

# **U.S. Department of Energy Orders Self-Study Program**



## **10 CFR 835**

OCCUPATIONAL RADIATION PROTECTION

**NATIONAL NUCLEAR SECURITY ADMINISTRATION  
LEARNING AND CAREER DEVELOPMENT DEPARTMENT**

Change No: 1 10 CFR 835 Level: Familiar Date:11/1/08
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**10 CFR 835  
OCCUPATIONAL RADIATION PROTECTION  
FAMILIAR LEVEL**

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**OBJECTIVES**

Given the familiar level of this module and the resources, you will be able to perform the following:

1. State the scope of 10 CFR 835.
2. Define the following terms.
  - annual limit on intake
  - bioassay
  - contamination area
  - derived air concentration
  - high contamination area
  - radiation weighting factor
3. State the requirements of the general rule.
4. State the radiation protection program requirements.
5. State the requirements of the internal audit.
6. Describe the conditions that must be met before a radiological worker is authorized to receive planned special exposure.
7. State what the estimation of internal dose shall be based on for all conditions.
8. Describe the conditions under which personnel dosimetry shall be provided to monitor exposures to external radiation for the following groups:
  - radiological workers
  - declared pregnant workers
  - minors and members of the general public

Change No: 1 10 CFR 835 Level: Familiar Date:11/1/08
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9. State the conditions under which internal dose evaluation programs shall be performed for the following groups:
  - radiological workers
  - declared pregnant workers
  - minors and members of the general public
10. State the entry control program requirements to enter the following areas.
  - radiological area
  - high radiation area
  - very high radiation area
11. State the requirements of the individual monitoring records.
12. State the objectives to be used in designing new, or modifying old, facilities with regard to ALARA.
13. State what the facility design features and administrative control procedures must provide during routine operations.
14. Discuss the requirements and the guidelines for control of emergency exposure situations.

<b>Note: If you think that you can complete the practice at the end of this level without working through the instructional material and/or examples, complete the practice now. The course manager will check your work. You will need to complete the practice at this level successfully before taking the criterion test.</b>
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**RESOURCES**

10 CFR 835, Occupational Radiation Protection, January 1, 2008.

Change No: 1 10 CFR 835 Level: Familiar Date:11/1/08
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## INTRODUCTION

The familiar level of this module is designed to provide the basic information to meet the requirements that are related to 10 CFR 835, “Occupational Radiation Protection,” in the following DOE Functional Area Qualification Standards:

- DOE-STD-1177-2004, Emergency Management
- DOE-STD-1151-2002, Facility Representative
- DOE-STD-1146-2007, General Technical Base
- DOE-STD-1138-2007, Industrial Hygiene
- DOE-STD-1183-2007, Nuclear Safety Specialist
- DOE-STD-1174-2003, Radiation Protection
- DOE-STD-1175-2006, Senior Technical Safety Manager
- DOE-STD-1178-2004, Technical Program Manager
- DOE-STD-1155-2002, Transportation and Traffic Management

Completion of this module also meets certain requirements associated with the DOE Facility Representative Program and the DOE Intern Program. The information contained in this module addresses specific requirements and as such does not include the entire text of the source document. Before continuing, you should obtain a copy of the regulation. Copies of the regulation are available at <http://www.gpoaccess.gov/cfr/index.html> or through the course manager.

## SUBPART A—GENERAL PROVISIONS

### SECTION 835.1, SCOPE

General. The rules in this part establish radiation protection standards, limits, and program requirements for protecting individuals from ionizing radiation resulting from the conduct of DOE activities.

Exclusion. Except as provided in paragraph (c) of this section, the requirements in this part do not apply to:

- Activities that are regulated through a license by the Nuclear Regulatory Commission (NRC) or a state under an agreement with the NRC, including activities certified by the NRC under section 1701 of the Atomic Energy Act;
- Activities conducted under the authority of the Deputy Administrator for Naval Reactors, as described in Pub. L. 98-525 and 106-65;

Change No: 1 10 CFR 835 Level: Familiar Date:11/1/08
---

- Activities conducted under the Nuclear Explosives and Weapons Surety Program relating to the prevention of accidental or unauthorized nuclear detonations;
- DOE activities conducted outside the United States on territory under the jurisdiction of a foreign government to the extent governed by occupational radiation protection requirements agreed to between the United States and the cognizant government;
- Background radiation, radiation doses received as a patient for the purposes of medical diagnosis or therapy, or radiation doses received from participation as a subject in medical research programs; or
- Radioactive material on or within material, equipment, and real property which is approved for release when the radiological conditions of the material, equipment, and real property have been documented to comply with the criteria for release set forth in a DOE authorized limit which has been approved by a Secretarial Officer in consultation with the Chief Health, Safety and Security Officer.
- Radioactive material transportation not performed by DOE or a DOE contractor.

Occupational doses received as a result of excluded activities and radioactive material transportation listed in paragraphs (b)(1) through (b)(4) and (b)(7) of this section, shall be included to the extent practicable when determining compliance with the occupational dose limits at Sec. Sec. 835.202 and 835.207, and with the limits for the embryo/fetus at Sec. 835.206. Occupational doses resulting from authorized emergency exposures and planned special exposures shall not be considered when determining compliance with the dose limits at Sec. Sec. 835.202 and 835.207.

The requirements in subparts F and G of 10 CFR 835 do not apply to radioactive material transportation by DOE or a DOE contractor conducted:

- Under the continuous observation and control of an individual who is knowledgeable of and implements required exposure control measures, or
- In accordance with Department of Transportation regulations or DOE orders that govern such movements.

## SECTION 835.2, DEFINITIONS

10 CFR 835 contains several definitions. Some of those definitions that are included in functional area qualification standards are repeated here for your convenience.

