TS

NOT MEASUREMENT SENSITIVE

DOE–STD–1183-2004
April 2004

DOE STANDARD

NUCLEAR SAFETY SPECIALIST FUNCTIONAL AREA QUALIFICATION STANDARD

DOE Defense Nuclear Facilities Technical Personnel

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

AREA TRNG

This document has been reproduced directly from the best available copy.

Available to DOE and DOE contractors from ES&H Technical Information Services, U.S. Department of Energy, (800) 473–4375, fax: (301) 903-9823.

Available to the public from the U.S. Department of Commerce, Technology Administration, National Technical Information Service, Springfield, VA 22161; (703) 605–6000.

APPROVAL

The Federal Technical Capability Panel consists of senior U.S. Department of Energy 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.

Roy J. Schepens
Chairman
Federal Technical Capability Panel

INTENTIONALLY BLANK

TABLE OF CONTENTS

INTENTIONALLY BLANK

ACKNOWLEDGMENT

The Livermore Site Office is the Sponsor for the Nuclear Safety Specialist Qualification Standard. The Sponsor is responsible for coordinating the development and/or review of the Functional Area Qualification Standard 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 Nuclear Safety Specialist area. The Sponsor, in coordination with the Federal Technical Capability Panel, is also responsible for ensuring that the Functional Area Qualification Standard is maintained current.

The following subject matter experts (SMEs) participated in the development and/or review of this Qualification Standard:

Carol Sohn	NNSA Livermore Site Office (Team Leader)
James Low	NNSA Nevada Site Office,
Frank Rowsome	NNSA Service Center
Al MacDougall	NNSA Service Center
Ed Branagan	DOE-Headquarters Office of Nuclear Energy,
Richard Englehart	DOE-Headquarters (EH-22)
Robert Nelson	Office of River Protection

U.S. DEPARTMENT OF ENERGY
FUNCTIONAL AREA QUALIFICATION STANDARD

Nuclear Safety Specialist

PURPOSE

DOE M 426.1-1, Federal Technical Capability Manual, commits the Department to continuously strive for technical excellence. The Technical Qualification Program, along with the supporting Technical Qualification Standards, complements the personnel processes that support the Department's drive for technical excellence. In support of this goal, the competency requirements defined in the Technical Qualification Standards should be aligned with and integrated into the recruitment and staffing processes for technical positions. The Technical Qualification Standards should form the primary basis for developing vacancy announcements, qualification requirements, crediting plans, interviewing questions, and other criteria associated with the recruitment, selection, and internal placement of technical personnel. Office of Personnel Management minimum qualifications standards will be greatly enhanced by application of appropriate materials from the technical Functional Area Qualification Standards.

The Technical Qualification Standards are not intended to replace the OPM Qualifications Standards nor other Departmental personnel standards, rules, plans, or processes. The primary purpose of the Technical Qualification Program is to ensure that employees have the requisite technical competency to support the mission of the Department. The Technical Qualification Program forms the basis for the development and assignment of DOE personnel responsible for ensuring the safe operation of defense nuclear facilities.

APPLICABILITY

The Nuclear Safety Specialist Functional Area Qualification Standard establishes common functional area competency requirements for Department of Energy personnel who provide assistance, direction, guidance, oversight, or evaluation of contractor technical activities that could impact the safe operation of DOE's defense nuclear facilities. The technical Functional Area Qualification Standard has been developed as a tool to assist DOE Program and Field offices in the development and implementation of the Technical Qualification Program in their organization. For ease of transportability of qualifications between DOE elements, Program and Field offices are expected to use this technical Functional Area Qualification Standard without modification or additions. Needed additional office/site/facility specific technical competencies should be handled separately. Satisfactory and documented attainment of the competency requirements contained in this technical Functional Area Qualification Standard ensures that personnel possess the requisite competence to fulfill their functional area duties and responsibilities. Office/Facility-Specific Qualification Standards supplement this technical Functional Area Qualification Standard and establish unique operational competency requirements at the Headquarters or Field element, site, or facility level.

IMPLEMENTATION

This technical Functional Area Qualification Standard identifies the minimum technical competency requirements for Department of Energy personnel. Although there are other competency requirements associated with the positions held by DOE personnel, this Functional Area Qualification Standard is limited to identifying the specific technical competencies. The competency statements define the expected knowledge and/or skill that an individual must meet. Each of the competency statements is further explained by a listing of supporting knowledge and/or skill statements.

The competencies identify a familiarity level, a working level, or an expert level 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 defined as 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 defined as the knowledge required to monitor and assess operations/activities, to apply standards of acceptable performance, and to reference appropriate materials and/or expert advice as required to ensure the safety of Departmental activities.
>
> **Expert level** is defined as a comprehensive, intensive knowledge of the subject or process sufficient to provide advice in the absence of procedural guidance.
>
> **Demonstrate the ability** is defined as the actual performance of a task or activity in accordance with policy, procedures, guidelines, and/or accepted industry or Department practices.

Headquarters and Field elements shall establish a program and process to ensure that DOE personnel possess the competencies required of their position. That includes the competencies identified in this technical Functional Area Qualification Standard. Documentation of the completion of the requirements of the Standard shall be included in the employee's training and qualification record.

Equivalencies should be used with the utmost rigor and scrutiny to maintain the spirit and intent of the TQP. Equivalencies may be granted for individual competencies based upon objective evidence of previous education, training, certification, or experience. Objective evidence includes a combination of transcripts, certifications, and, in some cases, a knowledge sampling through a written and/or oral examination. Equivalencies shall be granted in accordance with the Technical Qualification Program Plan of the office qualifying the individual. The supporting knowledge and/or skill statements, while not requirements, should be considered before granting equivalency for a competency.

