

Approved: 06-12-06

SUBJECT: NUCLEAR EXPLOSIVE SAFETY

1. **OBJECTIVES.** This Department of Energy (DOE) Order establishes specific nuclear explosive safety (NES) program requirements to implement the DOE NES standards and other NES criteria for routine and planned nuclear explosive operations (NEOs).
2. **CANCELLATIONS.** DOE O 452.2B, *Safety of Nuclear Explosive Operations*, dated 08-07-01, and AL SD 452.2B, *Safety of Nuclear Explosive Operations*, Change 1, dated 3-22-02. Cancellation of a directive does not, by itself, modify or otherwise affect any contractual obligation to comply with the directive. Canceled directives that are incorporated by reference in a contract remain in effect until the contract is modified to delete the references to the requirements in the canceled directives.
3. **APPLICABILITY.**
 - a. **Departmental Elements.** Except for the exclusions in paragraph 3c, this Order applies to all Departmental elements listed in Attachment 1 that are involved in performing, managing, overseeing, or directly supporting NEOs or associated activities. This Order also applies to Departmental elements created after it is issued if they are involved in performing, managing, overseeing, or directly supporting NEOs or associated activities.

The Administrator of the National Nuclear Security Administration (NNSA) will assure that NNSA employees and contractors comply with their respective responsibilities under this Order.

- b. **DOE Contractors.**
 - (1) Except for the exclusions in paragraph 3c, the Contractor Requirements Document (CRD), Attachment 2, sets forth requirements of this Order that will apply to contracts that include the CRD.
 - (2) This CRD must be included in all contracts that involve performing, managing, overseeing, or directly supporting NEOs or associated activities.
 - (3) Site office managers are responsible for notifying contracting officers of which contracts are affected. Once notified, contracting officers are responsible for incorporating the CRD into each affected contract.
- c. **Exclusions.** This Order does not apply to unplanned events. DOE M 231.1-2, *Occurrence Reporting and Processing of Operations Information*, dated 8-19-03,

provides requirements for categorizing and reporting non-emergency NES occurrences. DOE O 151.1C, *Comprehensive Emergency Management*, dated 11-2-05, provides requirements for categorizing and reporting emergency NES occurrences. Additional requirements and responsibilities for responses to unplanned events are addressed in the 5530-series Orders. The senior energy official, or higher authority, will determine when to transition from emergency management directives to this Order.

4. REQUIREMENTS.

- a. DOE Nuclear Explosive Safety Standards. All NEOs must meet the following qualitative NES standards to prevent unintended nuclear detonation or fissile material dispersal from the pit.

- (1) There must be controls to minimize the possibility of accidents, inadvertent acts, or authorized activities that could lead to fire, high explosive (HE) deflagration, or unintended HE detonation.
- (2) There must be controls to minimize the possibility of fire, HE deflagration, or HE detonation, given accidents or inadvertent acts.
- (3) There must be controls to minimize the possibility of deliberate unauthorized acts that could lead to HE deflagration or HE detonation.

There must be multiple layers of defense (defense-in-depth). It is beneficial and preferable for controls to interrupt the chain of events as early as possible and as often as practical to raise confidence in the overall effectiveness of the control set. A primary objective of NES controls is to protect nuclear explosive main charge HE from insults capable of producing HE detonation or deflagration, including those arising from insults to main charge detonators.

- b. Nuclear Explosive Safety Program. NEOs require special consideration because of the potentially high consequences of an accident or unauthorized act. Site offices and the Office of Secure Transportation (OST) must ensure implementation of a formal, comprehensive NES program that includes the following.

- (1) General Nuclear Explosive Safety Rules (NESRs). The general NESRs set forth in this paragraph are mandatory for all NEOs.
 - (a) Nuclear Explosive Safety Evaluations. DOE-STD-3015 provides specific information regarding the three types of NES evaluations—nuclear explosive safety studies (NESSs), operational safety reviews (OSRs), and nuclear explosive safety change evaluations (NCEs). NEOs must not be performed until a NES study has been conducted, the NESS report has been approved, and approved prestart findings have been closed.

- (b) Nuclear Explosive Operating Procedures. NEOs must be performed in accordance with approved written procedures.
- (c) One-Point Safety.
 - 1 NEOs involving a nuclear explosive not certified to be one-point safe must be conducted only at Nevada Test Site (NTS), except as authorized in accordance with paragraph 4b(1)(c)2, below.
 - 2 If it is determined that a nuclear explosive no longer meets the one-point safety criteria, all assembly/disassembly production plant operations (including onsite transportation) and offsite transportation with that nuclear explosive must be discontinued in a safe manner. Before operations with that nuclear explosive can be resumed, a path forward must be developed, a NES evaluation must be conducted, the NES evaluation report must be approved, and approved prestart findings must be closed.
 - 3 Tooling and equipment must be evaluated as required to ensure that their use does not impact the one-point safety of a nuclear explosive certified to be one-point safe.
- (d) Nuclear Explosive Areas (NEAs).
 - 1 Authorized energy sources must be identified and documented. Unauthorized energy sources must not be available in an NEA during NEOs.
 - 2 Ignition sources in NEAs must be identified and eliminated or minimized and controlled to prevent adverse interaction with combustible/flammable materials and the nuclear explosive.
 - 3 Combustible and flammable materials in NEAs must be identified and eliminated or minimized and controlled to prevent adverse interaction with the nuclear explosive.
- (e) Electrical Testing. Except as authorized in accordance with paragraph 4b(1)(f), Anomalous Units, nuclear explosives must not be subjected to—
 - 1 redundant electrical tests or

- 2 electrical troubleshooting (i.e., to confirm the existence of a fault or aid in fault isolation) except with authorized test equipment and procedures that have been subjected to a NES evaluation and found to be acceptable for the specific application.

(f) Anomalous Units.

- 1 If it is determined that a nuclear explosive is no longer in a condition covered by a NES evaluation, all operations with that nuclear explosive and in the associated facility must be discontinued in a safe manner, resulting in a safe and stable nuclear explosive configuration.

- 2 Before operations with the anomalous unit can be resumed, a design agency special instruction engineering release (SIER) must be developed, and the NEO change control process must be completed in accordance with paragraph 4b(4). A decision to resume other activities in the facility must include consideration of possible interactions with the anomalous unit.

a The responsible design agencies must specifically review the SIER for impact on NES.

b Transportation operations, if applicable, must be specifically addressed in the SIER, and offsite transportation operations are subject to the OST NEO change control process.

- (2) Supplemental Nuclear Explosive Safety Rules. Supplemental NESRs may be developed as needed to support specific tests, operations, or characteristics of a nuclear explosive.

- (3) Nuclear Explosive Safety Evaluations. NES evaluations must be performed in accordance with DOE-STD-3015-2004, *Nuclear Explosive Safety Evaluation Process*, dated November 2004.

- (a) Urgent Nuclear Explosive Safety Concerns. NESSG chairs, as defined and described in DOE-STD-3015-2004, must promptly notify line management, the NNSA-Service Center/Nuclear Explosive Safety Division (NNSA-SC/NESD), and the Office of Nuclear Weapon Surety and Quality of identified NES concerns requiring urgent attention and recommend whether NEOs should continue pending resolution.

- (b) Nuclear Explosive Safety Study Prerequisites. A NESS may not begin until preparatory work on the facilities and operations have

been completed, including completion of the DOE-approved safety basis for the operation. A formal readiness statement by the appropriate federal line manager must be made to initiate the NESS.

- (c) Nuclear Explosive Safety Evaluation Findings and Actions. NES evaluation findings are statements of deficiencies that require corrective action and formal closure.

1 Findings are categorized as either “prestart” or “poststart.”

a Prestart findings involve concerns that must be addressed before initiation or continuation of the affected NEOs.

b Poststart findings involve concerns that may be addressed in parallel with the initiation or continuation of the affected NEOs.

2 Actions. The applicable NNSA line management organizations are responsible for ensuring that actions on NES evaluation findings are both timely and effective. This responsibility includes formally tasking affected contractors, status reporting, and tracking findings through closure.

