



**U.S. Department of Energy
Technical Qualifications Program**

Nuclear Explosive Safety Topical Area

**Training-to-Competency Curriculum Matrix
&
Training-to-Competency Matrix**

Nevada Operations Office

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A. Introduction

1. Scope and Background

This curriculum matrix and training-to-competency matrix encompass those competencies addressing nuclear explosive safety (weapons) skills and knowledge which have been identified as part of the "common functional area competency requirements" in the Department of Energy (DOE) *Nuclear Explosive Safety Qualification Standard*, August 1995. The implementation of this Standard fulfills one of DOE's commitments to Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 93-3, *Improving DOE Technical Capability in Defense Nuclear Facilities Programs*. This curriculum matrix and training-to-competency matrix were developed in support of the Lead Site Concept by the Nevada Operations Office.

As referenced in DOE Manual 360.1-1A, Training, the acquisition of these nuclear fundamentals competencies can be demonstrated by three methods:

competency equivalency documented by previous training, education, and experience;
competency evaluation of knowledge and skills using examinations and performance evaluations usually following the completion of a course;
competency exemption which is a written release from the requirement to meet a specific competency.

Some general examples of these methods include:

- documentation of equivalent training or education
- a test-out (or challenge test)
- a requirement waiver
- completion of applicable course work
- taking a course of instruction
- demonstrating competency acquisition through job performance

2. Purpose

The purpose of the curriculum matrix is to provide a **suggested** roadmap of courses and developmental assignments that allow acquisition of appropriate nuclear explosive safety skills and knowledge.

The purpose of the training-to-competency matrix is to provide a listing of courses that either fully or partially meet the stated competency.

3. How to Use the Curriculum Matrix

Each curriculum matrix depicts the suggested course or courses that help an individual acquire the skills and knowledge associated with a particular nuclear explosive safety (weapon) competency. **The curriculum matrix is not mandatory**, but provides a recommended sequence for course completion and identifies advanced courses that can be taken, if required, for an individual's current duty assignment. Additionally, the curriculum matrix suggests that individual developmental assignments be designed and administered by the owning organization, to ensure the qualification candidate fully meets the competency requirements. **Attending courses does not ensure an individual is competent to perform a particular job. Controlled and supervised practice in the field or developmental assignment is a necessity for the nuclear explosive safety area.**

4. How to Use the Training-to-Competency Matrix

The training-to-competency matrix identifies courses that either fully or partially meet a particular competency. The matrix also identifies advanced courses that may be desirable for personnel requiring more extensive knowledge in a particular competency area. **The training-to-competency matrix is not mandatory**, but provides a quick reference to the available courses and what competency the course supports. For courses that partially meet or exceed competency requirements, it is incumbent on the supervisor to match the skills and/or knowledge associated with the competency to the course description/objectives to ensure unique job requirements for each employee are met.

5. DOE Nuclear Explosive Safety Training Program

Efforts to develop the DOE Nuclear Explosive Safety (NES) Training Program began in FY 1998. Sandia has coordinated the development of this program and will manage the program at the request of DOE/HQ DP-21.

As specified in the tasking letter, there are three levels to the program:

1. Functional area training for all personnel engaged in NES work within the DOE complex.
2. DOE Nuclear Explosive Safety Study Group (NESSG) member training.
3. Site-specific training

Level two of the program has been initiated through a team composed of NES and NESSG members. The team began with the development of a NESSG curriculum consisting of the identification of 11 training courses based on the requirements of DOE-STD-3015-97. A listing of completed and proposed NESSG curriculum can be found in **Section J**. As courses are developed, course descriptions, objectives and points of contact will be made available.

6. Omission of a Nuclear Explosive Safety (Weapons) Self-Study Guide

No self-study material has been developed for the nuclear explosive safety (weapons) topical area.

- The self-study material required to satisfy the competencies is extremely voluminous and in most cases classified.
- Subject-matter experts, from around the complex felt that self-study guides would be both inappropriate and insufficient to meet the needs of personnel in the nuclear explosive safety area. However, in an effort to assist personnel to become familiar with the nuclear explosive safety area, primer-level texts are referenced in Section 7.

7. Available Primer-Level Texts

a. Title: *An Introduction to Nuclear Weapons,
Samuel Glasstone and Leslie M. Redman*

Sponsored By: U.S. Atomic Energy Commission
Report Number: WASH - 1037
Security Classification: Secret
Ordering Information: Contact your local technical library for ordering.

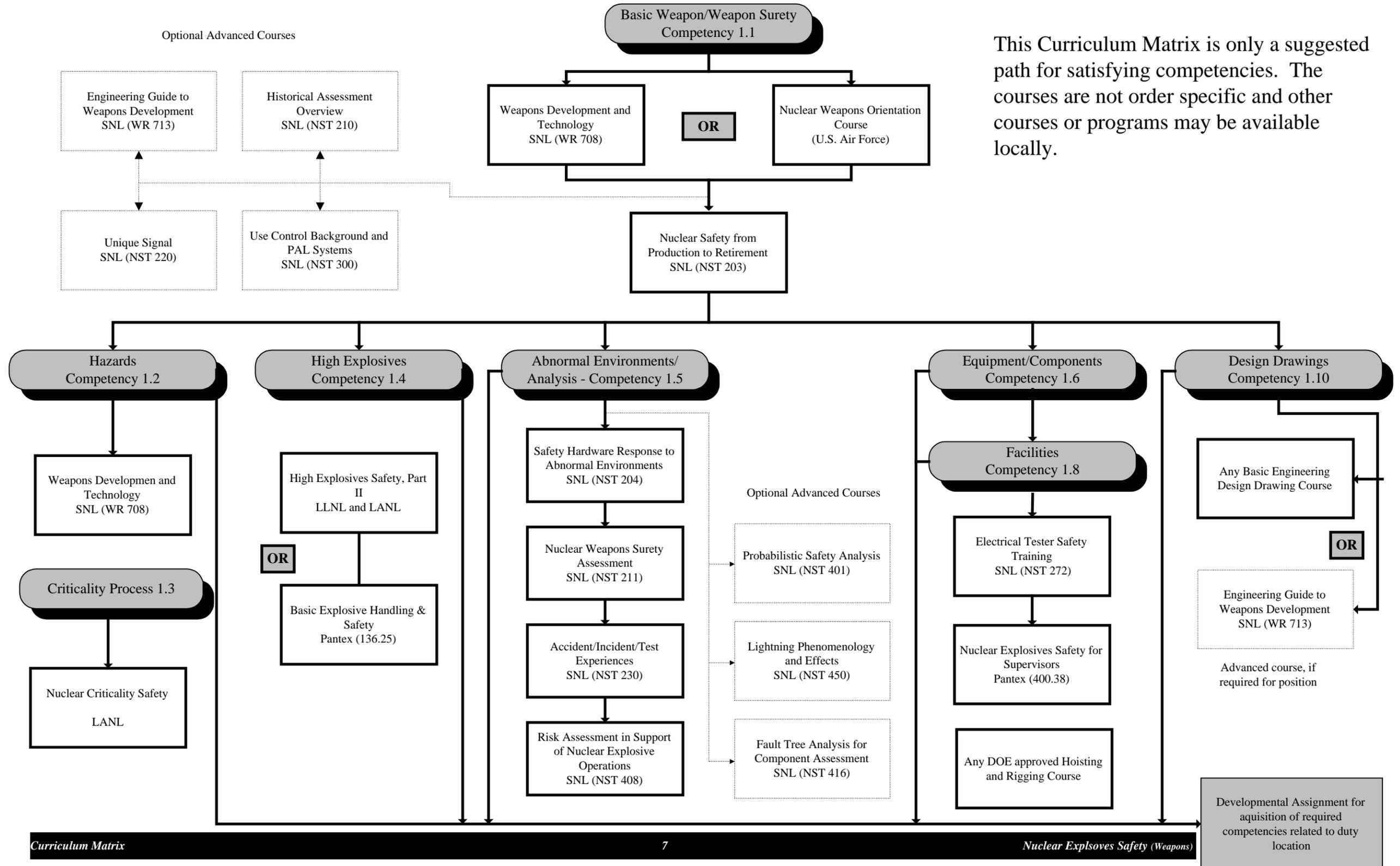
b. Title: *Nuclear Explosive Training Manual*

