

SUBJECT: NUCLEAR EXPLOSIVE AND WEAPON SURETY PROGRAM

1. **PURPOSE.** All nuclear explosives and nuclear explosive operations require special safety, security, and use control consideration because of the potentially unacceptable consequences of an accident or unauthorized act; therefore, a Nuclear Explosive and Weapon Surety (NEWS) Program is established to prevent unintended/unauthorized detonation and deliberate unauthorized use of nuclear explosives.
 - a. The NEWS Program is implemented through this Order and the following Directives:
 - (1) DOE O 452.2D Chg 1, *Nuclear Explosive Safety*, dated 07-10-13, or successor directive;
 - (2) DOE O 452.4B, *Security and Use Control of Nuclear Explosives and Nuclear Weapons*, dated 1-22-10, or successor directive;
 - (3) DOE O 452.6A, *Nuclear Weapon Surety Interface with the Department of Defense*, dated 4-14-09, or successor directive;
 - (4) NA SD 452.2, *Nuclear Explosive Safety Evaluation Processes*, dated 11-17-14, or successor directive.
 - b. The objectives of the NEWS Program are:
 - (1) To prevent accidents involving U.S. nuclear weapons and nuclear explosives.
 - (2) To prevent inadvertent or unauthorized use of U.S. nuclear weapons and nuclear explosives.
 - (3) In conjunction with the Department of Defense (DoD), to protect the public health and safety by providing dual-Agency judgment and responsibility for the safety, security, and use control (surety) of nuclear weapons.
 - (4) To establish nuclear explosive surety standards and nuclear weapon design surety requirements.
 - (5) To address surety vulnerabilities during all phases of the nuclear weapon life cycle and to upgrade surety during weapon stockpile refurbishments and/or new weapon development.

- (6) To establish requirements and responsibilities for preplanned and scheduled nuclear explosive operations (NEOs) such as assembly, disassembly, rebuild, repair, refurbishment, recodes, limited life component exchanges, dismantlement, transport, and staging. [Responses to emergency events (e.g., Accident Response Group activities) are addressed in DOE O 151.1C, *Comprehensive Emergency Management System*, dated 11-02-05, or successor directive.]
 - (7) To prevent malicious hardware and software from entering the Nuclear Security Enterprise supply chain.
 - (8) To establish requirements for enhanced weapon trust features that are resilient to subversion attempts.
2. CANCELLATION. DOE O 452.1D, *Nuclear Explosive and Weapon Surety Program*, dated 4-14-09. Cancellation of a directive does not, by itself, modify or otherwise affect any contractual obligation to comply with the directive. Contractor requirements documents (CRDs) that have been incorporated into or attached to a contract remain in effect until the contract is modified to either eliminate requirements that are no longer applicable or substitute a new set of requirements.
3. APPLICABILITY.
- a. Departmental Elements. This Order applies to NNSA which is the only Departmental element that is involved in performing, managing, overseeing, and directly supporting the nuclear explosive and weapon surety program and associated activities.

The Administrator of the National Nuclear Security Administration (NNSA) must assure that NNSA employees comply with their responsibilities under this directive. Nothing in this directive will be construed to interfere with the NNSA Administrator's authority under section 3212(d) of Public Law (P.L.) 106-65 to establish Administration-specific policies, unless disapproved by the Secretary.
 - b. Nuclear Security Enterprise Contractors.
 - (1) The Contractor Requirements Document (CRD), Attachment 1, 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) Field Element 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. Exemptions.

As per the requirements of DOE O 420.1C, *Facility Safety*, activities involving criticality safety or the safety of critical assembly operations are covered under the applicable ANSI/ANS standards. These are ANSI/ANS-1 for critical assembly operations, ANSI/ANS-8 for general criticality safety, and ANSI/ANS-14.1 for fast pulse reactors. As such, these activities are not included in the scope of this order. However, if critical assembly operations have the potential to affect nuclear explosive operations (i.e. are in close proximity to one another), then those operations are within the scope of this order.

d. Equivalencies.

In accordance with the responsibilities and authorities assigned by Executive Order 12344, codified at 50 USC sections 2406 and 2511 and to ensure consistency through the joint Navy/DOE Naval Nuclear Propulsion Program, the Deputy Administrator for Naval Reactors (Director) will implement and oversee requirements and practices pertaining to this Directive for activities under the Director's cognizance, as deemed appropriate.