- (4) Change Control. Organizations responsible for NEOs and associated activities and facilities must establish and implement a NES change evaluation process. This NES evaluation is separate and independent from the unreviewed safety question process required by 10 CFR 830, *Nuclear Safety Management*, and must be completed before approval and implementation of the change.

- (a) General Applicability. All proposed changes to authorized NEOs, including the following, are subject to the NEO change control process.

1 Proposals that may have direct NES implications (e.g., procedural, equipment, or facility changes to an approved NEO).

2 Proposals that may have indirect NES implications (e.g., changes or new activities that could impact the foundation established by previous NES Master Studies).

3 Changes in knowledge affecting an approved NEO (e.g., new understanding of a potential threat to NES or new data

regarding the response of a nuclear explosive to a stimulus).

- (b) Pantex Site Office (PXSO). PXSO must implement the NEO change control process for Pantex Plant operations in accordance with the Development and Production (D&P) Manual, Chapter 11.7, *Nuclear Explosive Operations Change Control Process*.
- (c) Office of Secure Transportation. OST in consultation with the NNSA-SC/NESD must develop and implement an Office of Nuclear Weapon Surety and Quality—approved NEO change control process for offsite transportation of nuclear explosives.
 - 1 OST NES representatives will review change proposals to authorized offsite transportation of nuclear explosives and associated activities using Office of Nuclear Weapon Surety and Quality—approved criteria.
 - 2 NEO change proposals that do not meet these approved criteria require a NES evaluation performed in accordance with DOE-STD-3015-2004.
- (d) Nevada Site Office (NSO). NSO in consultation with the NNSA-SC/NESD must develop and implement an Office of Nuclear Weapon Surety and Quality—approved NEO change control process for NTS operations.
 - 1 NTS operating contractor NES representatives will review change proposals to authorized NSO NEOs and associated activities using Office of Nuclear Weapon Surety and Quality—approved criteria.
 - 2 NEO change proposals that do not meet these approved criteria require a NES evaluation performed in accordance with DOE-STD-3015-2004.
- (5) Documented Safety Controls. All NEOs and associated activities must be conducted, and associated facilities must be operated, in accordance with a system of documented controls.
 - (a) This system of documented controls must incorporate the principles of independence, redundancy, and defense-in-depth.
 - (b) Multiple layers of protection must be used to prevent accidents and mitigate the consequences of an accident.
 - (c) Implementation of a requirement to prevent or mitigate one hazard must be assessed to ensure that the likelihood of a significant

safety incident involving another hazard is not increased. (10 CFR 830, Subpart B, *Safety Basis Requirements*, provides requirements for establishing a safety basis.)

(6) Configuration Management.

- (a) Organizations responsible for NEOs and associated activities and facilities must develop and implement a configuration management program incorporating elements applicable to NEOs and associated activities and facilities. (DOE-STD-1073-2003 establishes the objectives of a configuration management process.)
- (b) To ensure consistency with design requirements and the safety basis, the configuration management program must specifically include the following:
 - 1 control of the physical configuration of a nuclear explosive and its components; the tooling, equipment, and procedures used in NEOs and associated activities; and the interface with the facilities in which these operations and activities are conducted;
 - 2 unique identification of special tooling and equipment used in NEOs;
 - 3 positive identification of tooling and equipment requiring calibration/testing within a calibration/testing control program; and
 - 4 incorporation of approved changes into all affected documents (including design documents, drawings, procedures, and safety basis documents) and programs (including maintenance and training).

(7) Positive Verification.

- (a) Organizations responsible for NEOs and associated activities and facilities must develop and implement a verification process to ensure use of qualified personnel, operationally ready facilities, correct equipment, and current procedures.
- (b) The configuration and condition of a nuclear explosive and its components must be known or determined as early as practical during any planned NEO.

- (8) Two-Person Concept. Organizations responsible for NEOs and associated activities and facilities must establish and implement the two-person concept in accordance with DOE M 452.2-1 to ensure no lone individual has unrestricted access to a nuclear explosive.
- (9) Electrical Equipment. Organizations responsible for NEOs and associated activities and facilities must establish and implement safety requirements for electrical equipment used in NEAs in accordance with DOE M 452.2-1.
- (10) Tooling and Equipment. Organizations responsible for NEOs and associated activities and facilities must verify that all tooling and equipment used in NEOs specifically meet the following requirements.
 - (a) Design specifications and technical requirements must be documented.
 - (b) Designs must ensure nuclear explosives will remain in safe condition should a system or component of the tool/equipment fail.
- (11) Procedures.
 - (a) Organizations responsible for NEOs and associated activities and facilities must use approved written procedures for all NEOs.
 - (b) Design agencies must review and concur with original issues of procedures for NEOs and associated activities.
 - (c) Proposed changes to procedures must be subject to the NEO change control process.
 - (d) All written procedures for NEOs must accomplish the following.
 - 1 Comply with design specifications and technical requirements.
 - 2 Clearly state cautions and warnings.
 - 3 Identify appropriate points to interrupt work safely.
 - 4 Include generic contingency procedures directed toward quickly achieving a safe and stable nuclear explosive configuration to be applied in response to all unexpected situations not covered by other written procedures.

5 Place proper emphasis on preventing accidents and detecting abnormal conditions.

6 Incorporate human factors considerations.

(12) Transportation of Nuclear Explosives.

(a) Organizations responsible for NEOs and associated activities and facilities must establish requirements and procedures to ensure safe onsite transportation of nuclear explosives.

(b) Offsite transportation of nuclear explosives is performed by OST and begins when the loaded conveyance is closed and ends with the opening of the conveyance at its destination.

(c) Transportation operations and shipping configurations, including all items in the conveyance, are subject to the NES evaluation requirements of paragraph 4b(1)(a).

1 Nuclear explosives must be transported in conveyances specifically reviewed and approved through the NES evaluation process.

2 Criteria must be established for protecting nuclear explosives during transportation. The criteria and tie-down designs for specific nuclear explosive configurations must be reviewed and approved through the NES evaluation process.

(13) Maintenance of Facilities, Tooling, and Equipment. Organizations responsible for NEOs and associated activities and facilities must review maintenance programs and activities for impact on NES. Maintenance implementation plans must include a detailed description of maintenance activity control and approval, including limitations on materials that are allowed in NEAs.

(14) Nuclear Explosive-Like Assemblies (NELAs).

(a) Nuclear Explosive-Like Assembly Standards. All NELA operations must meet the following qualitative NELA standards.

1 There must be controls to minimize the possibility of accidental, inadvertent, or deliberate unauthorized assembly of a nuclear explosive in place of a NELA configuration.

2 There must be controls to minimize the possibility of accidental, inadvertent, or deliberate unauthorized

transfer of a nuclear explosive in place of a NELA configuration.

- (b) Nuclear Explosive-Like Assembly Requirements. Organizations responsible for NELA operations must implement the NELA requirements in accordance with DOE M 452.2-1.
- (15) Marking Instructions. Nuclear explosives and NELAs must be marked to distinguish configurations capable of a nuclear detonation from those that are not. Organizations responsible for NEOs or NELA operations must implement marking requirements in accordance with DOE M 452.2-1.
- (16) Training. Each organization responsible for and/or involved in NEOs and associated activities must implement training, qualification, and certification programs for personnel that manage, oversee, perform, or directly support these operations and activities. Annual training for personnel assigned to nuclear explosive duty must include the following NES-specific topics.
 - (a) Responsibilities associated with custody of nuclear explosives.
 - (b) Use of general and supplemental NESRs, site/facility and program-specific Technical Safety Requirements, and other controls associated with NEOs.
 - (c) The purpose, objective, and responsibilities of the two-person concept for operations.
 - (d) Explosive safety appropriate for assigned responsibilities.
- (17) Exemptions. Exemptions must be requested when release is sought from a requirement in this Order or DOE M 452.2-1. The exemption process is outlined in DOE M 251.1-1A, *Directives System Manual*, dated 1-30-98.
- (18) Records. Records (documentation) must be maintained in accordance with National Archives and Records Administration-approved DOE or site-specific records retention and disposition schedules in accordance with DOE O 200.1, *Information Management Program*, dated 9-30-96.
- (19) Implementation. This revision involves no substantive administrative or programmatic changes from the previous directive, DOE O 452.2B, and no implementation plan is required. This revision is effective upon issue.

