensee shall lock and physically secure the transport package containing radioactive material in the transporting vehicle to prevent accidental loss, tampering, or unauthorized removal.

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

**RH 5.15 Conducting Industrial Radiographic Operations.**

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

5.15.1.1 The licensee or registrant shall have until June 30, 2001 to hire and train individuals to meet the requirements of RH 5.15.1.

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

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

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

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

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

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

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

- 5.16.1.3 Formal training in the establishment and maintenance of a radiation protection program.
- 5.16.2 The Department will consider alternatives to RH 5.16.1 when the radiation safety officer has appropriate training and experience in the field of ionizing radiation, and in addition, has adequate formal training with respect to the establishment and maintenance of a radiation safety protection program.
- 5.16.3 The specific duties and authorities of the radiation safety officer include:
  - 5.16.3.1 Establishing and overseeing all operating, emergency, and ALARA procedures as required by Part 4 of these regulations and reviewing them regularly to ensure that they conform to Department regulations and to the license or registration conditions;
  - 5.16.3.2 Overseeing and approving the training program for radiographic personnel to ensure that appropriate and effective radiation protection practices are taught;
  - 5.16.3.3 Ensuring that required radiation surveys and leak tests are performed and documented in accordance with the regulations, including any corrective measures when levels of radiation exceed established limits;
  - 5.16.3.4 Ensuring that personnel monitoring devices are calibrated, if applicable, and used properly; that records are kept of the monitoring results; and that timely notifications are made as required by Part 4 of these regulations; and
  - 5.16.3.5 Ensuring that operations are conducted safely and for implementing corrective actions including terminating operations.
- 5.16.4 Licensees and registrants will have until July 1, 2002 to meet the requirements of RH 5.16.1 and 2.

RH 5.17 Training.

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

- 5.17.1.1 Has received at least 40 hours of training in the subjects outlined in RH 5.17.7, in addition to on the job training consisting of hands-on experience under the supervision of a radiographer and is certified through a radiographer certification program by a certifying entity in accordance with the criteria specified in Appendix A of this Part<sup>2</sup>. The on the job training shall include a minimum of 2 months (320 hours) of active participation in the performance of industrial radiography utilizing radioactive material and/or 1 month (160 hours) of active participation in the performance of industrial radiography utilizing radiation machines. Individuals performing industrial radiography utilizing radioactive materials and radiation machines must complete both segments of the on the job training (3 months or 480 hours); or
- 5.17.1.2 The licensee or registrant may, until July 1, 2002, allow an individual who has not met the requirements of RH 5.17.1.1, to act as a radiographer after the individual has received:
- 5.17.1.2.1 At least 40 hours of training in the subjects outlined in RH 5.17.7 and demonstrated an understanding of these subjects by successful completion of a written examination that was previously submitted to, and approved by, the Department, the Nuclear Regulatory Commission, or another Agreement State; and
- 5.17.1.2.2 On the job training consisting of hands-on experience under the supervision of a radiographer. The on the job training shall include a minimum of 2 months (320 hours) of active participation in the performance of industrial radiography utilizing radioactive material and/or 1 month (160 hours) of active participation in the performance of industrial radiography utilizing radiation machines. Individuals performing industrial radiography utilizing radioactive materials and radiation machines must complete both segments of the on the job training (3 months or 480 hours).
- 5.17.2 In addition, the licensee or registrant may not permit any individual to act as a radiographer until the individual:
- 5.17.2.1 Has received copies of and instruction in the requirements described in the regulations contained in this Part, and applicable sections of Parts 4, 10 and 17 of these regulations; in the license or registration under which the radiographer will perform industrial radiography; and the licensee's or registrant's operating and emergency procedures;
- 5.17.2.2 Has demonstrated an understanding of items in RH 5.17.2.1 by successful completion of a written or oral examination;.
- 5.17.2.3 Has received training in the use of the registrant's radiation machines, or the licensee's radiographic exposure devices, sealed sources, in the daily inspection of devices and associated equipment, and in the use of radiation survey instruments; and

