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DOE-STD-1173-2024
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DOE STANDARD

CRITICALITY SAFETY FUNCTIONAL AREA QUALIFICATION STANDARD

DOE Defense Nuclear Facilities Technical Personnel

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

AREA TRNG

This document is available on the Department of Energy National Training Center's Federal Technical Capabilities SharePoint site at

https://ntc.doe.gov/sites/tqp/SitePages/Home.aspx

APPROVAL

The Federal Technical Capabilities (FTC) Panel is responsible for reviewing and approving Functional Area Qualification Standards (FAQSs) for department-wide application. Approval of this FAQS from the FTCP is indicated by the signature below.

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Federal Technical Capabilities Panel

Date

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ACRONYM LIST

ANSI/ANS	American National Standards Institute / American Nuclear Society
CAAS	Criticality Accident Alarm System
CAS	Contractor Assurance System
CSCT	Criticality Safety Coordinating Team
CSPD	Criticality Safety Program Description (CSPD).
CSE	Criticality Safety Evaluations
CSS	Criticality Safety Specialist
CSSG	Criticality Safety Support Group
DOE	U.S. Department of Energy
DSA	Documented Safety Analysis
DNFSB	Defense Nuclear Facilities Safety Board
EA	Enterprise Assessments
eTQP	electronic Technical Qualification Program
FAQS	Functional Area Qualification Standard
FPE	Fire Protection Engineer
FR	Facility Representative
FTC	Federal Technical Capabilities
FTCP	Federal Technical Capabilities Panel
G	Guide
GTB	General Technical Base
HDBK	Handbook
JTA	Job Task Analysis
MC&A	Material Control and Accountability
MPA	Mandatory Performance Activity
NDA	Non-Destructive Analysis
NNSA	National Nuclear Security Administration
NSS	Nuclear Safety Specialist
NTC	National Training Center
O	Order
PDSA	Preliminary Documented Safety Analyses
PLC	Programmable Logic Controller
QO	Qualifying Official
QS	Qualification Standard
RP	Radiation Protection
SDS	Safety Design Strategy
SME	Subject Matter Expert
SSO	Safety System Oversight
STD	Standard
TQP	Technical Qualification Program
TSR	Technical Safety Requirements

DOE-STD-1173-2024

U.S. DEPARTMENT OF ENERGY
FUNCTIONAL AREA QUALIFICATION STANDARD

PURPOSE

Functional area qualification standards (FAQSs) establish common performance competencies in key nuclear facility functional areas for personnel in the U.S. Department of Energy (DOE) Technical Qualification Program (TQP).

This FAQS establishes performance competencies to ensure designated personnel have the technical competency to perform the duties and responsibilities of a criticality safety specialist (CSS).

The content of this FAQS should be referenced and used, as appropriate, to develop vacancy announcements, interview questions, and other criteria associated with the recruitment, selection, and placement of personnel assigned to this FAQS.

APPLICABILITY

The DOE Order (O) 426.1, *Federal Technical Capabilities,* requires FAQS to be developed for DOE employees whose duties and responsibilities could affect the safe operation of defense nuclear or high hazard facilities to assist a DOE program, field offices, and sites with implementation of their organization specific TQP.

This FAQS establishes common performance competencies for DOE personnel who perform the duties and responsibilities of a CSS. For ease of transportability of qualifications between DOE elements, program and field offices must use this FAQS without modification or addition to the competency requirements.

Satisfactory and documented attainment of the competencies in this FAQS ensures personnel possess the minimum requisite knowledge and skills to perform criticality safety duties and tasks. To supplement this FAQS, DOE O 426.1 requires organization-specific qualification standards to establish unique organization (headquarters, field element, site, or facility) level competencies.

IMPLEMENTATION

This FAQS, derived from a criticality safety job task analysis (JTA), is comprised of performance competencies based on task performances. Each performance competency includes knowledge requirements and, if necessary, mandatory performance activities (MPAs). The objective of the MPA(s) is to demonstrate that the competency has been met by having the participant apply the related knowledge to satisfactorily perform the associated job task.