5. RESPONSIBILITIES.

a. Secretary of Energy.

- (1) Establishes policy to ensure the safety of all NEOs conducted by DOE and DOE contractors, including NNSA and NNSA contractors.
- (2) Is responsible for NEOs safety programs for all NEOs conducted by DOE and DOE contractors, including NNSA and NNSA contractors.

b. Administrator for NNSA is responsible for the safety of all NEOs conducted by NNSA and NNSA contractors.

c. Deputy Administrator for Defense Programs.

- (1) Ensures implementation of NES programs.
- (2) Approves exemptions from the general NESRs.

d. Assistant Deputy Administrator for Military Application and Stockpile Operations.

- (1) Approves NESS and operational safety review reports and resolves minority opinions.
- (2) Interfaces with the Office of Environment, Safety and Health (ES&H) to ensure the requirements of ES&H directives are compatible with the requirements of this Order and that divergence does not occur.

e. Assistant Deputy Administrator for Secure Transportation.

- (1) Provides overall management and direction for safety of offsite transportation of nuclear explosives.
- (2) Informs NNSA-SC/NESD of proposed operations that involve NES concerns.
- (3) Acts as the lead line manager for support of NES evaluations involving offsite transportation of nuclear explosives.
- (4) Identifies specific individuals to lead (or perform) the development and implementation of corrective actions for NES evaluation findings for which OST has line management responsibilities.
- (5) Acts as the closure authority for NES evaluation findings relevant to offsite transportation of nuclear explosives.

- (6) Analyzes and acts upon lessons learned from the offsite transportation of nuclear explosives, as appropriate.
- (7) Establishes self, management, and independent assessments of offsite transportation of nuclear explosives.

f. Site Office Managers.

- (1) Identify which contracts this Order applies to and ensure those contracts are modified to reflect the attached CRD within 6 months.
- (2) Ensure that identified contractors and national laboratories are responsible for compliance with the requirements of this Order, regardless of the performer of the work.
- (3) Develop and promulgate specific NES requirements, as appropriate.
- (4) Manage actions assigned to the site office or its contractors as a result of NES evaluation activities.
- (5) Work with appropriate line management organizations to identify and resolve site safety issues involving NEOs.
- (6) Analyze and act upon lessons learned, as appropriate.

g. Director, Office of Nuclear Weapon Surety and Quality.

- (1) Approves the NSO, OST, and PXSO NEO change control processes.
- (2) Approves the design of the DOE authentication stamp.

h. National Laboratories and Management and Operating Contractors. Support the NES program for the safety of NEOs. Each organization is responsible for ensuring hazards associated with NEOs are identified, mitigated, and/or controlled by providing qualified personnel to support the NES program and related activities, such as safety analysis report and hazard analysis report preparation, readiness reviews, NES evaluation activities, evaluation of nuclear explosive occurrence reports and corrective actions, and by providing technical advice and expertise.

6. DEFINITIONS.

- a. Access. The proximity to a nuclear explosive that allows the opportunity to divert, steal, tamper with, and/or damage the nuclear explosive *in spite of any controls* that have been established to prevent such unauthorized actions.

- b. Certified Nuclear Explosive Duty Personnel. Operations personnel who are current with respect to Human Reliability Program certification and the training and qualification program for the specific nuclear explosive operation to which they are assigned.
- c. Controls. Design features, safety rules, Technical Safety Requirements, procedures, and other measures that individually or collectively contribute to nuclear explosive surety.
- d. Custody of Nuclear Explosives. Responsibility for access to and control of nuclear explosives.
- e. Defense-In-Depth. Multiple layers of protection (e.g., equipment design, procedures, and training) to prevent accidents and/or to mitigate the consequences of accidents.
- f. Deliberate Unauthorized Act (DUA). Any intentional action that has not been authorized and approved by proper authority. In the context of the third nuclear explosive surety standard, a DUA is one that is not sanctioned as part of an approved nuclear explosive operation or associated activity, but which could affect a nuclear explosive or main charge high-explosive part collocated with a pit.
- g. Dummy Pit. A component or set of components designed to simulate a live pit, but which does not contain fissile material and cannot therefore create a nuclear explosive if placed in the central cavity of an implosion system. A “high-fidelity” dummy pit is one that also has dimensions representative of a live pit.
- h. Electrical Equipment. Includes the items that contain or use an electrical energy source and the interface (if any) with the nuclear explosive (NE). For Category 1, this includes associated adapters, test cables, switch boxes, etc. For *some* Category 2 equipment, this includes a mechanical connection to the NE and associated electrical isolation feature.
- i. Facility. Any equipment, structure, system, process, or activity that fulfills a specific purpose.
- j. Fissile Material Dispersal. The aerosolization and transport of fissile material by a driving force such as fire, high explosive deflagration, or high explosive detonation.
- k. Hazard Analysis. The determination of material, system, process, and plant characteristics that can produce undesirable consequences followed by the assessment of hazardous situations associated with a specific process or activity.

- l. Hazard Analysis Report. A report that documents the systematic evaluation of hazards to workers, the public, and the environment for a specific nuclear explosive operation and its associated activities.
- m. High Explosive Deflagration. A rapid chemical reaction in which the output of heat is sufficient for the reaction to proceed and accelerate without input of heat from another source. Deflagration is a surface phenomenon, with the reaction products flowing away from the unreacted material along the surface at subsonic velocity. Confinement of the reaction increases pressure, rate of reaction, and temperature and may cause transition to detonation.
- n. High Explosive Detonation. A violent chemical reaction within a chemical compound or mechanical mixture evolving heat and pressure. A detonation is a reaction that proceeds through the reacted material toward the unreacted material at a supersonic velocity. The result of the chemical reaction is exertion of extremely high pressure on the surrounding medium, forming a propagation shock wave that is originally of supersonic velocity.
- o. Human Reliability Program. A program that establishes the requirements and responsibilities for screening, selecting, and continuously evaluating employees assigned to or being considered for assignment to nuclear explosive duties.
- p. Main Charge. The high explosive whose explosive energy implodes the pit.
- q. Mock High Explosive. A nondetonable material used to simulate one or more properties of a high explosive.
- r. Nuclear Detonation. An energy release through a nuclear process, during a period of time on the order of 1 microsecond, in an amount equivalent to the energy released by detonating 4 or more pounds of TNT.
- s. Nuclear Explosive. An assembly containing fissionable materials and main charge high explosive parts or propellants capable of producing a nuclear detonation (e.g., a nuclear weapon or test device).
- t. Nuclear Explosive Area. An area that contains a nuclear explosive or collocated pit and main charge high explosive parts.
- u. Nuclear Explosive Duty. Work assignments that allow custody of a nuclear explosive or access to a nuclear explosive device or area.
- v. Nuclear Explosive-Like Assembly (NELA). An assembly with components representing the main charge HE and pit that has the potential for component substitution resulting in accidental, inadvertent, or deliberate unauthorized assembly or transfer of a nuclear explosive may be considered a NELA.