Sponsored By: DOE Albuquerque Operations Office
Security Classification: Secret
Ordering Information: Contact DOE/AL Nuclear Weapons Surety Division
(NESD) (505) 845-5902

c. Title: *Caging the Dragon - The Containment of Underground Nuclear
Explosions, James Carothers, Lawrence Livermore National Laboratory.*

Sponsored By: DOE/Defense Programs
Defense Nuclear Agency
Report Number: DOE/NV-388
DNA-TR-95-74
Security Classification: Unclassified
Ordering Information: Contact the Office of Scientific and Technical Information,
Oak Ridge, TN (615) 576-8401

B. Curriculum Matrix - General Technical Competencies



This Curriculum Matrix is only a suggested path for satisfying competencies. The courses are not order specific and other courses or programs may be available locally.

C. Competency-to-Training Matrix - General Technical Competencies

Activity	Nuclear Explosive Safety General Technical Competencies							
	1.1	1.2	1.3	1.4	1.5	1.6	1.8	1.10
Course: <i>Accident, Incident, Abnormal Environments and Test Experiences</i> (SNL NST 230)					*			
Course: <i>An Engineering Guide to Weapons Development, Production, and Stockpile</i> (SNL 713)	*,A							X,A
Course: <i>Risk Assessment in Support of Nuclear Explosive Operations</i> (SNL NSTE 408)					*			
Course: <i>Electrical Tester Safety Training</i> (SNL NST 272)						*	*	
Course: <i>Fault Tree Analysis for System Assessment</i> (SNL NST 416)					*, A			
Course: <i>Explosives Safety for Supervisors</i> (Pantex 400.38)							X	
Course: <i>Basic Explosive Handling & Safety</i> (PANTEX 136.25)				*				
Course: <i>High Explosives Safety - Part II Applications for Nuclear Weapons</i> (LANL/LLNL)				X				
Course: <i>Historical Assessment Overview</i> (SNL NST 210)	*,A							
Course: <i>Lightning Phenomenology and Effects</i> (SNL NST 450)					*, A			

X Fully Meets the Competency

* Partially Meets the Competency

A Advanced Course - exceeds certain competency requirements, but does not necessarily cover all associated skills and knowledge

NOTE: For courses that partially meet or exceed the competency requirements, the supervisor should match the skills and/or knowledge associated with the competency to the course description/objectives to ensure unique job requirements for each employee are met.

Competency-to-Training Matrix - General Technical Competencies

Activity	Nuclear Explosive Safety General Technical Competencies							
	1.1	1.2	1.3	1.4	1.5	1.6	1.8	1.10
Course: <i>Nuclear Safety From Production to Retirement: Background and Principles</i> (SNL NST 203)	*							
Course: <i>Safety Hardware Response to Abnormal Environments and Historical Experiences</i> (SNL NST 204)					*			
Course: <i>Nuclear Weapons Orientation Course</i> (USAF DNWS-R001)	*							
Course: <i>Nuclear Weapons Surety Assessment</i> (SNL NST 211)					*			
Course: <i>Probabilistic Safety Analysis</i> (SNL NST 401)					*, A			

- X Fully Meets the Competency
- * Partially Meets the Competency
- A Advanced Course - exceeds certain competency requirements, but does not necessarily cover all associated skills and knowledge

NOTE: For courses that partially meet or exceed competency requirements, the supervisor should match the skills and/or knowledge associated with the competency to the course description/objectives to ensure unique job requirements for each employee are met.

Competency-to-Training Matrix - General Technical Competencies

Activity	Nuclear Explosive Safety General Technical Competencies							
	1.1	1.2	1.3	1.4	1.5	1.6	1.8	1.10
Course: <i>Survey of Weapons Development and Technology</i> (SNL WR 708)	*	*						
Course: <i>Unique Signal</i> (SNL NST 220)	*, A							
Course: <i>Use Control and Background and PAL Systems</i> (SNL NST 300)	*, A							
Course: <i>Nuclear Criticality Safety</i> (LANL)			*					

- X Fully Meets the Competency
- * Partially Meets the Competency
- A Advanced Course - exceeds certain competency requirements, but does not necessarily cover all associated skills and knowledge

NOTE: For courses that partially meet or exceed competency requirements, the supervisor should match the skills and/or knowledge associated with the competency to the course description/objectives to ensure unique job requirements for each employee are met.

D. Nuclear Explosive Safety - General Technical Competencies

1. Competency 1.1

Nuclear explosive safety personnel shall demonstrate a working level knowledge of the internal design of nuclear explosive/weapon systems, components and mechanisms.

Supporting Knowledge and/or Skills

- a. 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 (zippers)
 - Ancillary hazardous systems

- b. Describe the nuclear explosive/weapon command and control features with respect to the following:
 - Personnel
 - Electronics
 - Mechanics/required signals - PAL (permissive action link)

- c. Discuss the principles of nuclear weapon design specific to the following:
 - Stockpile-to-Target Sequence
 - Military Characteristics

- d. State and discuss the nuclear weapon design safety criteria from DOE Order 452.1A, Nuclear Explosive and Weapon Surety Program including:
 - Normal environment
 - Abnormal environment
 - One-point safety
 - Dispersal safety

- e. Discuss nuclear detonation safety design principles and describe nuclear explosive components/features that have been employed to provide isolation, inoperability, and incompatibility, including:
 - Barriers
 - Weak links
 - Strong links
 - Unique signals
- f. Discuss the role of independence and first principles in the implementation of the nuclear detonation safety design principles (safety theme).
- g. Describe nuclear explosive design features that have been employed to prevent/mitigate fissile material dispersal including:
 - Insensitive high explosives
 - Fire-resistant pits

2. Competency 1.2

Nuclear explosive safety personnel shall demonstrate a working level knowledge of the radiological, equipment, and personnel hazards associated with nuclear explosives/weapons.

Supporting Knowledge and/or Skills

- a. Discuss the radiological characteristics, and related hazards to personnel and equipment from the following materials used in nuclear explosives/weapons:
 - Uranium
 - Plutonium
 - Tritium
- b. Discuss the general quantity and configuration of the materials used in nuclear explosives/weapons that present a potential radiological hazard to personnel and equipment.
- c. Describe how as-low-as-reasonably-achievable (ALARA) considerations are incorporated into the procedures for the handling and storage of nuclear explosives/weapons.

- d. Identify the hazards to personnel and equipment from each of the following features of nuclear explosive/weapon design:
- Spin rockets
 - Retarding devices
 - Pre-flight controllers
 - Boosting device
- e. Describe toxic materials typically found in nuclear explosives and weapons, the hazards associated with them, and the safety precautions that should be taken.
- f. Describe the physical effects of a high explosive detonation and a nuclear detonation in terms of:
- Blast
 - Radiation
 - Thermal

Competency 1.3

Nuclear explosive safety personnel shall demonstrate a working level knowledge of the criticality process and its application to nuclear explosive/weapon design and operations.

