

## **Section 2.05 Ionizing and Nonionizing Radiation**

### **1. Scope**

This section applies to Bureau of Reclamation facilities to protect employees from potential exposure to ionizing and nonionizing radiation while performing their job tasks.

### **2. General Requirements**

#### **a. Ionizing and Nonionizing Radiation Levels**

Reclamation's goal is to maintain employee exposures as low as reasonably achievable (ALARA) and at no time shall ionizing/nonionizing radiation levels exceed limits set by Federal Occupational Safety and Health (OSHA) 29 CFR 1910.1096, Ionizing Radiation, 29 CFR 1910.97, Nonionizing Radiation. At no time shall anyone under 18 years perform work in or around ionizing radiation.

#### **b. Nuclear Regulatory Commission Licensed Device Requirements**

Reclamation facilities using a Nuclear Regulatory Commission (NRC) licensed device must meet the specific requirements of their device(s) outlined in 10 CFR part 20, Standards for Protection Against Radiation, Subparts A-O, and Part 31, General Domestic Licenses for Byproduct Material. Reclamation facilities that possess or use source material, byproduct material, or special nuclear material, as defined in the Atomic Energy Act of 1954, under a license issued by the NRC and in accordance with the requirements of 10 CFR part 20, shall be considered in compliance with the requirements of 29 CFR 1910.1096 with respect to possession and use.

### **3. Responsibilities**

#### **a. Area Office Managers**

- Shall provide the necessary resources to implement and maintain the procedures within this section.
- Shall select a radiation safety officer (RSO) that meets the training and experience requirements for their generally licensed device(s).

#### **b. First-Line Supervisors**

- Shall ensure employees receive training according to paragraph 2.05.4, Radiation Safety Training, where there is reasonable likelihood of exposures to ionizing/nonionizing radiation (e.g., laser surveying equipment and microwave communication tower work).
- Shall coordinate with the regional/local industrial hygienist (IH), safety manager/safety specialist, and RSO to perform workplace assessments, training, job hazard analysis, and exposure monitoring as necessary and remove hazards whenever possible using the hierarchy of controls listed in RSHS Section 1.07.2, Personal Protective Equipment.

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- Shall coordinate with the regional/local IH and the safety manager/safety specialist to ensure employees performing job tasks with the potential for exposure to ionizing/nonionizing radiation with the appropriate controls, equipment, and personal protective equipment (PPE).
- Shall immediately notify all ionizing/nonionizing radiation exposures to the RSO and/or safety manager/safety specialist as appropriate.
- Shall coordinate with the RSO to ensure that the ionizing/nonionizing radiation exposure to an embryo/fetus carried by a pregnant employee exposed to radiation, that has voluntarily declared their pregnancy, does not exceed 0.5 rem during their entire pregnancy.

### c. Employees

- Shall complete radiation protection training requirements in paragraph 2.05.4, Radiation Safety Training.
- Shall review the job hazard analysis (JHA) and the identified precautions and controls before conducting job tasks that use ionizing/nonionizing radiation equipment.
- Shall report ionizing/nonionizing radiation exposure incidents and releases to the first-line supervisor immediately.
- Shall wear personal monitoring devices where required.
- Shall follow the voluntary facility reporting procedure, for pregnant employees exposed to radiation, to ensure the RSO, local safety specialist/manager, and first-line supervisor have been notified.

### d. Regional Safety Managers

- Shall provide support in developing a radiation safety program, as requested.

### e. Regional/Local Industrial Hygienists and Safety Managers/Safety Specialists

- Shall provide technical assistance such as workplace hazard assessments, exposure monitoring, and training.
- Shall develop and implement a local radiation safety program covering ionizing radiation equipment, that does not require an NRC license, and for nonionizing radiation equipment used at their facility.
- Shall have a basic understanding for operating ionizing/nonionizing radiation equipment used at their facility.
- Shall provide technical assistance such as workplace hazard assessments, exposure monitoring, and training.

### f. Radiation Safety Officer

- Shall oversee the NRC broad scope or specific licenses issued to their facility's equipment and implement the license requirements in accordance with NRC regulations.