4. REQUIREMENTS.

a. Nuclear Explosive Surety Standards.

- (1) For all nuclear explosive operations, there must be a positive measure that will effectively interrupt each credible scenario that leads to an unintended nuclear explosive detonation or main charge High Explosive Violent Reaction (HEVR).
- (2) For all nuclear explosive operations, there must be a second independent positive measure that will effectively interrupt each credible scenario that leads to an unintended nuclear explosive detonation or main charge HEVR given the first measure fails.
- (3) There must be positive measures to prevent unauthorized access, intentional physical damage, misuse, and theft of nuclear explosives.
- (4) There must be positive measures (a combination of site, facility, or nuclear explosive operation-specific as appropriate) to prevent malevolent acts that could lead to deliberate unauthorized use.
- (5) New and refurbished nuclear weapons must have design attributes to prevent nuclear explosive detonation and main charge high explosive violent reaction, given an adverse environment or unauthorized act.

- (6) New and refurbished nuclear weapons must have design attributes to prevent deliberate unauthorized use, given a malevolent act.
- b. Application and Intent of the Surety Standards. The Surety Standards of paragraph 4a are qualitative Standards. Organizations involved with NEWS management must use the following guidance in interpreting and applying the Surety Standards of paragraph 4a.
- (1) The term “prevent” implies an absolute assurance, which cannot be guaranteed and is rarely achievable. Nonetheless, prevention of unintended/unauthorized nuclear explosive detonation and unintended main charge high explosive violent reaction (HEVR) is a primary goal in the design and performance of nuclear explosive operations.
 - (2) A primary target of nuclear explosive surety positive measures is to protect nuclear explosive main charge high explosive (HE) from environments capable of initiating it, including those environments to which main charge detonator cable assemblies are exposed. Adequacy of positive measures must be established through application of the concept of defense-in-depth and demonstrated through their effectiveness and independence from other positive measures in all stages of nuclear explosive operations.
 - (3) “Environment” means the aggregate of surrounding conditions, circumstances, objects, and influences. An “adverse environment” is one that is capable of producing an unwanted response. The adverse environments of interest for the Surety Standards are those that, if unmitigated, might lead to nuclear explosive detonation or main charge HEVR. Examples include anything that introduces unintended or unauthorized energy hazardous to a nuclear explosive such as human error; deliberate acts; equipment malfunction; other accident initiators, precursors, or sequences; and the conditions those events create.
- c. Nuclear Explosive Safety (NES). The NES Standards in paragraphs 4a(1) and (2) above must be met for all NEOs conducted by the Department and its contractors to ensure adequate nuclear explosive safety, subject to the provision of this paragraph. When the NES Standards are met, the Authorizing Official may approve proposed operations (or allow ongoing operations to continue). If 4a(2) above is not met, and adequate nuclear explosive safety is achieved by other means, approval of the Under Secretary for Nuclear Security is required prior to initiating or continuing the affected operations.
- (1) It is desirable for the first positive measure to be as early in the scenario sequence of events as practical, and the second as late in the sequence as possible. It is also desirable to interrupt the scenario with positive measures as often as practical, and as reliably as reasonable to raise confidence in the overall effectiveness of the positive measures.

Continuous improvement of nuclear explosive safety is a goal for any nuclear explosive operation. However, satisfaction of the NES Standards is achieved by having at least two independent positive measures to effectively interrupt each credible scenario that could lead to nuclear explosive detonation or main charge HEVR.