- (1) A NELA represents a nuclear explosive in the U.S. Nuclear weapons program, including assemblies for development, testing, training, or other purposes.
 - (2) A NELA contains one of the following.
 - (a) Mock HE and high-fidelity dummy pit—referred to as an “Inert NELA.”
 - (b) Live HE and high-fidelity dummy pit—referred to as a “High Explosive NELA.”
 - (c) Mock HE and live pit—referred to as an “Inert-with-Live-Pit NELA.”
- w. Nuclear Explosive Operation. Any activity involving a nuclear explosive, including activities in which main charge high explosive parts and pit are collocated.
- x. Nuclear Explosive Operation Associated Activities. Activities directly associated with a specific nuclear explosive operation, such as work on a bomb nose or tail subassembly, even when physically separated from the bomb’s nuclear explosive subassembly.
- y. Nuclear Explosive Safety. The application of positive measures or controls to prevent or mitigate the possibility of unintended or unauthorized nuclear detonation or fissile material dispersal from the pit in a nuclear explosive area.
- z. Nuclear Explosive Safety Rules (NESRs). Requirements that significantly contribute to minimizing the possibility of nuclear detonation, high explosive detonation or deflagration, or fire in nuclear explosive operations.
- aa. Nuclear Weapon. A nuclear explosive configured for Department of Defense use.
- bb. One-Point Safe Nuclear Explosive. A nuclear explosive that, in the event a detonation is initiated at any one point in the high explosive system, presents no greater probability than one in a million of producing a nuclear detonation.
- cc. Operational Safety Review (OSR). A periodic, independent nuclear explosive safety evaluation of an ongoing nuclear explosive operation to determine whether the adequacy of controls has been degraded as a result of process changes, new information, or new expectations relevant to nuclear explosive safety.
- dd. Permanent Marking. A durable method, normally by metal deformation, of indicating on an external area of an assembly whether it is a nuclear explosive or a nuclear explosive-like assembly.
- ee. Pit (Live). A fissile component or set of fissile components designed to fit in the central cavity of an implosion system.

- ff. Records. Records are books, papers, photographs, machine-readable materials, maps, or other documentary materials, regardless of physical form or characteristics, which have documentary or evidential value. Such materials, created or received in connection with the transaction of official business, are preserved because of their informational value as evidence of the organization, functions, policies, decisions, operations, or other activities.
 - gg. Safety Analysis. A documented process to (a) provide systematic identification of hazards within facilities in which nuclear explosive operations and associated activities are conducted and during specific nuclear explosive operations and associated activities; (b) describe and analyze the adequacy of measures taken to eliminate, control, or mitigate identified hazards; and (c) analyze and evaluate potential accidents and their associated risks.
 - hh. Safety Analysis Report. A report that documents the results of safety analysis to ensure that a facility can be constructed, operated, maintained, shut down, and decommissioned safely and in compliance with applicable laws and regulations.
 - ii. Safety Basis. A safety basis for a DOE nuclear facility is documented in a documented safety analysis and the hazards controls for the nuclear facility. As changes are made or potential inadequacies of the safety analysis are discovered, contractors must perform unreviewed safety question (USQ) determinations. The results of the USQ determinations and any associated safety evaluations are part of the safety basis for the facility.
7. REFERENCES. The following list contains references that are relevant to this Order.
- a. DOE O 151.1C, *Comprehensive Emergency Management*, dated 11-2-05, which addresses responses to unplanned events.
 - b. DOE O 200.1, *Information Management Program*, dated 9-30-96, which provides a framework for managing information in accordance with Department policy and National Archives and Records Administration-approved DOE record schedules.
 - c. DOE O 226.1, *Implementation of Department of Energy Oversight Policy*, dated 9-15-2005, which provides direction for implementing DOE P 226.1, *Department of Energy Oversight Policy*, dated 6-10-05, which establishes DOE policy for assurance systems and processes established by DOE contractors and oversight programs performed by DOE line management and independent oversight organizations.
 - d. DOE M 231.1-2, *Occurrence Reporting and Processing of Operations Information*, dated 8-19-03, which provides detailed requirements to supplement DOE O 231.1A, *Environment, Safety, and Health Reporting*, dated 8-19-03, sets forth a minimum set of occurrence reporting requirements for DOE/NNSA elements and contractors and includes categorizing occurrences related to safety,

environment, health, or operations; notifying DOE; and developing followup reports.

- e. DOE M 251.1-1A, *Directives System Manual*, dated 1-30-98, which details the process for requesting exemptions from directives requirements.
- f. DOE O 360.1B, *Federal Employee Training*, dated 10-11-01, which establishes requirements and assigns responsibilities for DOE Federal employee training, education, and development under the Government Employees Training Act of 1958, as amended.
- g. DOE O 414.1C, *Quality Assurance*, dated 6-17-05, which ensures that the quality of DOE/NNSA products and services meets or exceeds the customers' expectations.
- h. DOE O 420.1B, *Facility Safety*, dated 12-22-05, which establishes the DOE/NNSA facility safety for nuclear safety design, criticality safety, fire protection, and natural phenomena hazards mitigation.
- i. DOE M 440.1-1A, *DOE Explosives Safety Manual*, dated 1-9-06, which describes DOE's explosives safety requirements applicable to operations involving the development, testing, handling, and processing of explosives or assemblies containing explosives.
- j. DOE O 452.1C, *Nuclear Explosive and Weapon Surety Program*, dated 9-20-05, which establishes requirements and responsibilities for the DOE Nuclear Explosive and Weapon Surety (NEWS) Program.
- k. DOE M 452.2-1, *Nuclear Explosive Safety Manual*, dated 06-12-06, which establishes mandatory procedures in selected topical areas to ensure the nuclear explosive safety of all nuclear explosive operations conducted by DOE/NNSA and its contractors.
- l. DOE O 5480.20A, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities*, dated 11-15-94, which establishes selection, qualification, and training requirements for management and operating contractor personnel involved in the operation, maintenance, and technical support of DOE/NNSA Category A and B reactors and nonreactor nuclear facilities.
- m. DOE-STD-1073-2003, *Configuration Management*, dated October 2003, which defines the objectives of a configuration management process for DOE nuclear facilities (including activities and operations) and provides detailed examples and supplementary guidance on methods to achieve those objectives.
- n. DOE-STD-1104-96, *Review and Approval of Nuclear Facility Safety Basis Documents (Documented Safety Analyses and Technical Safety Requirements)*,

dated February 1996, which describes DOE review and approval of documented safety analyses and Technical Safety Requirements for existing Hazard Category 1, 2, and 3 nuclear facilities that document their safety basis in accordance with 10 CFR 830.

- o. DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, dated July 1994, which describes a Safety Analysis Report preparation method that satisfies 10 CFR 830 requirements.
- p. DOE-STD-3015-2004, *Nuclear Explosive Safety Evaluation Process*, dated November 2004, which provides requirements and guidance for nuclear explosive safety studies, operational safety reviews, and nuclear explosive safety change evaluations.
- q. DOE-DP-STD-3016-99, *Hazard Analysis Reports for Nuclear Explosive Operations*, dated February 1999, which clarifies the requirements and provides guidance for conducting hazard analyses and preparing Hazard Analysis Reports for nuclear explosive operations and associated activities.
- r. Development & Production Manual, Chapter 11.7, Issue C, “Nuclear Explosive Operations Change Control Process,” dated 12-15-04, which specifies NNSA requirements and expectations for the change control process for nuclear explosive operations performed at the Pantex Plant.
- s. 10 CFR 712, *Human Reliability Program*, which establishes the policies and procedures for the DOE, including NNSA, human reliability program (HRP). The HRP is a security and safety reliability program designed to ensure that individuals who occupy positions affording access to certain materials, nuclear explosive devices, facilities, and programs meet the highest standards of reliability and physical and mental suitability.
- t. 10 CFR 820, *Procedural Rules for DOE Nuclear Activities*, which sets forth procedures to govern the conduct of persons involved in DOE nuclear activities and, in particular, to achieve compliance with the DOE Nuclear Safety Requirements by all persons subject to those requirements.
- u. 10 CFR 830, *Nuclear Safety Management*, which governs the conduct of DOE contractors, DOE personnel, and other persons conducting activities (including providing items and services) that affect, or may affect, the safety of DOE nuclear facilities.
- v. Title 32 of P.L. 106-65, the National Nuclear Security Administration Act, dated October 5, 1999, as amended, which established a separately organized agency within the Department of Energy.
- w. Joint Department of Energy/Department of Defense (DOE/DoD) Technical Publication 20-7, *Nuclear Safety Criteria*, dated 6-1-00.