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

- 5.17.2.4 Has demonstrated understanding of the use of the equipment described in RH 5.17.2.3 by successful completion of a practical examination.
- 5.17.3 The licensee or registrant may not permit any individual to act as a radiographer's assistant until the individual:
- 5.17.3.1 Has received copies of and instruction in the requirements described in the regulations contained in this Part, and applicable sections of Parts 4, 10, and 17 of these regulation, in the license or registration under which the radiographer's assistant will perform industrial radiography, and the licensee's or registrant's operating and emergency procedures;
- 5.17.3.2 Has demonstrated an understanding of items in RH 5.17.3.1 by successful completion of a written or oral examination;
- 5.17.3.3 Under the personal supervision of a radiographer, has received training in the use of the registrant's radiation machines, or the licensee's radiographic exposure devices and sealed sources, in the daily inspection of devices and associated equipment, and in the use of radiation survey instruments; and
- 5.17.3.4 Has demonstrated understanding of the use of the equipment described in RH 5.17.3.3 by successful completion of a practical examination.
- 5.17.4 The licensee or registrant shall provide annual refresher safety training for each radiographer and radiographer's assistant at intervals not to exceed 12 months.
- 5.17.5 Except as provided in RH 5.17.5.3, the radiation safety officer or designee shall conduct an inspection program of the job performance of each radiographer and radiographer's assistant to ensure that the Department's regulations, license or registration requirements, and operating and emergency procedures are followed. The inspection program must:
- 5.17.5.1 Include observation of the performance of each radiographer and radiographer's assistant during an actual industrial radiographic operation, at intervals not to exceed 6 months; and
- 5.17.5.2 If a radiographer or a radiographer's assistant has not participated in an industrial radiographic operation for more than 6 months since the last inspection, the radiographer must demonstrate knowledge of the training requirements of RH 5.17.2.3. and the radiographer's assistant must demonstrate knowledge of the training requirements of 5.17.3.3 by a practical examination before these individuals can next participate in a radiographic operation.
- 5.17.5.3 The Department may consider alternative inspection programs in those situations where one individual serves as the only radiographer and the radiation safety officer.

- 5.17.6 The licensee or registrant shall maintain records of the above training to include certification documents, written, oral and practical examinations, refresher safety training and inspections of job performance in accordance with RH 5.32.
- 5.17.7 The licensee or registrant shall include the following subjects required in RH 5.17.1:
  - 5.17.7.1 Fundamentals of radiation safety including:
    - 5.17.7.1.1 Characteristics of gamma and x-radiation;
    - 5.17.7.1.2 Units of radiation dose and quantity of radioactivity;
    - 5.17.7.1.3 Hazards of exposure to radiation;
    - 5.17.7.1.4 Levels of radiation from sources of radiation; and
    - 5.17.7.1.5 Methods of controlling radiation dose (time, distance, and shielding);
  - 5.17.7.2 Radiation detection instruments including:
    - 5.17.7.2.1 Use, operation, calibration, and limitations of radiation survey instruments;
    - 5.17.7.2.2 Survey techniques; and
    - 5.17.7.2.3 Use of personnel monitoring equipment;
  - 5.17.7.3 Equipment to be used including:
    - 5.17.7.3.1 Operation and control of radiographic exposure equipment, remote handling equipment, and storage containers, including pictures or models of source assemblies (pigtailed);
    - 5.17.7.3.2 Operation and control of radiation machines;
    - 5.17.7.3.3 Storage, control, and disposal of sources of radiation; and
    - 5.17.7.3.4 Inspection and maintenance of equipment.
  - 5.17.7.4 The requirements of pertinent state and federal regulations; and
  - 5.17.7.5 Case histories of accidents in radiography.
- 5.17.8 Licensees and registrants will have until July 1, 2001 to comply with the additional training requirements specified in RH 5.17.2.1 and 5.17.3.1.

