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DOE STANDARD

CRITICALITY SAFETY FUNCTIONAL AREA QUALIFICATION STANDARD

DOE Nuclear Facilities Technical Personnel

U.S. Department of Energy **AREA TRNG**
Washington, D.C. 20585

This document is available on the

Department of Energy

Technical Standards Program

Web Page at

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

APPROVAL

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

Karen L. Boardman, Chairperson
Federal Technical Capability Panel

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ACKNOWLEDGEMENT

The Office of Nuclear Energy, Idaho Field Office is the sponsor for the Criticality Safety Functional Area Qualification Standard. The sponsor is responsible for coordinating the development and/or review of the Functional Area Qualification Standard (FAQS) by subject matter experts to ensure that the technical content of the standard is accurate and adequate for Department-wide application for those involved in the Nuclear Criticality Safety Program. 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 version or previous versions of this qualification standard:

Jerry McKamy	DOE-Headquarters (EH) Team Lead
Adolf Garcia	Idaho Operations Office
Gypsy Tweed	Consultant
Tom McLaughlin	Los Alamos National Laboratory
Tom Reilly	WSMS
Jim Morman	Argonne National Laboratory
Calvin Hopper	ORNL
Mike Westfall	ORNL
Jim Mincey	ORNL
Robert Wilson	Rocky Flats Field Office and DOE/EM
Robert Wilson	DOE EM
Tom Nirider	Richland Site Office
Jerry Hicks	NNSA Service Center

In addition, the following criticality safety personnel participated in the review of the drafts of this version of the standard.

Larry Berg	ESE CNS
Glenn Christenbury	SR
Ivon Fergus	HSS
Brenda Hawks	ORO (EM)
Roy Hedtke	PX
Edward (Ed) Kendall	YSO
Mark Lee	LSO
Robert McBroom	OR
Patrick Moss	LASO
Jeff Petraglia	SSO

This revision of the standard includes the requirements of ANSI/ANS 8.26, “Criticality Safety Engineer Training and Qualification Program” although there are many requirements specific to federal oversight that are not included in the scope of ANSI/ANS 8.26. Use of consensus standards when they are available and applicable is required by PL 104-113.

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DOE-STD-1173-2009

U.S. DEPARTMENT OF ENERGY
FUNCTIONAL AREA QUALIFICATION STANDARD

Criticality Safety

PURPOSE

DOE M 426.1-1A, *Federal Technical Capability Manual*, commits the Department to strive continuously for technical excellence. The Technical Qualification Program (TQP), along with the supporting technical qualification standards, complements the personnel processes that support the DOE'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 qualification standards will be greatly enhanced by the application of appropriate materials from the technical FAQSs.

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 nuclear facilities.

APPLICABILITY

The Criticality Safety FAQS establishes common functional area competency requirements for DOE criticality safety personnel who provide assistance, or direction, guidance, oversight, or evaluation of contractor technical activities that could impact the safe operation of DOE's 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 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 FAQS (see the Federal Technical Capability Program [FTCP] Directives and Standards page at http://www.hss.energy.gov/deprep/ftcp/directives/directives.asp for an example of the Criticality Safety FAQS qualification card) ensures that criticality safety 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 competencies 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 these factors have a bearing on safety. Although the focus of this standard is technical competence, competencies such as good communication, recognized credibility, ability to listen and process information, and the ability to guide an effort to get it right the first time are recognized as important aspects of safety.

IMPLEMENTATION

This FAQS identifies the minimum technical competency requirements for DOE criticality safety personnel. Although there are other competency requirements associated with the positions held by DOE criticality safety 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 term "must" denote mandatory requirements, "should" denotes a recommended practice that is not required, and "may" denotes an option in this standard.

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 and 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 must establish a program and process to ensure that criticality safety personnel possess the competencies required of their position, including the competencies identified in this technical FAQS. Documentation of the completion of the requirements of this standard must be included in the employees' training and qualification records. Satisfactory attainment of the competency requirements contained in this technical FAQS may be documented using the example Criticality Safety 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 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, experience, certification, or training. Objective evidence includes a combination of transcripts, certifications, and, in some cases, a knowledge sampling obtained through written and/or oral examinations. Equivalencies must be granted in accordance with the TQP plan of the site/office/Headquarters organization qualifying the individual. The supporting knowledge and/or skill statements and mandatory performance activities should be considered before granting an equivalency for a competency.

Training must be provided to employees in the TQP who do not meet the competencies contained in this technical FAQS. Training may include, but is not limited to, formal classroom and computer-based courses, self-study, mentoring, on-the-job training, and special assignments. Departmental training must be based 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 FAQS competency requirements.

EVALUATION REQUIREMENTS

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

The qualifying official or immediate supervisor should ensure that the candidate meets the background and experience requirements of this FAQS. Unless stated otherwise within the program or site TQP plan, attainment of the competencies listed in the Criticality Safety FAQS should be evaluated and documented by either a qualifying official or immediate supervisor (note: if the immediate supervisor is not a current or former Criticality Safety SME, it is expected the supervisor consult with a qualified Criticality Safety SME using one or 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 must qualify candidates as possessing the basic technical knowledge, technical discipline competency, and position-specific knowledge, skills, and abilities required for their positions. Final qualification should be performed using one or a combination of the following methods:

- Satisfactory completion of a comprehensive written examination. 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 that includes at least one qualified STSM.
- Satisfactory completion of a walkthrough of a facility with a qualifying official for the purpose of verifying a candidate's knowledge and practical skills of selected key elements.

Guidance for 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 AND TRAINING

Qualification of criticality safety personnel must be conducted in accordance with the requirements of DOE M 426.1-1A.

