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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

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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, Chairperson
Federal Technical Capability Panel

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ACKNOWLEDGMENT

The U.S. DOE, Office of River Protection (ORP) is the sponsor for the Nuclear Safety Specialist (NSS) Functional Area Qualification Standard (FAQS). The sponsor is responsible for coordinating the development and/or review of the 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 nuclear safety specialist 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

Nuclear Safety Specialist (NSS)

PURPOSE

DOE Manual (M) 426.1-1A, *Federal Technical Capability Manual*, commits the Department to continuously strive for technical excellence. The Technical Qualification Program (TQP), 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. The U.S. Office of Personnel Management (OPM) minimum qualifications standards will be greatly enhanced by application of appropriate materials from the technical FAQS.

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 TQP is to ensure that 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.

APPLICABILITY

The Nuclear Safety Specialist FAQS establishes common functional area competency requirements for all DOE nuclear safety specialist 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 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 are expected to use this technical FAQS without modification. Needed additional office/site/facility-specific technical competencies should be handled separately. Satisfactory and documented attainment of the competency requirements contained in this technical FAQS (see the Federal Technical Capability Program Directives and Standards page at http://www.hss.energy.gov/deprep/ftcp/directives/directives.asp for an example of the Nuclear Safety Specialist FAQS qualification card) ensures that personnel possess the minimum requisite competence to fulfill their functional area duties and responsibilities common to the DOE complex. Additionally, office/site/facility-specific qualification standards 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 competency elements of management and leadership, general

technical knowledge, regulations, administrative capability and assessment and oversight are all embodied in the competencies listed in this Standard. All of the factors above have a bearing on safety. Although the focus of this Standard is technical competence, elements, 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 technical FAQS identifies the minimum technical competency requirements for DOE personnel. Although there are other competency requirements associated with the positions held by DOE personnel, this FAQS is limited to identifying the specific, common technical competencies required throughout all defense nuclear facilities. The competency requirements define the expected knowledge and/or skill that an individual must meet. Each of the competency requirements is further described by a listing of supporting knowledge and/or skill statements. The supporting knowledge and/or skill statements for each competency requirement are provided to challenge the employee in the breath and depth of his/her understanding of the subject matter. In selected competencies, expected knowledge and/or skills have been designated as “mandatory performance activities.” In these competencies, the actions are not optional.

The terms “shall,” “must,” and “will” denote mandatory requirements in this Standard. “Should” denotes a recommended practice that is not required. “May” denotes an option.

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 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.
>
> **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 DOE 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 FAQS. Documentation of the completion of the requirements of the Standard shall be included in the employee’s training and qualification record. Satisfactory attainment of the competency requirements contained in this technical FAQS may be documented using the example Nuclear Safety Specialist FAQS qualification card that can be

obtained from the Federal Technical Capability Program Directives and Standards page at 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 through a written and/or oral examination. Equivalencies shall be granted in accordance with the TQP Plan of the site/office/Headquarters organization qualifying the individual. The supporting knowledge and/or skill statements and mandatory performance activities should be considered before granting an equivalency for a competency.

Training shall be provided to employees in the TQP who do not meet the competencies contained in the 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 will be based on appropriate supporting knowledge and/or skill statements similar to the ones listed for each of the competency requirements. 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 FAQS competency requirements.

EVALUATION REQUIREMENTS

Attainment of the competencies listed in this technical FAQS shall be documented in accordance with the TQP Plan or Policy of the site/office/Headquarters organization qualifying the individual and the requirements in DOE M 360.1-1B, *Federal Employee Training Manual*, and DOE M 426.1-1A.

Unless stated otherwise within the program or site TQP Plan, attainment of the competencies listed in the Nuclear Safety Specialist FAQS should be evaluated and documented by a qualifying official or immediate supervisor who is qualified in the FAQS, using a combination of the following 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 shall 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. The 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 to include 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 oral interviews and written exams 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, REQUALIFICATION, AND TRAINING

Qualification of nuclear safety specialist personnel shall be conducted in accordance with the requirements of DOE M 426.1-1A.

Training shall be provided to employees during initial qualification for the following FAQS technical competencies numbered 5, 17, 22, 23, and 30. The following is a list of resources which may provide portions of training and is not all-inclusive.

- Energy Facility Contractor Group, Safety Analysis Working Group
- National Training Center (NTC)
- Institute of Nuclear Power Operations (INPO)
- American Institute of Chemical Engineers (AIChE)
- Center for Chemical Process Safety (CCPS)

Headquarters and field elements should use the supporting knowledge and/or skill statements as a basis for evaluating the content of any training courses used to provide individuals with the requisite knowledge and/or skills required to meet the Nuclear Safety Specialist FAQS competency statements.