Training shall be provided to employees in the Technical Qualification Program who do not meet the competencies contained in the technical Functional Area Qualification Standard. 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 will be based upon appropriate supporting knowledge and/or skill statements similar to the ones listed for each of the competency statements. Headquarters and Field elements should use the supporting knowledge and/or skill statements as a basis for evaluating the content of any training used to provide individuals with the requisite knowledge and/or skill required to meet the technical Functional Area Qualification Standard competency statements.

It is important to apply tailoring of the competencies of this standard as a function of the Nuclear Safety Specialist’s responsibilities. Dependent upon the individual’s responsibilities and site

specific conditions, as an example, more detailed knowledge may be required in understanding and application of DOE-STD-3009 instead of 29CFR1910.120. It is critical that the familiarity levels be achieved at a minimum for all the competencies, but working or expert level knowledge needs to be driven by the specific position. It is the goal that all individuals who qualify under this standard be at working level or greater for those competencies specifically designated. However, to assure transferability to other sites, familiarity level for all competencies is required but higher level expectations such as working or expert can be tailored subject to specific position requirements.

EVALUATION REQUIREMENTS

Attainment of the competencies listed in this technical Functional Area Qualification Standard should be documented by a qualifying official, immediate supervisor, or the team leader of personnel in accordance with the Technical Qualification Program Plan of the office qualifying the individual.

CONTINUING EDUCATION, TRAINING, AND PROFICIENCY

DOE personnel shall 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:

- Department of Energy
- 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 proficiency activities and the requirements for the continuing education and training program for Nuclear Safety Specialist are included in Appendix A of this document.

DUTIES AND RESPONSIBILITIES

The following are the typical duties and responsibilities expected of personnel assigned to the Nuclear Safety Specialist Functional Area:

1. Oversee implementation of nuclear safety requirements and programs including:

    - Participate in the oversight of contractor implementation of the Nuclear Safety Management Rule (10CFR830 Subpart B) e.g., preparation, review and/or recommendation for approval of nuclear safety documents: Documented Safety Analyses, Technical Safety Requirements, Unreviewed Safety Questions, Safety Evaluation Reports, etc.

    - Evaluate implementation of Integrated Safety Management as related to safety bases: identification, surveillance and maintenance of safety structures, systems and

components (SSC), safety-related QA (e.g., calculation notes), selection and implementation of safety related standards, related nuclear safety management programs, etc.

- Evaluate the nuclear safety of nuclear facilities and operations for Price-Anderson Amendment Act compliance, contract performance, operational readiness reviews, readiness assessments, and other periodic assessments. Participate in enforcement of Price-Anderson Amendments Act requirements.

- Participate in nuclear facility design reviews, safety system status monitoring, etc.

- Evaluate design and analysis uncertainties with the functionalities of systems as described in the Documented Safety Analysis.

2. Communicate Nuclear Safety issues to Department and contractor management and other stakeholders and assist in the resolution of these issues.

3. Participate in the development, review, approval and interpretation of Nuclear Safety Rules, orders, policies, standards, guides and documents.

4. Participate in Departmental self-assessments in the area of nuclear safety.

5. Participate in nuclear facility accident/incident investigations.

6. Participate in emergency response activities.

7. Maintain and increase professional knowledge and expertise related to the field of nuclear safety.

Position-specific duties and responsibilities for Nuclear Safety Specialists are contained in their Office/Facility-Specific Qualification Standard or Position Description.

BACKGROUND AND EXPERIENCE

The U. S. Office of Personnel Management's Qualification Standards Handbook 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.

The preferred education and experience for Nuclear Safety Specialists is:

1. Education:

   - Minimum of Bachelor's of Science in Engineering or Physics and

   - OPM requirements for Occupational Series 801, 810, 830, 840, 893 or 1310 (one or more).

2. Experience:

   Industrial, military, Federal, State, or other directly related background that has provided specialized experience in nuclear safety. Professional certifications such as a PE (professional engineering license) or a certified safety engineer are desirable. Specialized experience can be demonstrated through possession of the competencies outlined in this Standard. Advanced engineering degrees also represent additional credit for experience.

REQUIRED TECHNICAL COMPETENCIES

The competencies contained in this Standard are distinct from those competencies contained in the General Technical Base Qualification Standard. All Nuclear Safety specialists must satisfy the competency requirements of the General Technical Base Qualification Standard prior to or in parallel with the competency requirements contained in this Standard. Each of the competency statements defines the level of expected knowledge and or skill that an individual must posses to meet the intent of this Standard. The supporting knowledge and/or skill statements further describe the intent of the competency statements.

Note: When regulations, Department of Energy directives, or other industry standards are referenced in the Qualification Standard, the most recent revision should be used.

General Technical

1. Nuclear safety specialists shall demonstrate a working level knowledge of the fission process.

Supporting Knowledge and/or Skills

a. Define the following terms:

- Excitation energy
- Critical energy
- Fissile material
- Fissionable material
- Fertile material

b. Describe the curve of binding energy per nucleon vs. mass number and give a qualitative description of the reasons for its shape.

c. Explain why only the heaviest nuclei are easily fissioned.

d. Explain why uranium-235 fissions with thermal neutrons and uranium-238 fissions only with fast neutrons.

e. Characterize the fission products in terms of mass groupings and radioactivity.

2. Nuclear safety specialists shall demonstrate a familiarity level knowledge of the various methods to reduce exposure.

Supporting Knowledge and/or Skills

a. Describe aspects of dose reduction:

- Time
- Distance
- Shielding
- Inverse square law
- ALARA

3. Nuclear safety specialists shall demonstrate a familiarity level knowledge of criticality control, safety parameters, alarm systems and poisons.