**RH 5.18 Operating and Emergency Procedures.**

- 5.18.1 Operating and emergency procedures must include, as a minimum, instructions in the following:
- 5.18.1.1 Appropriate handling and use of sources of radiation so that no person is likely to be exposed to radiation doses in excess of the limits established in Part 4 of these regulations;
  - 5.18.1.2 Methods and occasions for conducting radiation surveys;
  - 5.18.1.3 Methods for posting and controlling access to radiographic areas;
  - 5.18.1.4 Methods and occasions for locking and securing sources of radiation;
  - 5.18.1.5 Personnel monitoring and the use of personnel monitoring equipment;
  - 5.18.1.6 Transporting equipment to field locations, including packing of radiographic exposure devices and storage containers in the vehicles, placarding of vehicles when required, and control of the equipment during transportation as described in Part 17 of these regulations;
  - 5.18.1.7 The inspection, maintenance, and operability checks of radiographic exposure devices, radiation machines, survey instruments, alarming ratemeters, transport containers, and storage containers;
  - 5.18.1.8 Steps that must be taken immediately by radiography personnel in the event a pocket dosimeter is found to be off-scale or an alarming ratemeter alarms unexpectedly;
  - 5.18.1.9 The procedure(s) for identifying and reporting defects and noncompliance, as required by RH 5.38;
  - 5.18.1.10 The procedure for notifying proper persons in the event of an accident or incident;
  - 5.18.1.11 Minimizing exposure of persons in the event of an accident or incident, including a source disconnect, a transport accident, or loss of a source of radiation;
  - 5.18.1.12 Source recovery procedure if licensee will perform source recoveries; and
  - 5.18.1.13 Maintenance of records.
- 5.18.2 The licensee or registrant shall maintain copies of current operating and emergency procedures in accordance with RH 5.33 and 5.37.

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

- 5.19.1 The radiographer's physical presence at the site where the sources of radiation are being used;
- 5.19.2 The availability of the radiographer to give immediate assistance if required; and
- 5.19.3 The radiographer's direct observation of the assistant's performance of the operations referred to in this section.

RH 5.20 Personnel Monitoring.

- 5.20.1 The licensee or registrant shall not permit any individual to act as a radiographer or a radiographer's assistant unless, at all times during radiographic operations, each individual wears, on the trunk of the body, a combination of direct reading dosimeter, an alarming ratemeter, and a film badge, a TLD or an optically stimulated luminescence (OSL) dosimeter. At permanent radiographic installations where other appropriate alarming or warning devices are in routine use, or during radiographic operations using radiation machines, the use of an alarming ratemeter is not required.
  - 5.20.1.1 Pocket dosimeters must have a range from zero to 2 millisieverts (200 mrem) and must be recharged at the start of each shift. Electronic personal dosimeters may only be used in place of ion-chamber pocket dosimeters.
  - 5.20.1.2 Each film badge, TLD or OSL dosimeter must be assigned to and worn by only one individual.
  - 5.20.1.3 Film badges, TLD's or OSL dosimeters must be exchanged at periods not to exceed one month.
  - 5.20.1.4 After replacement, each film badge, TLD or OSL dosimeter must be returned to the supplier for processing within 14 calendar days of the end of the monitoring period, or as soon as practicable. In circumstances that make it impossible to return each personnel monitoring device in 14 calendar days, such circumstances must be documented and available for review by the Department.
- 5.20.2 Direct reading dosimeters such as pocket dosimeters or electronic personal dosimeters, must be read and the exposures recorded at the beginning and end of each shift, and records must be maintained in accordance with RH 5.34.

- 5.20.3 Pocket dosimeters, or electronic personal dosimeters, must be checked at periods not to exceed 12 months for correct response to radiation, and records must be maintained in accordance with RH 5.34. Acceptable dosimeters must read within plus or minus 20 percent of the true radiation exposure.
- 5.20.4 If an individual's pocket dosimeter is found to be off-scale, or the electronic personal dosimeter reads greater than 2 millisieverts (200 mrem), the individual's film badge, TLD or OSL dosimeter must be sent for processing within 24 hours. In addition, the individual may not resume work associated with the use of sources of radiation until a determination of the individual's radiation exposure has been made. This determination must be made by the radiation safety officer or the radiation safety officer's designee. The results of this determination must be included in the records maintained in accordance with RH 5.34.
- 5.20.5 If a film badge, TLD or OSL dosimeter is lost or damaged, the worker shall cease work immediately until a replacement film badge, TLD or OSL dosimeter is provided and the exposure is calculated for the time period from issuance to loss or damage of the film badge, TLD or OSL dosimeter. The results of the calculated exposure and the time period for which the film badge, TLD, or OSL dosimeter was lost or damaged must be included in the records maintained in accordance with RH 5.34.
- 5.20.6 Reports received from the film badge, TLD or OSL dosimeter processor must be retained in accordance with RH 5.34.
- 5.20.7 Each alarming ratemeter must:
- 5.20.7.1 Be checked to ensure that the alarm functions properly before using at the start of each shift;
  - 5.20.7.2 Be set to give an audible alarm signal at a preset dose rate of 5 millisieverts (500 mrem) per hour; with an accuracy of plus or minus 20 percent of the true radiation dose rate;
  - 5.20.7.3 Require special means to change the preset alarm function; and
  - 5.20.7.4 Be calibrated at periods not to exceed 12 months for correct response to radiation. The licensee shall maintain records of alarming ratemeter calibrations in accordance with RH 5.34

RH 5.21 Radiation Surveys. The licensee or registrant shall:

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

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

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

5.21.4 Maintain records in accordance with RH 5.35.

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

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

#### Recordkeeping Requirements

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

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

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

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

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

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

RH 5.28 Records of Quarterly Inventory.