### *Annual Limit on Intake (ALI)*

The derived limit for the amount of radioactive material taken into the body of an adult worker

Change No: 1 10 CFR 835 Level: Familiar Date: 11/1/08
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by inhalation or ingestion in a year.

*Bioassay*

The determination of kinds, quantities, or concentrations, and, in some cases, locations of radioactive material in the human body, whether by direct measurement or by analysis, and evaluation of radioactive materials excreted or removed from the human body.

*Contamination Area*

Any area where contamination levels are greater than the values specified in appendix D of this regulation, but less than or equal to 100 times those levels.

*Derived Air Concentration (DAC)*

(DAC) means, for the radionuclides listed in appendix A of this part, the airborne concentration that equals the ALI divided by the volume of air breathed by an average worker for a working year of 2000 hours (assuming a breathing volume of 2400 m<sup>3</sup>).

*High Contamination Area*

Any area where contamination levels are greater than 100 times the values specified in appendix D of this regulation.

*Radiation Weighting Factor*

Radiation weighting factor means the modifying factor used to calculate the equivalent dose from the average tissue or organ absorbed dose; the absorbed dose (expressed in rad or gray) is multiplied by the appropriate radiation weighting factor.

<b>Note: You do not have to do example 1 on the following page, but it is a good time to check your skill or knowledge of the information covered. You may do example 1 or go to the next section.</b>
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Change No: 1 10 CFR 835 Level: Familiar Date:11/1/08
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**EXAMPLE 1**

Using the familiar level of this module and the resources, complete the following exercises.

1. State the scope of 10 CFR 835.

2. Define the following terms  
Annual Limit on Intake

Bioassay

High Contamination Area

Change No: 1  
10 CFR 835  
Level: Familiar  
Date:11/1/08

## Radiation Weighting Factor

**Note: When you have finished, compare your answers to those contained in the example 1 self-check. When you are satisfied with your answers, go to the next section.**



### EXAMPLE 1 SELF-CHECK

1. State the scope of 10 CFR 835.

To establish radiation protection standards, limits, and program requirements for protecting individuals from ionizing radiation resulting from the conduct of DOE activities.

2. Define the following terms

#### Annual Limit on Intake (ALI)

The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year.

#### Bioassay

The determination of kinds, quantities, or concentrations, and, in some cases, locations of radioactive material in the human body, whether by direct measurement or by analysis, and evaluation of radioactive materials excreted or removed from the human body.

#### High Contamination Area

Any area where contamination levels are greater than 100 times the values specified in appendix D of this regulation.

#### Radiation Weighting Factor (wR)

Radiation weighting factor means the modifying factor used to calculate the equivalent dose from the average tissue or organ absorbed dose; the absorbed dose (expressed in rad or gray) is multiplied by the appropriate radiation weighting factor.

Change No: 1 10 CFR 835 Level: Familiar Date:11/1/08
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## **SUBPART A—GENERAL PROVISIONS**

### **SECTION 835.3, GENERAL RULE**

#### *General Rule*

No person shall take or cause to be taken any action inconsistent with the requirements of this regulation or any program, plan, schedule, or other process established by this regulation.

With respect to a particular DOE activity, contractor management shall be responsible for compliance with the requirements of this regulation.

Where there is no contractor for a DOE activity, DOE shall ensure implementation of and compliance with the requirements of this regulation.

Nothing in this regulation shall be construed as limiting actions that may be necessary to protect health and safety.

## **SUBPART B—MANAGEMENT AND ADMINISTRATIVE REQUIREMENTS**

### **SECTION 835.101, RADIATION PROTECTION PROGRAMS**

#### *Radiation Protection Programs (RPP)*

The following are requirements related to RPPs.

- The DOE may direct or make modifications to a RPP.
- The content of each RPP shall be commensurate with the nature of the activities performed and shall include formal plans and measures for applying the ALARA process to occupational exposure.
- The RPP shall specify the existing and/or anticipated operational tasks that are intended to be within the scope of the RPP. Except for changes that do not decrease the effectiveness of the RPP, any task outside the scope of a RPP shall not be initiated until an update of the RPP is approved by DOE.
- The content of the RPP shall address each requirement in this regulation.
- The RPP shall include plans, schedules, and other measures for achieving compliance with regulations of this part. Compliance with the amendments to this part published on June 8, 2007 shall be achieved no later than July 9, 2010.

Change No: 1 10 CFR 835 Level: Familiar Date: 11/1/08
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- An update of the RPP shall be submitted to DOE:
  - Whenever a change or an addition to the RPP is made;
  - Prior to the initiation of a task not within the scope of the RPP; or
  - Within 180 days of the effective date of any modifications to this part.
- Changes, additions, or updates to the RPP may become effective without prior Department approval only if the changes do not decrease the effectiveness of the RPP and the RPP, as changed, continues to meet the requirements of this part. Proposed changes that decrease the effectiveness of the RPP shall not be implemented without submittal to and approval by the Department.
- An initial RPP or an update shall be considered approved 180 days after its submission unless rejected by DOE at an earlier date.

#### SECTION 835.102, INTERNAL AUDITS

Internal audits of the radiation protection program, including examination of program content and implementation, shall be conducted through a process that ensures that all functional elements are reviewed no less frequently than every 36 months.

#### SUBPART C—STANDARDS FOR INTERNAL AND EXTERNAL EXPOSURE

#### SECTION 835.202, OCCUPATIONAL DOSE LIMITS FOR GENERAL EMPLOYEES

##### *Occupational Dose Limits for General Employees*

Except for planned special exposures conducted consistent with Sec. 835.204 and emergency exposures authorized according to Sec. 835.1302, the occupational dose received by general employees shall be controlled such that the following limits are not exceeded in a year:

- A total effective dose of 5 rems (0.05 Sv);
- The sum of the equivalent dose to the whole body for external exposures and the committed equivalent dose to any organ or tissue other than the skin or the lens of the eye of 50 rems (0.5 Sv);
- An equivalent dose to the lens of the eye of 15 rems (0.15 Sv); and
- The sum of the equivalent dose to the skin or to any extremity for external exposures and the committed equivalent dose to the skin or to any extremity of 50 rems (0.5 Sv).

