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DOE STANDARD

RADIATION PROTECTION FUNCTIONAL AREA QUALIFICATION STANDARD

DOE Defense Nuclear Facilities Technical Personnel

U.S. Department of Energy
Washington, D.C. 20585

AREA TRNG

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Department of Energy

Technical Standards Program

Website at

http://www.hss.energy.gov/nuclearsafety/techstds/

APPROVAL

The Federal Technical Capability Panel consists of senior U.S. Department of Energy (DOE) managers responsible for overseeing the Federal Technical Capability Program. This Panel is responsible for reviewing and approving the Qualification Standard for Department-wide application. Approval of this qualification standard by the Federal Technical Capability Panel is indicated by signature below.

Karen L Boardman 11.5.13

KAREN L. BOARDMAN, CHAIRPERSON
FEDERAL TECHNICAL CAPABILITY PANEL

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ACKNOWLEDGEMENT

The Savannah River Operations Office is the sponsor for the Radiation Protection Qualification Standard. The sponsor is responsible for coordinating the development and/or review of the Functional Area Qualification Standard (FAQS) by subject matter experts to ensure that the technical content of the standard is accurate and adequate for Department-wide application for those involved in the Radiation Protection program. The sponsor, in coordination with the Federal Technical Capability Panel, is also responsible for ensuring that the FAQS is maintained current.

The following subject matter experts participated in the development and/or review of this qualification standard:

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U.S. DEPARTMENT OF ENERGY
FUNCTIONAL AREA QUALIFICATION STANDARD

RADIATION PROTECTION

PURPOSE

The primary purpose of the Technical Qualification Program (TQP) is to ensure employees have the requisite technical competency to support the mission of the Department. The TQP forms the basis for the development and assignment of DOE personnel responsible for ensuring the safe operation of defense nuclear facilities. The technical qualification standards are not intended to replace the U.S. Office of Personnel Management (OPM) qualifications standards or other departmental personnel standards, rules, plans, or processes. However, the technical qualification standards should form the primary basis for developing vacancy announcements, qualification requirements, crediting plans, interview questions, and other criteria associated with the recruitment, selection, and internal placement of technical personnel.

APPLICABILITY

The Radiation Protection Functional Area Qualification Standard (FAQS) establishes common functional area competency requirements for all DOE Radiation Protection personnel who provide assistance, or direction, guidance, oversight, or evaluation of contractor technical activities that could impact the safe operation of DOE's defense nuclear facilities. This technical FAQS has been developed as a tool to assist DOE program and field offices in the development and implementation of the TQP in their organization. For ease of transportability of qualifications between DOE elements, program and field offices must use this technical FAQS without modification. Satisfactory and documented attainment of the competency requirements contained in this technical FAQS ensures that personnel possess the minimum requisite competence to fulfill functional area duties and responsibilities common to the DOE complex. Additionally, needed office-/site-/facility-specific qualification standards, handled separately, supplement this technical FAQS and establish unique operational competency requirements at the Headquarters or field element, site, or facility level.

It should be noted that the competencies of management and leadership, general technical knowledge, regulations, administrative capability, and assessment and oversight are all embodied in the competencies in this standard. All of these factors have a bearing on safety. Although the focus of this standard is technical competence, competencies such as good communication, recognized credibility, ability to listen and process information, and the ability to guide an effort to get it right the first time are recognized as important aspects of safety.

IMPLEMENTATION

This FAQS identifies the minimum technical competency requirements for DOE personnel. Although there are other competency requirements associated with these positions, this FAQS identifies the specific, common technical competencies required throughout all defense nuclear facilities for Radiation Protection personnel.

The term “must” denotes a mandatory requirement, “should” denotes a recommended practice that is not required, and “may” denotes an option in this standard.

The competencies identify various levels of knowledge; or they require the individual to demonstrate the ability to perform a task or activity. These levels are defined as follows:

> **Familiarity level** is basic knowledge of or exposure to the subject or process adequate to discuss the subject or process with individuals of greater knowledge.
>
> **Working level** is knowledge required to monitor and assess operations/activities, to apply standards of acceptable performance, and to recognize the need to seek and obtain appropriate expert advice (e.g., technical, legal, safety) or consult appropriate reference materials required to ensure the safety of DOE activities.
>
> **Demonstrate the ability** is the actual performance of a task or activity in accordance with policy, procedures, guidelines, and/or accepted industry or DOE practices.

Headquarters and field elements must establish a program and process to ensure DOE personnel possess the competencies required by their position, including the competencies identified in this technical FAQS. Documentation of the completion of the requirements in this standard must be included in the employees’ training and qualification records. Satisfactory attainment of competency requirements contained in this technical FAQS may be documented using the example Radiation Protection FAQS qualification card from the Federal Technical Capability Program Directives and Standards page, http://www.hss.energy.gov/deprep/ftcp/directives/directives.asp.

Equivalencies should be used sparingly and with the utmost rigor and scrutiny to maintain the spirit and intent of the TQP. Equivalencies may be granted for individual competencies based on objective evidence of previous education, training, certification, or experience. Objective evidence includes a combination of transcripts, certifications, and in some cases, a knowledge sampling obtained through written and/or oral examinations. Equivalencies must be granted in accordance with the TQP plan of the site/office/headquarters organization qualifying the individual. Supporting knowledge and/or skill statements should, and mandatory performance activities must, be considered before granting an equivalency for a competency.

Training must be provided to employees in the TQP who do not meet competencies contained in this technical FAQS. Training may include, but is not limited to, formal classroom and computer-based courses, self-study, mentoring, on-the-job training, and special assignments. Departmental training must be based on appropriate supporting knowledge and/or skill statements similar to those listed for each competency requirement. Headquarters and field elements should use the supporting knowledge and/or skill statements as a basis for evaluating the content of any training.

