TS

NOT MEASUREMENT SENSITIVE

DOE–STD–1185–2007

CHANGE NOTICE No.1
April 2010

DOE STANDARD

NUCLEAR EXPLOSIVE SAFETY STUDY FUNCTIONAL AREA QUALIFICATION STANDARD

DOE Defense Nuclear Facilities Technical Personnel

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

AREA TRNG

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

INTENTIONALLY BLANK

DOE-STD-1185-2007

List of Changes

Page/paragraph	Change
Page ii	Change to new FAQS format
Page v	Added table of changes
Page vii	Changes to Table of Contents
Page ix	Change to original organizational author names and update organizational numbers.
Page 1 paragraphs 1 & 3	Updated DOE references
Page 2, all paragraphs	Change to new FAQS format
Page 3, all paragraphs	Change to new FAQS format
Page 3, paragraph 3	Updated organizational and course numbers
Page 4, paragraph 1	Updated DOE references
Page 4, paragraph 2	Change to new FAQS format
Page 4, paragraph 3	Added requirement for qualification; change to new FAQS format; updated DOE references
Page 5, paragraphs 1 & 2	Update DOE references
Page 7, list	Change to list of duties and responsibilities
Page 8, paragraph 2	Change to new FAQS format
Pages 9-29, all competencies	Change to new FAQS format to include the term “must” on all competencies
Page 18	Competency 19: change to K&S list; updated DOE references
Page 19	Competency 20: updated DOE references
Page 20	Competency 24: updated DOE references
Page 21	Competency 25: change to K&S list; original competency 26 deleted; competency 27 updated DOE references
Page 23	Competency 29: addition of three supporting skills and updated DOE references
Page 24	Competency 31: corrected CFR reference
Page 26	Competency 36: updated DOE references
Page 31, paragraph 3	Change to new FAQS format
Page 32	Updated organizational number

INTENTIONALLY BLANK

TABLE OF CONTENTS

INTENTIONALLY BLANK

ACKNOWLEDGMENT

The NNSA/NA-122.11, Nuclear Explosive Safety Branch, is the sponsor for the Nuclear Explosive Safety Study 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 Program. The sponsor, in coordination with the Federal Technical Capability Panel, is also responsible for ensuring that the FAQS is maintained current.

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

D. Ronald Baca	NNSA Headquarters, NA-122.11 (Co-Team Leader)
James Fingerlos	NNSA Headquarters, NA-122.11 (Co-Team Leader)
Daniel Bruns	NNSA Headquarters, NA-122.11
William Pecsok	NNSA Headquarters, NA-122.11
Robert Stroud	NNSA Headquarters, NA-122.11
Robert Fong	NNSA Headquarters, NA-122.11
Leroy Thompson	NNSA Headquarters, NA-122.11
Leslie Winfield	NNSA Nevada Site Office
Alton Donnell	Sandia National Laboratories
Tom Jones	Los Alamos National Laboratory
Carlos Avalle	Livermore National Laboratory

INTENTIONALLY BLANK

U.S. DEPARTMENT OF ENERGY
FUNCTIONAL AREA QUALIFICATION STANDARD

Nuclear Explosive Safety Study

PURPOSE

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

The technical qualification standards are not intended to replace the OPM qualifications standards or other departmental personnel standards, rules, plans, or processes. The primary purpose of the TQP is to ensure that employees have the requisite technical competency to support the mission of the Department. The TQP forms the basis for the development and assignment of DOE personnel responsible for ensuring the safe operation of defense nuclear facilities.

APPLICABILITY

A Nuclear Explosive Safety Study (NESS) is performed on all DOE Nuclear Explosive Operations (NEOs) in accordance with DOE O 452.1D, *Nuclear Explosive and Weapon Surety Program*; DOE O 452.2D, *Nuclear Explosive Safety*; and DOE M 452.2-2, *Nuclear Explosive Safety Evaluation Processes*. This qualification standard applies to Nuclear Explosive Safety Study Group (NESSG) members and chairs. Similar qualifications for non-Federal NESSG members are found in DOE M 452-2. The NESSG ensures that the DOE Nuclear Explosive Safety Standards and criteria contained in DOE O 452.1D and DOE O 452.2D have been met before the National Nuclear Security Administration (NNSA) approves NEOs.

The Nuclear Explosive Safety Study FAQS establishes common functional area competency requirements for all DOE nuclear explosive safety study personnel who provide assistance, direction, guidance, oversight, or evaluation of contractor or Federal technical activities that could impact the safe operation of DOE's defense nuclear facilities. The technical FAQS has been developed as a tool to assist DOE program and field offices in the development and implementation of the TQP in their organization. For ease of transportability of qualifications between DOE elements, program and field

offices are expected to use this technical FAQS without modification. Needed additional office/site/facility-specific technical competencies should be handled separately. Satisfactory and documented attainment of the competency requirements contained in this technical FAQS (see the Federal Technical Capability Program {FTCP} Directives and Standards page at http://www.hss.energy.gov/deprep/ftcp/directives/directives.asp for an example of the Nuclear Explosive Safety Study FAQS qualification card) ensures that personnel possess the minimum requisite competence to fulfill their functional area duties and responsibilities common to the DOE complex. Additionally, office/site/facility-specific qualification standards supplement this technical FAQS and establish unique operational competency requirements at the Headquarters or field element, site, or facility level.