DOE program managers, site/Service Center managers, or NNSA Deputy Administrators shall require personnel filling nuclear safety specialist positions to requalify every five (5) years. The DOE Departmental sponsor/Lead FTCP Agent shall establish the specific requalification training designed to update and maintain the qualifications of nuclear safety specialist personnel. DOE program managers, site/Service Center managers, or NNSA Deputy Administrators shall

document the requalification process which shall, at a minimum include the following:

1. Items added to the Nuclear Safety Specialist FAQS since the individual's last qualification or requalification.

2. A combination of written examinations, oral examination, or facility/site walkthroughs, as necessary, to demonstrate competency on the new material and those areas from the initial qualification where the individual has not demonstrated ongoing experience during the past five (5) years.

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:

- 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 nuclear safety specialist personnel 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 (10 CFR 830 Subpart B) e.g., preparation, review and/or recommendation for approval of nuclear basis safety documents: Documented Safety Analyses (DSAs), Technical Safety Requirements (TSRs), Unreviewed Safety Questions (USQ), Safety Evaluation Reports (SERs), etc.

   - Evaluate implementation of Integrated Safety Management (ISM) as related to safety bases: identification, surveillance and maintenance of safety Structures, Systems, and Components (SSCs), safety-related Quality Assurance (QA), selection and implementation of safety-related standards, related nuclear safety management programs, etc.

- Evaluate the nuclear safety posture 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 DSA.

2. Communicate nuclear safety issues through the site/office management 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 specialist personnel are contained in their office/site/facility-specific qualification standard and/or position description.

BACKGROUND AND EXPERIENCE

The OPM 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 specialist personnel are:

1. Education:

   An NSS must possess the minimum of a Bachelor's of Science degree in Engineering or Physics and meet OPM's requirements for Occupational Series 801, 810, 830, 840, 893, or 1310 (one or more).

2. Experience:

An NSS should have experience in industrial, military, Federal, State, or other directly-related areas that provides specialized experience in nuclear safety. Specialized experience can be demonstrated through possession of the competencies outlined in 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 nuclear safety specialist personnel must satisfy the competency requirements of DOE-STD-1146-2001, *General Technical Base 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 statements is further described by a listing of supporting knowledge and/or skill statements that describe the intent of the competency statement(s). 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 nuclear safety specialists may oversee facilities that utilize predecessor documents to those identified. In those cases, such documents should be included in local qualification standards via the TQP.

1. Nuclear safety specialists shall demonstrate a familiarity 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 qualitatively describe 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 principles and concepts for internal and external dosimetry, dose consequences, and the various methods to reduce exposure.

Supporting Knowledge and/or Skills

a. Define the following terms:

- Committed effective dose equivalent
- Total effective dose equivalent
- Whole body
- Derived Air Concentration (DAC)
- Annual Limit on Intake (ALI)
- Tissue
- Weighting factors
- Stochastic effects
- Non-stochastic (deterministic) effects

b. Discuss 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.

c. Describe the following aspects of dose reduction:

- Time
- Distance
- Shielding
- Inverse square law
- As Low As Reasonably Achievable (ALARA)

d. Describe the hierarchy of controls; engineered, administrative, and personnel protective equipment objectives of 10 CFR 835; for controlling personnel exposure from external sources of radiation in areas of continuous occupational occupancy.

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 and separation
- 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 (SL).

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 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 (LCO)
- Limiting control settings
- SL
- Specific Administrative Control (SAC)
- Administrative Control (AC)

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
- Worker (including collocated worker)

e. Differentiate between the function of SSCs 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:

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

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

- Mitigating controls
- Preventive controls
- AC
- SAC
- Design features
- Passive controls
- Active controls
- Safety SSCs
- Controls that provide confinement
- Controls that provide containment

h. Differentiate between the following types of facilities:

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

i. Differentiate between the following chemical terms:

- Acute Exposure Guideline Level (AEGL)-1
- AEGL-2
- AEGL-3
- Emergency Response Planning Guide (ERPG)-1
- ERPG-2
- ERPG-3
- Temporary Emergency Exposure Limit (TEEL)-1
- TEEL-2
- TEEL-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 methods used to categorize and bin hazardous conditions associated with nuclear safety analysis.

c. Identify and discuss the methods used to determine and analyze failure modes of SSCs, ACs, 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 DSA 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 (PRA) 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 processes for evaluating assumptions made for scenarios being modeled.