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- Shall provide technical oversight, support, and training for NRC licensed devices. Shall attend RSO training at intervals according to their licensed device requirements.
- Shall develop and implement a radiation safety program that includes operations using regulated licensed devices at their facility.
- Shall review the radiation safety program at least annually.
- Shall complete annual leak testing for radioactive sources, if required by their license, and ensure an approved laboratory analyzes the results.
- Shall conduct self-audits to ensure licensed device(s) are in compliance with Federal regulations.
- Shall make appropriate notification and reporting of radiation incidences and overexposures to the appropriate governing authority.
- Shall confirm that all authorized users, as defined in the license or permit of licensed equipment, are actively monitored for radiation exposure and accurately maintain exposure records.
- Shall confirm that all authorized users, as defined in the license or permit of licensed equipment, are actively monitored for radiation exposure and accurately maintain exposure records.
- Shall ensure transported licensed material complies with all applicable Department of Transportation requirements.
- Shall ship all licensed material using a commercial carrier according to 49 CFR, Transportation, parts 171-177.

### g. Human Resources Officers (HROs)

- Shall maintain all medical examination results, clearance documentation, and employee exposure monitoring records in the employee's medical folder according to 29 CFR 1910.1020(d)(1), Access to Employee Exposure and Medical Records, the Privacy Act of 1974 (P.L. 93-579), and provide the RSO, regional/local IH, first-line supervisor, and safety manager/safety specialist supervisor with clearance results as requested.

## 4. Radiation Safety Training

### a. Ionizing Radiation Training for Licensed Devices Elements

The RSO shall conduct and/or coordinate training for employees prior to using licensed devices, entering areas where radiation generating devices are used, or where there is a potential for an individual to receive a total effective dose equivalent of 100 mrem or more in 1 year covering the following minimum elements:

- type of radioactive material and/or the device used,
- NRC license conditions and requirements for use of equipment,

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- health and safety concerns associated with radiation and the potential effects of radiation on a pregnant female, the embryo/fetus, voluntary reporting procedure for declared pregnant employees,
- contents of the facility's radiation safety program,
- precautions and ALARA controls used to control radiation exposure,
- allowable radiation dose limits,
- types of equipment used for radiation monitoring and surveying,
- types of personal monitoring devices required,
- appropriate PPE used for shielding (e.g., lead apron, gloves, safety goggles, respirators for airborne radionuclides, etc.),
- review of caution signs, labels, and warning signals,
- notification requirements for radiation incidents,
- spill and contamination control of radioactive material, if appropriate for the facility,
- radioactive waste disposal procedure if applicable for the facility, and
- employee rights and responsibilities.

The safety manager/safety specialist, first-line supervisor, and/or the regional/local IH, shall coordinate training for non-licensed devices or equipment used at their facility, covering the appropriate elements in paragraph 2.05.4.a, Ionized Safety Training for Licensed Devices Elements.

### **b. Nonionizing Radiation Training Elements**

The safety manager/safety specialist, the first-line supervisor, and/or the regional/local IH, shall coordinate employee training covering the following minimum elements for the nonionizing devices/equipment used at their facility:

- electromagnetic radiation (e.g., microwave radiation for communications, radar, etc.) hazards,
- infrared radiation (e.g., furnaces, heat lamps, infrared lasers) hazards,
- ultraviolet radiation (e.g., welding arcs, ultraviolet lasers, black lights) hazards,
- radiofrequency radiation (e.g., radio waves, low energy microwaves, visible light),
- manufacturer's procedures for use and maintenance of nonionizing radiation devices/equipment, and
- OSHA's radiation protection guidance for normal environmental conditions and for incident electromagnetic energy addressed in paragraph 2.05.8.c, Radiation Protection Guidance for Nonionizing Radiation.

### **c. Lack of Proficiency**

Retraining is necessary when an employee demonstrates a lack of knowledge of ionizing/nonionizing work practices or elements of this section.

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## d. Recordkeeping

The RSO, safety manager/safety specialist, and first-line supervisors shall ensure training records are kept in the Department of the Interior's approved repository and managed in accordance with the Information Management Handbook as referenced in Reclamation Manual Directive and Standard, RCD 05-01, Information Management.

## 5. Hazard Identification, Assessment, and Safety Measures

Hazard Identification and Assessment. Authorized users shall survey and document locations where employees use licensed devices and/or equipment on and off the facility. Authorized users will also ensure the appropriate controls, personal monitoring devices, PPE, and any other requirements of the license is available to reduce potential employee exposure to ionizing radiation. The survey may include, as appropriate, a physical survey of the location of materials and equipment and measurements of radiation levels or concentrations of radioactive material. The safety manager/safety specialist shall survey and document areas where nonionizing radiation hazards are present, used, released, or disposed from non-licensed devices.