It should be noted that the 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 personnel. Although there are other competency requirements associated with the positions held by DOE personnel, this FAQS is limited to identifying the specific, common technical competencies required for all Nuclear Explosive Safety Study Members/Chairs. 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” denotes a mandatory requirement, “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/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 DOE personnel possess the competencies required by 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 Nuclear Explosive Safety Study FAQS qualification card that can be obtained from the Federal Technical Capability Program Directives and Standards page at http://www.hss.energy.gov/deprep/ftcp/directives/directives.asp.

Equivalencies should be used sparingly and with the utmost rigor and scrutiny to maintain the spirit and intent of the TQP. Equivalencies may be granted for individual competencies based on objective evidence of previous education, training, certification, or experience. Objective evidence includes a combination of transcripts, certifications, and in some cases, a knowledge sampling through 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 on appropriate supporting knowledge and/or skill statements similar to the ones listed for each of the competency requirements. Headquarters and field elements should use the supporting knowledge and/or skill statements as a basis for evaluating the content of any training used to provide individuals with the requisite knowledge and/or skill required to meet the technical FAQS competency requirements. The following courses, maintained by NA-122, were designed to help applicants meet specific requirements in this Qualification Standard:

- NSTE 270: NES Orientation (Technical Competencies (TCs) 19, 20, 21)
- NSTE 271: NES Materials (TC 2)
- NSTE 272: Electrical Equipment and Tester Design (TC 17)
- NSTE 276: Pantex [or Device Assembly Facility (DAF)] Facility Safety Systems (TCs 12, 13, 14, 15)
- NSTE 400: Lightning Protection (TC 13)

EVALUATION REQUIREMENTS

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

The qualifying official or immediate supervisor should ensure that the candidate meets the background and experience requirements of this FAQS. The adequate attainment of each competency listed in the Nuclear Explosive Safety Study FAQS should be evaluated and documented by either a qualifying official [Certified NESSG Member/Chair with required appointment] or immediate supervisor. This documentation is usually performed by signing the appropriate line in the candidate's qualification card. (Note: if the immediate supervisor is not a NESS qualifying official, it is expected that the supervisor consult with a qualified NESS qualifying official.) Satisfactory completion of each competency must be demonstrated 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)

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. Certification authorities (DOE M 452.2-2, Chapter III, paragraph 2.d) must document attainment of required competencies using each of the following methods:

- Satisfactory completion of a comprehensive written examination. The minimum passing grade should be 80 percent.
- Documented observation of performance on at least two NESSG activities by a certified NESSG Member/Chair
- Satisfactory completion of an oral examination by a qualification board consisting of certified NESSG Members/Chairs led by the Certification Authority.
- Satisfactory completion of a senior management interview with either the applicable Site Office Manager or the appropriate Deputy Assistant Administrator or his/her designee.

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, 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 that includes:

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

INITIAL QUALIFICATION, REQUALIFICATION, AND TRAINING

Qualification of Nuclear explosive safety study personnel must be conducted in accordance with the requirements of DOE O 426.1 and DOE M 452.2-2.

In addition to the annual certification requirements of DOE M 452.2-2, paragraph III.2.d, the supervisor over NNSA NESSG members/chairs must require personnel filling nuclear explosive safety study positions to re-qualify every five (5) years. The supervisor must establish the specific requalification training designed to update and maintain their qualifications. The supervisor must document the requalification process which must, at a minimum, include the following:

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

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

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

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

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

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

A description of suggested learning activities and the requirements for the continuing education and training program for the Nuclear Explosive Safety Study FAQS are

included in Appendix A of this document.

DUTIES AND RESPONSIBILITIES

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

A. Serves as a member or chair of the NESSG.

B. Provides guidance on and interpretation of nuclear explosive safety (NES) requirements and policy.

C. Briefs and consults with Defense Nuclear Facilities Safety Board (DNFSB) staff and ad-hoc technical groups about NES principles, responsibilities, and roles in nuclear explosive design and operations.

D. Drafts policy directives for the DOE/NNSA, Nuclear Explosive Safety Operations Branch (NESB) and reviews DOE/NNSA policies on NES.

E. Provides instruction and guidance regarding NES to individuals assigned NES responsibilities.

F. Works directly with officials in DOE/NNSA site offices, national laboratories, and the production plant in resolving NES issues.

G. Consults with line management during the NEO development process regarding NES.

H. Evaluates occurrences applicable to NES. Monitors corrective action.

I. Manages and implements the NES change evaluation process.

J. Monitors ongoing NEOs to ensure compliance with NES standards and other NES requirements.

K. Evaluates effectiveness of corrective action on NESSG findings and maintains a record of that assessment.

L. Provides formal briefings to DOE/NNSA management officials regarding problem areas requiring their attention to correct NES deficiencies.

M. Develops correspondence, reports, procedures, and other documents requiring written communication proficiency.

N. Advises, consults, and coordinates with various DOE/NNSA offices, line management, and the national laboratories to determine the scope and content of NES evaluations.