All occupational doses received during the current year, except doses resulting from planned special exposures conducted in compliance with Sec. 835.204 and emergency exposures

Change No: 1 10 CFR 835 Level: Familiar Date:11/1/08
---

authorized in accordance with Sec. 835.1302, shall be included when demonstrating compliance with Sec. 835.202(a) and 835.207.

Doses from background, therapeutic and diagnostic medical radiation, and participation as a subject in medical research programs shall not be included in dose records or in the assessment of compliance with the occupational dose limits.

#### SECTION 835.203, COMBINING INTERNAL AND EXTERNAL EQUIVALENT DOSES

The total effective dose during a year shall be determined by summing the effective dose from external exposures and the committed effective dose from intakes during the year.

Determinations of the effective dose shall be made using the radiation and tissue weighting factor values provided in Sec. 835.2.

#### SECTION 835.204, PLANNED SPECIAL EXPOSURES

A planned special exposure may be authorized for a radiological worker to receive doses in addition to and accounted for separately from the doses received under the limits specified in Sec. 835.202(a), provided that each of the following conditions is satisfied:

- The planned special exposure is considered only in an exceptional situation when alternatives that might prevent a radiological worker from exceeding the limits in Sec. 835.202(a) are unavailable or impractical;
- The contractor management specifically requests the planned special exposure, in writing; and
- Joint written approval is received from the appropriate DOE Headquarters program office and the Secretarial Officer responsible for environment, safety and health matters.

Prior to requesting an individual to participate in an authorized planned special exposure, the individual's dose from all previous planned special exposures and all doses in excess of the occupational dose limits shall be determined.

Change No: 1 10 CFR 835 Level: Familiar Date:11/1/08
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An individual shall not receive a planned special exposure that, in addition to the doses determined in Sec. 835.204(b), would result in a dose exceeding the following:

- In a year, the numerical values of the dose limits established at Sec. 835.202(a); and
- Over the individual's lifetime, five times the numerical values of the dose limits established at Sec. 835.202(a).

Prior to a planned special exposure, written consent shall be obtained from each individual involved. Each such written consent shall include:

- The purpose of the planned operations and procedures to be used;
- The estimated doses and associated potential risks and specific radiological conditions and other hazards which might be involved in performing the task; and
- Instructions on the measures to be taken to keep the dose ALARA considering other risks that may be present.

Records of the conduct of a planned special exposure shall be maintained and a written report submitted within 30 days after the planned special exposure to the approving organizations identified in Sec. 835.204(a)(3).

The dose from planned special exposures is not to be considered in controlling future occupational dose of the individual under Sec. 835.202(a), but is to be included in records and reports required under this part.

#### SECTION 835.209, CONCENTRATIONS OF RADIOACTIVE MATERIAL IN AIR

The derived air concentration (DAC) values given in appendices A and C of this regulation shall be used to control occupational exposures to airborne radioactive material.

With regard to inhalation exposures and external exposures from airborne radionuclides, compliance with this regulation shall be demonstrated through conformity with the requirements for RPPs and the occupational exposure limits for general employees.

Change No: 1 10 CFR 835 Level: Familiar Date:11/1/08
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The estimation of internal dose shall be based on bioassay data rather than air concentration values unless bioassay data are:

- unavailable,
- inadequate, or
- internal dose estimates based on representative air concentration values are demonstrated to be as or more accurate.

## **SUBPART E—MONITORING OF INDIVIDUALS AND AREAS**

### **SECTION 835.401, GENERAL REQUIREMENTS**

Monitoring of individuals and areas shall be performed to:

- Demonstrate compliance with the regulations in this part;
- Document radiological conditions;
- Detect changes in radiological conditions;
- Detect the gradual buildup of radioactive material;
- Verify the effectiveness of engineered and administrative controls in containing radioactive material and reducing radiation exposure; and
- Identify and control potential sources of individual exposure to radiation and/or radioactive material.

Instruments and equipment used for monitoring shall be:

- Periodically maintained and calibrated on an established frequency;
- Appropriate for the type(s), levels, and energies of the radiation(s) encountered;
- Appropriate for existing environmental conditions; and
- Routinely tested for operability.

### **SECTION 835.402, INDIVIDUAL MONITORING**

For the purpose of monitoring individual exposures to external radiation, personnel dosimeters shall be provided to and used by:

- Radiological workers who, under typical conditions, are likely to receive one or more of the following:
  - An effective dose of 0.1 rem (0.001 Sv) or more in a year;
  - An equivalent dose to the skin or to any extremity of 5 rems (0.05 Sv) or more in a year;
  - An equivalent dose to the lens of the eye of 1.5 rems (0.015 Sv) or more in a year;

Change No: 1 10 CFR 835 Level: Familiar Date:11/1/08
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- Declared pregnant workers who are likely to receive from external sources an equivalent dose to the embryo/fetus in excess of 10 percent of the applicable limit at Sec. 835.206(a);
- Occupationally exposed minors likely to receive a dose in excess of 50 percent of the applicable limits at Sec. 835.207 in a year from external sources;
- Members of the public entering a controlled area likely to receive a dose in excess of 50 percent of the limit at Sec. 835.208 in a year from external sources; and
- Individuals entering a high or very high radiation area.

External dose monitoring programs implemented to demonstrate compliance with Sec. 835.402(a) shall be adequate to demonstrate compliance with the dose limits established in subpart C of this part and shall be:

- Accredited, or excepted from accreditation, in accordance with the DOE Laboratory Accreditation Program for Personnel Dosimetry; or
- Determined by the Secretarial Officer responsible for environment, safety and health matters to have performance substantially equivalent to that of programs accredited under the DOE Laboratory Accreditation Program for Personnel Dosimetry.