- x. Joint DOE/DoD Technical Publication 35-51, *General Instructions Applicable to Nuclear Weapons*, dated 8-30-99.
 - y. Joint DOE/DoD Technical Publication 45-51, *Transportation of Nuclear Weapons Materiel, General Shipping and Limited Life Component Data (LLC)*, dated 2-12-99.
 - z. Joint DOE/DoD Technical Publication 45-51A, *Transportation of Nuclear Weapons Materiel (Supplement), Shipping and Identification Data for Stockpile Major Assemblies*.
 - aa. Joint DOE/DoD Technical Publication 45-51D, *Transportation of Nuclear Weapons Materiel (Supplement), Shipment by Safe-Secure Trailer (SST) and Safeguard Transporter (SGT)*.
8. CONTACT. Questions concerning this Order should be addressed to the Assistant Deputy Administrator for Military Application and Stockpile Operations, Office of Nuclear Weapons Surety and Quality at 202-586-0377.

BY ORDER OF THE SECRETARY OF ENERGY:



CLAY SELL
Deputy Secretary

DEPARTMENTAL ELEMENTS TO WHICH DOE O 452.2C IS APPLICABLE

Office of the Secretary
Chief of Defense Nuclear Safety
Chief Information Officer
Office of Congressional and Intergovernmental Affairs
Departmental Representative to the Defense Nuclear Facilities Safety Board
Office of Environment, Safety and Health
Office of General Counsel
Office of Hearings and Appeals
Office of the Inspector General
Office of Management
National Nuclear Security Administration
Office of Public Affairs
Secretary of Energy Advisory Board
Office of Security and Safety Performance Assurance

CONTRACTOR REQUIREMENTS DOCUMENT

DOE O 452.2C, *NUCLEAR EXPLOSIVE SAFETY*

This Contractor Requirements Document (CRD) establishes the requirements for Department of Energy (DOE) contractors, including National Nuclear Security Administration (NNSA) contractors, whose contracts involve the performance, management, oversight, or direct support of DOE/NNSA nuclear explosive operations (NEOs) or associated activities.

Regardless of the performer of the work, the contractor is responsible for complying with the requirements of this CRD. The contractor is responsible for flowing down the requirements of this CRD to subcontractors at any tier to the extent necessary to ensure the contractor's compliance with the requirements.

All contractors with this CRD incorporated in their contracts must comply with the following requirements.

1. DOE Nuclear Explosive Safety (NES) Standards. Contractors must ensure that all NEOs meet the following qualitative NES standards to prevent unintended nuclear detonation or fissile material dispersal from the pit.
 - a. There must be controls to minimize the possibility of accidents, inadvertent acts, or authorized activities that could lead to fire, high explosive (HE) deflagration, or unintended HE detonation.
 - b. There must be controls to minimize the possibility of fire, HE deflagration, or HE detonation, given accidents or inadvertent acts.
 - c. There must be controls to minimize the possibility of deliberate unauthorized acts that could lead to HE deflagration or HE detonation.
2. Nuclear Explosive Safety Program.
 - a. General Nuclear Explosive Safety Rules (NESRs).
 - (1) Nuclear Explosive Safety Evaluations. DOE-STD-3015 provides specific information regarding the three types of NES evaluations – nuclear explosive safety studies (NESSs), operational safety reviews (OSRs), and nuclear explosive safety change evaluations (NCEs). Contractors must ensure NEOs are not performed until a NES study has been conducted, a NESS report has been approved, and approved prestart findings have been closed.
 - (2) Nuclear Explosive Safety Procedures. Contractors must ensure NEOs are performed in accordance with approved written procedures maintained in

accordance with DOE-STD-1073-2003, *Configuration Management*, dated October 2003.

(3) One-Point Safety.

- (a) Contractors other than those operating at Nevada Test Site (NTS) must not perform NEOs involving nuclear explosives not certified to be one-point safe, except as authorized in accordance with paragraph 2a(3)(b).
- (b) If it is determined that a nuclear explosive no longer meets the one-point safety criteria, contractors must ensure all assembly/disassembly production plant operations (including onsite transportation) with that nuclear explosive are discontinued in a safe manner. Before operations with that nuclear explosive can be resumed, a NES evaluation report must be approved, and approved prestart findings must be closed.
- (c) Tooling and equipment must be evaluated as required to ensure that their use does not impact the one-point safety of a nuclear explosive certified to be one-point safe.

(4) Nuclear Explosive Areas (NEAs). Contractors must ensure the following.

- (a) Authorized energy sources are identified and documented. Unauthorized energy sources must not be available in an NEA during NEOs.
- (b) Ignition sources in NEAs are identified and eliminated or minimized and controlled to prevent adverse interaction with combustible/flammable materials and the nuclear explosive.
- (c) Combustible and flammable materials in NEAs are identified and eliminated or minimized and controlled to prevent adverse interaction with the nuclear explosive.

(5) Electrical Testing. Contractors must ensure the following, except as authorized in accordance with paragraph 2a(6), Anomalous Units.

- (a) Nuclear explosives are not subjected to redundant electrical tests.
- (b) Nuclear explosives are not subjected to electrical troubleshooting (i.e., to confirm the existence of a fault or aid in fault isolation).

(6) Anomalous Units.

- (a) If it is determined that a nuclear explosive is no longer in a condition covered by a NES evaluation, contractors must ensure all

operations with that nuclear explosive and in the associated facility are discontinued in a safe manner, resulting in a safe and stable nuclear explosive configuration.

- (b) Before operations with the anomalous unit can be resumed, contractors must ensure a design agency special instruction engineering release is developed and the NEO change control process, which includes both the unreviewed safety question (USQ) process and a separate, independent NES review, is completed. A decision to resume other activities in the facility must include consideration of possible interactions with the anomalous unit.
- b. Supplemental Nuclear Explosive Safety Rules. Contractors may propose supplemental NESRs to support specific tests, operations, or characteristics of a nuclear explosive.
- c. Nuclear Explosive Safety Study Prerequisites. Contractors must ensure they do not assert readiness for a NESS until preparatory work on the facilities and operations has been completed, including completion of the DOE-approved safety basis for the operation.
- d. Change Control. Contractors responsible for NEOs and associated activities and facilities must establish and implement both the USQ process required by 10 CFR 830, *Nuclear Safety Management*, and a separate, independent NES review. Contractors must ensure both the USQ process and the NES review are completed before approval and implementation of the change.
 - (1) Pantex. Pantex contractor NES representatives will review change proposals to authorized Pantex NEOs and associated activities using NNSA-approved criteria. Pantex contractors must ensure Pantex NEO change proposals that do not meet these approved criteria are forwarded for NES evaluation by NNSA.
 - (2) NNSA Contractors at Nevada Test Site (NTS). NNSA contractor NES representatives at NTS will review change proposals to authorized NTS NEOs and associated activities using NNSA-approved criteria. NTS contractors must ensure NTS NEO change proposals that do not meet these approved criteria are forwarded for NES evaluation by NNSA.
- e. Documented Safety Controls. Contractors must ensure all NEOs and associated activities are conducted and associated facilities operated in accordance with a system of documented controls. (10 CFR 830, Subpart B, *Safety Basis Requirements*, provides requirements for establishing a safety basis.)

- f. Configuration Management. Contractors responsible for NEOs and associated activities and facilities must develop and implement a configuration management program incorporating elements applicable to NEOs and associated activities and facilities. (DOE-STD-1073-2003, *Configuration Management*, defines the objectives of a configuration management process.) To ensure consistency with design requirements and the safety basis, the configuration management program must specifically include the following:

- (1) control of the physical configuration of a nuclear explosive and its components; the tooling, equipment, and procedures used in NEOs and associated activities; and the interface with the facilities in which these operations and activities are conducted;
- (2) unique identification of special tooling and equipment used in NEOs;
- (3) positive identification of tooling and equipment requiring calibration/testing within a calibration/testing control program; and
- (4) incorporation of approved changes into all affected documents (including design documents, drawings, procedures, and safety basis documents) and programs (including maintenance and training).