O. Coordinates with DOE/NNSA line management organizations to establish specific requirements for the technical input documentation delivery, and

technical and administrative support for each NES evaluation (chair only).

P. Evaluates the technical input documentation provided for each NES evaluation.

Q. Leads the NESSG and manages NESSG activities to ensure a thorough evaluation is performed (chair only).

R. Prepares the report of each NESSG activity and coordinates the DOE/NNSA management review. Provides DOE/NNSA management with an NES recommendation prior to forwarding the report to the DOE/NNSA Headquarters for approval (chair only).

S. Evaluates the adequacy of NEO controls to satisfy the NES standards.

T. Evaluates the safety of facilities, fixtures, electrical testers, electrical equipment, transport equipment, handling equipment, mechanical equipment, and administrative and operational procedures and controls as they affect NES.

U. Evaluates physical security (e.g., facilities, equipment, and procedures) employed for the protection of nuclear explosives to determine if it constitutes a threat to NES.

V. Ensures coordination between readiness review activities and NESSG activities (chair only).

W. Provides feedback to NESS chair and NESS member candidates regarding performance.

X. Serves as the DOE voting member, or technical advisor to the DOE member, on service Nuclear Weapon System Safety Groups (chair only).

Y. Serves as Accident Recovery Group (ARG) weapon recovery safety evaluation team (WRSET) leader (chair only).

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

NESSG members-in-training and NESSG chairs-in-training perform NESS duties under the direction of a fully qualified member or chair.

BACKGROUND AND EXPERIENCE

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

The preferred education and experience for nuclear explosive safety study personnel are:

1. Education:

   Bachelor of Science in engineering with a strong preference for individuals with advanced engineering degrees. Other technical degrees in physics, materials science, or chemistry will be considered by the Chief, Nuclear Explosive Safety Branch.

2. Experience:

   Five (5) years of industrial, military, Federal, state, or other directly related experience that has provided specialized experience in NES, or other, similar experience in high consequence, or nuclear safety operations. Specialized experience can be demonstrated through possession of the competencies outlined in this standard.

REQUIRED TECHNICAL COMPETENCIES

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

Note: When regulations, DOE directives, or other industry standards are referenced in the FAQS, the most recent revision should be used. It is recognized that some nuclear explosive safety study 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.

Note: Some competencies from the GTB Qualification Standard are repeated because the level of knowledge is raised and because the requirements of this Federal Qualification Standard will be used to update the qualifications for all NESSG members, not just Federal employees. Repeating the GTB qualifications, where applicable, makes this effort easier and more transparent.

General Technical

1. Nuclear explosive safety study personnel must demonstrate a working level knowledge of the physics of nuclear weapons and explosives.

Supporting Knowledge and/or Skills

a. Define the following terms:

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

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

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

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

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

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

f. Discuss the influence of the presence of non-fissionable materials in contact with fissionable material on nuclear criticality safety.

g. Discuss the following processes and their application in nuclear explosive design:

- Nuclear fission
- Nuclear fusion

h. Define the term “fissile materials” and give examples applicable to nuclear explosive design.

2. Nuclear explosive safety study personnel must demonstrate a working level knowledge of the materials used in nuclear weapons and nuclear explosives, including hazardous properties.

Supporting Knowledge and/or Skills

a. Discuss the mechanical, chemical, nuclear, and radiological characteristics and related hazards from the following materials used in nuclear explosives/weapons:

- Uranium
- Plutonium
- Tritium
- Thorium
- Beryllium

b. Discuss the NES implications of the following:

- LiH and LiD
- Fogbank
- UH_3
- Plutonium hydride

c. Discuss additional safety and toxicity issues associated with weapon and process materials as listed in the existing current weapon safety specifications for weapons in the stockpile.

d. Discuss the protocols for handling the components of nuclear weapons, tooling, materials, hand tools, and trainers during NES reviews.

3. Nuclear explosive safety study personnel must demonstrate a working level knowledge of the internal design of nuclear explosives.

Supporting Knowledge and/or Skills

a. Describe, in general terms, the basic design and working principles of implosion and gun-type devices.

b. Describe the basic design of a thermonuclear weapon using a secondary.

c. Explain the following nuclear explosive concepts and terminology:

- Initiation
- Boosting
- Alpha (neutron multiplication)

d. Discuss the function, purpose, and design of the following systems and components:

- Arming

- Fusing
- Firing
- High explosives
- Fissionable material
- Fissile material - primary and secondary
- Detonators
- Boosting device
- Neutron generators

4. Nuclear explosive safety study personnel must demonstrate a working level knowledge of nuclear detonation safety design concepts.