For the purpose of monitoring individual exposures to internal radiation, internal dosimetry programs, including routine bioassay programs shall be conducted for:

- Radiological workers who, under typical conditions, are likely to receive a committed effective dose of 0.1 rem (0.001 Sv) or more from all occupational radionuclide intakes in a year;
- Declared pregnant workers likely to receive an intake or intakes resulting in an equivalent dose to the embryo/fetus in excess of 10 percent of the limit stated at Sec. 835.206(a);
- Occupationally exposed minors who are likely to receive a dose in excess of 50 percent of the applicable limit stated at Sec. 835.207 from all radionuclide intakes in a year; or
- Members of the public entering a controlled area likely to receive a dose in excess of 50 percent of the limit stated at Sec. 835.208 from all radionuclide intakes in a year.

Change No: 1 10 CFR 835 Level: Familiar Date:11/1/08
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Internal dose monitoring programs implemented to demonstrate compliance with Sec. 835.402(c) shall be adequate to demonstrate compliance with the dose limits established in subpart C of this part and shall be:

- Accredited, or excepted from accreditation, in accordance with the DOE Laboratory Accreditation Program for Radiobioassay; or,
- Determined by the Secretarial Officer responsible for environment, safety, and health matters to have performance substantially equivalent to that of programs accredited under the DOE Laboratory Accreditation Program for Radiobioassay.

#### SECTION 835.403, AIR MONITORING

Monitoring of airborne radioactivity shall be performed:

- Where an individual is likely to receive an exposure of 40 or more DAC-hours in a year; or
- As necessary to characterize the airborne radioactivity hazard where respiratory protective devices for protection against airborne radionuclides have been prescribed.

Real-time air monitoring shall be performed as necessary to detect and provide warning of airborne radioactivity concentrations that warrant immediate action to terminate inhalation of airborne radioactive material.

#### **SUBPART F—ENTRY CONTROL PROGRAM**

##### SECTION 835.501, RADIOLOGICAL AREAS

Personnel entry control shall be maintained for each radiological area.

The degree of control shall be commensurate with existing and potential radiological hazards within the area.

One or more of the following methods shall be used to ensure control:

- Signs and barricades;
- Control devices on entrances;
- Conspicuous visual and/or audible alarms;
- Locked entrance ways; or
- Administrative controls.

Written authorizations shall be required to control entry into and perform work within



Change No: 1 10 CFR 835 Level: Familiar Date: 11/1/08
--

radiological areas. These authorizations shall specify radiation protection measures commensurate with the existing and potential hazards.

No control(s) shall be installed at any radiological area exit that would prevent rapid evacuation of personnel under emergency conditions.

#### SECTION 835.502, HIGH AND VERY HIGH RADIATION AREAS

The following measures shall be implemented for each entry into a high radiation area:

- The area shall be monitored as necessary during access to determine the exposure rates to which the individuals are exposed; and
- Each individual shall be monitored by a supplemental dosimetry device or other means capable of providing an immediate estimate of the individual's integrated equivalent dose to the whole body during the entry.

Physical controls. One or more of the following features shall be used for each entrance or access point to a high radiation area where radiation levels exist such that an individual could exceed an equivalent dose to the whole body of 1 rem (0.01 sievert) in any one hour at 30 centimeters from the source or from any surface that the radiation penetrates:

- A control device that prevents entry to the area when high radiation levels exist or upon entry causes the radiation level to be reduced below that level defining a high radiation area;
- A device that functions automatically to prevent use or operation of the radiation source or field while individuals are in the area;
- A control device that energizes a conspicuous visible or audible alarm signal so that the individual entering the high radiation area and the supervisor of the activity are made aware of the entry;
- Entryways that are locked. During periods when access to the area is required, positive control over each entry is maintained;
- Continuous direct or electronic surveillance that is capable of preventing unauthorized entry;
- A control device that will automatically generate audible and visual alarm signals to alert personnel in the area before use or operation of the radiation source and in sufficient time to permit evacuation of the area or activation of a secondary control device that will prevent use or operation of the source.

Very high radiation areas. In addition to the above requirements, additional measures shall be

Change No: 1 10 CFR 835 Level: Familiar Date: 11/1/08
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implemented to ensure individuals are not able to gain unauthorized or inadvertent access to very high radiation areas.

No control(s) shall be established in a high or very high radiation area that would prevent rapid evacuation of personnel.

## **SUBPART G—POSTING AND LABELING**

### **SECTION 835.601, GENERAL REQUIREMENTS**

Except as otherwise provided in this subpart, postings and labels required by this subpart shall include the standard radiation warning trefoil in black or magenta imposed upon a yellow background.

Signs required by this subpart shall be clearly and conspicuously posted and may include radiological protection instructions.

The posting and labeling requirements in this subpart may be modified to reflect the special considerations of DOE activities conducted at private residences or businesses. Such modifications shall provide the same level of protection to individuals as the existing provisions in this subpart.

### **SECTION 835.602, CONTROLLED AREAS**

Each access point to a controlled area shall be posted whenever radiological areas or radioactive material areas exist in the area. Individuals who enter only controlled areas without entering radiological areas or radioactive material areas are not expected to receive a total effective dose of more than 0.1 rem (0.001 sievert) in a year.

Signs used for this purpose may be selected by the contractor to avoid conflict with local security requirements.

### **SECTION 835.603, RADIOLOGICAL AREAS AND RADIOACTIVE MATERIAL AREAS**

Each access point to radiological areas and radioactive material areas shall be posted with conspicuous signs bearing the following wording.