DOE criticality safety personnel must participate in continuing education and training as necessary to improve their performance and proficiency in the criticality safety discipline 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 proficiency activities and the requirements for the continuing education and training program for criticality safety personnel are included in Appendix A of this document.

DUTIES AND RESPONSIBILITIES

The following are the typical duties and responsibilities expected of DOE technical personnel assigned to the Criticality Safety Functional Area:

A. Evaluates criticality safety programs to determine whether the program complies with applicable codes, standards and guides, regulations, Orders, and accepted practices.

B. Appraises facilities, procedures, and operations to determine their adequacy to protect the worker and members of the general public from the consequences of a nuclear criticality accident.

C. Administers and coordinates criticality safety programs for the Department, including performing independent evaluations and special studies.

D. Provides technical assistance and advice in the area of criticality safety to other organizations and independent review groups.

E. Reviews office and/or contractor performance to identify trends indicative of performance or compliance status.

F. Performs technical reviews and provides recommendations on criticality safety program documents (plans, schedules, etc.).

G. Reviews and comments on a wide variety of operating contractor documents including criticality safety evaluations and safety basis documents.

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

I. Develops, reviews, and implements criticality safety policy, requirements, and guidance.

J. Evaluates and oversees criticality experiment programs in accordance with applicable codes, standards and guides, regulations, Orders and accepted practices.

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

BACKGROUND AND EXPERIENCE

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

The preferred education and experience for criticality safety personnel are:

1. Education:

Bachelor of Science degree in Science or Engineering from an accredited institution or meet the alternative requirements specified in the *Qualification Standards Operating Manual* for the GS-0800, Professional Engineering Series.

2. Experience:

Industrial, military, Federal, State, or other directly related background that has provided specialized experience in criticality 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 criticality safety personnel must satisfy the competency requirements of the GTB Qualification Standard prior to or in parallel with the competency requirements contained in this standard. Each of the competency requirements defines the level of expected knowledge and or skill that an individual must posses to meet the intent of this standard. Each of the competency requirements is further described by a listing of supporting knowledge and/or skill statements that describe the intent of the competency statements. In selected competencies, expected knowledge and/or skills have been designated as "mandatory performance activities." In these competencies, the actions are not optional.

Note: When regulations, DOE directives, or other industry standards are referenced in the qualification standard, the most recent revision should be used. It is recognized that some criticality safety personnel 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.

Reference material for many of the following competencies should be chosen carefully. DOE Handbooks and Standards (Published on the DOE Directives website and Technical Standards Website), the Nuclear Criticality Safety (NCS) training modules published on the U. S. DOE Criticality Safety Program website, (http://ncsp.llnl.gov/), and widely accepted college textbooks are acceptable. Reports and documents referenced in the competencies are also acceptable references. Other references must be discussed with the appropriate Qualifying Official before being used for self-study. It is expected, unless specifically stated otherwise, that reference materials and other tools of the criticality safety discipline must be available and used in demonstrating the competencies, and in any written testing to demonstrate these competencies.

It is further expected that initial qualification be achieved through mentoring (ANSI/ANS 8.26, § 6.1) by one or more qualifying officials in criticality safety.

Criticality Safety Basics (Competencies 1 – 8)

1. Criticality safety personnel must demonstrate a working level knowledge of the fission process.

Supporting Knowledge and/or Skills:

a. Define the following terms:

- Excitation energy
- Cross section
- Fissile material
- Fissionable material
- Fertile material

b. Sketch the fission cross section for both U-235 and Pu-239 as a function of neutron energy. Label each significant energy region and explain the implications of the shape of the curves for criticality safety.

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.

f. Define the following terms:

- Sub-critical
- Critical
- Super-critical
- Reproduction factor
- Prompt neutron fraction
- Delayed neutron fraction

g. Discuss isotopes other than U-235 and Pu-239 that are fissionable.

2. Criticality safety personnel must demonstrate a working level knowledge of the various types of radiation interaction with matter.

Supporting Knowledge and/or Skills:

a. Describe the interactions of the following with matter:

- Alpha particle
- Beta particle
- Positron
- Neutron

b. Describe the following ways that gamma radiation interacts with matter:

- Compton scattering
- Photoelectric effect
- Pair production

3. Criticality safety personnel must demonstrate a working level knowledge of criticality controls and safety parameters.

Supporting Knowledge and/or Skills:

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

- Mass
- Absorption
- Geometry
- Interaction
- Concentration
- Moderation
- Enrichment
- Reflection
- Volume

b. Discuss the influence of the presence of non-fissionable materials mixed with, or in contact with, fissionable material on nuclear criticality safety. Include a discussion of the effects of mild absorbers (e.g. some absorption, but mostly scattering), and materials that behave as almost pure elastic scatterers, either with or without significant moderation per collision. (e.g., describe the effect of diluting plutonium oxide with either wet or dry silica, contrast the two, and explain the effects from an interaction viewpoint.)

c. Discuss the effects of density, heterogeneity, and enrichment with respect to resonance escape and lumped fuel.

d. Discuss the effects of mixtures of different fissionable nuclides and the appropriate applications of the “rule of fractions” and “fissionable equivalent mass” concepts.

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

4. Criticality safety personnel must demonstrate a working level knowledge of alarm systems for criticality accidents.

Supporting Knowledge and/or Skills:

a. Define the following terms:

- Criticality accident
- Minimum accident of concern
- Process area

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

- Installation

- Coverage
- Detection
- Alarms
- Dependability
- Removal

c. Discuss the requirements for testing the criticality alarm system.