Supporting Knowledge and/or Skills

a. Describe the following nuclear detonation safety design concepts:

- The concept of isolation:
  - Identify when barriers are breached during assembly/disassembly.
  - Identify when strong links are absent or potentially bypassed.
- The concept of incompatibility:
  - Identify available energy sources and their effects on nuclear explosive components.
  - Identify available signals that could drive a unique signal discriminator.
- The concept of inoperability:
  - Give examples of weak links in various nuclear explosives.
  - Describe the features and safety role of the weak link(s).
- The concept of independence:
  - Describe common-mode failure and give examples relevant to nuclear weapon designs.

b. Discuss the role of first principles listed above in the implementation of the nuclear detonation safety design principles (safety theme).

c. Describe nuclear explosive components or features that have been employed to provide isolation, inoperability, and incompatibility, including:

- Barriers
- Weak links
- Strong links
- Unique signals

d. Describe nuclear explosive design features that have been employed to prevent/mitigate fissile material dispersal, including:

- Insensitive high explosives (IHEs)
- Fire-resistant pits

5. Nuclear explosive safety study personnel must demonstrate a working level knowledge of the effects of abnormal environments on nuclear explosives.

Supporting Knowledge and/or Skills

a. Discuss the term “abnormal environment.”

b. List the categories of abnormal environments specific to NEOs, including staging and transportation, and describe the characteristics of each.

c. Discuss the Trinity Statement and the Nuclear Detonation Safety Exception.

6. Nuclear explosive safety study personnel must demonstrate a working level knowledge of one-point safety and related issues.

Supporting Knowledge and/or Skills

a. Describe the concept of one-point safety.

b. List possible conditions that might challenge one-point safety.

c. Describe designs that have been used to make warheads multi-point safe.

d. Discuss the interaction of nuclear explosives with each other including near-by-explosion.

e. Discuss the interaction of nuclear explosives with strong neutron sources.

7. Nuclear explosive safety study personnel must demonstrate a working level knowledge of fusing, arming, control, and ancillary systems in nuclear weapons.

Supporting Knowledge and/or Skills

a. Discuss the basic components of fusing systems for reentry bodies (RBs), reentry vehicles (RVs), and gravity bombs, including:

- Radar fuses
- Contact fuses
- Timer fuses
- Power supplies

b. Discuss the basic components of arming systems for RB/RVs and gravity bombs, including:

- Environmental sensing devices

- Fuse switches
- Power supplies
- Capacitor discharge units
- Ferro-magnetic units
- Switches

c. Describe the nuclear explosive use control features typical of U.S. weapons.

d. Describe the following as used in nuclear weapons and the hazards associated with each:

- Aeroshell
- Bomb case
- Radiation shielding
- Yield-select mechanisms
- Release mechanisms

8. Nuclear explosive safety study personnel must demonstrate a familiarity level of knowledge with the U.S. stockpile.

Supporting Knowledge and/or Skills

a. Discuss descriptions of the following weapon systems:

- B52/ALCM/ACM/W80
- B-2/B83/B61-7, 11
- F-16/B61-3, 4,10
- F-15/B61-3, 4, 10
- PA-200/ B61-3, 4, 10
- Trident II/W76/W88
- Minuteman/W62/W78/W87
- SLCM/W80

9. Nuclear explosive safety study personnel must demonstrate a working level knowledge of explosives and pyrotechnics and their applicability in nuclear explosives.

Supporting Knowledge and/or Skills

a. Define the following and describe where they might be used in a nuclear explosive:

- High explosive
- Pyrotechnic
- Propellant
- Primary explosive
- Secondary explosive
- Initiation

- Detonation train
- Critical temperature
- Detonation velocity

b. Discuss the difference between IHEs and conventional high explosives (CHEs) used in nuclear explosives.

c. Describe the function of primary and secondary high explosives in nuclear explosive design.

d. Discuss and compare the effects of the following interrelated high-explosive terms that apply to nuclear explosive design:

- Detonations
- High explosive violent reactions
- Deflagration
- Combustion
- Deflagration to detonation transition

e. Describe the response of high explosives used in nuclear explosive design to the following external stimuli:

- Mechanical
- Electrical
- Thermal

f. Discuss the effects of aging on the high-explosive materials used in nuclear explosive design.

g. Describe the composition and properties of each of the following and explain how they are used in nuclear explosives:

- TNT, Trinitrotoluene
- RDX, Hexahydrotrinitrotriazine, or hexogen
- HMX, Octahydrotetranitrotetrazine, or octogen
- PETN, Pentaerythritoltetranitrate
- PBX 9501
- PBX 9502
- Cyclotol
- Baratol
- LX-17
- LX-04
- XTX-8003
- XTX-8004
- TATB, Triaminotrinitrobenzene

10. Nuclear explosive safety study personnel must demonstrate a working level knowledge of detonators.

Supporting Knowledge and/or Skills

a. Describe the main-charge detonators used in nuclear weapons, including the principles of operation, overall design, operating thresholds, and aging characteristics.

b. Describe the following detonator types:

- Exploding bridge wire
- Hot wire
- Slapper
- Mechanical safe and arming

c. Describe the electrical sensitivity of detonators and squibs.

d. Describe the standards for a human electrostatic discharge (ESD).

e. Describe the use of booster explosives.

f. Describe the use of non-electrical initiators in nuclear weapons.

11. Nuclear explosive safety study personnel must demonstrate a working level knowledge of the hazards of squibs, propellants, and other pyrotechnics that are used in nuclear explosives.