Supporting Knowledge and/or Skills

a. Discuss the effects and applications of the following factors relevant to criticality safety of operations:

- Mass
- Shape
- Interaction
- Separation
- Geometry
- Moderation
- Reflection
- Concentration
- Volume
- Density
- Neutron absorbers
- Heterogeneity
- Enrichment

b. Discuss the influence of the presence of non-fissionable materials mixed with, or in contact with, fissionable material on nuclear criticality safety.

c. Discuss the concept of contingencies for checking the validity of criticality safety limits.

d. Define the following terms:

- Criticality accident
- Minimum accident of concern
- Process area

e. Discuss the general principles associated with the use of criticality alarm systems including the following:

- Installation
- Coverage
- Detection
- Alarms
- Dependability

f. Describe the use of neutron poisons.

g. Define the following terms:

- Burnable poison
- Non-burnable poison
- Chemical shim

h. Explain the purpose and use of Raschig Rings as a neutron poison.

4. Nuclear safety specialists shall demonstrate a working level knowledge of terminology used in nuclear safety analysis.

Supporting Knowledge and/or Skills

a. Define the following accident related terms:

- Accident
- Authorization agreement
- Authorization basis
- Beyond design basis accident
- Design basis
- Design basis accidents
- Evaluation guideline
- Safety basis
- Safety analysis
- Consequence
- Frequency
- Risk
- External event
- Internal event

b. Define the following hazard related terms:

- Hazard
- Hazard Categorization
- Hazard Category 1
- Hazard Category 2
- Hazard Category 3
- Hazardous Material

c. Define the following safety control related terms:

- Limiting conditions for operations
- Limiting control settings
- Safety limits

d. Differentiate between the following categories of individuals who may be affected by an accident at a Department nuclear facility:

- Off-site individual
- On-site individual
- Public
- Work

e. Differentiate between the function of structures, systems, and components in the following classifications:

- Safety-class structures, systems, and components (SC-SSC)
- Safety-significant structures, systems and components (SS-SSC)
- Defense-in-depth (DID)/Important to Safety

f. Differentiate between the function and contents of the following documents:

- Documented Safety Analysis (DSA)
- Preliminary Documented Safety Analysis (PDSA)
- Safety Analysis Report (SAR)
- Basis for Interim Operation (BIO)
- Technical Safety Requirements (TSR)
- Preliminary Hazards Analysis (PHA)

g. Differentiate between the controls which have the following designations:

- Mitigating controls
- Preventive controls
- Administrative controls
- Design features
- Passive controls
- Active controls
- Safety structures, systems and components

h. Differentiate between the following types of facilities:

- Nuclear facility
- Non-reactor nuclear facility
- Radiological (below Hazard Category 3 nuclear facility)

i. Differentiate between the following chemical terms:

- Temporary Emergency Exposure Limit (TEEL)-1
- Temporary Emergency Exposure Limit (TEEL)-2
- Temporary Emergency Exposure Limit (TEEL)-3
- Emergency Response Planning Guide (ERPG)-1
- Emergency Response Planning Guide (ERPG)-2
- Emergency Response Planning Guide (ERPG)-3

j. Identify the types of chemical or toxicological hazards that may be found in nuclear facilities.

5. Nuclear safety specialists shall demonstrate a working level knowledge of the principle hazard and accident analysis methods.

Supporting Knowledge and/or Skills

a. Identify and discuss the use of different methods for qualitative hazard analysis. Identify specific strengths and weaknesses with the various methods.

b. Discuss the methods used to identify and categorize the hazards associated with Department nuclear safety analysis.

c. Identify and discuss the methods used to determine and analyze failure modes of SSCs, administrative controls and control programs.

d. Identify and discuss methods available to reviewers to determine if a hazard analysis has omitted important accident vulnerabilities.

e. Identify and discuss the relationship between hazard analysis and the postulation of accidents for quantitative consequence analysis in Documented Safety Analyses for DOE nuclear facilities. Describe what factors govern the choice of an accident warranting further consequence analysis.

f. Identify and discuss essential elements of deterministic and probabilistic risk assessment techniques.

g. Given an accident source term of radionuclide/hazardous chemical release, discuss the factors that should be considered in selection of an appropriate computer code for off-site

transport and deposition.

h. Discuss the physics of fires and explosions as the means of generating airborne plumes of hazardous materials and damaging barriers to releases. Also describe how the physics affects the quantities or rates that hazardous materials may become airborne as a result of spills, evaporation, entrainment, fires and other accidents.

i. Discuss the phenomena and modeling of airborne dispersion of toxic materials addressing weather effects, turbulent mixing, mixing heights, plume temperature, evolution and potential settling or plate out of particulates and aerosols, precipitation, building wake and surface roughness effects.

j. Discuss the mechanisms involved in the damage caused by extreme natural phenomena including: hurricanes, tornadoes, ice storms, wind, flood, earthquakes and wild fires.

k. Define and discuss the following terms:

- Chi/Q
- Dose conversion factor
- Breathing rate
- Aerodynamic equivalent diameter
- Solubility class
- Population dose

l. Given a source term, determine dose consequences applying Chi/Q, dose conversion factor, breathing rate and specific activity as applicable.

m. Given a simple accident scenario, demonstrate knowledge by constructing a simple neutral gas dispersion and heavy gas dispersion. Estimate consequences using an accident modeling code including hand calculations and explain the assumptions, inputs and results.

n. Discuss the process for evaluating assumptions made for scenarios being modeled.

o. Discuss the methods used in the calculation of criticality accidents.

6. Nuclear safety specialists shall demonstrate a familiarity level knowledge of terminology associated with probabilistic risk assessment (PRA) techniques.