- g. Positive Verification.

- (1) Contractors responsible for NEOs and associated activities and facilities must develop and implement a verification process to ensure use of qualified personnel, operationally ready facilities, correct equipment, and current procedures.
- (2) Contractors must ensure the configuration and condition of a nuclear explosive and its components are known or determined as early as practical during any planned NEO.

- h. Two-Person Concept. Contractors responsible for NEOs and associated activities and facilities must establish and implement the two-person concept to ensure no lone individual has unrestricted access to a nuclear explosive. Contractors must also establish and implement two-person concept protection for other operations as required by the site office.

- (1) Basic Requirements. Contractors must ensure that each person on a two-person concept team—
 - (a) is certified in the Human Reliability Program,
 - (b) has authorized access to the nuclear explosive area (NEA),
 - (c) has technical knowledge of the task being performed,

- (d) is knowledgeable of pertinent safety and security requirements, and
 - (e) is in a position to detect incorrect or unauthorized acts and take appropriate action.
- (2) Implementation Options. Contractors must ensure appropriate implementation of the two-person concept using either person-to-person or zone coverage.
 - (a) Person-to-Person Coverage. Configurations requiring person-to-person coverage include the following.
 - 1 Exposed conventional high explosive (CHE) main charge in an NEA.
 - 2 Main charge high explosives [both CHE and insensitive high explosives (IHE)] with accessible detonator cable assemblies in an NEA.
 - 3 Nuclear explosives connected to Category 1 electrical equipment.
 - (b) Zone Coverage. Contractors must ensure that a two-person concept team is in an NEA when nuclear explosives not requiring person-to-person coverage are not protected by a dual-lock system or other NES-approved security system.
- (3) Application of Person-to-Person Coverage. Contractors must determine configurations requiring person-to-person coverage based on specific system characteristics. The application of person-to-person coverage allows recognition of the protection provided by design safety features (such as IHE, coded-signal-controlled detonators, and unique-signal-operated strong-link devices) and physical protection (such as closed shipping and storage containers and specially designed covers).
 - (a) Assembly/Disassembly Operations Involving Conventional High Explosive.
 - 1 For assembly operations involving CHE main charge, contractors must ensure person-to-person coverage of the CHE components begins when the CHE container is opened in an NEA.
 - 2 Coverage must continue until the nuclear explosive is in a configuration in which the application of design-specific environmental stimuli or unique or coded signals is

necessary for nuclear detonation or detonation of the main charge HE.

- 3 For disassembly operations, this requirement applies in reverse.

(b) Assembly/Disassembly Operations Involving Insensitive High Explosive.

- 1 For assembly operations involving IHE main charge, contractors must ensure person-to-person coverage for main charge components located in an NEA, and assemblies containing these components, that have accessible detonator cables attached.
- 2 Coverage must continue until the nuclear explosive is in a configuration in which the application of design-specified environmental stimuli or unique or coded signals is necessary for nuclear detonation or detonation of the main charge HE.
- 3 For disassembly operations, this requirement applies in reverse.

For purposes of person-to-person coverage, systems with installed and unactuated (safe/reset) mechanical safe and arm devices are not considered to have accessible detonator cables. Configurations with physical protection that precludes immediate and unrestricted access to the configuration by a lone individual are not considered exposed. When such physical protection is in place, zone coverage provides adequate protection for configurations that would otherwise require person-to-person coverage.

(4) Person-to-Person Coverage Requirements. When a configuration requires person-to-person coverage, contractors must ensure a qualified two-person concept team is either working on or observing the configuration so that the following criteria are met.

- (a) No lone individual is allowed within the immediate vicinity (approximately 6 feet) of a configuration that requires person-to-person coverage.
- (b) The two people providing person-to-person coverage are each responsible for the safe conduct of the operations.
- (c) During the performance of operations on a configuration requiring person-to-person coverage—

- 1 the two-person concept team must be in the immediate vicinity of the configuration;
 - 2 each person on the two-person concept team must observe all operations, ensure that only authorized operations are performed, and ensure that operations are performed correctly; and
 - 3 a reader-worker process that includes the following must be incorporated.
 - a The procedure must be read aloud to the other people, the operation must be performed, and the completion of the operation must be documented in the stated sequence.
 - b One of the two people performing the operation may read the procedure aloud to the other person provided that both people can move away from the immediate vicinity of the configuration while the reading is accomplished.
 - c If both people cannot move away from the immediate vicinity of the configuration while the reading is accomplished, then a third person must read the procedure aloud to the other people.
- (d) When operations are not being performed on a configuration requiring person-to-person coverage—
- 1 the two-person concept team must be in the immediate vicinity of the configuration when another individual is in the immediate vicinity of the configuration and
 - 2 the team members must remain in a position to observe the approach of any individual to the configuration.
- (e) Only one configuration requiring person-to-person coverage is allowed in a vacated bay or cell. This requirement does not apply to emergency evacuations.
- i. Electrical Equipment. Contractors responsible for NEOs and associated activities and facilities must establish and implement controls for electrical equipment used in NEAs commensurate with the various levels of potential electrical threat. For this purpose, NNSA recognizes three categories of electrical equipment used in NEAs.

- (1) Category 1 Electrical Equipment. Electrical equipment intended for connection to an electrical circuit of a nuclear explosive or HE subassembly and the introduction of electrical energy is referred to as “Category 1 electrical equipment.” Contractors must ensure Category 1 electrical equipment meets the following minimum requirements.

(a) General Requirements.

- 1 The equipment must use the lowest practical values of internal and output currents and voltages necessary to perform the intended function adequately.
- 2 The equipment must not apply unacceptable stimuli as a result of a single-point failure.
- 3 The equipment must have safety characteristics independent of the nuclear explosive’s safety features.
- 4 Each item of equipment and its interface with a nuclear explosive must have a comprehensive safety analysis.
- 5 Each drawing issue of equipment and its interface with a nuclear explosive must have a NES evaluation.
- 6 Computer-controlled equipment must have controls that preclude inadvertent or unauthorized actuation of NES critical components.
- 7 Software for computer-controlled equipment that could affect the state of components essential to NES must be identified as NES critical software. NES critical software must be evaluated for designation as safety software [See DOE O 414.1C, Quality Assurance, dated 6-17-05].
- 8 NES critical software must be subjected to an independent vulnerability analysis.
- 9 Accepted (or reaccepted) NES critical software must be protected by a two-person concept team.
- 10 Procedures must be established to operate, control, calibrate, maintain, and store equipment.
- 11 A record of approved equipment must be established and maintained.

- 12 The equipment must have a safety requirements document that identifies the safety features.
- (b) Two-Person Concept. Contractors must ensure that calibration and maintenance of Category 1 electrical equipment are protected by the implementation of a two-person concept team.
 - 1 Person-to-person coverage is required during calibration and all operations that afford internal access to equipment and associated cables and adapters.
 - 2 Zone coverage is required for fully assembled equipment and associated cables and adapters when that equipment is not protected by a dual-lock system or other NES-approved security system.
- (2) Category 2 Electrical Equipment. Electrical equipment that is not intended for connection to an electrical circuit of a nuclear explosive or HE subassembly but makes mechanical connection to, or could come in contact with, a nuclear explosive or HE subassembly is referred to as “Category 2 electrical equipment.” Contractors must ensure Category 2 electrical equipment meets the following minimum requirements.
 - (a) General Requirements.
 - 1 The equipment must not be connected to the electrical circuitry of a nuclear explosive.
 - 2 The equipment must be positioned in a manner to preclude contact with a nuclear explosive except when a mechanical connection is required to perform its intended and authorized function.
 - 3 The potential for inadvertent connection between the equipment and the nuclear explosive circuitry must be minimized.
 - (b) Positive Electrical Isolation. Contractors must ensure positive electrical isolation is established and demonstrated for Category 2 electrical equipment and its mechanical connection to a nuclear explosive. Contractors must ensure the electrical isolation scheme used is clearly identified and documented using one of the following subcategories, listed in priority order.
 - 1 Path-on isolation reducing leakage or fault current, from electrical energy sources associated with the equipment, to a defined safe value.