Supporting Knowledge and/or Skills

a. Identify the hazards from each of the following features of nuclear explosive design:

- Spin rockets
- Parachute subsystems
- Boosting device

12. Nuclear explosive safety study personnel must demonstrate a working level knowledge of the facilities used to assemble, disassemble, stage, test, and handle nuclear explosives, including facility safety equipment and equipment that interfaces with nuclear explosives.

Supporting Knowledge and/or Skills

a. Describe the following facilities, including unique safety features, such as blast valves, blast doors, fire detection, deluge, grounding, and lightning protection, as applicable to the Pantex Plant and the DAF:

- Assembly/disassembly bays

- Assembly/disassembly cells
- Corridors
- Ramps
- Storage bunkers (SAC magazines)
- Special purpose facilities
  - Vacuum chambers
  - Mass properties facilities
  - Radiography facilities
  - Separation test facility
  - Paint bay
  - Loading docks

13. Nuclear explosive safety study personnel must demonstrate a working level knowledge of electrical isolation systems and their importance to NES.

Supporting Knowledge and/or Skills

a. Describe the hazards presented to the safety of NEOs and associated activities by the introduction of electrical energy sources or equipment using any electrical source into a nuclear explosive area (NEA).

b. Describe the controls and design measures to prevent or limit the introduction of electrical energy into a nuclear explosive.

c. Describe measures to control static charges, including human and equipment (furniture) ESD.

d. Describe lightning protection measures used in bays, cells, and ramps and known vulnerabilities.

14. Nuclear explosive safety study personnel must demonstrate a working level knowledge of fire protection systems and their importance to NES.

Supporting Knowledge and/or Skills

a. List the various types of fire protection systems, including active and passive mitigation controls, detection systems, suppression systems, etc., that service NEAs and describe the effects of their use on the safety of NEOs and associated activities.

b. Discuss the derivation of combustible controls, such as standoff distances, fuel packages, and containerization.

15. Nuclear explosive safety study personnel must demonstrate a working level knowledge of threats such as seismic disturbances, extreme weather, aircraft crash, external fires, and other natural phenomena.

Supporting Knowledge and/or Skills

a. Describe the response of facilities to the design-basis seismic event and the predicted response of facility-related equipment.

b. Describe the response of facilities to tornadoes, hurricanes, and flooding and the predicted response of facility-related equipment.

c. Describe the response of facilities to aircraft crashes and the predicted response of facility-related equipment.

d. Describe the response of facilities to external fires and the predicted response of facility-related equipment.

e. Describe the response of facilities to explosive detonations in adjacent facilities, and the predicted response of the facility and facility-related equipment.

16. Nuclear explosive safety study personnel must demonstrate a working level knowledge of tooling, rigging, and hoisting equipment used for handling nuclear explosives.

Supporting Knowledge and/or Skills

a. Explain how the design of each of the following is important in minimizing or eliminating the potential for mishandling nuclear explosives and preventing accidents:

- Tooling
- Rigging equipment
- Hoisting equipment

b. Interpret design drawings and technical specifications for the tooling, rigging, and hoisting equipment used in handling nuclear explosives.

c. Identify the conditions that might disqualify slings and hoisting equipment for use in handling nuclear explosives.

d. Define “safety factor” as it applies to hoisting and rigging.

17. Nuclear explosive safety study personnel must demonstrate a working level knowledge of the control of electrical equipment used in an NEA.

Supporting Knowledge and/or Skills

a. Discuss the various types of electrical equipment that may be present in an NEA and the controls placed on them.

b. Discuss the approval process for category 1 and category 2 electrical equipment used at the Pantex Plant.

c. Discuss DG 10001, *Design Guide, Electrical Testers for Use with Nuclear Explosives.*

18. Nuclear explosive safety study personnel must demonstrate a working level knowledge of the requirements for the safe offsite and onsite transportation of nuclear explosives.

Supporting Knowledge and/or Skills

a. Discuss the scope and content of the applicable NES studies that address over-the-road transportation and onsite transportation of nuclear explosives.

b. Describe hazards associated with the design and construction of vehicles authorized to transport nuclear explosives and the positive measures to control hazards.

c. Discuss the tie-down requirements for nuclear explosives during offsite and onsite transportation.

d. Discuss loss of assured safety (LOAS) and the Trinity Statement in the context of transportation accidents.

Regulatory

19. Nuclear explosive safety study personnel must demonstrate an expert level knowledge of DOE O 452.2D, *Nuclear Explosive Safety*, DOE O 452.1D, *Nuclear Explosive and Weapon Surety Program*, and associated DOE Manuals.

Supporting Knowledge and/or Skills

a. Discuss the purpose and scope of the listed Orders.

b. Discuss this position's role and responsibilities regarding implementation of, and compliance with the listed Orders.

c. Discuss the following terms and requirements:

- Nuclear explosive
- NEA
- NEO
- NES
- Nuclear weapon
- Human Reliability Program (HRP)
- Surety
- Use control
- Change control
- Nuclear Explosive-Like Assembly (NELA) standards
- Exemption requirements

d. Discuss the purpose of the two-person concept and requirements as specified in DOE O 452.2D and DOE M 452.2-1A, *Nuclear Explosive Safety Manual.*

e. Discuss the general NES rules established for all DOE NEOs.

f. Discuss the attributes, objectives, and interrelationships of the six DOE Nuclear Explosive Surety standards.

g. Discuss in detail the two NES standards that all NEOs must meet as stated in DOE O 452.1D.

h. Discuss the requirements for operations involving nuclear explosives that are not known to be one-point safe.