An evaluation guide has been developed for this FAQS, detailing the expected level of knowledge required to obtain qualification and assist the Qualifying Officials (QOs) responsible

for verifying the attainment of the knowledge. The evaluation guide is available through the National Training Center (NTC) FTCP SharePoint site at: https://ntc.doe.gov/sites/tqp/SitePages/Home.aspx.

For initial qualification, participants assigned this FAQS must demonstrate attainment of the knowledge in the "Required Performance Competencies" section.

The MPAs listed in this FAQS must be satisfactorily performed and documented once. If any of the evaluation criteria are not satisfactorily met, the designated QO may require the participant to reperform the MPA. Some MPAs may be duplicated in other qualification standards. In these cases, the designated QO must verify and document the satisfactory completion of each MPA required by the applicable standards in the eTQP.

Participants should perform the MPAs in their assigned work area(s). When participants cannot perform the MPAs as written in their assigned work area(s) or within the required qualification timeframe, supervisors may use other options to facilitate completion. These options include performance in a simulated environment or making minor accommodations to either the MPA or the evaluation criteria. Justification(s) for the accommodation(s) must be documented by the QO, with approval of the supervisor and the FTCP agent.

EVALUATION CRITERIA

Attainment of the performance competency knowledge requirements and MPAs listed in this FAQS must be documented in accordance with the qualifying organization's TQP plan (or policy) and the requirements in DOE O 426.1.

Each performance competency includes knowledge requirements and/or MPAs designed to demonstrate attainment of competency. The QO verifies the evaluation criteria—including organization-specific requirements—was satisfactorily met during observation of the MPA and/or review of the MPA results. Attainment of competency knowledge or MPAs must be verified by a designated QO using one (or a combination) of the following methods listed in DOE O 426.1:

- Satisfactory completion of a written examination
- Satisfactory completion of an oral evaluation
- Documented evaluation of equivalencies
- Completion of approved training courses that confirm attainment of specific knowledge requirements

Satisfactory attainment of the competency knowledge requirements and MPAs contained in this FAQS must be documented in the electronic Technical Qualification Program (eTQP) at https://etqp.ntc.doe.gov.

Once the attainment of the performance competency knowledge requirements and the MPAs in this FAQS has been verified by a QO, the participant must satisfactorily complete the final qualification activity requirements identified in DOE O 426.1B and/or any applicable organization-specific requirements before being designated as a qualified criticality safety specialist (CSS).

INITIAL QUALIFICATION AND CONTINUING TRAINING

Appendix A, *Initial Qualification Training Recommendations*, includes a list of NTC and external training courses supporting the attainment of the required performance competencies for CSS participants.

Appendix B, *Continuing Training Recommendations*, outlines courses for CSS participants to participate in as part of the continuing training program.

DUTIES AND RESPONSIBILITIES

The following are typical duties and responsibilities expected of a CSS:

- Analyze documents related to criticality safety.
  - Review and make a recommendation for/against approval of the contractor's nuclear criticality safety program description document.
  - Review and make a recommendation for/against approval of the contractor's safety basis documentation as it relates to nuclear criticality safety.
- Monitor day-to-day program activities to support periodic contractor performance evaluations.
- Conduct oversight activities to evaluate contractor compliance to the applicable requirements and regulations.
- Provide subject-matter expertise.

Technical support duties are dependent on the organizational needs and the participant's level of subject-matter expertise and will not be addressed by the competencies in this FAQS. Position-specific duties and responsibilities for CSS should be included in position descriptions and other qualification standards, as applicable.

BACKGROUND AND EXPERIENCE

The preferred education and experience for criticality safety specialists are as follows:

1. **Education**: Bachelor's degree in engineering or a science-related field or meeting the alternative requirements specified for engineers or scientists in the Qualifications Standards Handbook. An advanced technical degree and/or a professional or industry certification is considered to be an advantage.

   And/or

2. **Experience**: Industrial, military, Federal, state, or other directly related background providing specialized experience in criticality safety. Specialized experience can be demonstrated through possession of the competencies outlined in this standard. **Additionally, previously qualified employees in the following functional areas may have some of the skills and experience CSS requires, such as a facility representative, nuclear safety specialist, or safety system oversight FAQS.**

The knowledge requirements and associated MPAs identified in this FAQS were developed with the supposition that participants have the above preferred education and experience. The supervisor and QO will determine if participants assigned this FAQS need additional developmental assignments and supporting training.

