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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

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DRAFT DOE-STD-1185-2007

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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DRAFT DOE-STD-1185-2007

TABLE OF CONTENTS

ACKNOWLEDGMENT	vii
PURPOSE	1
APPLICABILITY	1
IMPLEMENTATION	2
EVALUATION REQUIREMENTS	3
INITIAL QUALIFICATION, REQUALIFICATION, AND TRAINING	4
DUTIES AND RESPONSIBILITIES	5
BACKGROUND AND EXPERIENCE.....	7
REQUIRED TECHNICAL COMPETENCIES	7
APPENDIX A, CONTINUING EDUCATION, TRAINING, AND PROFICIENCY PROGRAM.....	29

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DRAFT DOE-STD-1185-2007

ACKNOWLEDGMENT

The NNSA/NA-121.1, Nuclear Explosive Safety Division, 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 Nuclear Explosive Safety Study program. The sponsor, in coordination with the Federal Technical Capability Panel, is also responsible for ensuring that the FAQS is maintained current.

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DRAFT DOE-STD-1185-2007

U.S. DEPARTMENT OF ENERGY FUNCTIONAL AREA QUALIFICATION STANDARD

Nuclear Explosive Safety Study

PURPOSE

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

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

APPLICABILITY

Nuclear Explosive Safety Study

A Nuclear Explosive Safety Study (NESS) is performed on all DOE Nuclear Explosive Operations (NEOs) in accordance with DOE Order (O) 452.2C *Nuclear Explosive Safety*, and DOE-STD-3015-2004, *Nuclear Explosive Safety Evaluation Process*. 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-STD-3015-2004. The NESSG insures that the DOE nuclear explosive safety standards and criteria contained in DOE O 452.2C 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

DRAFT DOE-STD-1185-2007

office/site/facility-specific technical competencies should be handled separately. Satisfactory and documented attainment of the competency requirements contained in this technical FAQs (see the Federal Technical Capability Program Directives and Standards page at <http://www.hss.energy.gov/deprep/ftcp/directives/directives.asp> for an example of the Nuclear 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 competency elements of management and leadership, general technical knowledge, regulations, administrative capability, and assessment and oversight are all embodied in the competencies listed in this Standard. All of the factors above have a bearing on safety. Although the focus of this Standard is technical competence, elements, such as good communication, recognized credibility, ability to listen and process information, and the ability to guide an effort to get it right the first time are recognized as important aspects of safety.

IMPLEMENTATION

This technical FAQs identifies the minimum technical competency requirements for DOE personnel. Although there are other competency requirements associated with the positions held by DOE personnel, this FAQs is limited to identifying the specific, common technical competencies required throughout all defense nuclear facilities. The competency requirements define the expected knowledge and/or skill that an individual must meet. Each of the competency requirements is further described by a listing of supporting knowledge and/or skill statements which, although not required, describe the intent of the competency statement(s). In selected competencies, expected knowledge and/or skills have been designated as “mandatory performance activities.” In these competencies, the actions are not optional.

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

The competencies identify a familiarity level, a working level, or an expert level of knowledge; or they require the individual to demonstrate the ability to perform a task or activity. These levels are defined as follows:

Familiarity level is defined as basic knowledge of or exposure to the subject or process adequate to discuss the subject or process with individuals of greater knowledge.

Working level is defined as the knowledge required to monitor and assess operations/activities, to apply standards of acceptable performance, and to recognize the need to seek and obtain appropriate expert advice (e.g., technical, legal, safety) or consult appropriate reference materials required to ensure the safety of DOE activities.

Expert level is defined as a comprehensive, intensive knowledge of the subject

DRAFT DOE-STD-1185-2007

or process sufficient to provide advice in the absence of procedural guidance.

Demonstrate the ability is defined as the actual performance of a task or activity in accordance with policy, procedures, guidelines, and/or accepted industry or DOE practices.