EVALUATION REQUIREMENTS

Attainment of the competencies listed in this technical FAQS must be documented in accordance with the TQP plan or policy of the site/office/Headquarters organization qualifying the individual and the requirements in DOE O 360.1C, *Federal Employee Training*, and DOE O 426.1, Chg.1, *Federal Technical Capability*.

The qualifying official or immediate supervisor should ensure the candidate meets the background and experience requirements of this FAQS. If the immediate supervisor is not

qualified in this functional area, the supervisor should consult with a qualified individual prior to using one or a combination of the following individual competency evaluation methods:

- Satisfactory completion of a written examination
- Satisfactory completion of an oral examination
- Satisfactory accomplishment of an observed task or activity directly related to a competency
- Documented evaluation of equivalencies (such as applicable experience in the field) without a written examination.

Field element managers/headquarters program managers must qualify candidates as possessing the basic technical knowledge, technical discipline competency, and position-specific knowledge, skills, and abilities required for their positions.

Final qualification should be performed using one or a combination of the following methods:

- Satisfactory completion of a comprehensive written examination with a minimum passing grade should be 80 percent.
- Satisfactory completion of an oral examination by a qualified Senior Technical Safety Manager (STSM) or a qualification board of technically qualified personnel that includes at least one qualified STSM.
- Satisfactory completion of a walkthrough of a facility with a qualifying official for the purpose of verifying a candidate's knowledge and practical skills of selected key elements.

Guidance for written exams and oral interviews is contained in DOE-HDBK-1205-97, *Guide to Good Practices for the Design, Development, and Implementation of Examinations*, and DOE-HDBK-1080-97, *Guide to Good Practices for Oral Examinations*.

For oral examinations and walkthroughs, qualifying officials or board members should ask critical questions intended to integrate identified learning objectives during qualification. Field element managers/headquarters program managers or designees should develop formal guidance for oral examinations and walkthroughs that includes:

- Standards for qualification
- Use of technical advisors by a board
- Questioning procedures or protocol
- Pass/fail criteria
- Board deliberations and voting authorization procedures
- Documentation process

INITIAL QUALIFICATION AND TRAINING

Qualification of radiation protection personnel must be conducted in accordance with the requirements of DOE O 426.1, Chg. 1.

DOE personnel must participate in continuing education and training as necessary to improve their performance and proficiency and ensure that they stay up-to-date on changing technology and new requirements. This may include courses and/or training provided by:

- DOE
- Other government agencies
- Outside vendors
- Educational institutions

Beyond formal classroom or computer-based courses, continuing training may include:

- Self-study
- Attendance at symposia, seminars, exhibitions
- Special assignments
- On-the-job experience

A description of suggested learning activities and the requirements for the continuing education and training program for this FAQS are included in Appendix A.

DUTIES AND RESPONSIBILITIES

The following are the typical duties and responsibilities expected of personnel assigned to the Radiation Protection Functional Area:

1. Evaluates radiological protection programs to determine whether the program complies with applicable codes, standards, guides, regulations, Orders, and accepted practices.

2. Appraises facilities, procedures, and operations to determine their adequacy to protect the workers and members of the general public from the effects of ionizing radiation.

3. Administers and coordinates radiation protection program(s) for the Department, including independent evaluations and special studies.

4. Provides technical assistance and advice in the area of radiation protection and health physics to other organizations and independent review groups.

5. Reviews Office and/or contractor performance to identify trends indicative of performance or compliance status.

6. Performs technical reviews and provides recommendations on Radiation Protection Program documents (plans, schedules, etc.).

7. Reviews and comments on a wide variety of operating contractor documents.

8. Evaluates, oversees, and provides emergency preparedness and emergency response support related to radiological incidents in conjunction with contractor, Federal, State, and local officials, as required.

9. Develops, reviews and implements radiation control policy, requirements, and guidance.

10. Communicates hazards associated with exposure to ionizing radiation.

Position-specific duties and responsibilities for Radiation Protection personnel are contained in their office/site/facility-specific qualification standard and/or position description.

BACKGROUND AND EXPERIENCE

The OPM *Qualification Standards Operating Manual* establishes minimum education, training, experience, or other relevant requirements applicable to a particular occupational series/grade level, as well as alternatives to meeting specified requirements.

1. The preferred education and experience for Radiation Protection personnel are:

   a. Education:

      At a minimum, the basic OPM educational requirements for Occupation Series (OS) 1306 must be met.

      The current OPM basic requirements for OS 1306 are:

      i. Degree: natural science or engineering that included at least 30 semester hours in health physics, engineering, radiological science, chemistry, physics, biology, mathematics, and/or calculus.

      OR

      ii. Combination of education and experience—courses as shown in A above, plus appropriate experience or other education; or certification as a health physicist by the American Board of Health Physics, plus appropriate experience and other education that provided an understanding of sciences applicable to health physics comparable to that described in paragraph A.

   b. Experience:

      Industrial, military, Federal, State, or other directly-related background that has provided specialized experience in Radiation Protection. Specialized experience can be demonstrated through possession of the competencies outlined in this standard.

2. In addition to the education and experience stated above, certification by the American Board of Health Physics (ABHP) is highly recommended, and typically may serve as the basis for equivalency for the competencies in the "General Technical" section of this Standard.

3. Successful completion of ABHP certification examination Part I or National Registry of Radiation Protection Technologists (NRRPT) certification may serve as the basis for equivalency for competencies 1-5 in the “General Technical” section of this Standard.

REQUIRED TECHNICAL COMPETENCIES

The competencies contained in this standard are distinct from those competencies contained in the General Technical Base (GTB) Qualification Standard. All Radiation Protection personnel must satisfy the competency requirements of the GTB Qualification Standard prior to or in parallel with the competency requirements contained in this standard. Each of the competency requirements defines the level of expected knowledge and/or skill that an individual must possess to meet the intent of this standard. Each of the competency requirements is further described by a listing of supporting knowledge and/or skill statements that describe the intent of the competency statements. In selected competencies, expected knowledge and/or skills have been designated as "mandatory performance activities." In these competencies, the actions are not optional.