REQUIRED PERFORMANCE COMPETENCIES

Each competency defines the expected level of knowledge and performance the participant must attain. The performance competencies contained in this FAQS include additional knowledge requirements distinct from the knowledge requirements contained in the General Technical Base (GTB) Part A and B qualification standard (QS). Prior to (or in parallel with) initial qualification to this FAQS, participants must satisfy the requirements of the GTB Part A and GTB Part B QS.

Note 1: When regulations, DOE directives, or other industry standards are referenced in this FAQS, the most recent revision should be used. However, CSS participants and QOs should also refer to the versions of requirements included in the local contract during qualification. Applicable knowledge requirements in preceding documents not included in this FAQS should be included in the organization-specific QS or continuing training program.

Note 2: If specific evaluation criteria are not identified for any of the MPAs in this FAQS, the following generic evaluation criteria should be used in conjunction with local requirements:

Generic MPA Evaluation Criteria:

- Identify criteria for the specific activity.
- Compare results to the criteria and document conclusions.
- Document identified issues or recommendations.
- Discuss, if applicable, how to communicate results to appropriate Federal and/or contractor personnel.

Criticality Safety Basics

1. A criticality safety specialist (CSS) shall demonstrate an understanding of criticality safety basics.

Knowledge Requirements:

A. Define the following fission terms:
   1. Excitation energy
   2. Cross section
   3. Fissile material
   4. Fissionable material
   5. 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 easily fission.

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.
   1. Subcritical
   2. Critical
   3. Supercritical
   4. Multiplication factor
   5. Prompt neutron fraction
   6. Delayed neutron fraction

G. Discuss isotopes other than U-235 and Pu-239 that are fissile or fissionable.

H. Describe the interactions of the following with matter.
   1. Alpha
   2. Beta minus (electron emission)
   3. Beta plus (Positron emission)
   4. Neutron

I. Describe the following ways that gamma radiation interacts with matter.
   1. Compton scattering
   2. Photoelectric effect
   3. Pair production
   4. Photonuclear

J. Discuss the effects and applications of the following factors relevant to criticality safety of operations.
   1. Mass
   2. Absorption
   3. Geometry
   4. Interaction
   5. Concentration
   6. Moderation
   7. Enrichment / isotopic distribution
   8. Reflection
   9. Volume

K. 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).

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

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

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

O. Define the following terms.
   1. Criticality accident
   2. Minimum accident for system design
   3. Process area

P. Discuss the general principles associated with the use of criticality alarm systems, including the following:
   1. Installation
   2. Coverage
   3. Detection
   4. Alarms
   5. Dependability
   6. Removal

Q. Discuss the requirements for testing the criticality accident alarm system.

R. Describe the use of fixed and soluble neutron poisons.

S. Explain the absorption characteristics of the following elements in terms of their cross sections.
   1. Cadmium
   2. Boron
   3. Chlorine
   4. Hydrogen
   5. Gadolinium

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

U. Describe and discuss the advantages and disadvantages of the following automation approaches.
   1. Analog control systems
   2. Hard wired relay logic
   3. Programmable logic controller (PLC) based systems
   4. Computer control systems

V. 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.

W. Describe the effect of the following items on control of a process or experimental system.
   1. Sensing elements (e.g., thermocouples, position sensors, level sensors, flow sensors, pressure sensors, power level sensors)
   2. Control logic element (e.g., the hardware and/or software that actuates the control action elements)
   3. 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)

4. Controlled system response to control action (e.g., change in temperature, position, level, flow, pressure, power level)

X. Discuss the effects of time dependence in sensing and control systems in relation to 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.

Y. For the following types of stationary assay equipment, briefly describe each type of assay machine, describe the strengths and weaknesses of each type of machine, and identify the types of materials that will grossly bias the assay, both high and low.
1. Calorimeter
2. Gamma spectrometer
3. Segmented gamma scanner
4. Package gamma scanner or “package counter”
5. Passive neutron counter
6. High-efficiency neutron counter
7. Passive/active neutron counter

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

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

BB. Discuss the types of nondestructive assay equipment used for in situ measurements.