Change No: 1 10 CFR 835 Level: Familiar Date:11/1/08
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- Radiation area. The words “Caution, Radiation Area” shall be posted at each radiation area.
- High radiation area. The words “Caution, High Radiation Area” or “Danger, High Radiation Area” shall be posted at each high radiation area.
- Very high radiation area. The words “Grave Danger, Very High Radiation Area” shall be posted at each very high radiation area.
- Airborne radioactivity area. The words “Caution, Airborne Radioactivity Area” or “Danger, Airborne Radioactivity Area” shall be posted at each airborne radioactivity area.
- Contamination area. The words “Caution, Contamination Area” shall be posted at each contamination area.
- High contamination area. The words “Caution, High Contamination Area” or “Danger, High Contamination Area” shall be posted at each high contamination area.
- Radioactive material area. The words “Caution, Radioactive Material(s)” shall be posted at each radioactive material area.

## **SUBPART H—RECORDS**

### **SECTION 835.701, GENERAL PROVISIONS**

Records shall be maintained to document compliance with this part and with radiation protection programs required by Sec. 835.101.

Unless otherwise specified in this subpart, records shall be retained until final disposition is authorized by DOE.

### **SECTION 835.702, INDIVIDUAL MONITORING RECORDS**

Except as authorized by Sec. 835.702(b), records shall be maintained to document doses received by all individuals for whom monitoring was conducted and to document doses received during planned special exposures, unplanned doses exceeding the monitoring thresholds of Sec. 835.402, and authorized emergency exposures.

Recording of the non-uniform equivalent dose to the skin is not required if the dose is less than 2 percent of the limit specified for the skin at Sec. 835.202(a)(4). Recording of internal dose (committed effective dose or committed equivalent dose) is not required for any monitoring result estimated to correspond to an individual receiving less than 0.01 rem (0.1 mSv) committed

Change No: 1 10 CFR 835 Level: Familiar Date:11/1/08
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effective dose. The bioassay or air monitoring result used to make the estimate shall be maintained in accordance with Sec. 835.703(b) and the unrecorded internal dose estimated for any individual in a year shall not exceed the applicable monitoring threshold at Sec. 835.402(c).

The records required by this section shall:

- Be sufficient to evaluate compliance with subpart C of this part;
- Be sufficient to provide dose information necessary to complete reports required by subpart I of this part;
- Include the results of monitoring used to assess the following quantities for external dose received during the year:
  - The effective dose from external sources of radiation;
  - The equivalent dose to the lens of the eye;
  - The equivalent dose to the skin; and
  - The equivalent dose to the extremities.
- Include the following information for internal dose resulting from intakes received during the year:
  - Committed effective dose;
  - Committed equivalent dose to any organ or tissue of concern; and
  - Identity of radionuclides.
- Include the following quantities for the summation of the external and internal dose:
  - Total effective dose in a year;
  - For any organ or tissue assigned an internal dose during the year, the sum of the equivalent dose to the whole body from external exposures and the committed equivalent dose to that organ or tissue; and
  - Cumulative total effective dose.
- Include the equivalent dose to the embryo/fetus of a declared pregnant worker.

Documentation of all occupational doses received during the current year, except for doses resulting from planned special exposures conducted in compliance with Sec. 835.204 and emergency exposures authorized in accordance with Sec. 835.1302(d), shall be obtained to demonstrate compliance with Sec. 835.202(a). If complete records documenting previous occupational dose during the year cannot be obtained, a written estimate signed by the individual may be accepted to demonstrate compliance.

Change No: 1  
10 CFR 835  
Level: Familiar  
Date:11/1/08

For radiological workers whose occupational dose is monitored in accordance with Sec. 835.402, reasonable efforts shall be made to obtain complete records of prior years occupational internal and external doses.

The records specified in this section that are identified with a specific individual shall be readily available to that individual.

Data necessary to allow future verification or reassessment of the recorded doses shall be recorded.

All records required by this section shall be transferred to the DOE upon cessation of activities at the site that could cause exposure to individuals.

#### SECTION 835.704, ADMINISTRATIVE RECORDS

Training records shall be maintained, as necessary, to demonstrate compliance with Sec. 835.901.

Actions taken to maintain occupational exposures ALARA, including the actions required for this purpose by Sec. 835.101, as well as facility design and control actions required by Sec. Sec. 835.1001, 835.1002, and 835.1003, shall be documented.

Records shall be maintained to document the results of internal audits and other reviews of program content and implementation.

Written declarations of pregnancy, including the estimated date of conception, and revocations of declarations of pregnancy shall be maintained.

Changes in equipment, techniques, and procedures used for monitoring shall be documented.

Records shall be maintained as necessary to demonstrate compliance with the requirements of Sec. 835.1201 and 835.1202 for sealed radioactive source control, inventory, and source leak tests.

**Note: You do not have to do example 2 on the following page, but it is a good time to check your skill or knowledge of the information covered. You may do example 2 or go to the next section.**

Change No: 1  
10 CFR 835  
Level: Familiar  
Date:11/1/08

**EXAMPLE 2**

1. List the elements that should be included in a radiation protection program.
2. List the three occupational dose limits for general employees.
3. Describe the calculation that is used to determine total effective dose for a year.

**Note: When you are finished, compare your answers to those contained in the example 2 self-check. When you are satisfied with your answers, go on to the next section.**

Change No: 1 10 CFR 835 Level: Familiar Date:11/1/08
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**EXAMPLE 2 SELF-CHECK**

1. List the elements that should be included in a radiation protection program.

The RPP shall include plans, schedules, and other measures for achieving compliance with 10 CFR 835.

2. List the three occupational dose limits for general employees

The three dose limits for employees are

- A total effective dose of 5 rems (0.05 Sv);
- The sum of the equivalent dose to the whole body for external exposures and the committed equivalent dose to any organ or tissue other than the skin or the lens of the eye of 50 rems (0.5 Sv);
- An equivalent dose to the lens of the eye of 15 rems (0.15 Sv); and
- The sum of the equivalent dose to the skin or to any extremity for external exposures and the committed equivalent dose to the skin or to any extremity of 50 rems (0.5 Sv).