Note: When regulations, DOE directives, or other industry standards are referenced in the FAQS, the most recent revision should be used. It is recognized that some Radiation Protection personnel may oversee facilities that utilize predecessor documents to those identified. In those cases, such documents should be included in local qualification standards.

GENERAL TECHNICAL

1. Radiation protection personnel must demonstrate a working level knowledge of the various types of radiation and how they interact with matter.

Supporting Knowledge and/or Skills:

a. Describe each of the following forms of radiation in terms of structure, mass, origin, and electrostatic charge:
- Alpha
- Beta
- Neutron
- Gamma
- X-ray

b. Describe the interactions of the following with matter:
- Charged particle interactions
  - Alpha particle
  - Beta particle (Positron annihilation and Bremsstrahlung)
- Neutron interaction
  - Elastic scattering
  - Inelastic scattering
  - Fission
  - Capture, absorption, or activation
- Photon interactions
  - Photoelectric effect
  - Compton scattering
  - Pair production

c. Discuss the shielding materials used for each of the above types of radiation and explain which are the best materials based on the interactions of radiation with matter.

d. Define “range” and describe the range energy relations of charged particles including:
- Factors that affect the range of charged particles
- Relative range of alpha and beta in air and tissue

e. Describe the attenuation of gamma and neutron radiation in shielding materials including:
- Exponential attenuation
- Build-up

f. Discuss radiation field characteristics for point, line, plane, and volume distributed sources.

g. Describe the following particle ejection nuclear reactions and provide an example of each:
- Alpha, n
- Gamma, n
- n, Alpha

2. Radiation protection personnel must demonstrate a working level knowledge of radioactivity and transformation mechanisms.

Supporting Knowledge and/or Skills

a. Define the following terms:
- Activity
- Radioactive decay constant
- Curie/Becquerel
- Radioactive half-life
- Radioactive equilibrium (i.e., secular & transient equilibrium)
- Decay products
- Parent nuclide
- Activation
- Specific activity
- Naturally Occurring Radioactive Material (NORM)
- Technologically Enhanced Naturally Occurring Radioactive Material (TENORM)

b. Describe the following processes including any resulting product of decay:
- Alpha decay
- Beta-minus decay
- Beta-plus decay
- Electron capture
- Isomeric transition
- Internal conversion
- X-ray generation

Mandatory Performance Activities

a. Given the “Chart of the Nuclides,” trace the decay chain for a specified nuclide.

b. Given either the half-life or the radioactive decay constant, solve radioactive decay problems.

c. Using the specific activity or decay constant of an isotope, convert between mass quantities and curies.

d Convert numerical amounts of radioactivity between curie, becquerel, and dpm.

3. Radiation protection personnel must demonstrate a working level knowledge of principles and concepts for internal and external dosimetry.

Supporting Knowledge and/or Skills

a. Define the following terms:
- Absorbed dose
- Annual limit on intake (ALI)
- Committed effective dose
- Committed equivalent dose
- Cumulative total effective dose
- Derived air concentrations (DAC)
- Deterministic effects
- Dose
- Effective dose
- Equivalent dose, including:
  - Equivalent dose to the lens of the eye (0.3 cm)
  - Equivalent dose to the skin or any extremity (0.007 cm)
  - Equivalent dose to whole body (1.0 cm)
- Extremity
- Gray
- Rad
- Radiation Weighting factor
- Rem
- Roentgen
- Sievert
- Stochastic effects
- Tissue Weighting factor
- Total effective dose
- Whole body

b. Describe the various types of bioassays, their applications and limitations.

c. Discuss the methods of reducing dose from internally deposited radionuclides.

d. Discuss the process used to evaluate dose based on bioassay results.

e. Describe the principle of operation, proper use, placement, function, and type of radiation detected by the following dose-measuring instruments:

- Thermoluminescent dosimeter, including Albedo dosimeter
- Pocket dosimeter (quartz fiber and electronic)
- Film badge
- Personnel nuclear accident dosimeter

f. Discuss the historical concepts of International Commission on Radiological Protection (ICRP) Publications 26 and 30 and how they related to internal and external dosimetry.

g. Discuss the newer concepts of ICRP Publications including; 60, 66, 68, 71, and 72 and DOE Radiological Control Technical Positions (RCTP) papers. The RCTPs are available at: http://www.hss.energy.gov/healthsafety/wshp/radiation/tpp.html

h. Discuss various methods used to estimate worker exposure in the absence of individual monitoring results.

Mandatory Performance Activity

Given airborne radioactivity concentration, DAC value and worker occupancy time, evaluate resulting worker dose.

4. Radiation protection personnel must demonstrate a working level knowledge of the biological effects of radiation.

Supporting Knowledge and/or Skills

a. Describe the effects of radiation exposure on the cellular level including:
- Direct effects
- Indirect effects

b. Describe the factors affecting radiation sensitivity of cells (i.e., The Law of Bergonie and Tribondeau).

c. Describe the acute effects and corresponding doses associated with the following:
- Hemopoietic syndrome (discuss blood changes as well as other symptoms)
- Gastrointestinal syndrome
- Central nervous system syndrome

d. Discuss delayed effects of radiation exposure including:
- Cancer induction
- Genetic effects
- Prenatal developmental effects
- Cataracts

e. Discuss how the Linear Non-threshold Theory is used in developing risk estimates and dose limits associated with exposure to radiation. (The use of International Commission on Radiological Protection (ICRP) Publications 26 and 60 or National Council on Radiation Protection and Measurements (NCRP) Report No. 116 may be helpful). Address the conservative nature of the LNT theory.

5. Radiation Protection personnel must demonstrate a working level knowledge of the principles and use of radiological instrumentation and radiological monitoring/survey practices.