5. Criticality safety personnel must demonstrate a working level knowledge of neutron absorbers.

Supporting Knowledge and/or Skills:

a. Describe the use of neutron poisons. (See competency 19, ANSI/ANS 8.14 and 8.21)

b. Explain the absorption characteristics of the following elements in terms of their cross-sections:

- Cadmium
- Boron
- Chlorine
- Hydrogen

c. Explain the purpose and use of Raschig Rings as a neutron poison. (See competency 19, ANSI/ANS 8.5)

6. Criticality safety personnel must demonstrate a familiarity level knowledge of the functional interfaces between safety system software and control components and the system level design and function.

Supporting Knowledge and/or Skills:

a. Identify how system level requirements are developed. Explain how these requirements are incorporated into an engineered system. Describe the methods a quality organization should use to verify that the “as installed” system meets the system level requirements as defined.

b. Describe and discuss the advantages and disadvantages of the following automation approaches:

- Analog control systems
- Hard wired relay logic
- Programmable Logic Controller (PLC) based systems.
- Computer control systems

c. Discuss the limitations and pitfalls of automation as it relates to criticality safety. Identify areas that are appropriate to automate and areas where automation might be a detriment to safety.

d. Describe the effect of the following items on control of a process or experimental

system:

- Sensing elements, (e.g. thermocouples, position sensors, level sensors, flow sensors, pressure sensors, power level sensors)
- Control logic element (e.g. the hardware and/or software that actuates the control action elements)
- Control action element and control action (e.g. induction furnace power, resistance furnace voltage, cooling coil flow control, refrigeration unit, modulating valve position, block valve position, pump speed, control rod position, scram system action)
- Controlled system response to control action (e.g. change in temperature, position, level, flow, pressure, power level)

e. Discuss the effects of time dependence in sensing and control systems in relation to the system dynamics. A possible example is a shock driven safety block in a fast burst reactor, as compared to a thermocouple sensor with motor driven reactivity removal in such a reactor.

7. Criticality safety personnel must demonstrate a familiarity level knowledge of non-destructive assay techniques for quantification of fissile and fissionable materials.

Supporting Knowledge and/or Skills:

a. For the following types of stationary assay equipment:

- Calorimeter
- Gamma spectrometer
- Segmented gamma scanner
- Package gamma scanner or 'package counter'
- Passive neutron counter
- High efficiency neutron counter
- Passive/Active neutron counter

1. Briefly describe each type of assay machine.
2. Describe the strengths and weaknesses of each type of machine.
3. Identify the types of materials that will grossly bias the assay, both high and low.

b. Discuss the various types of detectors (e.g. NaI, GeLi, HPGe, Geiger-Mueller, ^{3}He, BF_3) used, and the strengths and weaknesses of each.

c. Discuss the physics and mathematics that relate count time, amount of material, and precision of the assay.

d. Discuss the types of non-destructive assay equipment used for in-situ measurements.

e. Discuss the types of equipment and limitations of assay when the material of interest is the following:

- Shielded by containers or process equipment

- Low activity
- High activity
- Characteristic radiations are low energy
- Characteristic radiations are high energy

f. Briefly discuss how to derive detection criteria and select the appropriate Non-Destructive Analysis (NDA) methods for stationary and in-situ applications.

g. Briefly discuss how the geometry models for detector and source material (e.g. generalized geometry, plane source, point source, line source) affect the interpretation of raw NDA data.

8. Criticality safety personnel must demonstrate a familiarity level knowledge of the relationship between human factors, human performance, and implementation of criticality safety controls.

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 (PRA).

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g. Identify and discuss the methods for assessing the reliability of administrative controls in maintaining criticality safety.

Process Evaluation for Criticality Safety (Competencies 9 – 14)

9. Criticality safety personnel must demonstrate both a working level knowledge of calculational methods used in criticality safety evaluations, and must have demonstrated the ability to use such methods.

Supporting Knowledge and/or Skills:

a. Identify and discuss the application of several common hand calculation methods (e.g., buckling method, solid angle method, surface density, and density analog). Reference LA-14244, *Hand Calculation Methods for Criticality Safety – A Primer*,

Bowen and Busch, November 2006.

b. Prepare an example using each one of the hand calculational methods listed above, or others as accepted or identified by the qualifying official.

10. Criticality safety personnel must demonstrate a working level knowledge of critical and subcritical experiments.

Supporting Knowledge and/or Skills:

a. Describe the types of data derived from critical experiments and their use in criticality safety.

b. Discuss the physics of critical experiments including fundamental concepts associated with critical experiments (e.g. six factor formula, approach to critical, reactivity insertion, multiplication, reactor kinetics, reactivity changes, etc.).

c. Participate in a criticality experiment demonstration.

11. Criticality safety personnel must demonstrate both a working level knowledge of computer codes used in criticality safety evaluations, and must have demonstrated the ability to use such methods.

Supporting Knowledge and/or Skills:

a. Develop input model for one Monte Carlo and one deterministic code or code system (e.g., MONK, VIM, SCALE/KENO, MCNP, PARTISN, SCALE/XSDRN, and COG).

b. Describe how cross section data impact Monte Carlo and deterministic codes.

c. Discuss the advantages and disadvantages of point-wise continuous and multi-group cross-section data.

d. Briefly discuss the effect of geometry and spectral assumptions on the development of multi-group cross sections.

e. Describe the importance of validation of computer codes and how it is accomplished. (See competency 19, ANSI/ANS 8.1 & 8.24)

f. Describe the methodology supporting Monte Carlo codes and deterministic codes.

g. Describe advantages and pitfalls of Monte Carlo calculations and deterministic codes.

h. The diffusion theory model is not strictly valid for treating fissile systems in which neutron absorption, voids, and/or material boundaries are present. In the context of these limitations, identify a fissile system for which a diffusion theory solution would be adequate.

i. Discuss the *International Handbook of Evaluated Criticality Safety Benchmark Experiments*, including its purpose, accessibility, and application to computer code validation.