- 2 Path-off isolation reducing leakage or fault current, from electrical energy sources associated with the equipment, to a defined safe value.
 - 3 Electrical isolation scheme requiring at least two independent failures before exposing the nuclear explosive to unacceptable leakage or fault current from electrical energy sources associated with the equipment. Each failure mechanism must be identified.
 - (c) Records. Contractors must establish and maintain a record of approved Category 2 electrical equipment.
 - (3) Category 3 Electrical Equipment. Moveable and facility electrical equipment used in an NEA that is not intended for connection to an electrical circuit of a nuclear explosive or HE subassembly and does not make mechanical connection to, and cannot come in contact with, a nuclear explosive or HE subassembly is referred to as “Category 3 electrical equipment.”
 - (4) Change Control. Proposed changes to electrical equipment and its interface with a nuclear explosive are subject to the contractor NEO change control process.
- j. Tooling and Equipment. Contractors responsible for NEOs and associated activities and facilities must ensure the following for all tooling and equipment used in NEOs.
 - (1) The design specifications and technical requirements are documented.
 - (2) The design ensures that the nuclear explosive remains in a safe condition should a system or component of the tool/equipment fail.
- k. Procedures.
 - (1) Contractors responsible for NEOs and associated activities and facilities must use approved written procedures for all NEOs.
 - (2) Contractors must ensure design agency concurrence with original issues of procedures for NEOs and associated activities.
 - (3) Proposed changes to procedures must be subject to the contractor NEO change control process.
 - (4) Contractors must ensure NEOs procedures—
 - (a) comply with design specifications and technical requirements,

- (b) clearly state cautions and warnings,
- (c) identify appropriate points to safely interrupt work,
- (d) include generic contingency procedures directed toward quickly achieving a safe and stable nuclear explosive configuration to be applied in response to all unexpected situations not covered by other written procedures,
- (e) place proper emphasis on preventing accidents and detecting abnormal conditions, and
- (f) incorporate human factors considerations.

l. Transportation of Nuclear Explosives.

- (1) Contractors responsible for NEOs and associated activities and facilities must establish requirements and procedures to ensure safe onsite transportation of nuclear explosives.
- (2) Transportation operations and shipping configurations, including all items in a conveyance, are subject to the NES evaluation requirements of paragraph 2a(1).
 - (a) Contractors must ensure nuclear explosives are transported in conveyances specifically reviewed and approved through the NES evaluation process.
 - (b) Contractors must ensure criteria are established for protecting nuclear explosives during transportation. Contractors must ensure the criteria and tie-down designs for specific nuclear explosive configurations are reviewed and approved through the NES evaluation process.

m. Maintenance of Facilities, Tooling, and Equipment. Contractors responsible for NEOs and associated activities and facilities must review maintenance programs and activities for impact on NES. Maintenance implementation plans must include a detailed description of maintenance activity control and approval, including limitations on materials that are allowed in NEAs.

n. Nuclear Explosive-Like Assemblies (NELAs).

- (1) Nuclear Explosive-Like Assembly Definition. An assembly with components representing the main charge HE and pit that has the potential for component substitution resulting in accidental, inadvertent, or deliberate unauthorized assembly or transfer of a nuclear explosive may be considered a NELA.

- (a) A NELA represents a nuclear explosive in the U.S. nuclear weapons program, including assemblies for development, testing, training, or other purposes.
- (b) A NELA contains one of the following.
 - 1 Mock HE and high-fidelity dummy pit—referred to as an “Inert NELA.”
 - 2 Live HE and high-fidelity dummy pit—referred to as a “High Explosive NELA.”
 - 3 Mock HE and live pit—referred to as an “Inert-with-Live-Pit NELA.”
- (2) Nuclear Explosive-Like Assembly Standards. Contractors must ensure all NELA operations meet the following qualitative NELA standards.
 - (a) There must be controls to minimize the possibility of accidental, inadvertent, or deliberate unauthorized assembly of a nuclear explosive in place of a NELA configuration.
 - (b) There must be controls to minimize the possibility of accidental, inadvertent, or deliberate unauthorized transfer of a nuclear explosive in place of a NELA configuration.
- (3) Assembly/Disassembly of Nuclear Explosive-Like Assemblies. Contractors must ensure NELAs are not assembled or disassembled in close proximity to nuclear explosives where components may be interchanged. Contractors must ensure a two-person concept team performs all assembly/disassembly operations on Inert-with-Live-Pit NELAs.
- (4) Verification of Nuclear Explosive-Like Assembly Components before Assembly.
 - (a) Inert Nuclear Explosive-Like Assemblies. Repeated compliance with the verification requirements of this section is not necessary for repeated disassembly and reassembly training operations provided the mock HE and high-fidelity dummy pit remain in a training area where main charge HE and live pits are not authorized.
 - 1 Mock High Explosive Verification Requirements.
 - a Contractors must ensure all mock HE used in place of live main charge HE is nondetonable and

is clear or colored pink. Where possible, preference must be given to noncombustible formulations. Contractors must ensure live main charge HE is not colored pink.

- b Contractors must ensure pink mock HE used in place of live main charge HE is chemically verified before assembling the NELA. Clear mock HE refers to LEXAN or similar inert substance and does not require chemical verification.
- c Contractors must ensure an auditable record of chemical verification of the mock HE is available.

2 High-Fidelity Dummy Pit Verification Requirements.

- a Contractors must ensure the pit is verified by radiation detection means before assembly into an Inert NELA to verify the absence of radioactive material. If radiation is detected, the pit must be assayed using gamma spectrometry/multi-channel analyzer to verify the absence of fissile material. Contractors must ensure this verification is either performed or observed using person-to-person coverage.
- b Contractors must ensure that after dummy pit verification the pit is controlled until it is assembled into the NELA configuration or until it is delivered into an assembly area where live pits are not authorized. Contractors must ensure this control is achieved by a two-person concept team or a dual-lock or other NES-approved security system.
- c Contractors must ensure an auditable record of radiation detection verification of the high-fidelity dummy pit is available.

- (b) High Explosive Nuclear Explosive-Like Assemblies. Contractors must ensure High Explosive NELAs and Inert-with-Live-Pit NELAs are not assembled or disassembled in close proximity where components may be interchanged.

1 High-Fidelity Dummy Pit Verification Requirements.

- a Contractors must ensure the pit is verified by radiation detection means before assembly into a High Explosive NELA to verify the absence of radioactive material. If radiation is detected, the pit must be assayed using a gamma spectrometry/multi-channel analyzer to verify the absence of fissile material. Contractors must ensure this verification is either performed or observed using person-to-person coverage.
- b Contractors must ensure that after dummy pit verification the pit is controlled until it is assembled into the NELA configuration. Contractors must ensure this control is achieved by a two-person concept team or a dual-lock or other NES-approved security system.
- c Contractors must ensure an auditable record of radiation detection verification of the high-fidelity dummy pit is available.

2 Main Charge High Explosive Introduction Sequence.
Contractors must ensure the high-fidelity dummy pit verification is accomplished before introduction of the main charge HE and dummy pit into the same immediate assembly area of the High Explosive NELA.

(c) Inert-with-Live-Pit Nuclear Explosive-Like Assemblies.
Contractors must ensure Inert-with-Live-Pit NELAs and High Explosive NELAs are not assembled or disassembled in close proximity where components may be interchanged.

1 Mock High Explosive Verification Requirements.

- a Contractors must ensure all mock HE used in place of live main charge HE is nondetonable and is clear or colored pink. Where possible, preference must be given to noncombustible formulations. Contractors must ensure live main charge HE is not colored pink.
- b Contractors must ensure pink mock HE used in place of live main charge HE is chemically verified before assembling the NELA. Clear mock HE refers to LEXAN or similar inert substance and does not require chemical verification.

- c Contractors must ensure an auditable record of chemical verification of the mock HE is available.