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

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

RH 5.29 Utilization Logs.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

RH 5.36 Form of Records. Each record required by this Part must be legible throughout the specified retention period. The record may be the original or a reproduced copy or a microform provided that the copy or microform is authenticated by authorized personnel and that the microform is capable of reproducing a clear copy throughout the required retention period. The record may also be stored in electronic media with the capability for producing legible, accurate, and complete records during the required retention period. Records, such as letters, drawings, and specifications, must include all pertinent information, such as stamps, initials, and signatures. The licensee or registrant shall maintain adequate safeguards against tampering with and loss of records.

RH 5.37 Location Of Documents and Records.

- 5.37.1 Each licensee or registrant shall maintain copies of records required by this Part and other applicable Parts of these regulations at the location specified in RH 5.5.11.
- 5.37.2 Each licensee or registrant shall also maintain current copies of the following documents and records sufficient to demonstrate compliance at each applicable field station and each temporary jobsite;
  - 5.37.2.1 The license or registration authorizing the use of sources of radiation;
  - 5.37.2.2 A copy of Parts 1, 4, 5 & 10 of these regulations;
  - 5.37.2.3 Utilization logs for each source of radiation dispatched from that location as required by RH 5.29;
  - 5.37.2.4 Records of equipment problems identified in daily checks of equipment as required by RH 5.30.1;
  - 5.37.2.5 Records of alarm system and entrance control checks required by RH 5.31, if applicable;
  - 5.37.2.6 Records of dosimeter readings as required by RH 5.34;
  - 5.37.2.7 Operating and emergency procedures as required by RH 5.33;
  - 5.37.2.8 Evidence of the latest calibration of the radiation survey instruments in use at the site, as required by RH 5.26;
  - 5.37.2.9 Evidence of the latest calibrations of alarming ratemeters and operability checks of dosimeters as required by RH 5.34;
  - 5.37.2.10 Survey records as required by RH 5.35 and RH 4.42 of these regulations as applicable, for the period of operation at the site;
  - 5.37.2.11 The shipping papers for the transportation of radioactive materials required by Part 17 of these regulations; and

- 5.37.2.12 When operating under reciprocity pursuant to Part 3 of these regulations, a copy of the applicable State license or registration, or Nuclear Regulatory Commission license authorizing the use of sources of radiation.

#### Notifications

#### RH 5.38 Notifications.

- 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:
- 5.38.1.1 Unintentional disconnection of the source assembly from the control cable;
  - 5.38.1.2 Inability to retract the source assembly to its fully shielded position and secure it in this position;
  - 5.38.1.3 Failure of any component, which is critical to safe operation of the device, to properly perform its intended function; or
  - 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.
- 5.38.2 The licensee or registrant shall include the following information in each report submitted under RH 5.38.1, and in each report of overexposure submitted under RH 4.53.2 of these regulations which involves failure of safety components of radiography equipment:
- 5.38.2.1 Description of the equipment problem;
  - 5.38.2.2 Cause of each incident, if known;
  - 5.38.2.3 Name of the manufacturer and model number of equipment involved in the incident;
  - 5.38.2.4 Place, date, and time of the incident;
  - 5.38.2.5 Actions taken to establish normal operations;
  - 5.38.2.6 Corrective actions taken or planned to prevent recurrence; and
  - 5.38.2.7 Names and qualifications of personnel involved in the incident.
- 5.38.3 Any licensee or registrant conducting radiographic operations or storing sources of radiation at any location not listed on the license or registration for a period in excess of 90 days in a calendar year, shall notify the Department prior to exceeding the 90 days.

RH 5.39 Reciprocity.