20. Nuclear explosive safety study personnel must demonstrate an expert level knowledge of DOE M 452.2-2, *Nuclear Explosive Safety Evaluation Processes*.

Supporting Knowledge and/or Skills

a. Discuss the purpose and scope of DOE M 452.2-2 *Nuclear Explosive Safety Evaluation Processes*.

b. Discuss this position's role and responsibilities regarding compliance with this standard.

c. Discuss the NESS, Operational Safety Review (OSR), and Nuclear Explosive Safety Change Evaluation (NCE) processes including group composition, meetings, documentation preparation, conduct, reporting, and approval.

d. Discuss the requirements for NESSG membership, including training, certification, and independence.

21. Nuclear explosive safety study personnel must demonstrate an expert level knowledge of the NESS, OSR and NCE processes.

Supporting Knowledge and/or Skills

a. Describe the composition requirements for an NESSG.

b. Describe the scope of the NESSG responsibilities.

c. Explain the functions of an NESS, an OSR, and an NCE.

d. Discuss the requirements for preparing for and conducting an NESS or an OSR.

e. Provide examples of situations that would require an NESS and an OSR.

f. Explain the relationship between master studies and operation-specific studies.

22. Nuclear explosive safety study personnel must demonstrate an expert level knowledge of the NELA requirements.

Supporting Knowledge and/or Skills

a. Discuss the difference between a nuclear explosive and a NELA.

b. Discuss specific NELA standards and requirements.

23. Nuclear explosive safety study personnel must demonstrate an expert level knowledge of the NES rules.

Supporting Knowledge and/or Skills

a. Discuss the different types of NES rules and provide examples of each.

24. Nuclear explosive safety study personnel must demonstrate an expert level knowledge of DOE M 452.2-2 Chapter VI, *Nuclear Explosive Safety Change Control Processes*.

Supporting Knowledge and/or Skills

a. State the purpose and applicability of chapter VI.

b. Discuss the change control process and why this is important to NEOs.

c. Discuss the actions required by each entity in the change control process.

d. Discuss the three levels of the NES change evaluation process and how each level is chosen.

e. Discuss the criteria for contractor NES change evaluations (CNCEs).

f. Discuss when a NESS would be used for NES Change Evaluation and how such a NESS differs from other NESSs.

g. Discuss the OST change control process.

25. Nuclear explosive safety study personnel must demonstrate a working level knowledge of nuclear safety requirements for the safety of NEOs at the Nevada Test Site.

Supporting Knowledge and/or Skills

a. Describe the mission of the Nevada Test Site.

b. Discuss the supplemental Nevada Test Site Testing Nuclear Explosive Safety Rule (NESR).

c. Describe the DAF transportation supplemental NESR.

26. Nuclear explosive safety study personnel must demonstrate a working level knowledge of DOE O 5480.19 Chg 2, *Conduct of Operations Requirements for DOE Facilities*, necessary to ensure implementation.

Supporting Knowledge and/or Skills

a. Discuss the purpose of DOE O 5480.19 Chg 2, *Conduct of Operations Requirements for DOE Facilities*.

b. Discuss the concept of graded approach and how it applies to the implementation of conduct of operations.

c. Explain the role of lessons learned in operations, and sources for identifying lessons learned and industry experience.

27. Nuclear explosive safety study personnel must demonstrate a familiarity level knowledge with the requirements in DOE Technical Standard DOE-STD-3009-94 Chg 3, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis*.

Supporting Knowledge and/or Skills

a. Discuss the conceptual basis and process for preparation of a facility/activity documented safety analysis (DSA).

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

- Worker safety
- Defense-in-depth
- Programmatic commitments

- Technical safety requirements (TSRs)
- Structures, systems, and components (SSCs)
- Hazard analysis
- Accident analysis
- Application of the graded approach
- Safe harbor methods

c. Compare the different requirements for the DSA section and content as specified in applicable safe harbor methods.

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

e. Identify and discuss the treatment of uncertainty in accident analyses.

f. Identify the purpose and relationship between chapters 3, 4, and 5 and the TSRs of the DSA.

28. Nuclear explosive safety study personnel must have a working level knowledge of the applicable requirements of DOE M 440.1-1A, *DOE Explosive Safety Manual*.