- (2) The term “positive measure” as used in paragraphs 4a(1) and (2) above may refer to a single positive measure or a suite of positive measures. A single positive measure meets the requirement of 4a(1) or (2) above if that positive measure can by itself effectively interrupt the scenario. A suite of positive measures (two or more) are necessary if the positive measures are dependent on each other to effectively interrupt the scenario.
- (3) Nuclear Explosive Safety Study Groups (NESSG) are convened to evaluate NEOs to determine if positive measures are adequate to meet these Standards. These NESSG evaluations are performed as specified in DOE O 452.2D, *Nuclear Explosive Safety*, and NA SD 452.2, *Nuclear Explosive Safety Evaluation Processes*, or their successor directives.
- (4) Hierarchy of Positive Measures.
 - (a) Elimination of the Hazard. Unless impossible or impractical, the hazard will be eliminated.
 - (b) Engineered Positive Measures. If the hazard cannot be eliminated, engineered positive measures, such as design features, should be implemented. Passive engineered positive measures are preferential to active ones. Unless impossible or impractical, engineered positive measures will be in place to prevent NES consequences.
 - (c) Administrative Positive Measures. Administrative positive measures should be incorporated when engineered positives measures cannot and as positive measures to provide defense-in-depth.
- (5) “Effectively interrupt” means that each sequence of credible causes and effects that begins with an initiating event and eventually leads to the NES consequence, is prevented or stopped at some point, so that the NES consequence does not occur. Similar to 4b(1) above, prevention of unintended/unauthorized nuclear explosive detonation and unintended main charge high explosive violent reaction is a primary goal in the design and performance of nuclear explosive operations. As used in this paragraph, the term “initiating event” means an initial event or unauthorized (non-malevolent) act that potentially leads to a NES consequence.

- (6) “Failure of a positive measure” means that during the scenario sequence of events, a positive measure meant to prevent the initiating event or prevent the scenario from progressing toward a NES consequence has failed to perform that function.
- d. Nuclear Explosive Security. NNSA implements Departmental requirements in accordance with the 470-series directives. Safeguards and security measures must be documented in the site safeguards and security plan. The Security Standard, paragraph 4a(3), above, must be met to ensure adequate nuclear explosive security for all NEOs conducted by the Department and its contractors. The NESSG must evaluate security operations for potential adverse NES impact.
- e. Nuclear Explosive Use Control. The Use Control (UC) Standard, paragraph 4a(4) above, must be met for all NEOs conducted by the Department and its contractors to ensure adequate use control measures. Additional UC requirements are specified in DOE O 452.4B, *Security and Use Control of Nuclear Explosives and Nuclear Weapons*, or its successor directive. Use control measures must be evaluated in accordance with the provisions of DOE O 452.4B to ensure all objectives are achieved. The NESSG must evaluate UC measures for potential adverse NES impact.
- f. Nuclear Weapon Design Surety. Surety must be an integral part of the design and development of new weapons and the refurbishment of existing weapons. The design and development of new weapons and the refurbishment of existing weapons is defined in Development and Production (D&P) Manual Chapters 3.1 and 3.2 (or successor documents). The Nuclear Weapon Design Surety Standards, paragraphs 4a(5) and (6) above must be met to support safe and secure response to adverse environments and unauthorized acts. This is evaluated by the Office of Stockpile Management [the Project Officers Group (POG) member] and the Office of Stockpile Stewardship (leads activities associated with Phase 6.1 – 6.2A and delivery of a certified design) during the phase gate reviews defined in D&P Manual Chapters 3.1 and 3.2 (or successor documents).
- (1) Documented consideration of surety must begin at the conception phase and continue throughout all weapon program phases.
- (2) Surety-related surveillance program information must be explicitly considered in nuclear weapon design and development activities.
- (3) The following are the NNSA positions for Military Characteristic negotiations for new or refurbished nuclear weapon designs.
- (a) Nuclear Detonation Safety. Nuclear weapons must incorporate design features that minimize the possibility of accidental and/or inadvertent nuclear explosive detonation. The following are design requirements for nuclear weapons.