Supporting Knowledge and/or Skills

- a. Discuss the following processes and their application in nuclear explosive/weapon design:
- Nuclear fission
 - Nuclear fusion
- b. Discuss the term “fissile materials” and give examples applicable to nuclear explosive/weapon design.
- c. Describe the effects of each of the following on critical mass:
- Reflectors
 - Absorbers
 - Moderators
 - Stray neutrons
 - Geometry
 - Poisons

- Enrichment
- d. Describe the methods used during the assembly, disassembly, transportation and storage of nuclear explosives/weapons to prevent criticality.
- e. Describe the criticality effects and criticality hazards associated with nuclear explosives/weapons in terms of personnel radiation exposure.
- f. Describe how each of the following categories of neutron interacting materials is used in, or may affect, the safe packaging, stacking, and storage of nuclear explosives/weapons. Give examples of materials and/or components within each category.
 - Reflectors
 - Absorbers
 - Moderators

3. Competency 1.4

Nuclear explosive safety personnel shall demonstrate a working level knowledge of high explosives and their applicability in nuclear explosives/weapons.

Supporting Knowledge and/or Skills

- a. Define the following terms:
 - Conventional high explosives (CHE)
 - Insensitive high explosive (IHE)
 - One point detonation
- b. Discuss the difference between insensitive high explosives (IHE) and conventional high explosives (CHE) used in nuclear explosives/weapons.
- c. Describe the function of primary and secondary explosives in nuclear explosive/weapon design.
- d. Define and compare the effects of the following interrelated high explosive terms that apply to nuclear explosive/weapon design:
 - Detonations
 - Violent reactions
 - Deflagration
 - Combustion

- e. Describe the response of high explosives used in nuclear explosive/weapon design to the following external stimuli:
 - Mechanical
 - Electrical
 - Thermal
- f. Discuss the effects of aging on the high explosive materials used in nuclear explosive/weapon design.
- g. Discuss the toxic properties of the high explosive materials used in nuclear explosive/weapon design.

4. Competency 1.5

Nuclear explosive safety personnel shall demonstrate a working level knowledge of the effects of abnormal environments on nuclear explosives/weapons.

Supporting Knowledge and/or Skills

- a. Define the term "abnormal environment."
- b. List the categories of abnormal environments specific to nuclear explosive/weapon operations and storage, and describe the characteristics of each.
- c. Given a set of conditions that make up an abnormal environment for a nuclear explosive/weapon, assess and evaluate a single abnormal environment including the credibility of multiple abnormal environments. Include the following in the evaluation:
 - Identifying hazards
 - Identifying the effects on the nuclear explosive
 - Identifying mitigating measures to be taken

5. Competency 1.6

Nuclear explosive safety personnel shall demonstrate a working level knowledge of tooling, testers, rigging, and hoisting equipment used for handling nuclear explosives/weapons.

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/weapons and preventing accidents.
 - Tooling
 - Testers
 - Rigging equipment
 - Hoisting equipment
- b. Read and interpret design drawings and technical specifications for the tooling, testers, rigging, and hoisting equipment used in handling nuclear explosives/weapons.
- c. Explain the importance of proper certification of slings and hoisting equipment used in handling nuclear explosives/weapons.
- d. Explain the importance of proper certification of testers used in nuclear explosives/weapons operations.

6. Competency 1.8

Nuclear explosive safety personnel shall demonstrate a working level knowledge of facility system interfaces and their potential effects on nuclear explosives.

Supporting Knowledge and/or Skills

- a. Identify the potential hazards that pneumatic and hydraulic systems present to the safety of nuclear explosive operations and associated activities.
- b. State the purpose and significant features of heating, ventilation, and air-conditioning systems that service nuclear explosive areas and discuss the effects of these systems in normal and abnormal environments.

- c. Describe the hazards presented to the safety of nuclear explosive operations and associated activities by the introduction of alternating current (AC) and direct current (DC) electrical energy sources, or equipment using any electrical source, into a nuclear explosive area.
- d. Describe the controls and design measures to prevent or limit the introduction of electrical energy into a nuclear explosive area.

7. Competency 1.10

Nuclear explosive safety personnel shall demonstrate the ability to interpret nuclear explosive design drawings and electrical schematics.

Supporting Knowledge and/or Skills

- a. Identify the symbols and/or codes used on design drawings and specifications to depict the relationship between components.
- b. State the condition in which all electrical devices are shown, unless otherwise noted on the diagram or schematic.
- c. Given a simple electrical schematic and initial conditions, identify the power sources and/or loads and their status.

E. General Technical Competencies - Supporting Courses and Descriptions

1. Accident, Incident, Abnormal Environments and Test Experiences (SNL NST 230)

This half-day course details selected accidents, incidents, and test experiences (including Palomares, Thule, and Damascus). The intent is to show by example some of the unexpected phenomena that safety analysts must learn to foresee, and to give a sense of how likely it is that something unlikely will happen.

Course Objectives:

- Explain the difference between an accident and an incident
- Explain the difference between a normal and an abnormal environment
- Identify the most hazardous environment for pre-ENDS weapons
- Explain the need for modern ENDS in a weapon
- Recognize the importance of establishing technically feasible situations
- Recognize the potential for deliberate accidents

Course Prerequisite

CONFIDENTIAL/FRD security clearance required.

This course is also available as a Computed Based Training (CBT) on CD-ROM.

How to Register:

Contact the Sandia National Nuclear Surety Training Program at (505) 844-9402.

2. An Engineering Guide to Nuclear Weapons Development, Production, and Stockpile (SNL WR 713)

This series of ten morning classes emphasize Sandia's role in the activities, procedures, and methods used to acquire and maintain a reliable stockpile of nuclear weapons. Major milestones in the seven weapon phases will be covered, including weapon project management, drawing and specification alternatives, documentation requirements, and resource management. Emphasis will be placed on activities that occur at SNL from both the system and component engineering perspectives. Weapon hardware and cutaways will be used as illustrations. The component sections will provide a basic understanding of weapon component design and operation including principles of operation, applications, manufacturing processes, design considerations, component limitations, availability, reliability, and method qualification. Guest speakers from other installations will explain their group's functions and how they interact with Sandia. One session will be a tour of the Nuclear Weapons School Museum.

Courses Objectives:

- To provide students with overview of nuclear weapons, stockpile obligation, future prospects for nuclear weapons

Course Prerequisites:

A Q-Clearance with access to weapons data ("W" badge).

How to Register:

Contact the Sandia National Laboratories Technical and Compliance Training Department at (505) 844-3247.

3. Hazard Analysis of Nuclear Explosive Operations (NST 408)

This three and one half-day course is designed to support the Nuclear Explosive and Weapon Safety (NEWS) program, and is required for Nuclear Explosive Safety Study Group (NESSG) members.

The purpose of this course is to provide the student with an introduction to system analysis techniques called risk assessments, provide instruction on hazard assessments for nuclear weapons, provide instruction on the use of event trees as an inductive system analysis tool for developing accident scenarios, and provide instruction on how a fault tree is used in assessing nuclear detonation pathways for a nuclear weapon system.

How to Register:

Contact the Sandia National Laboratories Nuclear Surety Training (NST) Program (505) 844-6340.

4. Electrical Tester Safety Training (SNL NST 272)

This one day course is designed to support the Nuclear Explosive and Weapon Safety (NEWS) program, and is required for Nuclear Explosive Safety Study Group (NESSG) members.

This course will give the student an understanding of the risks and safety of electrical tests, the design and construction of testers, the use of testers at PANTEX, Nevada Test Site (NTS) and related documents.