Headquarters and field elements shall establish a program and process to ensure that DOE personnel possess the competencies required of their position. That includes the competencies identified in this technical FAQs. Documentation of the completion of the requirements of the Standard shall be included in the employee's training and qualification record. Satisfactory attainment of the competency requirements contained in this technical FAQs may be documented using the example Nuclear 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 a written and/or oral examination. Equivalencies shall be granted in accordance with the TQP Plan of the site/office/Headquarters organization qualifying the individual. The supporting knowledge and/or skill statements and mandatory performance activities should be considered before granting an equivalency for a competency.

Training shall be provided to employees in the TQP who do not meet the competencies contained in the technical FAQs. Training may include, but is not limited to, formal classroom and computer-based courses, self-study, mentoring, on-the-job training, and special assignments. Departmental training will be based on appropriate supporting knowledge and/or skill statements similar to the ones listed for each of the competency requirements. Headquarters and field elements should use the supporting knowledge and/or skill statements as a basis for evaluating the content of any training used to provide individuals with the requisite knowledge and/or skill required to meet the technical FAQs competency requirements. The following courses, maintained by NA-121, were designed to help applicants meet specific requirements in this Qualification Standard:

- NESTE270; NES Orientation (Technical Competencies (TCs) 19, 20, 21)
- NESTE271: NES Materials (TC 2)
- NESTE272: Electrical Equipment and Tester Design (TC 17)
- NESTE276: Pantex [or Device Assembly Facility (DAF)] Facility Safety Systems (TCs 12, 13, 14, 15)
- NESTE400: Lightning Protection (TC 13)

EVALUATION REQUIREMENTS

Attainment of the competencies listed in this technical FAQs should be documented by

DRAFT DOE-STD-1185-2007

the Certification Authority (DOE-STD-3015-2004, paragraph 6.2) in accordance with the TQP Plan of the organization qualifying the individual and the requirements in DOE M 360.1-1B, *Federal Employee Training Manual*, and DOE M 426.1-1A.

The Certification Authority shall qualify candidates as possessing the basic technical knowledge, technical discipline competency, and position-specific knowledge, skills, and abilities required for NESS Members/ Chairs. Final qualification shall be performed using each 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 qualification board of certified NESS Members/Chairs led by the Certification Authority.
- Documented observation of performance on at least two NESSG activities by a certified NESS Member/Chair

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, board members should ask critical questions intended to integrate identified learning objectives and NESS participation during qualification. Certification Authorities should develop formal guidance for oral examinations and walkthroughs that includes:

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

INITIAL QUALIFICATION, REQUALIFICATION, AND TRAINING

Qualification of nuclear explosive safety study personnel shall be conducted in accordance with the requirements of DOE M 426.1-1A and DOE-STD-3015-2004.

In addition to the annual certification requirements of DOE-STD-3015-2004, paragraph 6.2, the supervisor over NNSA NESSG members/chairs shall require personnel filling nuclear explosive safety study positions to re-qualify every five (5) years. The supervisor shall establish the specific requalification training designed to update and maintain their qualifications. The supervisor shall document the requalification process which shall, at a minimum, include the following:

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

DRAFT DOE-STD-1185-2007

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

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

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

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

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

A description of suggested learning activities and the requirements for the continuing education and training program for 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 Division (NESOD) and/or Nuclear Explosive Safety Policy Division (NESPD) 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.

DRAFT DOE-STD-1185-2007

- 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. Consults and coordinates with various DOE/NNSA offices, line management, and the national laboratories to determine the scope and content of NES evaluations (chair only).
- O. Coordinates with DOE/NNSA line management organizations to establish specific requirements for the technical input documentation, 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. Coordinates input documentation adequacy reviews prior to commencing an NESS (chair only).
- W. Ensures coordination between readiness review activities and NESSG activities (chair only).

DRAFT DOE-STD-1185-2007

- X. Provides feedback to NESS chair and NESS member candidates regarding performance.
- Y. Serves as the DOE voting member, or technical advisor to the DOE member, on Service Nuclear Weapon Safety Study Groups (chair only).
- Z. 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 Director, Nuclear Explosive Safety.