12. Criticality safety personnel must demonstrate both a working level knowledge of development of criticality safety evaluations and the ability to develop such evaluations.

Supporting Knowledge and/or Skills:

a. Prepare criticality safety evaluations for two different applications selected from those listed in h., i., and k. below.

b. Describe development of contingency analysis and controls.

c. Describe practical ways to minimize the use of administrative controls, and discuss of how to evaluate whether the evaluation develops a proper mix of engineered and administrative controls.

d. Give an example of a practical method for controlling each of the following parameters:

- Mass
- Absorption
- Geometry
- Interaction
- Concentration
- Moderation
- Enrichment
- Reflection
- Volume

e. Describe key personnel in preparation of criticality safety evaluations and determination of process upsets.

f. Describe how subcritical margins and limits are determined.

g. Describe when validation and bias estimates must be considered, and when they may be disregarded.

h. Describe considerations when evaluating various fissile processes, including the following common process upsets:

- Aqueous
- Metal
- Recovery
- Fabrication/Foundry
- Mixed waste

i. Describe considerations for evaluating the following material storage:

- Pits
- Waste
- Fuel elements
- Solutions
- Metal parts

j. Discuss elements of the following industry reference material:

- LA-10860-MS, *Critical Dimensions of Systems Containing U235, Pu239, and U233*, 1986
- LA-12808, *Nuclear Criticality Safety Guide*, 1996
- BNWL-SA-4868 or successor PNL-SA-4868, *Anomalies of Criticality*
- LA-11627-MS, *Glossary of Nuclear Criticality Terms*

k. Describe elements to consider when preparing a Safety Analysis Report for Packaging (SARP). Reference 10 CFR 71 and 49 CFR 173.

l. Describe considerations for evaluating storage of DOE/DOT/NRC certified shipping containers and non-certified shipping containers. Potential references include 10 CFR 71, 49 CFR 173, and TID-7016, Chapter IV.

13. Criticality safety personnel must demonstrate a working level knowledge of the requirements in DOE Technical Standard (STD) DOE-STD-3007-2007, *Guidelines for Preparing Criticality Safety Evaluations at Department of Energy Non-Reactor Nuclear Facilities*.

Supporting Knowledge and/or Skills:

a. Describe the documentation requirements for a criticality safety evaluation conforming to this standard.

b. Discuss the role of this standard in establishing appropriate analytical techniques for criticality safety evaluations.

c. Discuss the relationship between DOE-STD-3007-2007 and DOE O 420.1B, *Facility Safety*.

d. Discuss the proper relationship between criticality analyses and controls, the Documented Safety Analysis (DSA), and TSR Controls, and design features documented in the DSA and TSRs. Example references include DOE-STD-3007-2007, 10 CFR 830, ANSI/ANS 8.26, § 7.7, DOE G 421.1-2, DOE G 423.1-1, and DOE-STD-3009-94 CN 3.

14. Criticality safety personnel must demonstrate a working level knowledge of the guidance provided in DOE-STD-1134-99, *Review Guide for Criticality Safety Evaluations*.

Supporting Knowledge and/or Skills:

a. Describe the purpose and general structure of the guide.

b. Using the guide as a reference, discuss the guidelines provided for use by DOE criticality safety personnel when reviewing criticality safety evaluations produced by a contractor.

Accidents and Abnormal Conditions (Competencies 15 & 16)

15. Criticality safety personnel must demonstrate a working level knowledge of previous criticality accidents and their causal factors.

Supporting Knowledge and/or Skills:

a. Discuss common precursors to criticality accidents.

b. Discuss with some detail three (3) historic accidents described in LA-13638 and the lessons learned from each. Reference LA-13638, McLaughlin, Monahan, & Pruvost, *A Review of Criticality Accidents*, May 2000.

c. Discuss generic lessons learned from criticality accident history, as described in LA-13638, Section 1C.

16. Criticality safety personnel must demonstrate a familiarity level knowledge of problem analysis principles and the techniques necessary to identify Department problems, potential causes, and corrective action(s) associated with criticality safety issues.

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 of the following:

- Type A
- Type B

c. Compare and contrast immediate, short term, and long-term actions taken as the result of a problem identification or an occurrence.

d. Given 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.

Criticality Safety Oversight (Competencies 17 - 22)

17. Criticality safety personnel must demonstrate a working level knowledge of DOE O 420.1B, *Facility Safety*, with respect to its impact on the Department's criticality safety.

Supporting Knowledge and/or Skills:

a. Discuss the purpose and objectives of the nuclear criticality safety requirements of DOE O 420.1B, including when they are applicable.

b. Discuss the following concepts associated with the nuclear criticality safety program:

- Criticality safety program description document
- Qualification requirements of nuclear criticality safety staff
- Acceptable preparation methodologies for nuclear criticality safety evaluations
- Acceptable review methodologies for nuclear criticality safety evaluations
- Proper treatment of the requirements and recommendations from the ANSI/ANS 8-series standards
- Proper treatment of the double contingency principle recommendation and deviations from the principle
- Single failure vulnerability
- Preferred order of criticality safety controls
- Fissionable material accumulation
- Firefighting guidelines

c. Discuss the contractor's responsibilities with respect to the implementation of the requirements of DOE O 420.1B.

d. 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

e. Discuss the role of Department criticality safety personnel with respect to the implementation of the requirements of DOE O 420.1B.