Supporting Knowledge and/or Skills

a. Discuss the applicability of the requirements of DOE M 440.1-1A to NEOs.

b. Identify and discuss the DOE M 440.1-1A requirements associated with the following:

- General operations safety guidelines
- Work environment
- Area controls
- Electrical storms and lightning protection:
  - Give the requirements for a Faraday cage-like facility.
- Static electricity:
  - Describe the three authorized methods for protecting against ESD.
- Electrical equipment and wiring
- Material handling
- Transportation
- Stand-off distance

29. Nuclear explosive safety study personnel must demonstrate a working level knowledge of the requirements for protection, security, and control of nuclear explosives and nuclear weapons as described in DOE O 452.4B, *Security and Use Control of Nuclear Explosives and Nuclear Weapons* and *NNSA Supplemental Directive (SD) 452.4 Nuclear Explosive Operation Deliberate Unauthorized Use Implementation and Evaluation Processes.*

Supporting Knowledge and/or Skills

a. Discuss the objectives of DOE O 452.4B, *Security and Control of Nuclear Explosives and Nuclear Weapons.*

b. Discuss the relationship between NES and deliberate unauthorized use measures.

c. Describe the NESSG's role in evaluating security and use-control operations, equipment, and facilities.

d. Describe how a deliberate unauthorized use review team (DUURT) is formed, including its membership and scope.

e. Describe how a DUURT report is published and who receives the report.

f. Describe the differences between an NESSG evaluation and an associated DUU evaluation.

30. Nuclear explosive safety study personnel must demonstrate a working level knowledge of the HRP described in 10 CFR 712, *Human Reliability Program*.

Supporting Knowledge and/or Skills

a. Discuss the following terms as they relate to HRP:

- Nuclear explosive duty
- HRP certification
- Temporary removal

b. Discuss the relationship between HRP certification and other job qualification requirements.

c. Identify the prerequisites for HRP certification and describe the HRP certification process.

d. Discuss the responsibilities of HRP-certified personnel and their supervisors.

31. Nuclear explosive safety study must demonstrate a familiarity level knowledge of 10 CFR 830, *Nuclear Safety Management*, Subpart A, *Quality Assurance Requirements*.

Supporting Knowledge and/or Skills

a. Describe each of the ten quality assurance criteria and their relationship to NES and nuclear explosive study activities.

b. Discuss the relationship between quality assurance and NES management.

32. Nuclear explosive safety study personnel must demonstrate a familiarity level knowledge with the DSA requirements of 10 CFR 830, *Nuclear Safety Management*, Subpart B, *Safety Basis Requirements*.

Supporting Knowledge and/or Skills

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

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

c. Describe the different requirements for the scope and content of each type of DSA.

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

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

33. Nuclear explosive safety study personnel must demonstrate a familiarity level knowledge with the unreviewed safety question (USQ) process with respect to its impact on NEOs and associated activities and facilities.

Supporting Knowledge and/or Skills

a. Discuss the purpose of the USQ process.

b. Discuss the reasons for performing a USQ determination.

c. Define the following terms:

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

d. Define the conditions for a USQ.

e. Describe the actions to be taken by a contractor upon identifying information that indicates a potential inadequacy of safety analyses or a possible reduction in the margin of safety as defined in the TSRs.

f. Discuss the procedures for performing a USQ evaluation and its relationship to NES and the NCE process.

g. Discuss the application of the graded approach as it applies to the USQ process.

h. Explain why TSRs do not go through a USQ process.

34. Nuclear explosive safety study personnel must demonstrate a familiarity level knowledge with TSRs as described in 10 CFR 830.205, *Technical Safety Requirements*.

Supporting Knowledge and/or Skills

a. Discuss the purpose of TSRs.

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

- Safety limit
- Operating limits
- Limiting control settings
- Limiting conditions for operation
- Surveillance requirements
- Administrative controls
- Specific administrative controls

c. Describe the general content of each of the following sections of the TSRs:

- Use and application
- Bases
- Design features

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

e. Discuss the relationship of functional requirements and performance criteria to the TSRs.

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

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

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

i. Discuss the role of DSAs in selecting TSRs and the respective flow down.

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

k. Discuss the application of the graded approach relative to TSRs.

35. Nuclear explosive safety study personnel must demonstrate a familiarity level knowledge with the impact of software quality assurance on NES.

Supporting Knowledge and/or Skills

a. Describe the potential impact on NES caused by poor software quality assurance in the following situations:

- Software that controls weapon movement at the Pantex Plant
- Software that controls testers
- Software used to write, control, record or display Nuclear Explosive Operating Procedures (NEOPs) and processes during operations
- Software used to analyze hazards
- Software used to monitor HRP and personnel access

36. Nuclear explosive safety study personnel must demonstrate a working level knowledge of the service Nuclear Weapon System Safety Group process as described in DoD 3150.2-M and DOE O 452.6A, *Nuclear Weapon Surety Interface with the Department of Defense* (chairs and technical advisors only).

a. Describe the four Department of Defense **(**DoD) Nuclear Weapon System Safety Standards.

b. Define “positive measure.”

c. Describe the DoD nuclear weapon system safety policy.

d. Discuss the DoD nuclear weapon safety criteria.

e. Describe the timing and function of the following types of studies and reviews:

- Initial Safety Study (ISS)
- Preliminary Safety Study (PSS)
- Interim Safety Study (INSS)
- Pre-Operational Safety Study (POSS)
- Operational Safety Review (OSR)
- Special Safety Study (SSS)
- Transportation Safety Study (TSS)

f. Describe the following study and review procedures:

- Pre-study review
- Conduct of the study or review
- Determinations
- Post-study or review requirements
- Safety rules
- Minority opinions

g. Describe the DOE rules package coordination procedure.

h. Describe the requirements and use of the "field review."