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 requirements defines the level of expected knowledge and/or skill that an individual must possess to meet the intent of this

DRAFT DOE-STD-1185-2007

Standard. Each of the competency requirements is further described by a listing of supporting knowledge and/or skill statements, which although not requirements, do describe the intent of the competency statement(s). In selected competencies, expected knowledge and/or skills have been designated as “mandatory performance activities.” In these competencies, the actions are not optional.

Note: When regulations, DOE directives, or other industry standards are referenced in the FAQs, the most recent revision should be used.

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 shall 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

DRAFT DOE-STD-1185-2007

- 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 shall 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
 - UH₃
 - 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 shall demonstrate a working level knowledge of the internal design of nuclear explosives.**

Supporting Knowledge and/or Skills

DRAFT DOE-STD-1185-2007

- 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 shall 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).

DRAFT DOE-STD-1185-2007

- 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 shall 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 shall 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 shall demonstrate a working level knowledge of fusing, arming, control, and ancillary systems in nuclear weapons.

Supporting Knowledge and/or Skills

DRAFT DOE-STD-1185-2007

- 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 shall 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 shall demonstrate a working level knowledge of explosives and pyrotechnics and their applicability in nuclear explosives.**

DRAFT DOE-STD-1185-2007

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, Octahydrotrinitrotetrazine, or Octagon
 - PETN, Pentaerythritoltetranitrate
 - PBX 9501
 - PBX 9502

DRAFT DOE-STD-1185-2007

- Cyclotol
- Baratol
- LX-17
- LX-04
- XTX-8003
- XTX-8004
- TATB, Triaminotrinitrobenzene

10. Nuclear explosive safety study personnel shall 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 shall 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 shall 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.

DRAFT DOE-STD-1185-2007

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 shall 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 shall 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.

DRAFT DOE-STD-1185-2007

15. **Nuclear explosive safety study personnel shall 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 shall 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 shall 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.

DRAFT DOE-STD-1185-2007

- 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 shall demonstrate a working level knowledge of the requirements for the safe off-site and on-site 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 on-site 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 off-site and on-site 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 shall demonstrate an expert level knowledge of DOE O 452.2C, *Nuclear Explosive Safety*, DOE O 452.1C, *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

DRAFT DOE-STD-1185-2007

- 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 452.2C.
- e. Discuss the general NES rules established for all DOE NEOs.
- f. Discuss the attributes, objectives, and interrelationships of the five DOE nuclear explosive surety standards.
- g. Discuss in detail the three NES standards that all NEOs must meet as stated in DOE O 452.2C.
- h. Discuss the requirements for operations involving nuclear explosives that are not known to be one-point safe.
- 20. Nuclear explosive safety study personnel shall demonstrate an expert level knowledge of DOE-STD-3015-2004, *Nuclear Explosive Safety Evaluation Process*.**

Supporting Knowledge and/or Skills

- a. Discuss the purpose and scope of DOE-STD-3015-2004, *Nuclear Explosive Safety Evaluation Process*.
- 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 shall 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.

DRAFT DOE-STD-1185-2007

- 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 a master study and an operation-specific study.

22. Nuclear explosive safety study personnel shall 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 shall 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 shall demonstrate an expert level knowledge of Chapter 11.7 of the *Development and Production Manual, Nuclear Explosive Operations Change Control Process* and the Office of Secure Transportation (OST) Change Control Process.

Supporting Knowledge and/or Skills

- a. State the purpose and applicability of chapter 11.7.
- 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 guidance on the NES change evaluation process.
- e. Discuss the criteria for contractor approved (trivial) NES changes.
- f. Discuss the criteria for DOE/NNSA approval not requiring a NESS.
- g. Discuss the OST Change Control Process.

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

Supporting Knowledge and/or Skills

DRAFT DOE-STD-1185-2007

- a. Describe the mission of the Nevada Test Site.
- b. Discuss the general supplemental Nevada Site Office Nuclear Explosive Safety Rules (NESRs).
- c. Discuss the Nevada Site Office NESRs for electrical instruments connected to a nuclear device.
- d. Discuss the NESRs for nuclear devices at the Nevada Test Site.