3. Describe the calculation that is used to determine the total effective dose for a year.

The total effective dose during a year shall be determined by summing the effective dose from external exposures and the committed effective dose from intakes during the year.

Change No: 1 10 CFR 835 Level: Familiar Date: 11/1/08
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## **SUBPART K—DESIGN AND CONTROL**

### **SECTION 835.1001, DESIGN AND CONTROL**

Measures shall be taken to maintain radiation exposure in controlled areas ALARA through engineered and administrative controls.

The primary methods used shall be physical design features (e.g., confinement, ventilation, remote handling, and shielding). Administrative controls shall be employed only as supplemental methods to control radiation exposure.

For specific activities where use of engineered controls is demonstrated to be impractical, administrative controls shall be used to maintain radiation exposures ALARA.

### **SECTION 835.1002, FACILITY DESIGN AND MODIFICATIONS**

During the design of new facilities or modification of existing facilities, the following objectives shall be adopted:

- Optimization methods shall be used to assure that occupational exposure is maintained ALARA in developing and justifying facility design and physical controls.
- The design objective for controlling personnel exposure from external sources of radiation in areas of continuous occupational occupancy (2000 hours per year) shall be to maintain exposure levels below an average of 0.5 millirem (5 [micro]Sv) per hour and as far below this average as is reasonably achievable. The design objectives for exposure rates for potential exposure to a radiological worker where occupancy differs from the above shall be ALARA and shall not exceed 20 percent of the applicable standards in Sec. 835.202.
- Regarding the control of airborne radioactive material, the design objective shall be, under normal conditions, to avoid releases to the workplace atmosphere and in any situation, to control the inhalation of such material by workers to levels that are ALARA; confinement and ventilation shall normally be used.
- The design or modification of a facility and the selection of materials shall include features that facilitate operations, maintenance, decontamination, and decommissioning.



Change No: 1 10 CFR 835 Level: Familiar Date:11/1/08
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## SECTION 835.1003, WORKPLACE CONTROLS

During routine operations, the combination of engineered and administrative controls shall provide that:

- The anticipated occupational dose to general employees shall not exceed the limits established at Sec. 835.202; and
- The ALARA process is used for personnel exposures to ionizing radiation.

## SUBPART L—RADIOACTIVE CONTAMINATION CONTROL

### SECTION 835.1101, CONTROL OF MATERIAL AND EQUIPMENT

Material and equipment in contamination areas, high contamination areas, and airborne radioactivity areas shall not be released to a controlled area if:

- Removable surface contamination levels on accessible surfaces exceed the removable surface contamination values specified in appendix D of this part; or
- Prior use suggests that the removable surface contamination levels on inaccessible surfaces are likely to exceed the removable surface contamination values specified in appendix D of this part.

Material and equipment exceeding the removable surface contamination values specified in appendix D of this part may be conditionally released for movement on-site from one radiological area for immediate placement in another radiological area only if appropriate monitoring is performed and appropriate controls for the movement are established and exercised.

Material and equipment with fixed contamination levels that exceed the total contamination values specified in appendix D of this part may be released for use in controlled areas outside of radiological areas only under the following conditions:

- Removable surface contamination levels are below the removable surface contamination values specified in appendix D of this part; and
- The material or equipment is routinely monitored and clearly marked or labeled to alert personnel of the contaminated status.

Change No: 1 10 CFR 835 Level: Familiar Date:11/1/08
---

## SECTION 835.1102, CONTROL OF AREAS

Appropriate controls shall be maintained and verified that prevent the inadvertent transfer of removable contamination to locations outside of radiological areas under normal operating conditions.

Any area in which contamination levels exceed the values specified in appendix D of this part shall be controlled in a manner commensurate with the physical and chemical characteristics of the contaminant, the radionuclides present, and the fixed and removable surface contamination levels.

Areas accessible to individuals where the measured total surface contamination levels exceed, but the removable surface contamination levels are less than, corresponding surface contamination values specified in appendix D of this part, shall be controlled as follows when located outside of radiological areas:

- The area shall be routinely monitored to ensure the removable surface contamination level remains below the removable surface contamination values specified in appendix D of this part; and
- The area shall be conspicuously marked to warn individuals of the contaminated status.

Individuals exiting contamination, high contamination, or airborne radioactivity areas shall be monitored, as appropriate, for the presence of surface contamination.

Protective clothing shall be required for entry to areas in which removable contamination exists at levels exceeding the removable surface contamination values specified in appendix D of this part.

## **SUBPART M—SEALED RADIOACTIVE SOURCE CONTROL**

### SECTION 835.1201, SEALED RADIOACTIVE SOURCE CONTROL

Sealed radioactive sources shall be used, handled, and stored in a manner commensurate with the hazards associated with operations involving the sources.

Change No: 1 10 CFR 835 Level: Familiar Date:11/1/08
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## SECTION 835.1202, ACCOUNTABLE SEALED RADIOACTIVE SOURCES

Each accountable sealed radioactive source shall be inventoried at intervals not to exceed six months. This inventory shall:

- Establish the physical location of each accountable sealed radioactive source;
- Verify the presence and adequacy of associated postings and labels; and
- Establish the adequacy of storage locations, containers, and devices.

Except for sealed radioactive sources consisting solely of gaseous radioactive material or tritium, each accountable sealed radioactive source shall be subject to a source leak test upon receipt, when damage is suspected, and at intervals not to exceed six months. Source leak tests shall be capable of detecting radioactive material leakage equal to or exceeding 0.005 [micro]Ci.