Supporting Knowledge and Skills:

a. Describe the principle of operation of gas-filled detectors.

b. Discuss the following for gas-filled detectors:
- Voltage-response curve (i.e., six region curve)
- The three regions useful for radiation detection and measurement
- The sequence of events that occur following an initial ionizing event in an Ionization Chamber, a Proportional Counter and a Geiger-Mueller Detector

c. Describe the principles of operation of liquid and crystal scintillation detectors.

d. Describe the principles of operation and applications of semiconductor detectors (i.e., HPGe, diffused junction, etc).

e. Describe the various types and application of spectroscopy.

f Discuss the purpose, principles of detection and operation, and field application of the following:
- Continuous air monitors (CAM)
- Airborne radioactivity samplers
- Area radiation monitors (ARM)
- Criticality detection/alarm systems
- Personnel contamination monitors
- Process radiation monitors

g. Discuss the basic elements and applicable standards of a radiological instrument calibration program, including the following:
- Calibration source selection and traceability
- Source check and calibration frequency
- Instrument energy dependence
- Purpose of 10 CFR 835 requirement of routine testing for operability

h. Discuss the following concepts as they relate to radiological counting measurements:
- Background
- Minimum detectable activity
- Counting efficiency
- Counting uncertainties

i. Describe various radiological situations and the use of appropriate radiological surveys including: radiation, contamination, and airborne radioactivity surveys.

6. Radiation protection personnel must demonstrate a working level knowledge of internal and external radiation protection principles and control techniques.

Supporting Knowledge and Skills

a. Discuss the implication of the following on the identification of hazards associated with radiological work activities and how it might affect the controls specified on a Radiation Work Permit (RWP):
   - Location of the work (i.e., in a radiation, contaminated, or airborne area)
   - System being worked on (i.e., fluid under pressure, hazardous or radioactive)
   - Nature of the work activity (inspection, opening system, etc.)

b. Discuss special exposure control, survey and personnel monitoring techniques associated with work in the following areas or situations:
   - Non-uniform radiation fields
   - High radiation areas
   - Contact work with radioactive materials/sources

c. Discuss the hierarchy of controls used to prevent uptakes of radioactive material by personnel, and potential worker hazards associated with implementation of these controls.

d. For a radiological incident (i.e., spill, loss of containment), discuss the potential and magnitude of the following:
   - Loose surface contamination levels
   - Airborne radioactivity levels

e. Discuss appropriate personal protective equipment (including respiratory protection) for subsequent entry into and decontamination of radiological areas.

Mandatory Performance Activities

a. Using reference material and given the activity, calculate radiation levels from a point, line, and plane source.

b. Given buildup factors and half value layers, perform shielding calculations.

c. Using reference material and given a scenario including bioassay results, isotopic and chemical form etc., calculate the internal dose to be assigned to an individual.

7. Radiation protection personnel must demonstrate a working level knowledge of as-low-as-reasonably-achievable (ALARA) principles, and their application to radiological work activities.

Supporting Knowledge and/or Skills

a. Describe the various components of an effective ALARA program, including operations, engineering, and management controls.

b. Describe how optimization techniques, including cost-benefit analysis, are used in the ALARA process.

c. Discuss the essential elements of the job planning process and the post-job ALARA review for work performed in a radiation or radioactive contamination area.

d. Describe the various radiological performance indicators that are applicable to the ALARA process.

e. Discuss methods to minimize Total Effective Dose (TED) by evaluating the trade-offs in considering the internal and external dose components.

f. Using knowledge of ALARA principles, discuss how to perform an evaluation of a radiation job plan and the associated worker job performance.

Mandatory Performance Activity

a. Calculate person-rem estimates and use the results in ALARA cost-benefit analysis.

8. Radiation protection personnel must demonstrate a working level knowledge of the application of engineered radiological controls and facility design, including containment/confinement systems.

Supporting Knowledge and/or Skills

a. Discuss the general principles relating to the design and installation of radiation protection containment/confinement systems, including the following radiological protection considerations:
- Layout design for nuclear facilities
- Design and selection of components for nuclear facilities
- Selection of materials and the associated surfaces for components used in radiological control areas
- Design, construction, and operation of containment/confinement systems to minimize internal radiation exposure including:
  - Engineered ventilation
  - Engineered containment
  - Hot cells
  - Radioactive liquid and solid waste processing facilities
- Design, construction, and operation of systems that minimize personnel external radiation exposure including:
  - Shielding
  - Interlock systems

b. Discuss the design and application of temporary engineered radiological controls.

9. Radiation protection personnel must demonstrate a familiarity level knowledge of the radiological hazards associated with the following and a working level knowledge for site specific radiological hazards:
- **Plutonium operations**
- **Uranium operations**
- **Tritium operations**
- **Nuclear explosive operations**
- **Production/experimental reactors**
- **Accelerator operations**
- **Waste handling/processing operations**

- **Decontamination and decommissioning**
- **Use of radiation generating devices**
- **Environmental restoration activities**

Supporting Knowledge and/or Skills

a. Discuss the basic function and work activities associated with the above list.

b Discuss fundamental characteristics of the major radiological hazards at the above listed activities. This could include discussion of:
- Mode of decay
- Source
- Energies of major radiations emitted
- Relative principle biological hazard
- Half-life

c. Discuss unique radiological exposure control techniques associated with the above listed activities.