2 Mock High Explosive Two-Person Concept Verification Requirements.

- a In addition to the mock HE verification requirements, contractors must ensure another chemical verification of all mock HE used in place of live main charge HE is accomplished before assembly into an Inert-with-Live-Pit NELA. Contractors must ensure this verification is either performed or observed using person-to-person coverage.
- b After the mock HE two-person concept verification, contractors must ensure the mock HE is controlled until it is assembled into the NELA configuration. Contractors must ensure this control is achieved by a two-person concept team or a dual-lock or other NES-approved security system.
- c Contractors must ensure an auditable record of two-person concept chemical verification of the mock HE is available.

3 Live Pit Introduction Sequence. Contractors must ensure the mock HE and mock HE two-person verifications are accomplished before introduction of the live pit and mock HE into the same immediate assembly area of the Inert-with-Live-Pit NELA.

(5) Offsite Transportation of Nuclear Explosive-Like Assemblies.

- (a) General Requirements. Contractors must ensure a configuration assembled as an Inert-with-Live-Pit NELA is not transferred to the custody of the Department of Defense.
- (b) Identification Requirements. Contractors must ensure NELAs that are shipped between DOE sites are identified externally (e.g., stencil or tag) with the following information.

1 NELA contents identified as one of the following.

- a Inert NELA.
- b High Explosive NELA.

- c Inert-with-Live-Pit NELA.
 - 2 Name and agency of responsible person at the shipping location.
 - 3 Name and agency of person who authorized the shipment at the receiving location.
 - (c) Permission to Ship between DOE Agencies. Contractors must ensure the shipping agency obtains permission from the receiving agency to ship before shipment of a NELA.
 - (d) Nuclear-Explosive-Like Assembly Survey before Transfer.
 - 1 Before offsite transfer of a NELA, contractors must ensure the NELA is surveyed in its shipping configuration using radiation detection to verify the absence or presence of fissile material. Anomalies or ambiguities detected by radiation detection means must be resolved before shipment.
 - 2 Contractors must ensure an auditable record of this survey is available.
 - (e) Nuclear Explosive-Like Assembly Survey upon Receipt.
 - 1 Upon receipt of a NELA, contractors must ensure the NELA is surveyed in its shipping configuration by a radiation detection means to verify the absence or presence of fissile material. Anomalies or ambiguities detected by radiation detection means must be resolved before release.
 - 2 Contractors must ensure an auditable record of this survey is available.
- o. Marking Instructions. Nuclear explosives and NELAs must be marked to distinguish configurations capable of a nuclear detonation from those that are not. Contractors responsible for NEOs or NELA operations must permanently mark nuclear explosives and NELAs in accordance with the following requirements. Additional permanent markings such as serial numbers and configuration identification may also be required by design agencies.
 - (1) Permanent Marking Legends.
 - (a) Nuclear Explosives. Contractors must ensure a “NUCLEAR” permanent marking legend is applied to nuclear explosives (i.e., units containing a live pit and an HE main charge).

(b) Nuclear Explosive-Like Assemblies.

- 1 Inert Nuclear Explosive-Like Assemblies. Contractors must ensure the “INERT” permanent marking is applied to a NELA containing mock HE or void in place of the live main charge HE and a dummy pit or void.
- 2 High Explosive Nuclear Explosive-Like Assemblies. Contractors must ensure the “HIGH EXPLOSIVE” permanent marking is applied to a NELA containing live main charge HE and a dummy pit or void.
- 3 Inert-with-Live-Pit Nuclear Explosive-Like Assemblies. Contractors must ensure the “INERT-WITH-LIVE-PIT” permanent marking is applied to a NELA containing mock HE, in place of the live main charge HE, and a live pit.

(2) Permanent Marking Location. Contractors must ensure nuclear explosives and NELAs are permanently marked on an external surface.

- (a) The permanent marking must be on a part that encloses the live main charge or mock HE.
- (b) The marking location is specified by the applicable design agency.

(3) Permanent Markings. Contractors must ensure nuclear explosives and NELAs are marked in accordance with the following requirements. The particular marking method is specified by the applicable design agency.

- (a) Contractors must ensure the permanent marking method produces the most durable mark possible consistent with acceptable deleterious effect on the material to which the marking is applied.
 - 1 The preferred marking methods are mechanical engraving (with or without fill) and impression-die stamping.
 - 2 Other acceptable methods are impression freehand, impression sandblast, and surface conversion.
- (b) Contractors should use the preferred marking size, 1/4-inch characters with 1/4-inch spacing between lines, if space permits.

(4) Permanent Marking Obliteration. When a nuclear explosive or NELA is altered or disassembled to the point that its permanent marking is no longer valid, contractors must ensure the permanent marking is obliterated in accordance with the following requirements.

(a) Methodology.

- 1 The preferred method of obliteration is overprinting the letter “X” on each letter of the permanent marking legend using the same permanent marking method as that used to apply the original marking.
- 2 If obliteration by overprinting is not feasible for technical reasons, contractors must remove the permanent marking using a method specified by the applicable design agency.

(b) Authentication. Contractors must ensure all obliterated permanent markings are immediately authenticated with the DOE authentication stamp.

—Obliterated permanent markings on components that will be scrapped need not be authenticated.

(c) Components That Will Be Reassembled. Permanent marking need not be obliterated on marked components that will be reassembled into the same configuration in accordance with the following requirements.

1 General Requirements.

- a After the marked component is removed, contractors must control the disassembled components until the disassembled components and marked component are reassembled into the same configuration.
- b Contractors must ensure control is achieved by a two-person concept team or a dual-lock or other NES-approved security system.

2 Nuclear Explosives. Contractors must ensure nuclear explosive components are not assembled or disassembled in close proximity to NELAs, where components may be interchanged.

3 Nuclear Explosive-Like Assemblies. Contractors must ensure NELAs are not assembled or disassembled in close proximity to nuclear explosives, where components may be interchanged.

- a Inert Nuclear Explosive-Like Assemblies. Contractors must ensure Inert NELAs are not

assembled or disassembled in close proximity to High Explosive or Inert-with-Live-Pit NELAs, where components may be interchanged.

- b High Explosive Nuclear Explosive-Like Assemblies. Contractors must ensure High Explosive NELAs are not assembled or disassembled in close proximity to Inert or Inert-with-Live-Pit NELAs, where components may be interchanged.
 - c Inert-with-Live-Pit Nuclear Explosive-Like Assemblies. Contractors must ensure Inert-with-Live-Pit NELAs are not assembled or disassembled in close proximity to High Explosive or Inert NELAs, where components may be interchanged.

- (5) DOE Authentication Stamp. Contractors receiving authentication stamps and templates must establish controls to preclude their unauthorized use.

- p. Training. Contractors responsible for and/or involved in NEOs and associated activities must implement training, qualification, and certification programs for personnel that manage, oversee, perform, or directly support these operations and activities.
 - (1) Contractor training, qualification, and certification programs must comply with DOE O 5480.20A, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities*, dated 11-15-94, except Chapters II and III (Reactor Operations), and include requirements equivalent to those in Chapter IV. Training and qualification requirements must be commensurate with assigned responsibilities.
 - (2) Contractors must select, train, and certify personnel for positions with access to nuclear explosives and/or Category I special nuclear material and ensure their continuing fitness for nuclear explosive duty [See 10 CFR 712, *Human Reliability Program*].
 - (3) Contractors must provide annual training for personnel assigned to nuclear explosive duty that includes the following NES-specific topics.
 - (a) Responsibilities associated with custody of nuclear explosives.
 - (b) Use of general and supplemental NESRs, site/facility and program-specific Technical Safety Requirements, and other controls associated with NEOs.

- (c) The purpose, objective, and responsibilities of the two-person concept for operations.
 - (d) Explosive safety appropriate for assigned responsibilities.
- q. Records. Contractors must maintain records (documentation) in accordance with National Archives and Records Administration-approved DOE or site-specific records retention and disposition schedules (See DOE O 200.1, *Information Management Program*, dated 9-30-96).