Course Objectives:

- Understanding Hazards of Voltage and Current
- Comparison of Electricity and Fluids
- Faults and Combination of Faults
- Nuclear Explosive Safety
- Possible Consequences of Unintended Currents
- Design Principles and Considerations
- Voltage Limiters
- Electro-Static Discharge (ESD)

How to Register:

Contact the Sandia National Laboratories Surety Training (NST) Program (505) 844-9945.

5. Fault Tree Analysis for System Assessment (SNL NST 416)

This one-half day course examines the principles of performing weapon system fault tree safety assessment. The logic of fault tree construction, some examples of assessment, and the use of fault tree software will be included. Limitations of fault trees will also be addressed.

Course Objectives:

- Provide familiarity with system analysis concepts
- Recognize fault tree symbology
- Understand the thought processes and logic inherent in fault tree analysis
- Build, solve, and quantify a fault tree model
- Provide benefits of a fault tree analysis
- Appreciation of data limitations related to weapon systems analysis

How to Register:

Contact the Sandia National Laboratories Nuclear Surety Training (NST) Program (505) 844-9402.

6. Explosive Safety for Supervisors (PANTEX 400.38)

This sixteen-hour course is the definitive basic training course for explosives safety as defined by the Department of Energy. It provides an overview of every requirement identified in DOE M 440.1-1, The DOE Explosives Safety Manual. It incorporates the latest information and issues from within DOE and the entire explosives community. It is designed for operations supervisors, managers and safety personnel. Operators may also benefit from the course. Instruction is comprised of multimedia presentations using real life examples and providing historical perspective. Practical exercises reinforce the material covered and provide problem-solving experience using DOE M 440.1-1. A comprehensive test given at the end of the course ensures that each student has met the training objectives. Provided with the course is the latest update of DOE M 440.1-1 to include the latest approved changes from the DOE Explosives Safety Committee.

Students successfully completing this course will take away a general understanding of DOE Explosives Safety criteria and requirements regarding explosives operations and activities processes in accordance with the DOE Explosives Safety Manual (DOE M 440.1-1). They will also be able to systematically evaluate an explosives operation or activity to identify and respond to explosives safety concerns. An official course completion certificate is provided.

Course Objectives:

- Identify the major components of the DOE Explosives Safety Manual
- Describe the DOE Explosives Safety Manual administration and management process
- Describe the three steps in the Explosives Safety Application System
- Demonstrate the Explosives Safety Application System

How to Register:

Contact John Taylor at PANTEX Plant (806) 477-6392.

7. Basic Explosive Handling & Safety (PANTEX 136.25)

This four-hour course is designed for personnel who handle bare, consolidated explosives and explosive articles. It discusses basic explosive terms, definitions and concepts. It explains Department of Transportation explosive hazard classifications and storage compatibility groups. It also relates the main conditions and events that cause explosives to initiate, and specific methods used to prevent this from happening. It introduces explosives sensitivity testing and discusses different detonator types.

Students successfully completing this course will take away an understanding of basic explosive terms and classifications. They will be able to recognize specific hazards associated with different types of explosives to include detonators and the methods used to mitigate them.

Course Objectives:

- State the difference between deflagration and detonation.
- State the difference between primary high explosives and secondary high explosives.
- Identify the characteristics of different DOT Hazard Class 1 Divisions.
- Identify the characteristics of different explosives storage compatibility groups.
- State the forum main events/conditions that cause explosives to initiate.
- Identify the problems associated with electrostatic charges and explosives handling.
- Identify methods used to test the sensitivity of explosives.
- Recognize Pantex Programmatic High Explosives.
- Identify the origin of Pantex Programmatic High Explosives from their designation.
- Identify the difference between raw explosives material and explosives formulations.
- Identify the difference between Exploding Bridge Wire and Low Energy detonators.
- Connect physical protective measures used to reduce the possibility of explosives initiation to the cause of initiation they protect against.
- Connect operational protective measures used to reduce the possibility of explosives initiation to the cause of initiation they protect against.

How to Register:

Contact John Taylor at PANTEX Plant (806) 477-6392.

8. High Explosive Safety - Part II Applications for Nuclear Weapons (LANL/LLNL)

This two-day course covers the following topics:

- Types of High Explosives in Nuclear Weapons
- High Explosive Development Process

Small Scale Safety Tests and Results (materials)

- Drop Weight Impact
- Thermal

Large Scale Safety Tests and Results (components)

- Impact Tests
- Thermal Tests
- Thermal Modeling
- Detonator/Booster
- Bullet Testing

Full Scale Weapons Tests and Results

- LANL Impact Tests
- LANL Impact Modeling
- LLNL Impact Tests
- LLNL Impact Modeling
- LANL Thermal Test Results
- LLNL Thermal Test Results
- Aging Effects on High Explosive Safety Properties
- Risk Assessment Applications NESS
- Test Movies - Discussion - Review

How to Register:

Contact James Humphrey, LLNL (510) 423-1844 or Larry Hatler, LANL (505) 667-6738 to register.

9. Historical Assessment Overview (SNL NST 210)

This one-half day course looks at the first approaches to surety assessment, including the evolution of the DOD and DOE Standards and Military Characteristics for Nuclear Weapon Safety. Early study techniques are outlined including the Technical Working Group (TWG) Studies of the Mid 1970's. More recent studies/assessments are also discussed, including the Soft Spot Analyses of the 1980's, WAP and NSAFE. Also discussed are the incidents of concern and the changes in approach.

Course Objectives:

- Explain the criteria for one-point safety, and nuclear detonation safety in normal and abnormal environments
- Describe the early study techniques for nuclear weapon safety assessment
- Identify the shortcomings or "fatal flaws" of early study techniques
- Describe the scope, objective, and outcomes of the TWG studies

How to Register:

Contact the Sandia National Laboratories Nuclear Surety Training (NST) Program at (505) 844-9402.

10. Nuclear Criticality Safety, 3 day Program (LANL)

This course will enable the students to understand the principles of nuclear chain reaction and criticality, with emphasis on criticality safety.

Course Objectives:

- Explain the concept of criticality
- Identify the major factors which influence criticality and common criticality controls
- Explain the likelihood and consequences of criticality accidents.

How to Register:

Contact Dr. Tom McLaughlin (505-667-4789)

11. Nuclear Criticality Safety, 5 day Program (LANL)

This course consists of lectures and laboratory sessions, including active student participation in actual critical experiments, a visit to a plutonium processing facility, and in-depth discussion of safety philosophy.

Course Objectives:

- Perform simple and complex analytical methods for criticality analysis
- Review regulations applicable to fissile material operations.
- Identify important administrative practices
- Explain the likelihood and consequences of criticality accidents.

How to Register:

Contact Dr. Tom McLaughlin (505-667-4789)

12. Lightning Phenomenology and Effects (SNL NST 450)

This one-half day course will provide information on the following: characteristics and frequency of occurrence of lightning, the interaction of lightning with nuclear weapons and nuclear weapon systems, and engineered protection against direct strike and nearby lightning.

Course Objectives:

- Lightning phenomenology
- Interaction of lightning with nuclear explosives
- Interaction of lightning with buildings and other structures in which nuclear weapons are assembled, maintained and stored
- Positive measures that are in stockpile weapons to prevent unintended detonation due to lightning
- Knowledge of lightning and of the effects of lightning to evaluate and improve the lightning protection features found in nuclear weapons.

How to Register:

Contact the Sandia National Laboratories Nuclear Surety Training (NST) Program at (505) 844-9945.

13. Nuclear Safety from Production to Retirement: Background and Principles (SNL NST 203)

This half-day course summarizes the reasons for extraordinary care in the design, production, and use of abnormal-environment-resistant safety features in nuclear weapons. Nuclear safety principles and their implementation are shown, including the background for Enhanced Nuclear Detonation Safety (ENDS), the concepts of active and passive safety, traceable safety subsystems and a brief introduction to identification of Pentagon S features.