## 6. Safety Measures

Radiation Safety Program for Ionizing/Nonionizing Devices/Equipment. The RSO, in coordination with the safety manager/safety specialist and radiation safety council, where present, shall develop and implement a radiation safety program covering the following minimum elements appropriate to the type of licensed/non-licensed equipment used at their facility:

- use of appropriate ALARA procedures to reduce potential exposures,
- a dosimetry program for personal exposure monitoring,
- surveys to document potential radiation exposure,
- radiological controls (e.g., entry/exit and inventory/storage/disposal controls),
- employee training,
- emergency procedures for responding to radiological situations,
- recordkeeping and reporting requirements, and
- annual internal audit procedures.

## 7. Pre-job Briefing and Planning Requirements

Job Hazard Analysis. The RSO, in coordination with the first-line supervisor and the safety manager/specialist, shall ensure JHAs include ALARA procedures and the appropriate PPE for reducing potential exposures to radiation devices/sources and nonionizing equipment when performing job tasks.

## 8. Safe Practices

### a. As Low as Reasonably Achievable

RSOs and the safety managers/specialist shall develop ALARA procedures and/or work practices to minimize an employee's radiation exposure when working with or around radioactive materials using the following principles:

- reducing the amount of time spent near a radioactive source to reduce the dose,
- increasing distance from a radioactive source to decrease the dose, and
- using proper shielding for the radiation source to protect employees from potential exposure.

### b. Radiation Exposure to Employees in Restricted Areas

Reclamation shall not possess, use, or transfer sources of ionizing radiation that may cause any individuals in a restricted area to receive, in any period of 1 calendar quarter, from a dose more than the limits specified below:

- 1.25 rems per calendar quarter whole body: head and trunk, active blood-forming organs, lens of eyes, or gonads,
- 18.75 rems per calendar quarter: hands and forearms, feet and ankles,
- 7.50 rems per calendar quarter: skin of whole body, and
- The dose to an embryo/fetus shall follow the guidelines in 10 CFR 20.1208, Dose Equivalent to an Embryo/Fetus.

Dose Monitoring. The RSO shall coordinate dose monitoring when an employee is likely to receive a dose in any calendar quarter more than 25 percent of the applicable occupational limit and for each employee who enters a high radiation area.

### c. Radiation Protection Guidance for Nonionizing Radiation

For normal environmental conditions and for incident electromagnetic energy of frequencies from 10 MHz to 100 GHz, the radiation protection guide is 10 mW/cm<sup>2</sup> (milliwatt per square centimeter) as averaged over any possible 0.1-hour period (i.e., the guide applies whether the radiation is continuous or intermittent) as follows:

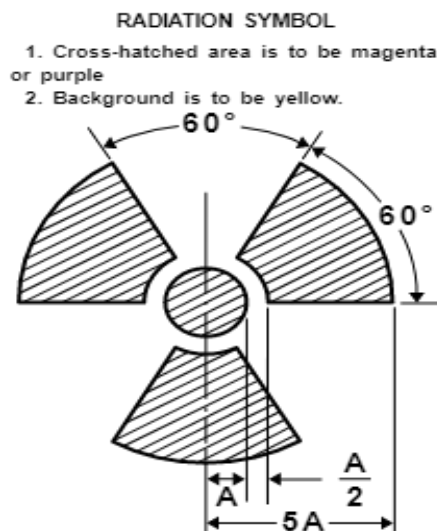
- power density: 10 mW/cm<sup>2</sup> for periods of 0.1-hour or more, and
- energy density: 1 mW-hr/cm<sup>2</sup> (milliwatt hour per square centimeter) during any 0.1- hour period.

This guide applies whether the radiation is continuous or intermittent.

## d. Ionizing and Nonionizing Radiation Signs

- Caution Radiation Area. The RSO shall ensure that each radiation area has conspicuous signs posted with the radiation caution colors (black, magenta, or purple on a yellow background) and symbol (3-bladed fan) with the words: **CAUTION RADIATION AREA** where radiation exists at such levels that a major portion of the body could receive a dose more than 5 mrem per hour, or in any 5 consecutive days a dose more than 100 mrem.