Supporting Knowledge and/or Skills

a. Identify the strengths and weaknesses of probabilistic risk assessment for safety design and regulatory decision-making.

b. Define the following terms with respect to reliability engineering and probabilistic risk assessments:

- Probability
- Reliability
- Availability
- Unavailability
- Risk
- Safety
- Accident sequence
- Dominant contributors
- Minimal cut set

c. Define the following terms and differentiate between the associated processes:

- Event tree
- Fault tree
- Failure Modes and Effects Analysis (FMEA)

d. Discuss how probabilistic risk assessment methods can help in understanding accident scenarios.

7. Nuclear safety specialists shall demonstrate a familiarity level knowledge of basic heating, ventilation, air conditioning system (HVAC) and filtration system construction, operation, and application.

Supporting Knowledge and/or Skills

a. Given engineering diagrams of a heating, ventilation, air conditioning system, identify the following components and discuss their purposes:

- Blowers
- Fans
- Dampers
- Chillers
- Filters
- HEPA Filters
- Heat exchangers
- Scrubbers
- Hoods
- Glove boxes
- Flow, pressure, temperature, current, level, voltage and position indicators, recorders and controllers

b. Discuss the relationships between the following in heating, ventilation, and air conditioning systems:

- Supply ventilation
- Flow
- Exhaust ventilation

c. Describe the purpose of the heating, ventilation, and air conditioning system in the following applications:

- Hoods
- Glove boxes
- Hot cells
- Confinement systems
- HEPA Filtration

d. Discuss the reason for and safety significance of the following system parameters:

- Positive vs. Negative system pressure
- Differential pressure across filters
- Differential pressure across components

e. Discuss the potential hazards and failure modes (to equipment and personnel) associated with the use of heating, ventilation, and air conditioning systems and components within

nuclear safety-related systems.

8. Nuclear safety specialists shall demonstrate a familiarity level knowledge of process instrumentation principles of operation as applied to nuclear safety-related systems.

Supporting Knowledge and/or Skills

a. Explain the process-related reason for measuring temperature, pressure, flow, and fluid level.

b. For the temperature detection devices listed, explain how the instrument provides an output representative of the temperature being measured:

- Thermocouple (TC)
- Resistance temperature detector (RTD)

c. For the pressure detection devices listed, explain how the instrument provides an output representative of the pressure being measured:

- Magnehelic differential pressure device
- Photohelic differential pressure device

d. For the position detection devices listed, explain how the detector provides an output representative of the position being represented:

- Limit switches
- Potentiometer
- Linear variable differential transformer types

e. Referring to a piping and instrumentation drawing (P&ID) containing temperature, pressure, level, flow, or position detection components, explain their function in the designated system and relationship to system safety.

f. Discuss the importance of safety and process instrumentation to nuclear safety including redundancy and calibration requirements.

9. Nuclear safety specialists shall demonstrate a familiarity level knowledge of piping and instrumentation drawings (P&ID).

Supporting Knowledge and/or Skills

a. Given a piping and instrumentation drawing, identify/interpret the symbols used for system components including the following as a minimum:

- Valves
- Pumps
- Heat exchangers
- Filters/Strainers
- Fans
- Compressors
- Instruments
- Indicators
- Controllers

b. Identify how valve conditions (open/closed) are depicted.

c. Determine and follow system flowpath(s).

d. Discuss the role of piping and instrumentation diagrams relative to identification of failure modes and mapping fault propagation through networks to support the identification of accident vulnerabilities.

10. Nuclear safety specialists shall demonstrate a familiarity level knowledge of electrical diagrams and schematics.

Supporting Knowledge and/or Skills

a. Given a system diagram, identify/interpret the following symbols:

- Motors
- Controllers
- Breakers
- Generators
- Batteries

b. Given the appropriate diagram, state the condition (energized/de-energized) in which all electrical devices are shown, unless otherwise noted on the diagram.

c. Given a system diagram, identify the power sources and/or loads and their status.

d. Discuss the role of electrical one-line diagrams for identifying failure modes and for mapping fault propagation through networks to support the identification of accident vulnerabilities.

11. Nuclear safety specialists shall demonstrate a familiarity level knowledge of electrical logic diagrams.

Supporting Knowledge and/or Skills

a. Given a logic diagram, identify/interpret the symbols used on logic diagrams to represent the components.

b. Identify the symbols used to denote a logical "1" (high/on) and a logical "0" (low/off) as used in logic diagrams.

c. Given a logic diagram and appropriate information, determine the output of each component and the logic circuit.

d. Given a logic diagram, identify three different trip settings and trace the resulting actions should the trip occur.

e. Discuss the role of control logic diagrams in identifying failure modes and for mapping fault propagation through networks to support the identification of accident vulnerabilities.

12. Nuclear safety specialists shall demonstrate a working level knowledge of radioactivity and transformation mechanisms.

Supporting Knowledge and/or Skills

a. Define the following term:

- Activation

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

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

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

13. Nuclear safety specialists shall demonstrate a working level knowledge of principles and concepts for internal and external dosimetry and dose consequences.

Supporting Knowledge and/or Skills

a. Define the following terms:

- Committed effective dose equivalent
- Total effective dose equivalent
- Whole body
- Derived air concentrations (DAC)
- Annual limit of intake (ALI)
- Weighting factors
- Stochastic effects
- Non-stochastic (deterministic) effects

b. Discuss the conservatisms of International Commission on Radiological Protection (ICRP) Publications 26, 30, 60, 68, 71 and 72 as they relate to dose conversion factors and consequence analysis in hazard categorization and accident analysis.

14. Nuclear safety specialists shall demonstrate a familiarity 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 regulatory limits established by EPA federal guidance reports No.11 and 13 and subsequent DOE radiological evaluation guideline and EPA protective actions guides for nuclear accidents.

c. Identify and discuss the range of doses above which one may expect acute radiation illness and early fatalities.