CC. Discuss the types of equipment and limitations of an assay when the material of interest is the following:
1. Shielded by containers or process equipment
2. Low activity
3. High activity
4. Characteristic radiations are low energy
5. Characteristic radiations are high energy

DD. Discuss how to derive detection criteria and select the appropriate nondestructive analysis (NDA) methods for stationary and in situ applications.

EE. 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.

FF. Discuss two criticality safety accidents, including:
1. background;
2. cause, precursors, and process upsets;
3. consequences;
4. and lessons learned.

GG. Describe the purpose of and difference between critical and subcritical experiments.

HH. Discuss CSS interface with other technical disciplines.

Criticality Safety Program Requirements

2. A CSS shall demonstrate an understanding of orders, standards, and other requirements for a criticality safety program.

Knowledge Requirements:

A. Discuss each section in DOE O 420.1, *Facility Safety,* as it applies to criticality safety.

B. Discuss purpose, scope, and applicability of DOE O 232.2, *Occurrence Reporting and Processing of Operations Information*.

C. Discuss purpose, scope, and applicability of DOE O 226.1, *Implementation of Department of Energy Oversight Policy.*

D. Discuss purpose, scope, and applicability of DOE O 425.1, *Verification of Readiness to Start Up or Restart Nuclear Facilities.*

E. Discuss purpose, scope, and applicability of DOE O 426.2, *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities*.

F. Discuss purpose, scope, and applicability of DOE O 460.1, *Hazardous Materials Packaging and Transportation Safety*.

G. Discuss purpose, scope, and applicability of DOE STD-3007-2017, *Preparing Criticality Safety Evaluations at DOE Nonreactor Nuclear Facilities*.
   1. Describe what section 6 of DOE-STD-3007-2017 states on how to elevate controls based on interactions with DOE-STD-3009-2014, *Preparation of Nonreactor Nuclear Facility Documented Safety Analysis*.
   2. Describe section 3.4 on methodology and validation.

H. Discuss purpose, scope, and applicability of 10 CFR 71, *Packaging and Transportation of Radioactive Material*, Subpart C, 71.22, *General license: Fissile material*.

I. Discuss purpose, scope, and applicability of 10 CFR 830, *Nuclear Safety Management*, Subpart B, 830.204.

J. Discuss purpose, scope, and applicability of DOE-STD-1027, including the following:
   1. Threshold quantities
   2. Fissile material limits
   3. Hazard categorizations, including downgrading through nature of process or segmentation

K. Discuss purpose, scope, and applicability of DOE-STD-1189, *Integration of Safety Design* and DOE O 413.1, *Program and Project Management for the Acquisition of Capital Assets*.

L. Discuss purpose, scope, and applicability of DOE-STD-5506-2021, *Preparation of Safety Basis Documents for Transuranic (TRU) Waste Facilities*.

M. Discuss purpose, scope, and applicability of DOE-HDBK-3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*.

N. Discuss purpose, scope, and applicability of DOE O 410.1, *Central Technical Authority Responsibilities Regarding Nuclear Safety Requirements*.