Course Objectives

- Identify the principles of nuclear weapon safety
- Identify the nuclear weapon safety principle(s) being implemented in any given safety feature
- Explain the difference between active and passive safety
- Describe the purpose, and principles of a unique signal
- Describe the elements of a traceable safety subsystem

How to Register

Contact the Sandia National Laboratories Nuclear Surety Training (NST) Program at (505) 844-9402.

14. Nuclear Safety Hardware Response to Abnormal Environments and Historical Experiences (Burned Board Room) (SNL NST 204)

This half-day course utilizes laboratory/exhibit demonstrations with the aim of explaining the reasons for extraordinary safety care, the role of abnormal environments, abnormal-environment safety features, and the background for Enhanced Nuclear Detonation Safety (ENDS).

Course Objectives:

- Explain the importance of abnormal environment testing
- Describe the effects of electrical power on components (printed circuit boards, cables, connectors, junction boxes, etc.)
- Describe the effects of other abnormal environments on the weapon components
- Explain the advantages of passive safety
- Describe how a safety feature might be bypassed in an abnormal environment
- For a given piece of hardware and a description of its function in the system, identify the principle of nuclear weapon safety that is addressed
- Identify abnormal environment in which it might be vulnerable and explain why

Course Prerequisites:

A SECRET/RD security clearance is required for entry into the Burned Board Room.

How to Register:

Contact the Sandia National Laboratories Nuclear Surety Training (NST) Program at (505) 844-9402.

15. Nuclear Weapons Orientation Course (USAF)

This four-day course provides an overview of the U.S. Nuclear Weapons Program including the history and development of nuclear weapons, management of our nuclear stockpile, and issues and challenges now facing this program. Course curriculum includes twenty classes organized into the functional areas of Nuclear Weapons Fundamentals, Nuclear Weapons Effects, Nuclear Weapons Stockpile, and Nuclear Weapons Issues. The course focuses on the Weapons Display Area where students are instructed on every nuclear weapon system ever stockpiled by the United States. The themes of Safety, Security, Operational Effectiveness, and Counter proliferation are developed throughout the course.

Course Objectives:

- Evaluate the scope of the national nuclear weapons program.
- Describe basic nuclear physics and materials.
- Identify the key elements of nuclear surety.
- Describe the operational and physical characteristics of nuclear weapons.
- Evaluate future development, testing, command and control, and weapons effects on stockpiled nuclear weapons.
- Describe intelligence estimates and international agreements.
- Discuss current nuclear weapons issues.

Prerequisites:

Secret/Restricted Data (Sigma 1-4) security clearance required. .

How to Register:

DOE employees should call (202) 426-1534 to register.

Mobile Training Teams

A mobile training team version of this course is available. Have your training office contact the DNWS Registrar for information on how to have a mobile training team visit your agency.

DNWS Registrar
FCDNA/FCINTR
1900 Wyoming Blvd SE
Kirtland AFB NM 87117-5669 or call (505) 846-5666.

15 Nuclear Weapons Surety Assessment (SNL NST 211)

This one-half day course is designed to brief system surety assessors on principles and techniques of the assessment process.

It explains the scope and purpose of nuclear weapon surety assessment, describes the objectives and process, and explains how to identify technically feasible threat conditions and safety needs at each stage of weaponization. Examples are given to illustrate a productive approach and to illustrate common problems.

Course Objectives:

- Explain the scope and purpose of nuclear weapon surety assessment
- Describe the two objectives of a nuclear weapon surety assessment
- Describe the process for conducting a nuclear weapon surety assessment
- Identify technically feasible threat conditions for a nuclear weapon at any stage of the manufacturing-to-retirement sequence
- Identify the safety needs at each stage of weaponization

How to Register:

Contact the Sandia National Laboratories Nuclear Surety Training (NST) Program at (505) 844-9402.

17. Probabilistic Safety Analysis (SNL NST 401)

Basic Probabilistic Risk Assessment (PRA) analysis techniques are introduced during this two-day course. Application to system assessment through fault trees and event trees is summarized. The use of analysis results and perception of risk are considered as factors. Abnormal and other extreme environments are addressed, and the need for special approaches to account for these environments is discussed. The advantages of applying analysis proactively rather than retroactively is discussed. Emphasis is placed on common conceptual, perceptual, and analytic traps and misconceptions, and several examples of sophisticated subtle traps are shown in order to raise caution about unexpected effects.

Course Outline

- Scope of Problems/Analyses
- Analyses as Part of a Process
- Difference between Safety Analysis and Failure Analysis
- Retrospect on Analysis Through Incidents History
- Probability and Statistics, Probability Distributions
- Boolean Algebra/Logic Constructions
- Fault Trees/Event Trees
- Source Data
- Role of Risk Perception
- Redundancy Management

How to Register:

Contact the Sandia National Laboratories Nuclear Surety Training (NST) Program at (505) 844-6340.

18. Unique Signal (SNL NST 220)

This one-half day course details on the unique signal concept including background on why the approach was chosen from among other approaches (such as pattern recognition), the principles on which the approach is based and what the use of principles accomplishes, the design details of unique signal sequence patterns, and the payoffs to safety analysts, weapon system developers, and those responsible for the delivery system.

Course Outline

- Safety Philosophy
- The Unique Signal Concept
- Patterns Synthesis
- Communication
- Software
- Analysis
- Input Strategy
- Stronglink Strategy

How to Register:

Contact the Sandia National Laboratories Nuclear Surety Training (NST) Program at (505) 844-6340.

19. Use Control Background and PAL Systems (SNL NST 300)

This course consists of an introduction to Use Control with concentration on Permissive Action Link (PAL) systems. The course includes presentation on the definition and history of Use Control, the release system, and current and planned PAL systems and associated control equipment (code processors, recoders, decoders, coded switches, and other controllers).

The course covers the basics of PAL code management as well as key management for National Security Agency (NSA) materials, encryption concepts, and an overview and rationale for Use Control systems in development. Specific design details and operational parameters of Use Control systems, particularly Sensitive Use Control Information (SUCI), are not discussed.

This course comprises two consecutive half-day sessions (mornings) and will be offered approximately 2 times per year in response to request and general interest.

Prerequisites:

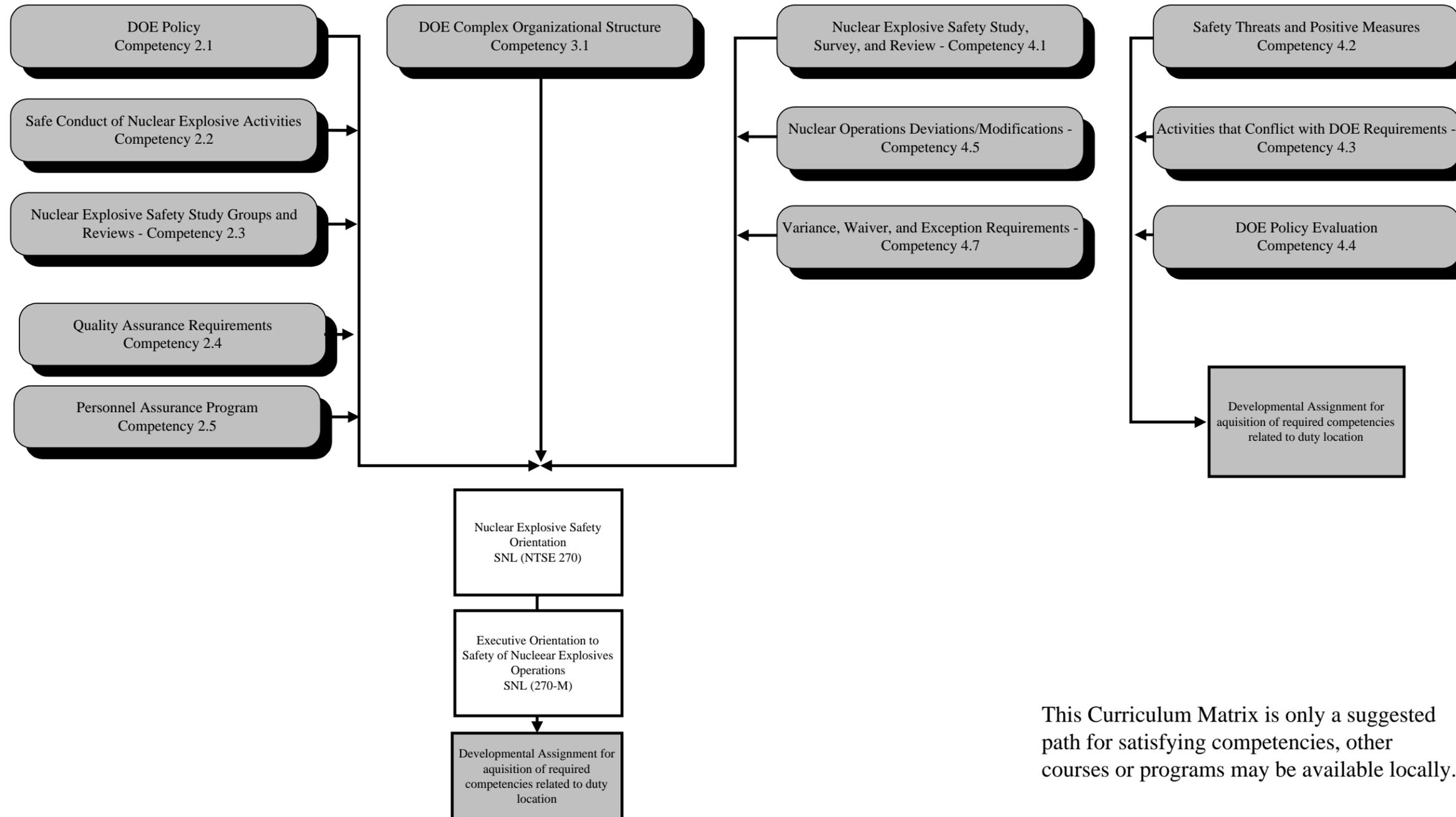
Manager approval is required. Course is classified up to Secret-Restricted-Data. The student's need-to-know will be established by course instructors in conjunction with the respective manager using the NST enrollment form.

How to Register:

Contact the Sandia National Laboratories Nuclear Safety Training (NST) Program at (505) 844-6340.

F. Curriculum Matrix - Regulatory, Administrative, and Management, Assessment, and Oversight Competencies

Curriculum Matrix - Regulatory, Administrative, and Management, Assessment, and Oversight Competencies



This Curriculum Matrix is only a suggested path for satisfying competencies, other courses or programs may be available locally.

Training-to-Competency Matrix - Regulatory, Administrative, and Management, Assessment, and Oversight Competencies

G. Training-to-Competency Matrix - Regulatory, Administrative, and Management, Assessment, and Oversight Competencies

Activity	Nuclear Explosive Safety Regulatory, Administrative, and Management, Assessment, and Oversight Competencies										
	2.1	2.2	2.3	2.5	3.1	4.1	4.2	4.3	4.4	4.5	4.7
Course: <i>Nuclear Explosive Safety Orientation</i> (SNL/ NSTE 270 (505) 844-9402	X	X	X	X	X	X				X	X
Course: <i>Executive Orientation to Safety of Nuclear Explosive Operations</i> (SNL/NSTE 270M)	*	*	*	*	*	*				*	*

- X Fully Meets the Competency
- * Partially Meets the Competency

NOTE: For courses that partially meet or exceed competency requirements, the supervisor should match the skills and/or knowledge associated with the competency to the course description/objectives to ensure unique job requirements for each employee are met.

H. Nuclear Explosive Safety - Regulatory, Administrative, and Management, Assessment, and Oversight Competencies

1. Competency 2.1

Nuclear explosive safety personnel shall demonstrate an expert level knowledge of the Department of Energy (DOE) policy, objectives, standards and criteria, authorities, and responsibilities as described in DOE Order 452.1A, Nuclear Explosive and Weapon Surety Program.

Supporting Knowledge and/or Skills

- a. Discuss the purpose, scope and applicability of DOE Order 452.1A, Nuclear Explosive and Weapon Surety Program.
- b. Define the following terms that are used in DOE Order 452.1A, Nuclear Explosive and Weapon Surety Program:
 - Abnormal environment
 - Environment, Safety, and Health (ES&H)
 - Normal environment
 - Nuclear explosive
 - Nuclear weapon
 - Nuclear explosive operation
 - Nuclear explosive operation associated activities
 - Nuclear Explosive Safety (NES)
 - Positive measures
- c. Discuss the Nuclear Explosive and Weapons Surety Program policy and objectives and describe its basic elements.
- d. Explain the line management responsibilities within the Nuclear Explosive and Weapons Surety Program.
- e. Discuss the nuclear explosive surety standards established in DOE Order 452.1A, Nuclear Explosive and Weapons Surety, and their application to nuclear explosive operations.

2. Competency 2.2

Nuclear explosive safety personnel shall demonstrate an expert level knowledge of the policy, procedures, authorities, and responsibilities established to ensure safe conduct of nuclear explosive activities as described in DOE Order 452.2A, Safety of Nuclear Explosive Operations.

Supporting Knowledge and/or Skills

- a. Discuss the policy, objectives, and applicability of DOE Order 452.2A, Safety of Nuclear Explosive Operation.
- b. Define the following terms used in DOE Order 452.2A, Safety of Nuclear Explosive Operation:
 - Access
 - Custody
 - Fissile Material Contamination
 - Fissile Material Dispersal
 - High explosive deflagration
 - High explosive detonation
 - Nuclear detonation
 - Nuclear explosive area
 - Nuclear explosive duty
 - One-point-safe nuclear explosive
- c. Discuss the program requirements for initial training and qualifying of Department of Energy and DOE contractor personnel for assignment to nuclear explosive duties as described in DOE Order 452.2A, Safety of Nuclear Explosive Operations.
- d. Explain the two-person concept for operations involving nuclear explosives.
- e. Discuss the nuclear explosive safety standards in DOE Order 452.2A, Safety of Nuclear Explosive Operations, to prevent unintended nuclear detonation or fissile material dispersal.
- f. Discuss the general nuclear explosive safety rules established in DOE Order 452.2A, Safety of Nuclear Explosive Operations, for all Department nuclear explosive operations.