18. Criticality safety personnel must demonstrate a familiarity level knowledge of historical criticality safety-related requirements.

Supporting Knowledge and/or Skills:

a. Describe the history of criticality safety standards, and inconsistencies between DOE Orders and those standards, including regulatory lessons learned. Useful documents may include the following:

- LA-3366
- ANSI N16.1
- ANSI/ANS-8.1, *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors,* prior and current versions
- DOE O 6430.1A, *General Design Criteria*, § 1300-4
- DOE O 5480.5, *Safety of Nuclear Facilities*
- DOE O 5480.24, *Nuclear Criticality Safety*
- DOE O 420.1, 420.1A, and 420.1B, *Facility Safety*
- DOE-STD-1189-2008, *Integration of Safety Into the Design Process*, § 7.5 and Table 7-2
- LA-2063
- TID-7016

19. Criticality safety personnel must demonstrate a working level knowledge of the following criticality safety-related ANSI/ANS standards:

- **ANSI/ANS-8.1, *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors***
- **ANSI/ANS-8.3, (ANSI N-16.2), *Criticality Accident Alarm System***
- **ANSI/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-8.14, *Use of Soluble Absorbers in Nuclear Facilities Outside of Reactors***
- **ANSI/ANS-8.15, *Nuclear Criticality Control of Special Actinide Elements***
- **ANSI/ANS-8.19, *Administrative Practices for Nuclear Criticality Safety***
- **ANSI/ANS-8.20, *Nuclear Criticality Safety Training***
- **ANSI/ANS-8.21, *Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors***
- **ANSI/ANS-8.22, *Nuclear Criticality Safety Based on Limiting and Controlling Moderators***
- **ANSI/ANS-8.23, *Nuclear Criticality Accident Emergency Planning and***
- ***Response***
- **ANSI/ANS-8.24, *Validation of Neutron Transport Methods for Nuclear Criticality Safety Calculations***
- **ANSI/ANS-8.26, *Criticality Safety Engineer Training and Qualification Program***

Supporting Knowledge and/or Skills:

a. Describe the contents, requirements, and relationships among the above ANSI/ANS standards.

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

c. Discuss the role of the Department's criticality safety personnel in implementing the requirements of these standards.

20. Criticality safety personnel must demonstrate a familiarity level knowledge of the following criticality safety-related ANSI/ANS standards:

- **ANSI/ANS-8.6, *Safety in Conducting Subcritical Neutron-Multiplication Measurements In Situ***
- **ANSI/ANS-8.10, *Criteria for Nuclear Criticality Safety Controls in Operations With Shielding and Confinement***
- **ANSI/ANS-8.12, *Nuclear Criticality Control and Safety of Plutonium-Uranium Fuel Mixtures Outside Reactors***
- **ANSI/ANS-8.17, *Criticality Safety Criteria for the Handling, Storage and Transportation of LWR Fuel Outside Reactors***
- **ANSI/ANS-8.27, *Burnup Credit for LWR Fuel***

Supporting Knowledge and/or Skills:

a. Describe the contents, requirements, and relationships between the above Orders and Technical Standards.

b. Describe the role of criticality safety personnel with respect to the requirements in these standards.

21. Criticality safety personnel must demonstrate a familiarity level knowledge of the following criticality safety experiment related ANSI/ANS standards:

- **ANSI/ANS-1, *Conduct of Critical Experiments***
- **ANSI/ANS-14.1, *Operation of Fast Pulse Reactors***

Supporting Knowledge and/or Skills:

a. Discuss when ANS 1 is applicable in a critical experiments facility and when these standards (ANS-1 or ANS 14.1) become the governing criteria as opposed to ANS 8.1.

b. Discuss the similarities between ANS 1 and ANS 8.6.

c. Discuss the differences in safety device actions between operations governed by ANS 1 and ANS 14.1.

d. Discuss the similarities in management practices among ANS 1, ANS 8.1, and ANS 14.1.

e. State the multiplication criteria limits that should be applied to manually performed criticality experiments.

f. Give a brief explanation of the physics reason(s) for ANS-1, § 4.4.

22. Criticality safety personnel must 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 criticality safety personnel in the assessment of Government Owned Contractor Operated (GOCO) and Government Owned Government Operated (GOGO) facilities.

b. Describe how DOE-STD-1158-2002, *Self-Assessment Standard for DOE Contractor Criticality Safety Programs*, should be used in assessments.

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

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

- Investigation
- Fact finding
- Exit interview
- Reporting
  - Including review for factual accuracy
- Follow-up
- Closure

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

- Document review
- Observation
- Interview

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

General Oversight (Competencies 23 - 32)

23. Criticality safety personnel must demonstrate a working level knowledge of DOE O 231.1A Chg 1, *Environment, Safety, and Health Reporting*, and DOE M 231.1-2, *Occurrence Reporting and Processing of Operations Information*, with respect to their impact on Department nuclear safety.

Supporting Knowledge and/or Skills:

a. State the purpose of DOE O 231.1A and DOE M 231.1-2.

b. Define the following terms:

- Event
- Condition
- Facility
- Notification report
- Occurrence report
- Reportable occurrence

c. Discuss the Department's policy regarding the reporting of occurrences as outlined in DOE O 231.1A, Environment, Safety and Health Reporting.

d. State the different categories of reportable occurrences and discuss each.

e. Discuss the categorization, notification, and timeliness requirements associated with the following:

- Notification report
- Final report
- Closing out and verifying occurrence reports
- Contractor occurrence reporting procedures

f. Discuss the general process for preparing and submitting occurrence reports and their follow-up.

g. Using DOE O 231.1A, discuss the role of criticality safety personnel in nuclear safety-related reportable occurrences.

h. Given an occurrence report, determine the following:

- The adequacy of the review process used
- That causes were appropriately defined
- That corrective actions addressed causes
- That the lessons learned were appropriate
- That corrective actions have been completed

i. Using an occurrence report involving criticality safety activities, identify and discuss the factors contributing to the occurrence.