O. Discuss purpose, scope, and applicability of DOE-HDBK-1224-2024, *Hazard and Accident Analysis Handbook*.

P. Discuss purpose, scope, and applicability of ANS-8 Series Standards, including:
   1. ANS-8.1-2014 (R2023), *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors*
   2. ANS-8.3-2022, *Criticality Accident Alarm System*
   3. ANS-8.6-1983 (R2022), *Safety in Conducting Subcritical Neutron-Multiplication Measurements in Situ*
   4. ANS-8.7-2022, *Nuclear Criticality Safety in the Storage of Fissile Materials*
   5. ANS-8.10-2015 (R2020), *Criteria for Nuclear Criticality Safety Controls in Operations with Shielding and Confinement*
   6. ANS-8.12-1987 (R2021), *Nuclear Criticality Control and Safety of Plutonium-Uranium Fuel Mixtures Outside Reactors*
   7. ANS-8.14-2004 (R2021), *Use of Soluble Neutron Absorbers in Nuclear Facilities Outside Reactors*
   8. ANS-8.15-2014 (R2019), *Nuclear Criticality Control of Selected Actinide Nuclides*
   9. ANS-8.17-2004 (R2019), *Criticality Safety Criteria for the Handling, Storage, and Transportation of LWR Fuel Outside Reactors*
   10. ANS-8.19-2014 (R2019), *Administrative Practices for Nuclear Criticality Safety*
   11. ANS-8.20-1991 (R2020), *Nuclear Criticality Safety Training*
   12. ANS-8.21-2023, *Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors*
   13. ANS-8.22-1997 (R2021), *Nuclear Criticality Safety Based on Limiting and Controlling Moderators*
   14. ANS-8.23-2019, *Nuclear Criticality Accident Emergency Planning and Response*
   15. ANS-8.24-2017 (R2023), *Validation of Neutron Transport Methods for Nuclear Criticality Safety Calculations*
   16. ANS-8.26-2007 (R2022), *Criticality Safety Engineer Training and Qualification Program*
   17. ANS-8.27-2015 (R2020), *Burnup Credit for LWR Fuel*
   18. ANS-8.28-2024, *Administrative Practices for the Use of Nondestructive Assay Measurements for Nuclear Criticality Safety*

Q. Discuss purpose, scope, and applicability of ANSI/ANS-1, *Conduct of Critical Experiments,* and ANSI/ANS-14.1, *Operation of Fast Pulse Reactors*.

Criticality Safety Program Approval

3. A CSS shall evaluate and recommend approval of the criticality safety program (CSP) description document.

Knowledge Requirements:

A. Discuss application of ANS-8 series Standards requirements to the criticality safety program document, including explanations of why any standard and/or recommendation(s) are not implemented.

B. Describe contractor's criticality safety organization.

C. Discuss fissile material accumulation controls.

D. Discuss firefighting restrictions.

E. Discuss contractor compliance with DOE-STD-3007-2017, *Preparing Criticality Safety Evaluations at DOE Nonreactor Nuclear Facilities,* or other authorized process.

Mandatory Performance Activities (MPA)

MPA 3.1: Evaluate the adequacy of the nuclear criticality safety program description document.

4. A CSS shall evaluate and recommend approval of the criticality safety portion of a documented safety analysis (DSA).

Knowledge Requirements:

A. Discuss the adequacy of controls, their elevation, and the method to document the basis for the elevation of controls.

B. Discuss identification of criticality accidents and progression through DSA, including criticality accident development and determination of fission yield.

C. Discuss the need and applicability for a criticality accident alarm system (CAAS).

D. Discuss the need for technical safety requirements (TSR) for elevated controls and CAAS.

E. Discuss firefighting restrictions based on moderator limitations.

F. Discuss the integration of controls for criticality safety into Safety Design Strategy (SDS) and Preliminary Documented Safety Analyses (PDSA) documents based on DOE-STD-1189.

Mandatory Performance Activities (MPA)

MPA 4.1: Evaluate the adequacy of the criticality safety program in the facility's DSA.

Criticality Safety Program Implementation

5. A CSS shall evaluate the performance of the site’s contractor’s implementation of key elements of the criticality safety program.

Knowledge Requirements:

A. Describe overall implementation of the contractor's nuclear criticality safety program description document and implementation document(s).

B. Describe a site's oversight procedures/processes for the criticality safety program, including interfaces with safety management programs, DOE headquarter elements, and other organizations.

C. Describe nuclear criticality safety computational codes and cross section libraries implemented.

D. Identify and discuss the application of several common hand calculation methods.

E. Identify and discuss the contractor's criticality safety technical documents.

F. Describe the relationship between human factors, human performance, and implementation of criticality safety controls.

Mandatory Performance Activities (MPA)

MPA 5.1: Select two program description requirements and perform a focused review/walk down of contractor implementation and document it.

MPA 5.2: Review at least two criticality safety evaluations (CSE) to ensure compliance with DOE-STD-3007, including the following aspects.