- g. Explain why the following are needed to ensure the safe conduct of nuclear explosive operations and associated activities:
- Nuclear Explosive-Like Assembly (NELA) requirements
 - Permanent Marking Instructions
 - Control of Electrical Testers/Equipment

3. Competency 2.3

Nuclear explosive safety personnel shall demonstrate a working level knowledge of the Nuclear Explosive Safety Study Group (NESSG), and the Nuclear Explosive Safety Study (NES Study), Nuclear Explosive Safety Survey (NES Survey), and Nuclear Explosive Safety Review (NES Study Revalidation) processes described in the following Department of Energy (DOE) directives:

- **DOE Order 452.2A, Safety of Nuclear Explosive Operations**
- **DOE-STD-3015-97, Nuclear Explosive Safety Study Process (when issued)**

Supporting Knowledge and/or Skills

- a. Describe the organization requirements for a Nuclear Explosive Safety Study Group (NESSG).
- b. Describe the scope of the Nuclear Explosive Safety Study Group (NESSG) responsibilities.
- c. Explain the functions of a NES Study, a NES Survey, and a NES Study Revalidation .
- d. Discuss DOE Order 452.2A, Safety of Nuclear Explosive Operations requirements for conducting a NES Study and NES Survey.
- e. Explain how changes in each of the following types of planned operations could require a new NES Study and NES Survey:
 - Dismantlement schedule
 - Nuclear testing schedule
 - Testing schedule
 - New build and rebuild schedule
 - Transportation schedule
 - Revised programmatic/safety priorities
 - Weapon custody

- f. Describe the approval level requirements for a NES Study, a NES Survey, and a NES Study Revalidation .
- g. Explain the relationship between a Master Study and a specific study.

4. Competency 2.5

Nuclear explosive safety personnel shall demonstrate a working level knowledge of the Personnel Assurance Program described in the following Department of Energy (DOE) directives:

- **DOE Order 452.2A, Safety of Nuclear Explosive Operations**
- **10 CFR 711, Personnel Assurance Program**

Supporting Knowledge and/or Skills

- a. Discuss the purpose of the Personnel Assurance Program.
- b. Discuss the responsibilities of management and supervisory personnel under the Personnel Assurance Program.
- c. Discuss the Personnel Assurance Program certification requirements.
- d. Describe the purpose for the immediate, temporary removal from nuclear explosive duties of an individual whose suitability for performing such duties is in question.
- e. Explain the purpose of a Personnel Assurance Program certification list.

5. Competency 3.1

Nuclear explosive safety personnel shall demonstrate a working level knowledge of the Department of Energy (DOE) organizational structure, its technical laboratories, relevant Department of Defense interfaces, and DOE contractor responsibilities.

Supporting Knowledge and/or Skills

- a. Discuss the responsibilities and authorities for nuclear explosive safety of the following positions within the Department of Energy:
 - Secretary of Energy (S-1)
 - Assistant Secretary for Defense Programs (DP-1)
 - Assistant Secretary for Environment, Safety, and Health (EH-1)
 - Deputy Assistant Secretary for Military Application and Stockpile Support (DP-20)
 - Office of Security Affairs (NN-50)
 - Director of Security Evaluation (EH-4)
 - Managers of Operations Offices
- b. Discuss the lines of authority between the Department of Energy and its technical laboratories involved with nuclear explosive safety.
- c. Describe the Department of Defense and Department of Energy interfaces relative to nuclear weapon safety.
- d. Describe the relationship between the Department of Energy and its contractors regarding responsibility for nuclear explosive safety.

6. Competency 4.1

Nuclear explosive safety personnel shall demonstrate the ability to plan, prepare, and perform a Nuclear Explosive Safety (NES) Study, a Nuclear Explosive Safety (NES) Survey, and a Nuclear Explosive Safety (NES) Review.

Supporting Knowledge and/or Skills

- a. Given a set of conditions from which the need to perform a NES Study, a NES Survey, or a NES Study Revalidation has been determined:
 - Identify the scope of nuclear explosive safety operations, facilities, and equipment to be studied or surveyed.
 - Describe the study group membership.
 - Communicate Department of Energy (DOE) expectations of the conduct of the Nuclear Explosive Safety Study to all those who will participate in the study.
 - Identify any potential concerns pertinent to the device being studied.
 - Prepare a comprehensive draft report for the study.
- b. During the planning and performance of a NES Study, a NES Survey, or a NES Study Revalidation coordinate the participation of contractors in the compilation, analysis, and evaluation of data.
- c. During the planning and performance of a NES Study, a NES Survey, or a NES Study Revalidation evaluate the need for special briefings to provide supplemental information to study participants.

7. Competency 4.2

Nuclear explosive safety personnel shall demonstrate the ability to identify potential threats to nuclear explosive safety, and evaluate the adequacy of positive measures to assure nuclear explosive safety.

Supporting Knowledge and/or Skills

- a. Evaluate nuclear explosive operations and all applicable technical data.
- b. Evaluate nuclear detonation safety design and configuration during nuclear explosive operations including:
 - Isolation:
 1. Identify when barriers are breached during assembly/disassembly
 2. Identify when strong links are absent or potentially bypassed.
 - Incompatibility:
 1. Identify available energy sources and their effects on nuclear explosive components
 2. Identify available signals, such as in testers, that could drive a unique signal discriminator
 - Inoperability:
 1. Identify defined weak links in various nuclear explosives
 2. Describe the features and safety role of the weak link(s)
- c. Evaluate potential nuclear criticality risks associated with an operation or test to be performed.
- d. Evaluate the description and analysis of the design safety features of a nuclear explosive.
- e. Evaluate electrical tester designs, safety analyses, and tester/nuclear explosive interfaces.
- f. Evaluate special tooling and written procedures used for nuclear explosive operations.

- g. Evaluate facilities and associated equipment used for nuclear explosive operations.
- h. Evaluate the adequacy of a Safety Analysis Report (SAR), a Hazard Analysis Report (HAR), and a Nuclear Explosive Safety Study (NES Study) input document (including Nuclear Explosive Hazards Assessment) and evaluate the associated:
 - Hazard analyses
 - Accident analyses
 - Identification of safety-class and safety-significant Structures, Systems, Components
 - Derivation of Technical Safety Requirements, Operational Safety Controls, and Nuclear Explosive Safety Rules.
- i. Evaluate the safety analyses of nuclear explosive pre-arming, arming, timing, and firing systems and procedures.
- j. Analyze descriptions of countdowns, emergency stops and hold capabilities.
- k. Analyze security operations for potential threats to a nuclear explosive.
- l. Evaluate the on-site and off-site transportation of nuclear explosives.
- m. Evaluate analyses of nuclear detonation responses of nuclear explosives to an abnormal environment.

8. Competency 4.3

Nuclear explosive safety personnel shall demonstrate the ability to identify conflicting requirements between other regulatory documents and nuclear explosive safety.

Supporting Knowledge and/or Skills

- a. Given a set of conditions for a nuclear explosive operation, identify activities that present potential hazards or conflicts with DOE Order 452.2A, Safety of Nuclear Explosive Operations.
- b. Given a set of conditions for a nuclear explosive operation where a potential hazard or conflict has been identified, develop and implement recommendations and/or guidelines to mitigate the identified hazards or conflicts.

9. Competency 4.4

Nuclear explosive safety personnel shall demonstrate the ability to review nuclear explosive safety Orders, policies, guidelines, and directives.

Supporting Knowledge and/or Skills

- a. Given a proposed Order, policy, guideline, or directive, evaluate the document for adequacy, impact on the safety of nuclear explosive operations, and consistency with other policies, guidelines, and procedures.

10. Competency 4.5

Nuclear explosive safety personnel shall demonstrate the ability to process requests for administrative approval of deviations/modifications to a nuclear explosive operation.

Supporting Knowledge and/or Skills

- a. Review requests for deviations to a nuclear explosive operation.
- b. Document positions for administrative approval of requests for deviations to a nuclear explosive operation.

11. Competency 4.7

Nuclear explosive safety personnel shall demonstrate a working level knowledge of variance, waiver, and exception requirements specified in DOE Order 452.2A, Safety of Nuclear Explosive Operations.