Management, Assessment, and Oversight

37. Nuclear explosive safety study personnel must demonstrate a familiarity level of knowledge with safety analysis techniques and their application to NEOs, facilities, and associated activities.

Supporting Knowledge and/or Skills

a. Discuss safety analysis techniques and their applications to NEOs, facilities, and associated activities.

b. Describe the following hazard evaluation techniques and the types of results they produce:

- Checklist analysis
- Preliminary hazard analysis
- What-if analysis
- Hazard and operability analysis
- Failure modes and effects analysis
- Fault tree analysis
- Event tree analysis
- Human reliability analysis

c. Describe the basis upon which to judge the adequacy of a hazard evaluation including:

- Thoroughness of hazard identification
- Rigor of analysis versus complexity of operation and potential consequences of accidents
- Conservatism of assumptions
- Applicability of data
- Consistency and control of expert elicitation process
- Validity and conservatism of scenario screening criteria
- Reflection of lack of knowledge in uncertainty estimates

38. Nuclear explosive safety study personnel must demonstrate a working level knowledge of technical communications.

Supporting Knowledge and/or Skills

a. Demonstrate proficiency in written communication, including business and technical writing.

b. Demonstrate proficiency in oral communications, including briefings, one-on-one presentations, and formal presentations.

c. Demonstrate knowledge of interpersonal communications necessary to effectively communicate, verbally and non-verbally, with DOE management, DOE technical personnel, and all levels of contractor personnel.

d. Demonstrate proficiency in writing a defensible NESS finding.

39. Nuclear explosive safety study personnel must demonstrate the ability to perform the duties of an NESSG chair (chair only).

Supporting Knowledge and/or Skills

a. Participate in a minimum of three NESSG activities as an NESSG chair-in-training, member-in-training, member, or technical advisor in the three years preceding initial qualification to the requirements in this document. Participation includes attending planning meetings; selecting members; reviewing input documentation; conducting adequacy reviews; managing briefings, demonstrations, and deliberations; questioning briefers; identifying safety concerns; drafting findings; and coordinating and producing reports.

b. For a minimum of one of the required NESSG activities, the candidate, acting as an NESSG chair-under-instruction, must lead an NESSG under the guidance and direction of a certified chair. This includes leading the phases listed above to the satisfaction of a qualified NESSG chair.

Note: NESSG chairs-in-training must not sign NESSG reports. The certified chair acting as a mentor during these activities retains all responsibilities, including signing the report.

40. Nuclear explosive safety study personnel must demonstrate the ability to perform the duties of an NESSG member (members only).

Supporting Knowledge and/or Skills

a. Participate in a minimum of two NESSG activities in the three years immediately preceding final qualification to the requirements in this document as an NESSG member-in-training. As a member-in-training, the candidate is expected to review input documentation, participate in final planning meetings, briefings, and demonstrations; question briefers; identify safety concerns; engage in deliberations; and contribute to the NESSG report.

b. The candidate must be under the guidance and direction of the certified NESSG member from the candidate's organization. The certified NESSG member and NESSG chair must provide feedback to the candidate regarding performance.

Note: NESSG members-in-training must not sign NESSG reports.

INTENTIONALLY BLANK

APPENDIX A
CONTINUING EDUCATION, TRAINING AND PROFICIENCY PROGRAM

The following list represents suggested continuing education, training, and other opportunities that are available for DOE personnel after completion of the competency requirements in this technical FAQS. It is extremely important that personnel involved with this program maintain their proficiency primarily by regularly demonstrating their 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 Nuclear Explosive Safety Study Functional Area after completion of the competencies in the Standard and other requirements of the TQP.

LIST OF CONTINUING EDUCATION, TRAINING, AND OTHER ACTIVITIES

NESSG members and chairs must participate in a minimum of 30 hours of office/ facility/position-specific continuing training per year (the year starts/ends when a NESSG member/chair's certification letter is signed) that includes the following elements:

1. Technical education and/or training covering topics directly related to the duties and responsibilities of the incumbent as determined by management. This may include courses and/or training provided by:

    - DOE NSTE 270, NES Orientation Course, should be repeated as a participant or instructor periodically. Credit may be taken every four years.
    - National laboratories
    - Management and operations (M&O) contractors
    - Annual nuclear explosive safety workshops
    - Other government agencies
    - Outside vendors, or
    - Educational institutions

2. Training covering topics that addresses identified deficiencies in the knowledge and/or skill of the candidate.

3. Training in areas added to the Nuclear Explosive Safety Study FAQS since initial qualification.

4. Training in new technical developments in NES.

5. Specific continuing training requirements must be documented.

NESS members and chairs must participate in two major NESSG activities (NESSs or OSRs) every three years to remain certified. Two NCEs, limited scope NESSs, Nuclear Weapon System Safety Group (NWSSG) studies, or ARG exercises may be substituted for one NESS/OSR with the concurrence of the certifying official.

CONCLUDING MATERIAL

Review Activity:
EM
NNSA
NE

Preparing Activity:
DOE-NNSA/NA-122.11

Project Number:
TRNG-0051

Area and Site Offices
Livermore Site Office
Los Alamos Site Office
Nevada Site Office
Pantex Site Office