REGULATORY

Note: Many of the documents referenced in this Section can be obtained via the DOE Office of Health & Safety home page (http://www.hss.energy.gov/healthsafety) or via the Office of Worker Safety and Health Policy home page (www.hss.energy.gov/HealthSafety/WSHP)

10. Radiation protection personnel must demonstrate a working level knowledge of the Department of Energy (DOE) radiation protection system for occupational workers as set forth in the following policy, requirements and guidance documents:

- **10 CFR 835, Occupational Radiation Protection**
- **DOE G 441.1-1C, Radiation Protection Programs Guide for Use with 10 CFR 835, Occupational Radiation Protection**
- **DOE P 450.4A, Department of Energy Integrated Safety Management Policy**

Supporting Knowledge and/or Skills

a. Discuss the relationship of the above documents in defining the DOE system of radiation protection.

b. Give examples of how DOE P 450.4, Department of Energy Integrated Safety Management Policy is reflected in requirements and guidance.

c. Explain how the 10 CFR 835 Programs Guide is used to develop and implement local programs to comply with the radiation protection requirements at the site/facility level.

d. Discuss methods of meeting the key requirements in 10 CFR 835 Subpart A (General Provisions). Include:
- Scope and exclusions
- Definitions

- Radiological units

e. Discuss methods of meeting the key requirements in 10 CFR 835 Subpart B (Management and Administrative Requirements) based upon the guidance in DOE G 441.1-1C, Radiation Protection Programs Guide, including:
   - Radiation Protection Program
   - Internal audits
   - Education, Training and Skills
   - Written Procedures

f. Discuss methods of meeting the key requirements in 10 CFR 835, Subpart C (Standards for Internal and External Exposure) based upon the guidance in the Internal Dosimetry, the External Dosimetry, the Radiation-Generating Devices, and the Evaluation and Control of Fetal Exposure sections of the Programs Guide, including:
   - Occupational Limits for general employees
   - Combining internal and external dose equivalents resulting from DOE activities
   - Determination of compliance for non-uniform exposure of the skin
   - Limits for the embryo/fetus
   - Limits for members of the public and minors entering a controlled area
   - Concentrations of radioactive materials in air

g. Discuss methods of meeting the key requirements in 10 CFR 835, Subpart E (Monitoring of Individuals and Areas) based upon guidance in the External Dosimetry, the Internal Dosimetry, the Evaluation and Control of Fetal Exposure, the Instrument Calibration for Portable Survey Instruments, and the Workplace Air Monitoring sections of the Programs Guide, including:
   - General monitoring requirements
   - Individual monitoring
   - Area monitoring
   - Radioactive contamination control and monitoring
   - Receipt of Packages containing radioactive material

h. Discuss methods of meeting the key requirements in 10 CFR 835, Subpart F (Entry Control Program), including:
   - Radiological Areas
   - High Radiation Areas
   - Very High Radiation Areas

i. Discuss methods of meeting the key requirements in 10 CFR 835, Subpart G (Posting and Labeling) based upon the guidance in the Posting and Labeling for Radiological Control section of the Programs Guide, including:
   - General posting and labeling requirements
   - Controlled areas
   - Radiological areas

j. Discuss methods of meeting the key requirements in 10 CFR 835, Subpart H (Records) based upon the guidance in the Occupational Radiation Protection Record-Keeping and Reporting section of the Programs Guide, including:
   - Individual monitoring records

- Monitoring and workplace records
- Administrative records

k. Discuss methods of meeting the key requirements in 10 CFR 835, Subpart I (Reports to Individuals) based upon the guidance in the Occupational Radiation Protection Record-Keeping and Reporting section of the Programs Guide, including:
- Annual Dose Report to Monitored Individuals
- Termination Report

l. Discuss methods of meeting the key requirements in 10 CFR 835, Subpart J (Radiation Safety Training) based upon the guidance in the Radiation Safety Training section of the Programs Guide, including:
- General employee training
- Radiological worker training
- Radiological control technician training
- Use of escorts

m. Discuss methods of meeting the key requirements in 10 CFR 835, Subpart K (Design and Control) based upon the guidance in the Occupational ALARA Program section of the Programs Guide, including:
- Design features, administrative controls and procedural requirements
- Facility design and modification
- Control features

n. Discuss methods of meeting the key requirements in 10 CFR 835, Subpart L (Radioactive Contamination Control).

o. Discuss methods of meeting the key requirements in 10 CFR 835, Subpart M (Sealed Radioactive Source Control). Use the guidance in the Sealed Radioactive Source Accountability section of the Programs Guide to support the discussion on sealed source accountability.

p. Discuss methods of meeting the key requirements in 10 CFR 835, Subpart N (Emergency Exposure Situations), including:
- General provisions
- Emergency exposure situations
- Nuclear accident dosimetry

q. Discuss methods of meeting the key requirements on Administrative Control Levels, Work Authorizations, Radiation Safety Training, and Posting.

r. Explain how the Radiation Control Technical Positions, 10 CFR 835 exemption decisions, and official interpretations of 10 CFR 835 are used to adapt the radiation protection requirements to unique conditions at DOE sites and facilities.

11. Radiation protection personnel must demonstrate a working level knowledge of the following DOE Policy, Order, and Manual Directives, and Technical Standards related to radiation protection:
- **DOE P 450.4A, Integrated Safety Management Policy**

- **DOE O 458.1, Admin. Ch. 3, *Radiation Protection of the Public and the Environment***
- **DOE O 440.1B, Admin. Chg. 1, *Worker Protection Program for DOE Federal Employees***
- **DOE O 232.2, *Occurrence Reporting and Processing of Operations Information***
- **DOE O 422.1, Admin. Chg.1, *Conduct of Operations***
- **DOE-STD-1098-2008, Ch. 1, Department of Energy Standard – Radiological Control**
- **DOE-STD-1121-2008, Department of Energy Standard – Internal Dosimetry**
- **DOE O 231.1B, Admin. Chg 1, *Environment, Safety, and Health Reporting***

Supporting Knowledge and/or Skills

a. Describe the relevant requirements, interrelationships and importance of the listed Orders, notices, codes, and regulations, guides, technical manual(s).

b. Discuss the role of radiation protection personnel with respect to these Orders and regulations.

c. Discuss how Conduct of Operations is applied to radiation protection activities.

d. Discuss how the standard, Radiological Control, is now applied (i.e., as a requirement or as a technical standard) in your Program, or at the site(s) or facility(s) for which you have responsibility.