15. Nuclear safety specialists shall demonstrate a familiarity level knowledge of the principles and use of radiological instrumentation and radiological monitoring/survey practices.

Supporting Knowledge and Skills:

a. Discuss the purpose, principles of detection and operation and field application of the following:

- Continuous air monitors (CAM) including tritium alarms

- Area radiation monitors (ARM)
- Criticality detection/alarm systems
- Process radiation monitors

Regulatory

16. Nuclear safety specialists shall demonstrate a working level knowledge of 10 CFR 830.204, Documented Safety Analysis and DOE Guide 421.1-2, with respect to its impact on Department nuclear safety.

Supporting Knowledge and/or Skills

a. Discuss the basic purposes and objectives of a Documented Safety Analysis.

b. Describe the responsibilities of contractors for the development and maintenance of a Documented Safety Analysis.

c. Define the following terms and discuss the purpose of each:

- Design Basis
- Engineered Design Features
- Safety Analysis
- Safety Basis
- Basis for Interim Operation
- Transportation Safety Document
- Safety Analysis Report for Packaging
- Health and Safety Plan
- Hazards Analysis Report

d. Describe the different requirements for the scope and content of each type of Documented Safety Analysis and discuss the general content of each as well as the required sections of each.

e. Discuss the approval requirements for the Documented Safety Analysis for new facilities and subsequent changes to the Documented Safety Analysis.

f. Define who approves facility operations prior to achieving Documented Safety Analysis upgrade approval.

g. Discuss the provisions for deviations, temporary and permanent exemptions from the 10 CFR 830.204 and safe harbor methodologies.

h. Discuss the application of the graded approach relative to the DSA development.

17. Nuclear safety specialists shall demonstrate a working level knowledge of the safety basis requirements for environmental restoration and decommissioning activities.

Supporting Knowledge and/or Skills:

a. Discuss the application of DOE-STD-1120 and 29 CFR 1910.120 to decommissioning and certain environmental restoration activities.

b. Discuss the content of a safety basis HASP and how it can be used in a dynamic project, including management of hazard controls.

c. Discuss the provisions of 29 CFR 1926.65 and 1910.120 for Technical Safety Requirements.

d. Describe the application of DOE-STD-3011, *Guidance for Preparation of Basis for Interim Operations (BIO) Documents*, to nuclear facilities safety basis.

e. Discuss the limitations associated with the safety basis for "certain environmental restoration activities."

f. Review a chapter of an environmental restoration/decommissioning activity safety basis.

g. Discuss the unique considerations with respect to control selection for waste management activities.

18. Nuclear safety specialists shall demonstrate a working level knowledge of 10 CFR 830.207, DOE Approval of Safety Basis and DOE-STD-1104, with respect to its impact on Department nuclear safety.

Supporting Knowledge and/or Skills

a. Describe the basic purpose and contents of a Safety Evaluation Report.

b. Describe the bases for approval contained in a Safety Evaluation Report.

c. Prepare a Safety Evaluation Report consistent with DOE-STD-1104 for a safety basis amendment or annual update.

19. Nuclear safety specialists shall demonstrate a working level knowledge of 10 CFR 830.206, Preliminary Documented Safety Analysis, with respect to its impact on Department nuclear safety.

Supporting Knowledge and/or Skills

a. Describe the application of the requirements of DOE Order 420.1A and its guidance to the development process for the Preliminary Documented Safety Analyses.

b. Describe the sequencing of the Preliminary Documented Safety Analysis relative to design, procurement, construction and operation of new facilities.

c. Describe the circumstances when a Preliminary Documented Safety Analysis must be prepared.

d. Describe the relationship between the PDSA and the design process.

e. Perform a detailed review of a PDSA chapter.

20. Nuclear safety specialists shall demonstrate a working level knowledge of 10 CFR 830.202, Safety Basis and DOE-STD-1027, with respect to its impact on Department nuclear safety.

Supporting Knowledge and/or Skills

a. Describe when a contractor must establish a safety basis for a facility.

b. Describe the requirements for the safety basis.

c. Describe the requirements the contractor must perform to maintain the safety basis.

d. Discuss the purpose and determine the hazard categorization of an operating nuclear facility.

e. Describe the exclusions types for radionuclides associated with hazard categorization determination.

f. Describe the differences between initial and final hazard categorizations and where these designations occur in the DSA development process.

21. Nuclear safety specialists shall demonstrate a familiarity level knowledge of Department of Energy (DOE) Order 420.1A, Facility Safety, DOE G 420.1-1, Nonreactor Nuclear Safety Design Criteria and Explosive Safety Criteria Guide for use with DOE O 420.1 Facility Safety and DOE-STD-1020, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*, with respect to its impact on Department nuclear safety.

Supporting Knowledge and/or Skills

a. Discuss the purpose and policy associated with DOE Order 420.1A, Facility Safety.

b. Discuss the role of Department nuclear safety specialists with respect to the implementation of the requirements of DOE Order 420.1A, Facility Safety.

c. Discuss the Department policy and objectives with respect to safety-class and safety-significant criteria.

d. Discuss the facility and activity applicability of DOE Order 420.1A, with respect to implementation associated with the design of nuclear facilities.

e. Identify and discuss the use of DOE standards for seismic safety.

f. Define PC-1, PC-2, PC-3 and PC-4 and its relationship to nuclear facility design and the DSA.

g. Discuss aspects of fire protection, fire hazards analysis and its relationship to nuclear facility design and the DSA.

h. Identify and discuss the strengths and weaknesses of methods utilized to analyze the initiation and propagation of fires, and of their potential release of hazardous materials.

i. Identify and discuss the methods used to determine the seismic hazard level to be used in design.

j. Identify and discuss the methods used to assess the structural response of structures and determine whether safety systems may be expected to remain functional following an earthquake of postulated intensity.

k. Identify the methods for evaluating the tolerance of structures and systems for natural phenomenon.