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

Mandatory Performance Activities:

a. Demonstrate by participation on at least five (5) safety basis document or amendment reviews whose major focus deals with hazard or accident analysis for the determination of adequacy of the analyses.

6. Nuclear safety specialists shall demonstrate a familiarity level knowledge of terminology associated with PRA techniques.

Supporting Knowledge and/or Skills

a. Identify the strengths and weaknesses of PRA for safety design and regulatory decision-making.

b. Define the following terms with respect to reliability engineering and PRAs:

- Probability
- Reliability
- Availability
- Unavailability
- Uncertainty
- 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 PRA methods can help in understanding accident scenarios.

7. Nuclear safety specialists shall demonstrate a familiarity level knowledge of basic Heating, Ventilation, Air Conditioning (HVAC) system and filtration system construction, operation, and application.

Supporting Knowledge and/or Skills

a. Given engineering diagrams of a HVAC 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 HVAC systems:

- Supply ventilation
- Flow
- Exhaust ventilation

c. Describe the purpose of the HVAC 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 versus negative system pressure
- Differential pressure across filters
- Differential pressure across components
- Adequacy of flow across filters versus differential pressure

e. Discuss the failure modes and potential hazards (to equipment and personnel) associated with the use of HVAC 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 reasons 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 P&ID.

Supporting Knowledge and/or Skills

a. Given a P&ID, identify/interpret the symbols used for system components including the following at 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
- Transformers
- 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. Given a logic diagram and appropriate information, determine the output of each component and the logic circuit.

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

d. 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 “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 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 the Environmental Protection Agency (EPA) federal guidance reports No. 11 and 13, DOE emergency exposure situations from 10 CFR 835, 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.

14. 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

15. Nuclear safety specialists shall demonstrate a working level knowledge of 10 CFR 830.204, *Documented Safety Analysis,* and DOE Guide (G) 421.1-2, *Implementation Guide For Use in Developing Documented Safety Analyses To Meet Subpart B Of 10 CFR 830*, with respect to their impact on the Department's nuclear safety.

Supporting Knowledge and/or Skills

a. Discuss the basic purposes and objectives of a DSA.

b. Describe the responsibilities of contractors for the development and maintenance of a DSA.

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

- Design basis
- Safety analysis
- Safety basis
- BIO

- Transportation safety document
- SAR for packaging
- Health and safety plan
- Hazards analysis report

d. Discuss the six items a DSA for a hazard Category 1, 2, or 3 DOE nuclear facility must address:

- Description of facility and work to be performed
- Systematic identification of natural and man-made hazards
- Evaluation of normal, abnormal, and accident conditions
- Derivation of hazard controls, demonstration of the adequacy of the controls, and description of how the controls are maintained
- Definition of the characteristics of safety management programs
- Definition of criticality safety program, when required

e. Discuss the approval requirements for the DSA for new facilities and subsequent changes to the DSA.

f. Define who approves facility operations prior to achieving DSA upgrade approval.

g. Discuss the provisions for deviations and 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.

16. Nuclear safety specialists shall demonstrate a working level knowledge of 10 CFR 830.207, *DOE Approval of Safety Basis* and DOE-STD-1104-96, *Review and Approval of Nuclear Facility Safety Basis Documents (Documented Safety Analysis and Technical Safety Requirements)*, with respect to their impact on the Department's nuclear safety.

Supporting Knowledge and/or Skills

a. Describe the basic purpose and contents of a SER.

b. Describe the bases for approval contained in a SER.

Mandatory Performance Activities:

a. Demonstrate by direct preparation or assistance in the development of at least two (2) SERs consistent with DOE-STD-1104-96 for a new safety basis, significant update, or safety basis amendment.

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

Supporting Knowledge and/or Skills

a. Describe the application of the requirements of DOE Order (O) 420.1B, *Facility Safety*, and its guidance to the development process for the PDSA.

b. Describe the sequencing of the PDSA relative to design, procurement, construction, and operation of new facilities.

c. Describe the circumstances when a PDSA must be prepared.

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

18. Nuclear safety specialists shall demonstrate a working level knowledge of 10 CFR 830.202, *Safety Basis*, and DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, with respect to their impact on the Department's 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.

Mandatory Performance Activities:

a. Participate in at least two (2) hazard categorization designation reviews.

19. Nuclear safety specialists shall demonstrate a familiarity level knowledge of DOE O 420.1B, *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-1020-2002, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*; with respect to their impact on the Department's nuclear safety.

Supporting Knowledge and/or Skills

a. Discuss the purpose and policy associated with DOE O 420.1B.

b. Discuss the role of the Department's NSSs with respect to the implementation of the requirements of DOE O 420.1B.