24. Criticality safety personnel must demonstrate a familiarity level knowledge of DOE O 413.3A Chg 1, *Program and Project Management for the Acquisition of Capital Assets*, and DOE-STD-1189-2008, *Integration of Safety into the Design Process*.

Supporting Knowledge and/or Skills:

a. Identify the four project phases and four major decision points in an acquisition project.

b. Identify the safety documents and the DOE response documents [e.g. Safety Evaluation Report (SER)] associated with each critical decision.

c. Discuss the criticality guidance provided in DOE-STD-1189, Section 7.5, Table 7-2, Appendix H, and Appendix I. Also, discuss the type of evaluations that should be provided at each critical decision point as identified in DOE-STD-1189, Table 7-1.

25. Criticality safety personnel must demonstrate a familiarity level knowledge of DOE O 425.1C, *Startup and Restart of Nuclear Facilities*, with respect to nuclear safety issues.

Supporting Knowledge and/or Skills:

a. Discuss the purpose, scope, and applicability sections of DOE O 425.1C.

b. Discuss the content of the requirements section of DOE O 425.1C.

c. Discuss the responsibilities and authorities section of DOE O 425.1C, with respect to implementation.

d. Define the following terms as they relate to DOE O 425.1C and nuclear safety:

- Facility shutdown
- Operational Readiness Review (ORR)
- ORR implementation plan
- ORR scope
- Plan-of-action
- Prestart finding
- Readiness assessment
- Unplanned shutdown

e. Discuss M&O contractor responsibilities for implementing DOE O 425.1C.

f. Discuss the role of Department criticality safety personnel in implementing the requirements of DOE O 425.1C.

26. Criticality safety personnel must demonstrate a familiarity level knowledge of the following DOE Orders, Technical Standards, Notice, and Nuclear Regulatory Commission (NRC) Regulatory Guide:

- **DOE O 5400.5 Chg 2, *Radiation Protection of the Public and the Environment***
- **DOE-STD-3011-2002, *Guidance for Preparation of Basis for Interim Operation (BIO) Documents***
- **Secretary of Energy Notice (SEN) SEN-35-91, *Nuclear Safety Policy***
- **DOE-STD-3009-94-CN3, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports***
- **DOE-HDBK-3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities***
- **Regulatory Guide 3.71, (Rev 1, October 2005) *Nuclear Criticality Safety Standards for Fuels and Material Facilities***

- **DOE-STD-5506-2007, *Preparation of Safety Basis Documents for Transuranic (TRU) Waste Facilities***
- **DOE O 410.1, *Central Technical Authority Responsibilities Regarding Nuclear Safety Requirements***
- **DOE O 460.1B, *Packaging and Transportation Safety***

Supporting Knowledge and/or Skills:

a. Describe the contents, requirements, and relationships between the above Orders, Technical Standards, and SEN.

b. Describe the role of criticality safety personnel with respect to the requirements in these Orders, Standards, and SEN.

c. Discuss the DOE criticality safety interest in NRC Regulatory Guide 3.71.

27. Criticality safety personnel must demonstrate a familiarity level knowledge of the following oversight related DOE Orders and Technical Standards:

- **DOE O 224.3, *Audit Resolution and Follow-up Program***
- **DOE O 224.2A, *Auditing of Programs and Operations***
- **DOE O 226.1A, *Implementation of Department of Energy Oversight Policy***
- **DOE P 226.1A, *Department of Energy Oversight Policy***
- **DOE M 470.4-6 Chg. 1, *Nuclear Material Control and Accountability***
- **DOE P 450.4, *Safety Management System Policy***
- **DOE M 450.4-1, *Integrated Safety Management System Manual***
- **DOE-STD-3006-2000, *Planning and Conduct of Operational Readiness Reviews (ORR)***

Supporting Knowledge and/or Skills:

a. Describe the contents, requirements, and relationships between the above Orders and Technical Standard.

b. Describe the role of criticality safety personnel with respect to the requirements in these Orders and standard.

28. Criticality safety personnel must demonstrate a familiarity level knowledge of the Price-Anderson Amendments Act of 1988 and its impact on DOE criticality safety activities.

Supporting Knowledge and/or Skills:

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

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

c. Discuss the civil and criminal penalties imposed on the Department, M&O contractors, and subcontractors as the result of a violation of applicable rules and regulations related to criticality safety.

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

- Safety analysis reports
- Unreviewed Safety Questions (USQs)
- Quality assurance requirements
- Defect identification and reporting
- Conduct of operations at DOE nuclear facilities
- TSR
- Training and certification
- Maintenance management
- Categorization, notification, reporting, and processing of operational occurrences at DOE nuclear facilities

e. Discuss the role of Department criticality safety personnel with respect to implementing the requirements of the Price-Anderson Amendments Act in accordance with the following:

- 10 CFR 820, *Procedural Rules for DOE Nuclear Activities*
- 10 CFR 830, *Nuclear Safety Management*
- 10 CFR 835, *Occupational Radiation Protection*
- DOE-STD-1083, *Requesting and Granting Exemptions to Nuclear Safety Rules*
- Office of Enforcement and Investigation procedure, "Enforcement of DOE Nuclear Safety Requirements under Price-Anderson Amendments Act of 1988"
- Office of Enforcement and Investigation procedure, "Identifying, Reporting, and Tracking Nuclear Safety Noncompliance under Price-Anderson Amendments Act of 1988"

29. Criticality safety personnel must demonstrate a familiarity level knowledge of communications (both oral and written) when working or interacting with the contractor, stakeholders, and other internal and external organizations.