An accountable sealed radioactive source is not subject to periodic source leak testing if that source has been removed from service. Such sources shall be stored in a controlled location, subject to periodic inventory as required by paragraph (a) of this section, and subject to source leak testing prior to being returned to service.

An accountable sealed radioactive source is not subject to periodic inventory and source leak testing if that source is located in an area that is unsafe for human entry or otherwise inaccessible.

An accountable sealed radioactive source found to be leaking radioactive material shall be controlled in a manner that minimizes the spread of radioactive contamination.

## **SUBPART N—EMERGENCY EXPOSURE SITUATIONS**

### SECTION 835.1301, GENERAL PROVISIONS

A general employee whose occupational dose has exceeded the numerical value of any of the limits specified in Sec. 835.202 as a result of an authorized emergency exposure may be permitted to return to work in radiological areas during the current year providing that all of the following conditions are met:

- Approval is first obtained from the contractor management and the Head of the responsible DOE field organization;

Change No: 1 10 CFR 835 Level: Familiar Date:11/1/08
---

- The individual receives counseling from radiological protection and medical personnel regarding the consequences of receiving additional occupational exposure during the year; and
- The affected employee agrees to return to radiological work.

All doses exceeding the limits specified in Sec. 835.202 shall be recorded in the affected individual’s occupational dose record.

When the conditions under which a dose was received in excess of the limits specified in Sec. 835.202, except those received in accordance with Sec. 835.204, have been eliminated, operating management shall notify the Head of the responsible DOE field organization.

Operations which have been suspended as a result of a dose in excess of the limits specified in Sec. 835.202, except those received in accordance with Sec. 835.204, may be resumed only with the approval of DOE.

**ADDITIONAL INFORMATION**

The following information is provided to illustrate the difference between the dosimetric terms used in 1998 and those currently used in 10 CFR 835.

Differences in Radiological Terminology

1998 Dosimetric Terms	2007 Dosimetric Terms
Committed effective dose equivalent	Committed effective dose
Committed dose equivalent	Committed equivalent dose
Cumulative total effective dose equivalent	Cumulative total effective dose
Deep dose equivalent	Deep equivalent dose
Dose equivalent	Equivalent dose
Effective dose equivalent	Effective dose
Lens of the eye dose equivalent	Lens of the eye equivalent dose
Quality factor	Radiation weighting factor
Shallow dose equivalent	Shallow equivalent dose
Weighting factor	Tissue weighting factor
Total effective dose equivalent	Total effective dose

*Source:* Federal Register—10 CFR Parts 820 and 835, “Procedural Rules for DOE Nuclear Activities and Occupational Radiation Protection;” “Final Rule”

Change No: 1  
10 CFR 835  
Level: Familiar  
Date:11/1/08

**Note: You have finished the familiar level of this module. The practice follows.**



Change No: 1 10 CFR 835 Level: Familiar Date:11/1/08
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4. State the conditions under which internal dose evaluation programs shall be performed for the following groups:
  - radiological workers
  - declared pregnant workers
  - minors and members of the public
  
5. State the entry control program requirements for the following areas:
  - radiological area
  - high radiation area
  - very high radiation area
  
6. State the primary design method to maintain radiation exposure in controlled areas ALARA.





Change No: 1  
10 CFR 835  
Level: Familiar  
Date:11/1/08

10. List three methods used to control access to a radiological area.

**Note: The course manager will check your practice and verify your success at the familiar level. When you have successfully completed this practice, go to the general level if required.**

Change No: 1  
10 CFR 835  
Level: General  
Date: 11/1/08

**10 CFR 835  
OCCUPATIONAL RADIATION PROTECTION  
GENERAL LEVEL**

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**OBJECTIVES**

Given the familiar level of this module, and a scenario, you will be able to perform the following:

1. List the key elements you would look for in the contractor's action plan to correct the situation described in the scenario; and
2. State which requirements, sections, or elements of 10 CFR 835 apply to the situation described in the scenario.

**Note: If you think that you can complete the practice at the end of this level without working through the instructional material and/or the examples, complete the practice now. The course manager will check your work. You will need to complete the practice in this level successfully before taking the criterion test.**

**RESOURCES**

DOE Orders Self-Study Program, 10 CFR 835, Familiar Level, 10/1/08.  
10 CFR 835, Occupational Radiation Protection, 1/1/08.

Change No: 1  
10 CFR 835  
Level: General  
Date: 11/1/08

### **INTRODUCTION**

The familiar level of this module introduced the purpose and scope of 10 CFR 835. Several definitions and the requirements associated with the regulation were discussed. In the general level of this module, students are asked to apply the information contained in the familiar level and the regulation to a scenario related to the regulation. Please refer to the resources listed on the previous page to make your analysis and answer the questions. You are not required to complete the example. However, doing so will help prepare you for the practice and criterion test.

**Note: You do not have to do the example on the following page, but it is a good time to check your skill and knowledge of the information covered. You may do the example or go on to the practice.**

## EXAMPLE SCENARIO

Please review the following scenario, and then answer these questions.

1. Is the contractor's action plan correct? If not, state what should have been done.
2. Were the correct documents or requirements cited? If not, state the correct documents or requirements.

## SCENARIO

On June 17, 1996, a custodial cleaning crew entered and worked in a posted radioactive materials area without proper authorization. The crew cleaned and waxed the floor in a laboratory room. Part of the laboratory room was also posted as a radioactive materials management area and contained radioactive material in the form of metal tritides. When the room owner and a radiological control technician discovered that it had been entered and cleaned, they surveyed the room and two others cleaned afterward for tritium contamination. They found no contamination; however, the breakdown in access control could have resulted in personnel exposure to radiation and spread of contamination.