26. Nuclear explosive safety study personnel shall demonstrate a working level knowledge of the specific NESRs for NEO conducted at the DAF.

Supporting Knowledge and/or Skills

- a. Describe the DAF rules pertaining to high explosives.
- b. Describe the DAF rule pertaining to fire sets.
- c. Describe the DAF rule pertaining to NELAs.
- d. Describe the DAF rules pertaining to transportation.

27. Nuclear explosive safety study personnel shall demonstrate a working level knowledge of DOE O 5480.19, *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, *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.

28. Nuclear explosive safety study personnel shall demonstrate a familiarity level knowledge with the requirements in DOE Technical Standard DOE-STD-3009-94, *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

DRAFT DOE-STD-1185-2007

- 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.
- 29. 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 440.1-1 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
- 30. Nuclear explosive safety study personnel shall demonstrate a working level knowledge of the requirements for protection, security, and control of nuclear explosives and nuclear weapons as described in DOE O 452.4A, *Security and Control of Nuclear Explosives and Nuclear Weapons*.**

DRAFT DOE-STD-1185-2007

Supporting Knowledge and/or Skills

- a. Discuss the objectives of DOE O 452.4, *Security and Control of Nuclear Explosives and Nuclear Weapons*.
- b. Discuss the relationship between NES and deliberate unauthorized use measures.
- c. Describe the NESSGs role in evaluating security and use-control operations, equipment, and facilities.

31. Nuclear explosive safety study personnel shall 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.

32. Nuclear safety study personnel shall demonstrate a familiarity level knowledge of 10 CFR 830 Part 120, *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.

33. Nuclear explosive safety study personnel shall 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

DRAFT DOE-STD-1185-2007

- 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.
- 34. Nuclear explosive safety study personnel shall 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 an USQ determination.
 - c. Define the following terms:
 - Discrepant as found condition
 - Potential inadequacy in the safety analysis
 - Proposed change
 - d. Define the conditions for an USQ.
 - e. Describe the 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.
- 35. Nuclear explosive safety study personnel shall 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.

DRAFT DOE-STD-1185-2007

- 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.
- 36. Nuclear explosive safety study personnel shall 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 Pantex
 - Software that controls testers
 - Software used to write, control, record or display Nuclear Explosive Operating Procedures (NEOPs) and processes during operations

DRAFT DOE-STD-1185-2007

- Software used to analyze hazards
 - Software used to monitor HRP and personnel access
37. **Nuclear explosive safety study personnel shall demonstrate a working level knowledge of the Service Nuclear Weapon System Safety Group Process as described in DoD 3150.2-M and DOE O 452.6, *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)
 - 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

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

Supporting Knowledge and/or Skills

DRAFT DOE-STD-1185-2007

- 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

39. Nuclear explosive safety study personnel shall 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.

Mandatory Performance Activities

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

DRAFT DOE-STD-1185-2007

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, shall 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 shall not sign NESSG reports. The certified chair acting as a mentor during these activities retains all responsibilities, including signing the report.

41. Nuclear explosive safety study personnel shall 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 shall be under the guidance and direction of the certified NESSG member from the candidate's organization. The certified NESSG member and NESSG chair shall provide feedback to the candidate regarding performance.

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

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DRAFT DOE-STD-1185-2007

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 shall 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
 - NESTE270, 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 address 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 shall be documented in Individual Development Plans (IDPs).

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 Safety Study Group (NWSSG) Studies, or ARG exercises may be substituted for one NESS/OSR with prior permission from the certifying official.

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DRAFT DOE-STD-1185-2007

CONCLUDING MATERIAL

Review Activity:

EM
NNSA
NE

Preparing Activity:
DOE-NNSA/NA-121.1

Project Number:
TRNG-0051

Area and Site Offices

Livermore Site Office
Los Alamos Site Office
Nevada Site Office
Pantex Site Office