Supporting Knowledge and/or Skills:

a. Identify the various internal and external groups with whom criticality safety personnel must interface in the performance of their duties.

b. Describe the media that can be utilized to communicate with these groups.

30. Criticality safety personnel must demonstrate a familiarity level knowledge of nuclear safety-related data and information management requirements in accordance with the requirements of the following DOE Orders:

- **DOE O 200.1A, *Information Technology Management***
- **DOE O 243.1, *Records Management Program***
- **DOE O 414.1C, *Quality Assurance***
- **DOE O 241.1A, *Scientific and Technical Information Management***

Supporting Knowledge and/or Skills:

a. Describe the authorized disposition requirements for criticality safety-related records in DOE O 200.1A.

b. Describe the requirements for documents and records in DOE O 414.1C.

c. Describe the purpose, scope, contents, and requirements in these Orders.

d. Discuss the applicability of the above Orders to the Department criticality safety activities and processes.

e. Discuss the role of the Department criticality safety personnel in implementing the requirements of these Orders.

31. Criticality safety personnel must demonstrate a familiarity level knowledge of the following DOE safeguards, security, and nuclear material accountability Orders for nuclear safety-related issues:

- **DOE O 452.6,** ***Nuclear Weapon Surety Interface with the Department of Defense***
- **DOE O 470.4A**, ***Safeguards and Security Program***
- **DOE P 470.1**, ***Integrated Safeguards and Security Management (ISSM) Policy***
- **DOE M 470.4-1 Chg 1**, ***Safeguards and Security Program Planning and Management***
- **DOE M 470.4-2 Chg 1**, ***Physical Protection***
- **DOE M 470.4-6 Chg 1**, ***Nuclear Material Control and Accountability***
- **DOE O 471.1A,** ***Identification and Protection of Unclassified Controlled Nuclear Information***
- **DOE O 475.2**, ***Identifying Classified Information***
- **DOE M 470.4-4A** , ***Information Security Manual***
- **DOE O 5660.1B,** ***Management of Nuclear Materials***

Supporting Knowledge and/or Skills:

a. Describe the purpose, scope, contents, and requirements of these Orders.

b. Discuss the applicability of the above Orders to the Department criticality safety activities and processes.

c. Discuss the role of the Department criticality safety personnel in implementing the requirements of these Orders.

32. Criticality safety personnel must 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 criticality safety personnel in contractor oversight.

b. Compare and contrast the following:
- DOE's expectations of a M&O contractor
- A M&O contractor's expectations of the DOE

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

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

e. Describe the role of criticality safety personnel in the performance measure process.

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

Interface with Safety Basis and Nuclear Safety (Competencies 33 - 40)

33. Criticality safety personnel must demonstrate a familiarity level of knowledge of the terminology used in nuclear safety analysis.

Supporting Knowledge and/or Skills:

a. Define the following accident related terms:

- Accident
- Safety basis
- Beyond design basis accident
- Design basis
- Design basis accidents
- Evaluation guidelines

b. Define the following hazard related terms:

- Hazard
- Hazard classification
- Hazard Category 1
- Hazard Category 2
- Hazard Category 3
- Hazardous material

c. Define the following safety limit related terms:

- Limiting conditions for operations
- Limiting control settings
- Risk

- Safety analysis
- Safety basis
- Safety limits
- Criticality safety limits

d. Differentiate between the following categories of individuals who might 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 structures, systems, and components in the following classifications:

- Safety-class structures, systems, and components
- Safety-significant structures, systems, and components

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

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

g. Differentiate between the plant/facility features that have the following designations:

- Mitigating features
- Preventive features

h. Differentiate between the following types of facilities:

- Nuclear facility
- Non-reactor nuclear facility

34. Criticality safety personnel must demonstrate a familiarity level knowledge of nuclear accident analysis techniques.

Supporting Knowledge and/or Skills:

a. Identify and discuss essential elements of deterministic and PRA techniques.

b. Identify and discuss the methods used to determine and analyze failure modes.

c. Discuss the methods used in the calculation of criticality safety, source term,

environmental transport, and dose assessment activities, including commonly used computer models.

d. Discuss the methods used to identify and categorize the hazards associated with Department nuclear systems.

e. Identify and discuss the role and use of human factors techniques in hazard and accident analysis.

35. Criticality safety personnel must demonstrate a familiarity level knowledge of terminology associated with PRA techniques.

Supporting Knowledge and/or Skills:

a. Define the following terms with respect to PRA:

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

b. Define the following terms and differentiate between the associated processes: Note: NUREG-0492, *Fault Tree Handbook*, may be useful for this competency:

- Event tree
- Fault tree

c. Discuss the concept of "credible" as used in criticality safety process evaluations as compared to the terms “not credible” or “beyond extremely unlikely” as used in DSAs.

36. Criticality safety personnel must demonstrate a working level knowledge of the 10 CFR 830, *Nuclear Safety Management*, requirements related to USQs and the associated DOE Guide 424.1-1A, *Implementation Guide for Use in Addressing Unreviewed Safety Question Requirements*.