22. Nuclear safety specialists shall demonstrate a working level knowledge of the Technical Safety Requirements as described in 10 CFR 830.205, Technical Safety

Requirements and DOE Guide 423.1-1, with respect to its impact on Department nuclear safety.

Supporting Knowledge and/or Skills

a. Discuss the purpose of Technical Safety Requirements.

b. Describe the responsibilities of contractors authorized to operate defense nuclear facilities for Technical Safety Requirements.

c. Define the following terms and discuss the purpose of each:

- Safety Limit
- Operating Limits
- Limiting Control Settings
- Limiting Conditions for Operation
- Surveillance Requirements
- Administrative Controls

d. Discuss the margin of safety in a TSR.

e. Describe the general content of each of the following sections of the Technical Safety Requirements:

- Use and Application
- Basis
- Design Features

f. Discuss the definition and implementation principles for the term OPERABILITY as used in a Technical Safety Requirement.

g. Discuss the relationship of functional requirements and performance criteria to the Technical Safety Requirements.

h. Discuss the conditions that constitute a violation of the Technical Safety Requirements and state the reporting requirements should a violation occur.

i. Discuss the requirements for administrative control of the Technical Safety Requirements.

j. Discuss the possible source documents that may be used in developing Technical Safety Requirements. Discuss the role of Documented Safety Analyses in selecting Technical Safety Requirements and the respective flowdown.

k. Differentiate between the following facility designations:

- Category A reactor facility
- Category B reactor facility

l. Discuss the requirements for emergency actions that depart from the approved Technical Safety Requirements.

m. Discuss the provisions a contractor may follow to develop alternatives to Technical Safety Requirements for environmental restoration activities.

n. Discuss the requirements for the contractor to maintain the Technical Safety Requirements current.

o. Discuss the application of the graded approach relative to Technical Safety Requirements.

p. Perform a review of a Safety-class or Safety-significant SSC including walking down the associated surveillance requirements and LCO/LCS.

23. Nuclear safety specialists shall demonstrate a working level knowledge of 10 CFR 830.203, Unreviewed Safety Question Process and DOE Guide 423.1-1, with respect to its impact on Department nuclear safety.

Supporting Knowledge and/or Skills

a. Discuss the purpose of the Unreviewed Safety Question process.

b. Discuss the reasons for performing an Unreviewed Safety Question determination.

c. Define the following terms:

- Discrepant as found condition
- Potential inadequacy in the safety analysis
- Proposed Change

d. Define the conditions for an Unreviewed Safety Question.

e. Describe the responsibilities of contractors authorized to operate defense nuclear facilities for the performance of safety evaluations.

f. Describe the actions to be taken by a contractor upon identifying information that indicates a potential inadequacy of safety analyses or, a possible reduction in the margin of safety as defined in the Technical Safety Requirements.

g. Discuss the qualification and training requirements for personnel who perform safety evaluations.

h. Discuss the actions to be taken if it is determined that a Potential Inadequacy in the Safety Analysis is involved.

i. Discuss the following terms as they apply to Unreviewed Safety Questions:

- Categorical exclusions
- Prior Unreviewed Safety Question Determinations
- Inconsequential changes
- Margin of Safety
- Design/Evaluation Basis Accidents
- Important to Safety
- Safety Basis
- Restoration modification
- Evaluation of safety
- Unreviewed safety question
- Justification for continued operations

j. Discuss the responsibilities of the contractor associated with Unreviewed Safety Question summaries and the USQ procedure.

k. Describe DOE's responsibilities when not agreeing with a negative determination.

l. Discuss why the application of the graded approach does not apply to the USQ process.

m. Review a USQ Determination including walking down the proposed change/potential inadequacy.

24. Nuclear safety specialists shall demonstrate a familiarity level knowledge of the functional interfaces between safety system software components and the system-level design.

Supporting Knowledge and/or Skills

a. Identify how system-level requirements are established and then assigned to hardware, software, and human components of a digital instrumentation and control system.

b. Identify the typical requirements that define functional interfaces between safety system software components and the system-level design, as described in standards such as ANSI/IEEE 830, IEEE Guide to Software Requirements Specifications and IEEE 7-4.3.2, Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations. Identify where this information is documented.

c. Identify the specific records that must be maintained and the requirements for maintaining these records to document the development of safety system software.

d. Review a development project for safety system software. Explain how the functional interfaces between components and the system level design were established and controlled.

25. Nuclear safety specialists shall demonstrate a familiarity level knowledge of the relationships between the problems being addressed by safety analysis and design codes, the design requirements for the codes, and the components of the codes.

Supporting Knowledge and/or Skills

a. Identify how functional requirements and applicability of safety analysis and design computer codes are defined, documented, and controlled relative to modeling and data assumptions, design constraints, sizing and timing conditions and input/output parameters.

b. Review a development project for safety analysis or design software. Explain how the problem being addressed by the software was translated into functional requirements, how the requirements were established and controlled, and how the code was reconciled with the original problem.

c. Discuss the DOE toolbox codes (reference http://tis.eh.doe.gov/techstds/toolbox_codes.html), their strengths, weaknesses and other factors governing their appropriate use and the applicable DOE standards and guides for modeling their phenomena.

26. Nuclear safety specialists shall demonstrate a familiarity level knowledge of Department of Energy (DOE) Policy 450.4, Safety Management System Policy and Policy 450.5, Line Environment, Safety and Health Oversight as applied to nuclear safety.