e. Discuss the following as they relate to occurrence reporting:
   - How soon after an event or condition is identified must it be characterized
   - Who must be notified at the facility where it occurred
   - The two broad groups or conditions in which a health physicist would likely be involved in identifying the reportable event

12. Radiation protection personnel must demonstrate a familiarity level knowledge of the identification, reporting, investigation, and enforcement related to potential noncompliance with nuclear safety requirements:

Supporting Knowledge and/or Skills

a. Describe the purpose and scope of the Price-Anderson Amendments Act (PAAA).

b. Discuss the PAAA's applicability to the Department's nuclear safety activities.

c. Discuss the purpose and scope of the current nuclear safety rules including:
   - 10 CFR 708, DOE Contractor Employee Protection Program
   - 10 CFR 820, Procedural Rules for DOE Nuclear Activities
   - 10 CFR 830, Nuclear Safety Management
   - 10 CFR 851, Worker Safety and Health Program

d. Discuss the Department's Enforcement Program including:
   - Identification and reporting of potential noncompliance with nuclear safety requirements

- Roles and responsibilities of Department of Energy employees

13. Radiation protection personnel must demonstrate a familiarity level knowledge of radioactive waste management:

Supporting Knowledge and/or Skills

a. Discuss the Department's policy regarding the handling and management of waste as described in DOE O 435.1, Ch. 1, *Radioactive Waste Management*.

b. Define the following terms:
- Low level waste
- High level waste
- Transuranic waste
- Mixed waste

c. Discuss the Department's policies on waste management including:
- Generation reduction
- Segregation
- Minimization
- Pollution prevention
- Disposal

d. Discuss the process for determining whether or not waste is classified as mixed waste.

14. Radiation protection personnel must demonstrate a familiarity level knowledge of Department of Energy (DOE) requirements and guidance related to safety management.

Supporting Knowledge and/or Skills

a. Describe the relevant requirements, purpose, interrelationships and importance of the following requirements and guides to radiation protection activities:
- 10 CFR 830, Nuclear Safety Management
- 10 CFR 851, Worker Safety and Health Program
- DOE O 450.2, *Integrated Safety Management*
- DOE O 414.1D, *Quality Assurance*
- DOE G 414.1-2B, Admin Ch 2, Quality Assurance Program Guide
- DOE O 420.1C, *Facility Safety*
- DOE G 421.1-2A, Implementation Guide For Use in Developing Documented Safety Analyses To Meet Subpart B Of 10 CFR 830
- DOE G 423.1-1A, Implementation Guide For Use In Developing Technical Safety Requirements
- DOE G 424.1-1B, Implementation Guide For Use In Addressing Unreviewed Safety Question Requirements
- DOE O 430.1B Ch 2, *Real Property and Asset Management*
- DOE-STD-1073-2003, Configuration Management Program
- DOE-STD-3009-94, Ch. 3, Preparation Guide for U.S. DOE Nonreactor Nuclear Facility Safety Analysis Reports

- DOE-HDBK-3010-94, Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities
- DOE-STD-3011-2002, Guidance for Preparation of Basis for Interim Operation (BIO) Documents
- DOE-STD-1027-92, Ch. 1, Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, *Nuclear Safety Analysis Reports*

b. Discuss the role of radiation protection personnel with respect to the above listed requirements and guidance.

c. Define the following accident related terms:
- Accident
- Safety basis
- Beyond design basis accident
- Design basis
- Design basis accidents
- Evaluation guidelines

d. Define the following hazard related terms:
- Hazard
- Hazard classification
- Hazard Category 1
- Hazard Category 2
- Hazard Category 3
- Hazardous material

e. Define the following safety limit related terms:
- Limiting conditions for operations
- Limiting control settings
- Risk
- Safety analysis
- Safety basis
- Safety limits
- Criticality safety limits

f. Differentiate between the following categories of individuals who might be affected by an accident at the Department nuclear facility:
- Off-site individual
- On-site individual
- Public
- Worker, including collocated worker

g. Differentiate between the function of structures, systems, and components in the following classifications:
- Safety-class structures, systems, and components
- Safety-significant structures, systems, and components

h. Differentiate between the function and contents of the following documents:
- TSR

- DSA
- Unreviewed Safety Question Determination (USQD)
- Safety design strategy
- Conceptual safety design report
- Preliminary safety design report
- Preliminary documented safety analysis

i. Differentiate between the plant/facility features that have the following designations:
- Mitigating features
- Preventive features

j. Differentiate between the following types of facilities:
- Nuclear facility
- Non-reactor nuclear facility

15. Radiation protection personnel must demonstrate a familiarity level knowledge of Federal regulations and Department of Energy (DOE) Orders related to emergency planning and preparedness as they pertain to radiological incidents.

Supporting Knowledge and/or Skills

a. Describe the relevant requirements, purpose, interrelationships and importance of the following Orders and regulation:

- 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response
- DOE O 151.1C, *Comprehensive Emergency Management System and Series of Guides* (G 151.1-1A thru G 151.1-5)
- DOE O 153.1, *Departmental Radiological Emergency Response Assets*

b. Describe what is meant by an Operational Emergency.

c. Describe how the following guides are used:
- Protective Action Guide
- Emergency Response Planning Guide

d. Discuss the conditions that would require an operational emergency to be classified as an:
- Alert
- Site Area Emergency
- General Emergency

e. Discuss the role of radiation protection personnel with respect to the Orders and regulations listed above in Competency 15.a.

f. Discuss the emergency response assistance that is available from the following:
- Nuclear Emergency Response Team
- Accident Response Group
- Aerial Measuring System
- National Atmospheric Release Advisory Capability
- Federal Radiological Monitoring and Assessment Center

- Radiation Emergency Assistance Center/Training Site
- Radiological Assistance Program

16. Radiation protection personnel must demonstrate a familiarity level knowledge of Department of Energy (DOE) Orders related to Federal and contractor personnel training and qualification.