Supporting Knowledge and/or Skills:

a. Discuss the reasons for performing an USQD.

b. Define the following terms:

- Accident analyses
- Safety analysis
- TSR

c. Describe the situations for which a criticality safety evaluation is required to be performed.

d. Define the conditions for an USQ.

e. Describe the responsibilities of contractors authorized to operate DOE 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 previous safety analyses or a possible reduction in the margin of safety as defined in the TSR.

g. Discuss the actions to be taken if it is determined that an USQ is involved.

h. Discuss the following terms as they apply to USQs:

- Margin of safety
- Important to safety
- Safety basis

37. Criticality safety personnel must demonstrate a working level knowledge of the 10 CFR 830, *Nuclear Safety Management*, requirements related to TSRs and the associated DOE Guide 423.1-1, *Implementation Guide for Use in Developing Technical Safety Requirements*.

Supporting Knowledge and/or Skills:

a. Discuss the purpose of TSRs.

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

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

- Safety limit
- Limiting control settings
- Limiting conditions for operation
- Surveillance requirements

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

- Use and application
- Safety limits
- Operating limits
- Surveillance requirements
- Administrative controls
- Basis
- Design features

e. Discuss the conditions that constitute a violation of the TSRs, and state the reporting requirements should a violation occur.

f. Discuss the requirements for administrative control of the TSRs.

g. Discuss the possible source documents that may be used in developing TSRs.

h. Discuss the requirements for emergency actions that depart from the approved TSRs.

38. Criticality safety personnel must demonstrate a familiarity level knowledge of DOE-STD-1186-2004, *Specific Administrative Controls* (SACs), with respect to its impact on criticality safety.

Supporting Knowledge and/or Skills:

a. Discuss how SACs are identified.

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

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

d. Discuss how SACs are implemented and maintained.

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

39. Criticality safety personnel must demonstrate a working level knowledge of 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 criticality safety.

Supporting Knowledge and/or Skills:

a. Discuss the differences between the hazard categorization for dose to the public, and hazard categorization when criticality risks exist.

b. Describe the requirements for a facility to remain hazard category 3 or below if a criticality program or criticality controls exist.

c. Discuss the role of criticality safety personnel in implementation of DOE-STD-1027-92.

40. Criticality safety personnel must demonstrate a working level knowledge of 10 CFR 830, *Nuclear Safety Management,* requirements related to DSAs and the associated DOE G 421.1-2, *Implementation Guide in Developing Documented Safety Analysis to Meet Subpart B of 10 CFR 830*.

Supporting Knowledge and/or Skills:

a. Discuss the four basic purposes and objectives of DSAs.

b. Describe the responsibilities of contractors authorized to operate DOE nuclear facilities for the development and maintenance of a DSA.

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

- Design basis
- Engineered safety features
- Safety analysis

d. Describe the requirements for the scope and content of a DSA, and discuss the general content of each of the required sections of the report.

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

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

g. Discuss the requirements for the contractor to maintain the DSA current.

APPENDIX A
CONTINUING TRAINING, EDUCATION, 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 competency 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 Criticality Safety Functional Area after completion of the competencies in the standard and other requirements of the TQP.

LIST OF CONTINUING EDUCATION, TRAINING, AND OTHER ACTIVITIES

Criticality safety personnel must participate in an office-/site-/facility-specific continuing training and qualification program that includes the following elements:

Item 1. must be completed at least annually. Items 2. and 3. should be completed on an as needed basis as new regulations and standards are published. At least two of items 4. through 8. must be completed every 2 years.

1. Actively perform the duties of a criticality safety engineer at one or more DOE facilities. Active performance includes the following at a minimum:

    - Do at least one assessment
    - Participate in at least 4 Criticality Safety Coordinating Team (CSCT) monthly phone calls
    - Engage in telephone, e-mail, and face-to-face discussions with members of the CSCT and Criticality Safety Support Group (CSSG) regarding current issues, changes in DOE standards, DOE Orders, and other matters pertinent to DOE criticality safety.

2. Engage in self-study of new DOE regulations and requirements related to criticality safety.

3. Maintain awareness of all current (new or revised) ANSI/ANS-8 standards as they are published.

4. Participate in continuing technical education and/or training covering topics directly related to the criticality safety area as determined appropriate by management. This may include courses/training provided by the DOE, other government agencies, outside vendors, local educational institutions, or hands on or practical courses approved by the DOE Nuclear Criticality Safety Program. Continuing training topics should also address identified weaknesses in the knowledge or skills of the individual personnel.

Participation may be as either student or instructor.

5. Attend seminars, symposia, or technical meetings (e.g., technical sessions, workshops, or tutorials sponsored the Nuclear Criticality Safety Division of the American Nuclear Society) related to criticality safety.

6. Engage in self-study of new regulations, requirements (other than DOE), or advances related to criticality safety.

7. Participate in practical exercises such as emergency or operational drills, simulations, or laboratory-type exercises. Participation may be as scenario developer, controller, evaluator, or cadre member.

8. Participate in the development of national standards related to criticality safety. These may include federal standards (e.g. DOE Standards related to criticality safety) or national or international consensus standards. This includes active service in writing groups or consensus committees such as ANS-8 or N-16.

9. Specific continuing training requirements must be documented in Individual Development Plans (IDPs).

CONCLUDING MATERIAL

Review Activity:
HSS
EH
EM
NE
SC
RW
CDNS
CNS

Preparing Activity:
NNSA-SC

Project Number:
TRNG-0066

Field and Operations Offices:
Idaho
Oak Ridge
Richland

Site Offices:
Los Alamos Site Office
Livermore Site Office
Pantex Site Office
Sandia Site Office
Savannah River Site Office
Y-12 Site Office