Supporting Knowledge and/or Skills

a. Discuss the fundamentals of Integrated Safety Management and direct application to nuclear safety.

b. Describe the key elements of an effective contractor self assessment nuclear safety program.

c. Discuss the following nuclear safety assessments/surveillance activities:

- Determination of assessment/surveillance requirements
- Operation/Area/Site Office and contractor notification
- Assessment/surveillance agenda

27. Nuclear safety specialists shall demonstrate a familiarity level knowledge of the following criticality safety-related American National Standards Institute/American Nuclear Society (ANSI/ANS) standards:

- **ANSI/ANS-8.1, Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors.**
- **ANS-8.3 (ANSI N-16.2), Criticality Accident Alarm System**
- **ANS-8.5 (ANSI N-16.4), Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material**
- **ANSI/ANS-8.7, Guide for Nuclear Criticality Safety in the Storage of Fissile Materials.**
- **ANS-8.15, Nuclear Criticality Control of Special Actinide Elements**
- **ANS-8.19, Administrative Practices for Nuclear Criticality Safety**

Supporting Knowledge and/or Skills

a. Describe the contents, requirements, and relationship among the above American National Standards Institute/American Nuclear Society Standards.

b. Discuss the applicability of the above American National Standards Institute/American Nuclear Society Standards to the Department facilities and processes.

c. Discuss the role of the Department nuclear safety specialists in implementing the requirements of these Standards.

d. Define the following terms associated with nuclear criticality safety:

- Criticality incident
- Double contingency principle
- Geometry control
- Nuclear criticality safety
- Significant quantity of fissionable material
- Temporary exemption

e. Discuss the Management and Operating (M&O) Contractor responsibilities for the following in relation to criticality safety activities:

- Criticality safety evaluations
- Monitoring
- Surveillance
- Transportation
- Storage

28. Nuclear safety specialists shall demonstrate a familiarity level knowledge of the following Department of Energy (DOE) Orders, Technical Standards, and Notice:

- **DOE-STD-3011, *Guidance for Preparation of Basis for Interim Operation (BIO) Documents* DOE-STD-3014, *Accident Analysis for Aircraft Crash into Hazardous Facilities***
- **US NRC Guide 1.70, Standard Format and Content of Safety Analysis Reports of Nuclear Power Plants**
- **29 CFR 1910.120, Safety and Health Programs, Work Plans, Health and Safety Plan**
- **DOE-STD-1163, *Integration of Multiple Hazard Analysis Requirements and Activities***
- **DOE-STD-3016, *Hazards Analysis Reports for Nuclear Explosive Operations***
- **DOE Order 460.1B, Packaging and Transportation Safety**
- **DOE Guide 460.1-1, Implementation Guide for Use with DOE Order 460.1A, Packaging and Transportation Safety**
- **DOE Order 461.1, Packaging and Transportation of Materials of National Security Interest**
- **DOE Manual 461.1-1, Packaging and Transfer of Materials of National Security Interest Manual**
- **Secretary of Energy Notice (SEN) SEN-35-91, Nuclear Safety Policy**

Supporting Knowledge and/or Skills

a. Describe the contents, requirements, and relationship between the above Technical Standards, and Secretary of Energy Notice.

b. Describe the role of nuclear safety specialists with respect to the requirements in these Orders, Standards, and Secretary of Energy Notice.

c. Determine whether aircraft crashes pose an acceptable or unacceptable hazard to safety of nuclear facilities.

d. Discuss the phenomena of aircraft crashes as a mechanism for releasing toxic materials.

e. Discuss the phenomena to which packaging is designed to withstand transportation accidents and the relationship to accident severity.

29. Nuclear safety specialists shall demonstrate a familiarity level knowledge of the Price-Anderson Amendments Act of 1988 and its relationship to Subparts A and B of 10 CFR 830.

Supporting Knowledge and/or Skills

a. Describe the purpose and scope of the Price-Anderson Amendment Act.

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

c. Describe the indemnity that DOE offers to contractors.

d. Discuss the requirements associated with the topics below, as they are affected by Rule-making aspect of the Price-Anderson Amendment Act:

- Quality Assurance Requirements
- Safety Basis Requirements

e. Discuss the role of Department nuclear safety specialists with respect to implementing the requirements of the Price-Anderson Amendment Act.

30. Nuclear safety specialists shall demonstrate a working level knowledge of the requirements in Department of Energy (DOE) Technical Standard DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports* and DOE-STD-3010, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*.

Supporting Knowledge and/or Skills

a. Discuss the conceptual basis and process for preparation of a facility/activity Documented Safety Analysis.

b. Discuss the following in relation to the preparation of the Documented Safety Analysis:

- Worker safety
- Defense-in-depth
- Programmatic Commitments
- Technical safety requirements (TSRs)
- Structures, systems, and components (SSCs)
- Hazard analysis
- Accident analysis
- Application of the graded approach.
- Safe harbor methods

c. Discuss the relationship between the safe harbor methods for a DSA in 10 CFR 830 Appendix A and the requirements for a DSA in 10 CFR 830.204 with regard to completeness.

d. Describe the objectives of requiring accident analyses in safety basis documents.

e. Identify and discuss the use of the source term five factor formula in accident analyses.

f. Given an accident scenario, determine a reasonably bounding estimate of the airborne release fraction (ARF) and respirable fraction (RF), material at risk (MAR), leak path factor (LPF) and damage ratio (DR) to determine the product (MAR x ARF x RF x DR x LPF).

g. Identify and discuss the methods, conventions and data sources used in developing estimates of the five factors for use in accident analyses.

h. Identify and discuss methods/codes used to determine the environmental dispersion and delivered doses from accidental releases of hazardous materials.

i. Discuss the effect of prevailing weather, building wake effects and plume buoyancy upon the magnitude and distribution of doses from hazardous releases into the atmosphere.

j. Identify and discuss the treatment of uncertainty and the realistic effects in accident analyses.

k. Identify the purpose and relationship between Chapters 3, 4 and 5 and the Technical Safety Requirements of the Documented Safety Analysis.

l. Complete a review of a hazards analysis including walking down the scope of work area.

m. Complete a review of an accident analysis including walking down the accident scenario.