FIGURE 2.05-1: Radiation Symbol



- Caution High Radiation Area. The RSO shall post conspicuous signs with the radiation caution colors and symbol with the words: **CAUTION HIGH RADIATION AREA**, where airborne radiation exists at such levels that a major portion of the body could receive a dose more than 100 mrem per hour.
- Caution Airborne Radioactivity Area. The RSO shall post conspicuous signs with the radiation caution colors and symbol with the words: **CAUTION AIRBORNE RADIOACTIVITY AREA**, for any room, enclosure, or operating area in which airborne radioactive materials, composed wholly or partly of radioactive material, exist in concentrations in excess of the amounts specified in column 1 of Table 1 of appendix B to 10 CFR part 20. The RSO shall also post conspicuous signs in any room, enclosure, or operating area in which airborne radioactive materials exist in concentrations which, averaged over the number of hours in any week during which individuals are in the area, exceed 25 percent of the amounts specified in column 1 of Table 1 of appendix B to 10 CFR part 20.
- Additional Radioactive Signage Requirements. The RSO shall post conspicuous signs with the radiation caution colors and symbol with the words: **CAUTION RADIOACTIVE MATERIALS** where airborne radioactive material is used or stored and which contains

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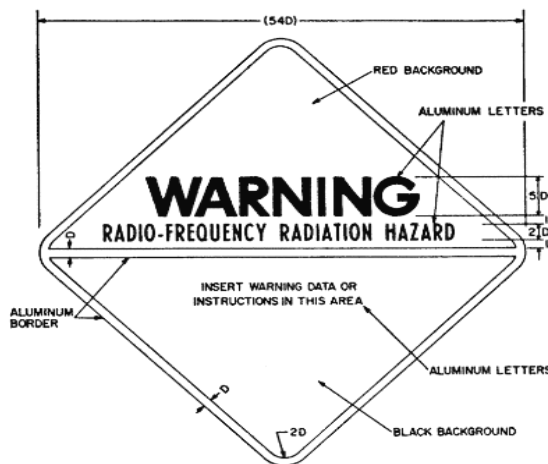
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any radioactive material (other than natural uranium or thorium) in any amount exceeding 10 times the quantity of such material specified in 10 CFR 20, appendix C, Quantities of Licensed Material Requiring Labeling, (1971 version). For natural uranium or thorium, this sign is required when the amount present exceeds 100 times the quantity of such material specified in 10 CFR 20 (as referenced in 29 CFR 1910.1096(e)(5)(ii)).

- Nonionizing Radiation Microwave. The RSO shall ensure that each nonionizing radiation area has conspicuous signs posted. The warning symbol for radio frequency radiation hazards shall consist of a red isosceles triangle above an inverted black isosceles triangle, separated and outlined by an aluminum color border. The words **WARNING—RADIO-FREQUENCY RADIATION HAZARD** shall appear in the upper triangle.

FIGURE 2.05-2: Radio Frequency Radiation Hazard Symbol



- Nonionizing Radiation Telecommunications. The RSO shall ensure that accessible areas associated with microwave communication systems where the electromagnetic radiation level exceeds the radiation protection guide given in §1910.97 are posted as described in that section. The warning symbol for telecommunications radio frequency radiation hazard shall consist of a red isosceles triangle above an inverted black isosceles triangle, separated and outlined by an aluminum color border. The words **WARNING—RADIO-FREQUENCY RADIATION HAZARD** shall appear in the upper triangle. The lower half of the warning symbol shall include the following: “Radiation in this area may exceed hazard limitations and special precautions are required. Obtain specific instruction before entering.”

### e. Ionizing Warning Signal

The RSO should ensure the design of radiation-producing equipment or devices has an audible alarm, in locations employees are present, that is at least 75 decibels to warn that a radiation hazard exists indicating immediate and complete evacuation is essential. The signal shall be



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unique to other alarms at the facility and initiated without requiring employee activation. The RSO shall coordinate periodic alarm tests, checks, and inspections to guard against malfunctions of the system.

## f. Notification of Incidents

The RSO shall immediately notify the NRC operations center by phone for reportable incidents and local management (e.g., lost or stolen devices/equipment, damaged devices/equipment that cannot be brought back into the shielding, personal dosimetry results exceeding allowable dose limits) with licensed devices/equipment that meet the radiation doses in 10 CFR 20.2202, Notification of Incidents.

## ▲ RSHS Appendix A: Definitions

RSHS Appendix A ([Definitions](#)) is available to print at:  
<https://www.usbr.gov/safety/rshs/index.html>.

## ▲ RSHS Appendix B: Additional References and Citations

RSHS Appendix B ([Additional References and Citations](#)) is available to print at:  
<https://www.usbr.gov/safety/rshs/index.html>.