Supporting Knowledge and/or Skills

a. Describe in general the training and qualification requirements for contractors specified in DOE O 426.2, Admin. Chg. 1, *Personnel Selection, Training, Qualification and Certification Requirements for DOE Nuclear Facilities*.

b. Describe the Technical Qualification Program for Federal employees delineated in DOE O 360.1C *Federal Employee Training*.

c. Discuss the purpose, scope, and application of DOE-STD-1107-97(CN1), Knowledge, Skills and Abilities for Key Radiation Protection Positions at DOE Facilities.

17. Radiation protection personnel must demonstrate a working level knowledge of national and international radiation protection standards and recommendations.

Supporting Knowledge and/or Skills

a. Discuss the content and application of the following national and international documents on radiation protection:
   - Radiation Protection Guidance to the Federal Agencies for Occupational Exposure (52 FR 2822)
   - BEIR V Executive Summary
   - Recommendations on Limits for Exposure to Ionizing Radiation, National Council on Radiological Protection, Report No. 91
   - Limitation of Exposure to Ionizing Radiation, National Council on Radiation Protection, Report No. 116
   - Practices for Respiratory Protection, American National Standards Institute (ANSI Z88.2)

b. Discuss how the previously referenced documents relate to Department of Energy (DOE) radiation protection requirements.

18. Radiation protection personnel must demonstrate a familiarity level knowledge of the Federal regulations, guidelines, and Department of Energy (DOE) Orders pertaining to the decontamination and decommissioning of nuclear facilities.

Supporting Knowledge and/or Skills

a. Familiarity with the DOE policy and requirements regarding the management, control, and release of property containing residual radioactivity, as contained in:
   - DOE/EH-413-0002, Facility Disposition: Principles for Accelerated Project Management
   - DOE O 458.1, Ch. 1, *Radiation Protection of the Public and the Environment*

- DOE-STD-1120-2005, Integration of Environment, Safety and Health into Facility Disposition Activities

b. General familiarity with requirements and guidance from other Federal agencies, or from DOE in collaboration with other Federal agencies (e.g., Nuclear Regulatory Commission, NRC; Environmental Protection Agency, EPA) regarding the decontamination, decommissioning, and release of property that may be applicable to the disposition of DOE sites and facilities.

c. Familiarity with the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM; NUREG-1575; EPA 402-R-97-016) for planning, conducting, evaluating, and documenting building surface and surface soil final status radiological surveys for demonstrating compliance with dose or risk-based regulations or standards.

d. Knowledge of guidance regarding the development and analysis of property release options, and determination of authorized limits for property and material to be managed or released from DOE, as contained in DOE Programs Guide G-441.1-1C.

e. Familiarity with DOE dose and risk modeling tools applicable to the decontamination and decommissioning of sites and facilities, such as: (1) the RESRAD (RESidual RADioactivity) code (User's Manual for RESRAD Version 6, Argonne National Laboratory, ANL/EAD-4, 2001); and (2) the RESRAD-BUILD code (A Computer Model for Analyzing the Radiological Doses Resulting from the Remediation and Occupancy of Buildings Contaminated with Radioactive Material, ANL/EAD/03-1, 2003).

f. Cursory knowledge of currently available technologies, and innovative technologies as available, that are applicable to the cleanup, decontamination, and decommissioning of DOE facilities.

g. Knowledge, as appropriate to decontamination and decommissioning activities, regarding radiological control practices to minimize occupational exposures to ionizing radiation, as contained in the DOE Standard, Radiological Control (DOE-STD-1098-2008).

19. Radiation protection personnel must demonstrate a familiarity level knowledge of the standards and Department of Energy (DOE) Orders pertaining to the packaging and transportation of radioactive materials.

Supporting Knowledge and/or Skills

a. Discuss the purpose and scope of the DOE O 460.1C, *Packaging and Transportation Safety*.

b. Describe the authorities and responsibilities of radiation protection personnel with respect to DOE O 460.1C, *Packaging and Transportation Safe*ty.

20. Radiation protection personnel must demonstrate a familiarity level knowledge of the Department's philosophy and approach to implementing Integrated Safety Management.

Supporting Knowledge and/or Skills

a. Explain the objective of Integrated Safety Management.

b. Discuss the following existing Department programs and initiatives that lead to successful implementation of Integrated Safety Management:
- Standards/Requirements Identification Documents (S/RIDs) and Work Smart Standards
- Contract reform and performance-based contracting
- Operational Readiness Reviews (ORR)

c. Discuss the purpose, content, and application of DOE P 450.4A, Integrated Safety Management Policy and DOE G 450.4-1C, Integrated Safety Management System Guide.

21. Radiation protection personnel must demonstrate a familiarity level knowledge of the Department's guidance for the structure, function, and operation of a radiation generating device (RGD) control program as discussed in DOE Programs Guide G 441.1-1C, section entitled Radiation Generating Devices.

Supporting Knowledge and/or Skills

a. Describe the different types of radiation-generating devices that may be used at Department of Energy (DOE) facilities including:
- X-ray machines
- Accelerators
- Irradiators
- Radiography sources

b. Using DOE-HDBK-1130-2008, discuss the difference between an open beam and cabinet X-ray system and the different types of controls (design, equipment, and administrative) that can be used to prevent radiation exposure above DOE limits

c. Discuss possible exposure incidents (or ones that have actually happened in medicine, private industry, or at DOE facilities) as a result of improper practices with accelerators, irradiators, and radiography sources, or loss of control of sources.

d. Discuss possible actions to control sources at DOE facilities, especially radiography sources brought on DOE sites by subcontractors who may be unaware of the site Radiation Protection Program (RPP) and 10 CFR 835, Occupational Radiation Protection, requirements.

MANAGEMENT, ASSESSMENT, AND OVERSIGHT

22. Radiation protection personnel must demonstrate a working level knowledge of assessment (compliance and performance) principles and techniques necessary to identify facility and program deficiencies, event precursors, potential systemic causes, corrective actions, and best practices.