An investigation of the situation revealed the following:

- The laboratory room was posted with signs indicating "Controlled Area," "Radioactive Materials Area," "Rad Worker I Training Required," and "Tritium."
- Another sign on the door stated that the room was a security limited-access area and that all visitors to the room must be escorted by laboratory owners. The laboratory owner's name and phone numbers were posted on the door.
- The custodial crew posted a sign on the laboratory door on May 24 that scheduled the area for cleaning on May 28. However, the laboratory owner, who resides in another building, did not see the sign.
- Security entry to the laboratory was controlled by a cipher lock, but a security officer allowed the crew access without regard to the postings.
- The custodial crews work in the facility after normal working hours posting signs on doors for areas that are to be cleaned. If no one responds, they proceed with the cleaning.
- The crew supervisor, custodians, and security officer were all current on the general employee radiological training because they were classified as general employees. However, none had radiation worker I training.

Change No: 1 10 CFR 835 Level: General Date: 11/1/08
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- The custodians were considered visitors and required authorized escorts.
- Investigators believe the working environment at the laboratory was one in which posting requirements were not adequately implemented and enforced.

Actions taken by the contractor

- The custodial cleaning crew was directed: (1) not to enter areas or rooms that have radiation or other Environment, Safety, and Health hazard signs without meeting posted requirements, (2) to comply with all hazard signs when performing their duties, and (3) to consult with their supervisor before performing their duties when unsure of the status of areas.
- The custodial cleaning crew immediately received refresher general employee radiological training, which includes training on postings.
- A root-cause analysis will be conducted to identify further corrective actions.

Requirements applicable to this situation:

10 CFR 835, Section 835.501

Personnel entry control shall be maintained for each radiological area.

Take some time to review the example scenario and the contractor actions taken to correct the situation. Then decide if all the correct actions were considered and if the appropriate requirements (from those included in this module) were selected. Write your answer below, and then compare your answer to the one contained in the example self-check.

Change No: 1 10 CFR 835 Level: General Date: 11/1/08
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**EXAMPLE SELF-CHECK**

Your answer does not have to match the following exactly. You may have added more corrective actions or cited other requirements that apply. To be considered correct, your answer must include at least the following:

The actions listed are correct. One additional action should be considered. Security officer training should be reviewed and job- and site-specific training should be developed.

The requirement cited is correct. There are two additional requirements that should have been mentioned.

10 CFR 835, Section 835.603

Each access point to a radiological area shall be posted with conspicuous signs bearing the wording provided in this section.

10 CFR 835, Section 835.901

All general employees shall be trained in radiation safety prior to receiving occupational exposure during access to controlled areas.

### **PRACTICE**

This practice is required if your proficiency is to be verified at the general level. The practice will prepare you for the criterion test. You will need to refer to the Order to answer the questions in the practice correctly. The practice and criterion test will also challenge additional analytical skills that you have acquired in other formal and on-the-job training.

Please review the following scenario and answer the following questions:

1. Was the situation handled correctly? If not, what should have been done?
2. Was the list of requirements, sections, and elements complete and correct? If not, state the correct or omitted requirements.

### **SCENARIO**

On 9/26/94 members of the dosimetry evaluation group informed the facility manager and facility representative that about 30 twenty-four hour urine samples, that had been held for three years, were not properly analyzed. Additionally, another 90 twenty-four hour urine samples have not been analyzed in over a year's time and procedures were not available to ensure that they would be properly analyzed or even could be properly analyzed. In the questioning that followed, the inability to analyze samples of a number of isotopes was identified.

An investigation of the situation revealed the following:

- The investigation committee determined that these samples were collected from two jobs. On previous work it was possible to obtain outside analyses from another DOE laboratory. This laboratory became concerned about competing with private enterprise and felt they could not continue performing the analyses.
- Some of the individuals whose samples were to be analyzed had left the company and had requested the results of the analysis.
- There was no direction about how to contract with another laboratory. There were no requirements that the transfer of work to another laboratory had to occur within a specified time period. There were no policies that established responsibility for the dosimetry process. So, when samples were collected no one knew when, or if a dose needed to be calculated. Therefore, the dose evaluators were unable to follow-up, because of not knowing what samples were submitted for dose calculations. No one was assigned responsibility for the entire program.
- Numerous upper level documents at the facility require a dosimetry program, including

bioassay to determine any exposures during work. The fact that the procedures were not in place to ensure the analysis and oversight of these samples shows that these policies were not implemented. The lack of clear responsibility, as to whose job it was to ensure that samples are analyzed and doses calculated, once samples are submitted, is an example of the problem.

- The lack of communication and this includes all forms, not just verbal, is evidenced by the fact that samples were kept in the laboratory for up to three years without analysis. Personnel were aware, but the fact was not pursued sufficiently to obtain the desired actions.
- Management at higher levels was unaware of samples not analyzed, lack of procedures to implement the program, and the lack of definition as to responsibilities in the program, are all indications of lack of management support.

The contractor performed the following corrective actions:

- Defined responsibilities for bioassay/dose process.
- Developed auditable method of tracking bioassay samples.
- Developed chain-of-custody procedure.
- Updated policy procedure manual for all policies involving bioassay/dose evaluation.
- Reviewed all areas for lack of administrative control and communication breakdown.

Applicable requirements:

10 CFR 835, Section 835.402

For the purpose of monitoring individual exposures to internal radiation, internal dose evaluation programs including routine bioassay programs shall be conducted.

Internal dose evaluation programs shall be adequate to ensure that the established limits are not exceeded.

Take some time to review the scenario and the actions the contractor took or did not take to correct the situation. Then decide if the contractor's actions were complete and correct. Finally, determine if the requirements, sections, or elements cited in the scenario were correct.

Use the space on the next page to write your answer and then bring the completed practice to the course manager for review.



Change No: 1  
10 CFR 835  
Level: General  
Date: 11/1/08

**Note: The course manager will check your practice and verify your success at the general level. When you have successfully completed this practice, the course manager will give you the criterion test.**