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 O 420.1B, 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 and fire hazards analysis and their 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.

l. Discuss the importance of integrating safety analysis development with facility design.

20. Nuclear safety specialists shall demonstrate a working level knowledge of the TSRs as described in 10 CFR 830.205, *Technical Safety Requirements,* and DOE G 423.1-1, *Implementation Guide for Use in Developing Technical Safety Requirements*, with respect to its impact on the Department's nuclear safety.

Supporting Knowledge and/or Skills

a. Discuss the purpose of TSRs.

b. Describe the responsibilities of contractors authorized to operate nuclear facilities for TSRs.

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

- SL
- Operating limits
- Limiting control settings

- LCO
- Surveillance requirements
- ACs
- SAC

d. Describe the general content of each of the following sections of the TSR:

- Use and Application
- Basis
- Design Features

e. Discuss the definition and implementation principles for the term “operability” as used in a TSR.

f. Discuss the relationship of functional requirements and performance criteria to the TSR.

g. Discuss the conditions that constitute a violation of the TSR and state the reporting requirements should a violation occur.

h. Discuss the requirements for AC of the TSR.

i. Discuss the role of DSA in selecting a TSR and the respective flowdown.

j. Discuss the requirements for emergency actions that depart from the approved TSR.

k. Discuss the provisions a contractor may follow to develop alternatives to TSR for environmental restoration activities.

l. Discuss the requirements for the contractor to change the TSR.

m. Discuss the application of the graded approach relative to the TSR.

Mandatory Performance Activities:

a. Participate on a combination of at least five (5) safety basis document reviews and/or review of safety basis documents and/or performance of a field walk-down of a safety related SSC [including the associated surveillance requirements and LCO/ Limiting Condition Statements (LCS)] to determine proper derivation of SL/LCS/LCO/SAC/AC, including associated surveillance requirements.

21. Nuclear safety specialists shall demonstrate a working level knowledge of 10 CFR 830.203, *Unreviewed Safety Question Process*, and DOE G 424.1-1A, *Implementation Guide for Use in Addressing Unreviewed Safety Question Requirements*, with respect to their impact on the Department’s nuclear safety.

Supporting Knowledge and/or Skills

a. Discuss the purpose of the USQ process.

b. Discuss the reasons for performing an USQ determination.

c. Define the following terms:

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

d. Define the conditions for an USQ.

e. Describe the responsibilities of contractors authorized to operate 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 TSR.

g. Discuss the qualification and training requirements for personnel who implement the USQ process.

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 USQs:

- Categorical exclusions
- Prior USQ determinations
- Inconsequential changes
- Margin of safety
- Design/evaluation basis accidents
- Important to safety
- Safety basis
- Restoration modification
- Evaluation of safety
- USQ
- Justification for Continued Operations (JCO)

j. Discuss the responsibilities of the contractor associated with USQ 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.

Mandatory Performance Activities:

a. Demonstrate by participation on either at least one (1) assessment of the contractor USQ process or one (1) regulatory review of either a new or revised contractor USQ procedure or review of one (1) JCO.

22. Nuclear safety specialists shall demonstrate a familiarity level knowledge of the relationships between the problems being addressed by safety analysis and computer 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. Explain how a safety analysis problem being addressed by software is translated into functional requirements, how these requirements are established and controlled, and how the code is reconciled with the original safety analysis problem.

c. Discuss the DOE toolbox codes (reference http://www.hss.energy.gov/CSA/CSP/sqa/central_registry.htm), their strengths, weaknesses, and other factors governing their appropriate use and the applicable DOE standards and guides for modeling their phenomena.

23. 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 ANSI/ANS standards.

b. Discuss the applicability of the above ANSI/ANS standards to the Department's facilities and processes.

c. Discuss the role of the Department's NSSs 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

d. Discuss the contractor's responsibilities for the following in relation to criticality safety activities:

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

24. Nuclear safety specialists shall demonstrate a familiarity level knowledge of the following DOE Orders, technical standards, and Guides:

- **DOE-STD-3011-2002, *Guidance for Preparation of Basis for Interim Operation (BIO) Documents***
- **DOE-STD-3014-96, *Accident Analysis for Aircraft Crash into Hazardous Facilities***
- **DOE-STD-1120-2005, *Integration of Environment, Safety, and Health into Facility Dispositions Activities***
- **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-1163-2003, *Integration of Multiple Hazard Analysis Requirements and Activities***
- **DOE-NA-STD-3016-2006, *Hazard Analysis Reports for Nuclear Explosive Operations***
- **DOE O 460.1B, *Packaging and Transportation Safety***
- **DOE G 460.1-1, *Packaging and Transportation Safety***
- **DOE O 461.1A, *Packaging and Transfer or Transportation of Materials of National Security Interest***
- **DOE M 461.1-1 CHG 1, *Packaging and Transfer of Materials of National Security Interest Manual***
- **Secretary of Energy Notice (SEN) SEN-35-91, *Nuclear Safety Policy***

<u>Supporting Knowledge and/or Skills</u>

a. Describe the contents, requirements, and relationship among the above technical standards.

b. Describe the role of NSSs with respect to the requirements in these Orders and standards.