Supporting Knowledge and/or Skills

a. Describe the relevant aspects and process of compliance-based assessments versus performance-based assessments.

b. Describe the elements of an inspection/assessment plan (investigation, fact-finding, validation, and reporting).

c. Explain what is meant by an event precursor.

d. Describe methods used to identify, develop, and group systemic deficiencies identified at the radiation protection program level and facility-specific level.

e. Explain documentation requirements used for the assessment processes.

f. Describe several performance indicators that would indicate the need to conduct a radiation protection audit.

g. Describe the key elements of an assessment appraisal report.

h. Explain methods used to select interview candidates and conduct interviews for the assessment process.

i. Describe how corrective actions/recommendations are developed and communicated to line management.

j. Describe administrative methods used to track and provide closure of identified deficiencies.

23. Radiation protection personnel must demonstrate the ability to evaluate the adequacy of radiation protection programs against the requirements of regulations, Department of Energy (DOE) Orders and rules pertaining to radiation protection.

Supporting Knowledge and/or Skills

a. Describe the scope, contents, development, review and approval process for a site's documented Radiation Protection Program as required by 10 CFR 835.101(a)-(i).

Mandatory Performance Activities

a. Using the documents listed below, prepare an action plan which adequately outlines interviews and observations to be conducted, and details documents to review during an evaluation of contractor compliance with radiation protection requirements:
   - 10 CFR 835, Occupational Radiation Protection
   - DOE G 441.1-1C, Radiation Protection Programs Guide for use with 10 CFR 835, Occupational Radiation Protection
   - DOE Order 458.1, Ch. 1, *Radiation Protection of the Public and the Environment*
   - DOE O 422.1, Admin. Chg. 1, *Conduct of Operations*
   - DOE-STD-1098-2008, Department of Energy Standard - Radiological Control

- DOE O 460.1C, *Packaging and Transportation Safety*
- 49 CFR 173, Subpart I, Shippers – General Shipping Requirements for Shipments and Packages – Class 7 (Radioactive) Materials

b. Using an appropriate level of coverage, conduct an evaluation of contractor compliance with radiation protection requirements. During this evaluation, demonstrate the ability to properly conduct interviews, observations, and document reviews.

c. Given data from an evaluation, analyze the results of the evaluation to determine contractor compliance or noncompliance with the requirements.

d. Given the results from an analysis of contractor compliance or noncompliance, document the results and communicate the results to contractor and Department line management.

24. Radiation protection personnel must demonstrate the ability to trend radiation protection-related information/data.

Mandatory Performance Activities

a. Trend and analyze operations information and discuss its relationship to radiation protection activities.

b. Given a list of performance indicators, determine what type of assessment should be performed and in what areas.

c. Analyze and trend radiological data available in the DOE Occupational Radiation Exposure Report or the Radiation Exposure Monitoring System (REMS) for the Department and contractor Employees (see Web site http://www.hss.energy.gov/csa/analysis/rems/ for this information).

25. Radiation protection personnel must demonstrate the ability to effectively communicate the hazards associated with exposure to ionizing radiation.

Supporting Knowledge and/or Skills

a. Discuss the essential elements of effective hazard communication.

b. Explain the health physicist's mission of protecting workers, the public, and the environment from unnecessary exposure to ionizing radiation.

c. Describe how an explanation of the following can be used to effectively communicate hazard:
- Comparing occupational dose limits to natural background radiation
- Develop comparisons to commonly accepted hazards that puts radiation exposure at a site in perspective

d. Explain how excessive hazard avoidance can be dangerous, costly, and wasteful.

e. Discuss other job related mortality statistics and how they compare with the risk of mortality from jobs that have occupational exposure to radiation.

f. Explain how to use the following techniques in the context of radiation hazard communication:
- Listening skills
- Tone of voice
- Body language, eye contact
- Analogies, illustrations, demonstrations
- Real-life experiences

Mandatory Performance Activity

Participate in hazard communication activities with peers, Department management, or contractor personnel.

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APPENDIX A

CONTINUING EDUCATION, TRAINING AND PROFICIENCY PROGRAM

This standard does not require requalification.

Headquarters or field element managers must ensure the following:

1. Establish expectations related to the performance of duties and responsibilities in this FAQS, considering regulatory and/or contractual requirements as appropriate.
2. Identify specific continuing training requirements in the site/office/position specific qualification standard(s) or procedures.
3. Approve all established continuing training requirements related to defense nuclear facility safety oversight as determined for their office or site.

Radiation Protection personnel must complete continuing technical education and/or training covering topics directly related to the Radiation Protection FAQS as determined by the appropriate headquarters or field element managers as follows:

1. Address changes to DOE directives, guides, standards, policies, and rules since the last qualification was completed.
2. Perform practical factor exercises as appropriate, especially those that are mandatory and others as required by the associated FAQS.
3. Attend seminars, symposia, or technical meetings related to Radiation Protection as resources are available.

   Note: Continuing technical education and/or training may include courses/training provided by the DOE, other government agencies, outside vendors, or local educational institutions. Continuing training topics should also address identified weaknesses in the knowledge or skills of the individual personnel, and current technical issues related to the associated FAQS. Where continuing education is mandatory for maintaining professional registration (e.g., Professional Engineer) or professional certification (e.g., Certified Health Physicist), this will normally be sufficient, and only needs to be augmented by DOE directives reviews and any site-specific requirements (e.g., new/revised DSAs).

CONCLUDING MATERIAL

Review Activity:
EM
NNSA
NE
SC

Field and Operations Offices:
CBFO
CH
ID
OH
ORO
ORP
RFFO
RL
SR

Site Offices:
Argonne Site Office
Brookhaven Site Office
Fermi Site Office
Kansas City Field Office
Livermore Field Office
Los Alamos Field Office
Nevada Field Office
NNSA Production Office
Savannah River Field Office
Sandia Field Office

Preparing Activity:
DOE-SR

Project Number:
TRNG-0075