- 1 Normal Environment. Prior to receipt of the enabling input signals and the arming signal, the probability of a premature nuclear explosive detonation must not exceed one in a billion (1E-09) per nuclear weapon lifetime.
 - 2 Abnormal Environment. Prior to receipt of the enabling input signals, the probability of a premature nuclear explosive detonation must not exceed one in a million (1E-06) per credible nuclear weapon accident or exposure to abnormal environments.
 - 3 One Point Safety. Nuclear explosives must be one-point safe without the use of a safing device (i.e. inherently one-point safe). The probability of achieving a nuclear yield greater than four (4) pounds of TNT equivalent in the event of a one-point initiation of the high explosive must not exceed one in a million (1E-06).
- (b) Fissile Material Dispersal Safety. Nuclear weapons must incorporate design features for reducing fissile material dispersal from the pit under credible abnormal environments.
- (c) Use Control. Nuclear weapons must incorporate use control design features that allow timely authorized use of a nuclear weapon while precluding or delaying unauthorized nuclear explosive detonation. The following are requirements for nuclear weapons delivered to DoD.
- 1 The protection of nuclear weapons must include a combination of administrative (e.g., personnel security) and technical measures (e.g., physical security and use control) designed to prevent deliberate unauthorized nuclear explosive detonation. These measures must be consistent with DoD operational requirements and must continually be assessed against existing and emerging threats as well as technological opportunities for improvement.
 - 2 Use control capabilities must be upgraded during significant weapon refurbishments.
- (d) Inadvertent Criticality. Nuclear weapons designs must preclude inadvertent criticality in both normal and abnormal environments as verified by the design agency.
- (e) Multipoint Safety. New and refurbished nuclear weapons must incorporate design features to achieve multipoint safety for

credible abnormal environments. These features must complement use control features of paragraph 4f(3)(c) above and must also allow for timely authorized use.

- g. Surety Research and Development (R&D).
- (1) R&D on a broad range of safety and control methods and devices must be conducted to improve the surety of nuclear weapons and nuclear weapon systems significantly by accomplishing the following:
 - (a) Identify and characterize physical processes that can lead to unacceptable response.
 - (b) Identify and address surety issues.
 - (c) Identify areas to improve surety.
 - (2) R&D must provide use control options with delay or denial capability that, at a minimum, are equivalent to that associated with current non-violent disablement systems.
 - (3) R&D must pursue technologies that render the unauthorized use of U.S. nuclear weapons impossible without their remanufacture.
- h. Nuclear Weapon Surveillance Program. The nuclear weapon surveillance program—which involves routine periodic examination, evaluation, and testing of stockpile weapons and weapon components to ensure they meet design requirements and are performing effectively—must include safety and use control components.
- i. Training and Qualification of Personnel. Each organization responsible for and/or involved in NEOs and activities that may affect the safety and use control of a nuclear explosive or nuclear weapon must implement training and qualification programs for personnel.
- (1) Training and qualification requirements must be commensurate with the particular responsibilities assigned.
 - (2) NEWS training must include specific training on the specific nuclear explosive and weapon hazards and positive measures for the responsibilities assigned.
 - (3) Training and qualification programs, as a minimum, must be based on the following.
 - (a) 10 CFR Part 712, *Human Reliability Program*, final rule.
 - (b) DOE O 360.1C, *Federal Employee Training*, dated 07-06-11.

- (c) DOE O 426.2 Chg. 1, *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities*, dated 7-29-13.
 - (d) DOE O 426.1 Chg. 1, *Federal Technical Capability*, dated 09-20-11.
- j. Exemptions. Exemptions must be requested when release is sought from a requirement in this Order. The exemption process is outlined in DOE O 251.1C, *Departmental Directives Program*, dated 1-15-09, or successor directive. The approval authority is the Deputy Administrator for Defense Programs with concurrence from the Central Technical Authority (CTA).
- k. Records. Records must be maintained in accordance with National Archives and Records Administration-approved DOE or site-specific records retention and disposition schedules per DOE O 243.1B, *Records Management Program*, dated 3-11-13.
- l. Implementation Requirements.
 - (1) This revision does not involve substantive administrative and programmatic changes from the previous directive, DOE O 452.1D, and an implementation plan is not required.
 - (2) This revision is effective upon issue.

5. RESPONSIBILITIES.

- a. NNSA Administrator. Is responsible for the design surety of all nuclear weapons delivered to the DoD and the surety of all NEOs conducted by NNSA and its contractors.
- b. Deputy Administrator for Defense Programs.
 - (1) Implements DOE/NNSA NEWS Program except independent Federal oversight.
 - (2) Ensures transition from emergency response for nuclear weapons in a damaged or abnormal state (or improvised nuclear device) under DOE 150-series directives to the requirements for planned nuclear explosive operations under the DOE 452-series directives.
- c. Assistant Deputy Administrator Stockpile Management. Ensures conduct of an active and continuous review of the nuclear stockpile to identify surety concerns and ensures a program exists to provide for stockpile improvement or controls to address identified concerns.
- d. Director, Office of Nuclear Weapon Surety and Quality.