- 5.39.1 All reciprocal recognition of licenses and registrations by the Department will be granted in accordance with Part 3 of these regulations.
- 5.39.2 Reciprocal recognition by the Department of an individual radiographer certification will be granted provided that:
  - 5.39.2.1 The individual holds a valid certification in the appropriate category issued by a certifying entity, as defined in RH 5.3;
  - 5.39.2.2 The requirements and procedures of the certifying entity issuing the certification affords the same or comparable certification standards as those afforded by RH 5.17.1;
  - 5.39.2.3 The applicant presents the certification to the Department prior to entry into the state; and
  - 5.39.2.4 No escalated enforcement action is pending with the Nuclear Regulatory Commission or in any other state.
- 5.39.3 Certified individuals who are granted reciprocity by the Department shall maintain the certification upon which the reciprocal recognition was granted, or prior to the expiration of such certification, shall meet the requirements of RH 5.17.1.

RH 5.40 Specific Requirements for Radiographic Personnel Performing Industrial Radiography.

- 5.40.1 At a job site, the following shall be supplied by the licensee or registrant:
  - 5.40.1.1 At least one operable, calibrated survey instrument for each exposure device or radiation machine in use;
  - 5.40.1.2 A current whole body personnel monitor (OSL dosimeter, TLD or film badge) for each person performing radiographic operations;
  - 5.40.1.3 An operable, calibrated pocket dosimeter with a range of zero to 2 millisieverts (200 milliroentgens) for each person performing radiographic operations;
  - 5.40.1.4 An operable, calibrated, alarming ratemeter for each person performing radiographic operations using a radiographic exposure device; and
  - 5.40.1.5 The appropriate barrier ropes and signs.
- 5.40.2 Each radiographer at a job site shall have on their person a valid certification ID card issued by a certifying entity.

- 5.40.3 Industrial radiographic operations shall not be performed if any of the items in RH 5.40.1 and 5.40.2 are not available at the job site or are inoperable.
- 5.40.4 During an inspection, the Department may terminate an operation if any of the items in RH 5.40.1. and 2 are not available or operable, or if the required number of radiographic personnel are not present. Operations shall not be resumed until all required conditions are met.

**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;
6. Have a set of written organizational by-laws and policies that provide adequate assurance of lack of conflict of interest and a system for monitoring and enforcing those by-laws and policies;
7. Have a committee, whose members can carry out their responsibilities impartially, to review and approve the certification guidelines and procedures, and to advise the organization's staff in implementing the certification program;
8. Have a committee, whose members can carry out their responsibilities impartially, to review complaints against certified individuals and to determine appropriate sanctions;
9. Have written procedures describing all aspects of its certification program, maintain records of the current status of each individual's certification and the administration of its certification program;
10. Have procedures to ensure that certified individuals are provided due process with respect to the administration of its certification program, including the process of becoming certified and any sanctions imposed against certified individuals;
11. Have procedures for proctoring examinations, including qualifications for proctors. These procedures must ensure that the individuals proctoring each examination are not employed by the same company or corporation (or a wholly-owned subsidiary of such company or corporation) as any of the examinees;
12. Exchange information about certified individuals with the Nuclear Regulatory Commission and other independent certifying organizations and/or Agreement States and allow periodic review of its certification program and related records; and

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

## **II. Requirements for Certification Programs.**

All certification programs must:

1. Require applicants for certification to (a) receive training in the topics set forth in RH 5.17.7. or equivalent State or Nuclear Regulatory Commission regulations, and (b) satisfactorily complete a written examination covering these topics;
2. Require applicants for certification to provide documentation that demonstrates that the applicant has:
  - (a) received training in the topics set forth in RH 5.17.7 or equivalent State or Nuclear Regulatory Commission regulations;
  - (b) satisfactorily completed a minimum period of on-the-job training as specified in RH 5.17.1; and
  - (c) received verification by a State licensee or registrant or a Nuclear Regulatory Commission licensee that the applicant has demonstrated the capability of independently working as a radiographer.
3. Include procedures to ensure that all examination questions are protected from disclosure;
4. Include procedures for denying an application and revoking, suspending, and reinstating a certification;
5. Provide a certification period of not less than 3 years nor more than 5 years;
6. Include procedures for renewing certifications and, if the procedures allow renewals without examination, require evidence of recent full-time employment and annual refresher training; and
7. Provide a timely response to inquiries, by telephone or letter, from members of the public, about an individual's certification status.

## **III. Requirements for Written Examinations**

All examinations must be:

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