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

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

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

f. Discuss the application of DOE-STD-1120 and 29 CFR 1910.120 to decommissioning and certain environmental restoration activities, and discuss the content of a safety basis Health and Safety Plan and how it can be used in a dynamic project, including management of hazard controls.

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

25. 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 of the Price-Anderson Amendment Act.

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

c. Describe the general indemnity that DOE offers to contractors.

d. Discuss the requirements associated with the topics below:

- QA
- Safety basis

e. Discuss the role of the Department's NSSs with respect to implementing the requirements of the Price-Anderson Amendment Act.

26. Nuclear safety specialists shall demonstrate a working level knowledge of the requirements in DOE technical standard DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis,* and DOE-STD-3010-94, *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 DSA.

b. Discuss the following in relation to the preparation of the DSA:

- Worker safety
- Defense-in-depth
- Programmatic commitments
- TSRs
- 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 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 TSRs of the DSA.

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

Mandatory Performance Activities:

a. Participate on a combination of at least two (2) safety basis documents or amendment reviews and/or review of safety basis documents whose scope

includes evaluation of the development of a source term or radiological dose consequences.

27. Nuclear safety specialists shall demonstrate a working level knowledge of DOE-STD-1186-2004, *Specific Administrative Controls*, with respect to its impact on the Department's nuclear safety.

Supporting Knowledge and/or Skills

a. Describe the relationship of DOE-STD-1186-2004 to 10 CFR 830, DOE G 423.1-1, and DOE G 421.1-2.

b. Define and discuss how SACs are identified.

c. Discuss the position of SACs in the preferred hierarchy of hazard controls.

d. Describe how SACs are treated in DSAs and TSRs.

e. Discuss how the concepts of validation and verification apply to SACs.

f. Discuss how SACs are implemented and maintained.

g. Describe measures used to ensure the dependability of SACs.

h. Discuss SAC violation reporting requirements.

Management, Assessment and Oversight

28. 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 NSSs 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.

29. Nuclear safety specialists shall demonstrate a working level knowledge of the DOE facility contract provisions necessary to provide oversight of a contractor's operations.

Supporting Knowledge and/or Skills

a. Describe the role of NSSs in contractor oversight.

b. Compare and contrast the following:

- DOE's expectations of a contractor
- A contractor's expectations of the DOE

c. Identify the key elements and features of an effective DOE and contractor relationship.

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

e. Describe the role of NSSs in the cost-plus-award fee process.

f. Explain the responsibilities of NSSs for DOE O 442.1A, *Department of Energy Employee Concerns Program*, and the identification, reporting, reviewing, and documentation of employee concerns.

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

30. Nuclear safety specialists shall demonstrate a familiarity 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 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.

31. Nuclear safety specialists shall demonstrate a familiarity level knowledge of DOE Policy 450.4, *Safety Management System Policy*; Policy 226.1A, *Department of Energy Oversight Policy*; and DOE O 226.1, *Implementation of Department of Energy Oversight Policy*, as applied to nuclear safety.

Supporting Knowledge and/or Skills

a. Discuss the fundamentals of ISM and its 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

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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 FAQS. It is extremely important that personnel involved with this program maintain their proficiency primarily by regularly demonstrating their NSS competencies through on-the-job performance, supplemented with 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 FAQS and is not all-inclusive.

Based on the knowledge and experience of the subject matter experts, it is suggested that the following activities support the maintenance of proficiency in the Nuclear Safety Specialist Functional Area after completion of the competencies in the Standard and other requirements of the TQP.

LIST OF CONTINUING EDUCATION, TRAINING, AND OTHER ACTIVITIES

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 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.

2. Actively perform the duties of nuclear safety specialist at a DOE facility a minimum of 500 hours per year.

3. Attend seminars, symposia, or technical meetings related to nuclear safety.

4. Engage in self-study of new regulations, requirements, or advances related to nuclear safety.

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 (IDPs).

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CONCLUDING MATERIAL

Review Activity:
EM
NNSA
HS
NE
SC

Preparing Activity:
HS-2

Project Number:
TRNG-0055

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

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