Supporting Knowledge and/or Skills

- a. Define the following terms and describe the approval requirements for each:
 - Variance
 - Waiver
 - Exception
- b. Describe the specific elements of information to be included with each request for a variance, waiver, or exception.
- c. Describe the use of alternate or equivalent means to meet a specific requirement of DOE Order 452.2A, Safety of Nuclear Explosive Operations.
- d. Using an actual or hypothetical request for a variance, waiver, or exception, evaluate the request for adequacy, completeness, and compliance with DOE Order 452.2A, Safety of Nuclear Explosive Operations.

I. Regulatory, Administrative, and Management, Assessment, and Oversight Competencies - Supporting Courses and Descriptions

1. Executive Orientation to Safety of Nuclear Explosive Operations (SNL NSTE 270-M)

This one-day course is intended to familiarize management level personnel with the fundamentals of the DOE nuclear explosive safety program. The course provides an overview of terms and standards, and program requirements (DOE Orders). It includes such topics as joint DOE/DoD Weapon System Safety, principles of nuclear explosive safety, principles of high explosive safety, stockpile status and design overview, packaging and transportation safety, and nuclear explosive operations at nuclear facilities.

How to Register:

Contact the Sandia National Laboratories Nuclear Surety Training (NST) Program at (505) 845-9402.

J. Nuclear Explosive Safety Qualification Program

1. Nuclear Explosive Safety (NES) Orientation (NSTE 270)

This four day course provides a general introduction to the safety of nuclear operations and of the associated DOE Order, Technical Standards, and Supplemental Directives.

Course Objectives:

After completing the course, the participants will demonstrate knowledge and application of the Nuclear Explosive Safety Study (NESS) process, specifically:

- Policies
- Objectives
- Standards and criteria
- Requirements, and authorities and responsibilities

Course Outline:

- Introduction
- Nuclear Weapon Program Overview
- NEWS Program Orders and Directives
- NESS Input Adequacy Review
- NESS Technical Briefings
- NESS Observations and Deliberations
NESS Reports
- Tours, Demonstrations, NESS Exercise, and Test
- Course Summary

Upon conclusion of the course a written test will be administered with a minimum passing score of 80% required

How to Register:

Contact the Sandia National Laboratories Nuclear Surety Training (NST) Program at (505) 844-9402

2. Survey of Weapons Development and Technology (SNL WR 708)

This five-day course is designed to give a broad technical perspective of the nuclear weapons program. The topics covered include factors within and outside of the weapons complex that affect the weapons program. The following topics are covered:

Nuclear Effects	Tour of the Nuclear Weapons Museum
High Explosives, Detonators	Arming, Firing, and Initiation
Physics, Explosion Theory	Transfer Systems
Fission	Access Control/Use Control
Thermonuclear	Nuclear Testing
Safety	Arms Control
Fuzing	Stockpile Matters

Emphasis is on both technology (what and how) and philosophy (why).

Course Objectives:

- Describe the principles of how nuclear weapons function from the nuclear physics perspective.
- Describe the principles of nuclear weapons from the engineering implementation perspective.
- Recognize some of the systems that are part of the nuclear weapons program.
- Discuss the principles of nuclear surety (nuclear safety, use control, and security) and how it is implemented in the enduring stockpile
- Discuss how weapons in the enduring stockpile operate and the interrelationship of the weapons.
- Discuss the evolution of nuclear weapons over the past 50 years.
- Describe the principle drivers of the nuclear stockpile over the last 50 years, i.e., what military requirements have had the greatest impact on the DOE and its predecessors.
- Discuss nuclear weapons subsystem components and their evolution.

Upon conclusion of the course a written test will be administered with a minimum passing score of 80% required

Prerequisites:

DOE Q-Clearance (“3”), Sigmas 1-5, or DOD clearance for SRD/CNWDI. Students must provide a “need to know” justification. Be specific about how your current job relates to nuclear weapons.

How to Register:

Contact the Sandia National Laboratories Nuclear Surety Training (NST) Program at (505) 845-9843.

- *3. High Explosive Safety**
- *4. Hazard Analysis of Nuclear Explosive Safety (NES) Operations**
- *5 Electrical Equipment and Testers**
- *6 Worker Safety Program Facility Interfaces**
- *7 On Site Transportation Operations and Associated Equipment**
- *8 Off-Site Transportation Operations and Associated Equipment**
- *9 Tooling Design, Use, and Effect**
- *10. Characteristics and Hazards of Plutonium, Uranium, and Tritium**
- *11. Integrated Safety Management**

***TO BE DEVELOPED**

K Index of Courses

Course Title	Duration Hours	Source
<i>Accident, Incident, Abnormal Environments and Test Experiences</i> (SNL NST 230)	4	Sandia National Laboratories Nuclear Safety Information Center (505) 844-4721
<i>An Engineering Guide to Weapons Development, Production, and Stockpile</i> (SNL 713)	40	Sandia National Laboratories Technical and Compliance Training Department (505) 844-3247
<i>Hazard Analysis of Nuclear Explosive Operations</i> (SNL NST 408)	28	Sandia National Laboratories Nuclear Safety Information Center (505) 845-9945
<i>Electrical Tester Safety Training</i> (SNL NST 272)	8	Sandia National Laboratories Nuclear Safety Information Center (505) 844-9945
<i>Fault Tree Analysis for Component Assessment</i> (SNL NST 416)	4	Sandia National Laboratories Nuclear Surety Training Program (505) 844-4721
<i>Basic Explosives Handling & Safety</i> (PANTEX)	4	Amarillo Area Office (806) 477-6845
<i>Explosive Safety for Supervisors</i> (PANTEX)	16	Amarillo Area Office (806) 477-6845
<i>High Explosives Safety – Part II Applications for Nuclear Weapons</i> (LANL/LLNL)	16	Los Alamos National Laboratory (505) 667-6738 Lawrence Livermore National Laboratory (510) 423-1844
<i>Historical Assessment Overview</i> (SNL NST 210)	4	Sandia National Laboratories Nuclear Surety Training Program (505) 844-9402
<i>Lightning Phenomenology and Effects</i> (SNL NST 450)	4	Sandia National Laboratories Nuclear Surety Training Program (505) 844-9945
<i>Nuclear Safety From Production to Retirement: Background and Principles</i> (SNL NST 203)	4	Sandia National Laboratories Nuclear Safety Information Center (505) 844-4721

Course Title	Duration Hours	Source
<i>Nuclear Safety Hardware Response to Abnormal Environments and Historical Experiences</i> (SNL NST 204)	4	Sandia National Laboratories Nuclear Safety Information Center (505) 844-9402
<i>Nuclear Weapons Orientation Course</i> (USAF DNWS-R001)	40	United States Air Force (202) 426-1534
<i>Nuclear Weapons Surety Assessment</i> (SNL NST 211)	4	Sandia National Laboratories Nuclear Surety Training Program (505) 844-9402
<i>Probabilistic Safety Analysis</i> (SNL NST 401)	16	Sandia National Laboratories Nuclear Surety Training Program (505) 844-9945
<i>Survey of Weapons Development and Technology</i> (SNL WR 708)	40	Sandia National Laboratories Nuclear Surety Training Program (505) 845-9843
<i>Unique Signal</i> (SNL NST 220)	8	Sandia National Laboratories Nuclear Surety Training Program (505) 844-4721
<i>Use Control and Background and PAL Systems</i> (SNL NST 300)	8	Sandia National Laboratories Nuclear Surety Training Program (505) 844-4721
<i>Nuclear Explosive Safety Orientation</i> (SNL NSTE 270)	32	Sandia National Laboratories Nuclear Surety Training Program (505) 844-4721
<i>Executive Orientation to Safety of Nuclear Explosive Operations</i> (SNL NSTE 270M)	8	Sandia National Laboratories Nuclear Surety Training Program (505) 844-4721