- Normal, credible abnormal/upset conditions, bounding assumptions
- Derived controls (infraction traps)
- Validation and bias estimates of any calculations
- Explain modeling techniques or handbook values used
- Explain common process upsets

Criticality Safety Program Performance

6. A CSS shall evaluate the performance of the criticality safety program.

Knowledge Requirements:

A. Identify and discuss the role of the Federal Safety System Oversight (SSO).

B. Identify and discuss the role of the contractor Cognizant System Engineer.

C. Describe the relationship between the Safety System Oversight (SSO), Facility Representative (FR), Nuclear Safety Specialist (NSS), Fire Protection Engineer (FPE), Security (Material Control and Accountability [MC&A]), Radiation Protection (RP), Training Subject Matter Expert (SME), Emergency Response SME, and CSS in providing oversight.

D. Discuss the elevation of criticality safety controls to the DSA, specifically chapters 2, 3, 4, 5, and 6 and the TSR.

E. Discuss the implementation of any criticality safety TSRs, including the associated surveillance requirements.

F. Discuss what constitutes a criticality safety TSR violation.

G. Review and discuss Defense Nuclear Facility Safety Board (DNFSB) criticality safety metrics.

H. Review and discuss contractor criticality safety internal self-assessment and metrics and how they are integrated into the contractor assurance system (CAS).

Mandatory Performance Activities (MPA)

MPA 6.1: Create an evaluation/assessment plan of the Criticality Safety Program Description (CSPD).

MPA 6.2: Evaluate and document an assessment of the CSPD (as appropriate to a field/site office

MPA 6.3: Select two program description requirements (not the same items from MPA 5.1) and perform a focused review/walk down of contractor performance and document it.

MPA 6.4: Observe and document an assessment of contractor training focused on criticality safety.

APPENDIX A

INITIAL QUALIFICATION TRAINING RECOMMENDATIONS

Technical education and/or training may include courses/training provided by the DOE, other government agencies, outside vendors, or local educational institutions. Training topics should also address identified weaknesses in the knowledge and/or skills of the participant and current technical issues related to the associated FAQS.

Table 1: Initial Qualification Training Recommendations	
(Performance competency category)	***Initial Qualification Training Recommendations***
	Non-destructive assay course offered by Nuclear Criticality Safety Program at ORNL: DOE NNSA Nondestructive Assay Program https://nda.llnl.gov/
1 and 2	Focus Areas: Training & Education | Nuclear Criticality Safety Program (llnl.gov): https://ncsp.llnl.gov/training-education
1	Nuclear Criticality Safety @ UNM: Nuclear Engineering | The University of New Mexico: https://ne.unm.edu/events/nuclear-criticality-safety/index.html
5.C	Computational basics: https://www.ornl.gov/scale/training, https://mcnp.lanl.gov/classes.html
1	CS courses taught by the University of Tennessee https://www.youtube.com/playlist?list=PLZWoB96AIfWHMcJOlCvZLcYqO_5X9mqp3
1	CS courses taught by Idaho State University Nuclear Engineering | Idaho State University (isu.edu)

APPENDIX B

CONTINUING TRAINING RECOMMENDATIONS

In accordance with DOE O 426.1, *Department of Energy Federal Technical Capabilities,* and with site FTCP Agent concurrence, CSS personnel should participate in a continuing training and qualification program that may include the following elements:

1. Continuing technical education and/or training covering topics directly related to criticality safety, as determined appropriate by management. This may include courses/training provided by DOE, other government agencies, outside vendors, or local educational institutions.
2. Continuing training topics should address identified weaknesses in the knowledge or skills of the participant.
3. Observe emergency or operational drills involving nuclear criticality incidents.
4. Perform at least one assessment.
5. Participate in at least four Criticality Safety Coordinating Team (CSCT) monthly phone calls.
6. Engage in telephone, email, 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.
7. Maintain awareness of all current (new or revised) ANSI/ANS-8 standards as they are published.
8. Attend seminars, symposiums, or technical meetings (e.g., technical sessions, workshops, or tutorials sponsored the Nuclear Criticality Safety Division of the American Nuclear Society or the Energy Facilities Contractors Operating Group) related to criticality safety.
9. 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.