31. Nuclear safety specialists shall demonstrate a working level knowledge of NSTP-2003-1 that describes the relationship between human factors/human performance and institutional programs that support the safety analysis.

Supporting Knowledge and/or Skills

a. Identify and discuss aspects of person-machine interface that can degrade or enhance the safety performance of personnel.

b. Identify and discuss how written procedures are conducive to reliable or unreliable performance of activities important to safety.

c. Identify and discuss how personnel training programs can be conducive to safety or prone to error.

d. Identify and discuss how staffing and qualification of operational personnel are conducive to safe versus unsafe operations.

e. Identify and discuss the influence of management and organizational factors upon safety of operations.

f. Identify and discuss the methods used to estimate the probability of significant mistakes made by personnel and the relationship to probabilistic risk assessment.

g. Identify and discuss the methods for assessing the reliability of administrative controls contained in TSRs and facility programs.

Management, Assessment and Oversight

32. Nuclear safety specialists shall demonstrate a working level knowledge of assessment techniques (such as the planning and use of observations, interviews, and document reviews) to assess facility performance, report results of assessments, and follow up on actions taken as the result of assessments.

Supporting Knowledge and/or Skills

a. Describe the role of nuclear safety specialists in the assessment of Government Owned Contractor Operated (GOCO) facilities.

b. Describe the assessment requirements and limitations associated with the interface with contractor employees.

c. Discuss the essential elements of a performance-based assessment including:

- Investigation
- Fact finding
- Exit interview
- Reporting
- Follow-up
- Closure

d. Describe the following assessment methods and the advantages or limitations of each method:

- Document review

- Observation
- Interview

e. Describe the action to be taken if the contractor challenges the assessment findings and explain how such challenges can be avoided.

33. Nuclear safety specialists shall demonstrate a working level knowledge of the Department of Energy (DOE)/facility contract provisions necessary to provide oversight of a contractor's operations.

Supporting Knowledge and/or Skills

a. Describe the role of nuclear safety specialists in contractor oversight.

b. Compare and contrast the following:

- Department of Energy's expectations of a Management and Operating (M&O) contractor
- A Management and Operating contractor's expectations of the Department of Energy

c. Identify the key elements and features of an effective Department of Energy and Management and Operating contractor relationship.

d. Describe the responsibility nuclear safety specialists have associated with contractor compliance under the Price-Anderson Amendments Act.

e. Describe the role of nuclear safety specialists in the cost-plus-award fee process.

f. Explain the responsibilities of nuclear safety specialists for DOE Order 442.1A, Employee Concerns Program, and the identification, reporting, reviewing, and documentation of employee concerns.

g. Describe the differing professional opinions process used in your office.

34. Nuclear safety specialists shall demonstrate a working level knowledge of problem analysis principles and the techniques necessary to identify problems, potential causes, and corrective action(s) associated with nuclear safety issues at DOE Defense Nuclear Facilities.

Supporting Knowledge and/or Skills

a. Describe and explain the application of problem analysis techniques including the following:

- Root cause analysis
- Causal factor analysis
- Change analysis
- Barrier analysis
- Management oversight risk tree analysis

b. Describe the following types of investigations and discuss an example of the application of each:

- Type A
- Type B

c. Compare and contrast immediate, short term, and long term actions taken as the result of

problem identification or an occurrence.

d. Given a nuclear safety event and/or occurrence data, apply problem analysis techniques and identify the problems and how they might have been avoided.

e. Describe various data gathering techniques and the use of trending/history when analyzing problems.

APPENDIX A
CONTINUING EDUCATION, TRAINING AND PROFICIENCY PROGRAM

The following list represents suggested continuing education, training, and other opportunities that are available for DOE personnel after completion of the competency requirements in this technical Functional Area Qualification Standard. It is extremely important that personnel involved with this program maintain their proficiency through continuing education, training, reading, or other activities such as workshops, seminars, and conferences. The list of suggested activities was developed by the Subject Matter Experts involved in the development of the Functional Area Qualification Standard and is not all-inclusive.

LIST OF CONTINUING EDUCATION, TRAINING, AND OTHER ACTIVITIES

Nuclear Safety specialists shall participate in an Office/Facility-specific continuing training and qualification program that includes the following elements:

1. Continuing technical education and/or training covering topics directly related to the Nuclear Safety specialist area as determined appropriate by management. This may include courses/training provided by Department of Energy, 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.

2. Actively perform the duties of a Nuclear Safety specialist a minimum of 500 hours per year.

3. Attend seminars, symposia, or technical meetings related to Nuclear Safety analysis.

4. Engage in self-study of new regulations, requirements, or advances related to Nuclear Safety analysis.

5. Participation in practical exercises such as emergency or operational drills, simulations, or laboratory-type exercises.

6. Participation in operational readiness reviews and readiness assessments.

7. Specific continuing training requirements shall be documented in Individual Development Plans.

INTENTIONALLY BLANK

CONCLUDING MATERIAL

Review Activity:
EM
NNSA
EH
NE
SC

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

Area and Site Offices
Argonne Area Office
Brookhaven Area Office
Fermi Area Office
Kansas City Site Office
Livermore Site Office
Los Alamos Site Office
Nevada Site Office
Pantex Site Office
Princeton Area Office
Savannah River Site Office
Sandia Site Office
Y-12 Site Office

Preparing Activity:
DOE-NNSA/LSO and EH-22

Project Number:
TRNG-0046