- (1) Supports the NNSA Associate Administrator for Safety and Health in development of NEWS Program directives.
 - (2) Provides overall NEWS Program management and direction and implements surety policies.
- e. Director, Office of Research and Development for National Security Science and Technology.
- (1) Sponsors R&D on a broad range of safety and control methods and devices for nuclear weapons and weapon systems, including use control, and delay and denial capabilities.
 - (a) Identifies and characterizes physical processes that can lead to unacceptable nuclear explosive response.
 - (b) Identifies and addresses surety issues.
 - (c) Identifies areas to improve surety.
 - (d) Ensures that the requirements specified in section 4g of this Order are met.
 - (2) Sponsors technologies that render the unauthorized use of nuclear weapons impossible without their remanufacture.
- f. NNSA Field Element Managers with NEWS Responsibilities.
- (1) Ensure (based on competent, independent reviews) that each NEO authorized meets the nuclear explosive surety standards applicable to NEOs [paragraphs 4a(1) to 4a(4) above]. Retain documentation of these reviews, their conclusions, and resolution of findings.
 - (2) Develop and publish office directives to implement this and related directives as appropriate.
 - (3) Notify contracting officers to incorporate the CRD into each affected contract.
- g. Assistant Deputy Administrator for Secure Transportation. Ensures (based on competent, independent reviews) that each NEO authorized meets the nuclear explosive surety standards applicable to NEOs [paragraphs 4a(1) to 4a(4) above]. Retain documentation of these reviews, their conclusions, and resolutions of findings.
- h. Associate Administrator for Safety and Health.
- (1) Develops and maintains this directive and NES directives.

- (2) Performs competent, independent oversight of the NES evaluation process.

6. DEFINITIONS.

a. Abnormal Environment.

- (1) In Department of Energy operations, an environment that is not expected to occur during nuclear explosive operations and associated activities.
- (2) In Department of Defense operations, as defined in a weapon's stockpile-to-target sequence and military characteristics, those environments in which the weapon is not expected to retain full operational reliability.

b. Adverse Environment. An "adverse environment" is an environment that is capable of producing an unwanted response. Examples include anything that introduces unintended or unauthorized energy hazardous to a nuclear explosive such as human error; deliberate acts; equipment malfunction; other accident initiators, precursors, or sequences; and the conditions those events create.

c. Authorizing Official. For the purposes of this directive, the authorizing official is the NNSA field element line manager responsible for authorizing nuclear explosive operations at any site that line manager is responsible for.

d. Deliberate Unauthorized Use (DUU). Any of the following consequences resulting from deliberate malevolent acts:

- (1) a nuclear explosive detonation not authorized by the National Command Authorities,
- (2) a high explosive violent reaction that could result in an unauthorized nuclear explosive detonation,
- (3) theft of nuclear explosives.

e. Documents. Recorded information that describes, specifies, reports, certifies, requires, or provides data or results. A document is not considered a record until it is a completed document that provides objective evidence of an item, service, or process.

f. Environment. The aggregate of surrounding conditions, circumstances, objects, and influences.

g. Fissile Material Dispersal. The aerosolization and transport of fissile material by a driving force, such as fire, or high explosive violent reaction.

- h. High Explosive Deflagration. A rapid chemical reaction in which the output of heat is sufficient to enable 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. The effect of a true deflagration under confinement is an explosion. Confinement of the reaction increases pressure, rate of reaction, and temperature and may cause transition into a detonation.
- i. 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.
- j. High Explosive Violent Reaction (HEVR). For the purposes of the nuclear explosive and weapon surety directives, an HEVR includes reactions ranging from a fast deflagration of the high explosive up to and including a detonation of the high explosive. The explosive wave may be subsonic or supersonic.
- k. Inadvertent Criticality. The release of energy as a result of accidental production of a self-sustaining or divergent neutron chain reaction.
- l. Multipoint Safety. The application of positive measures to prevent or mitigate the possibility of nuclear yield resulting from accidental or deliberate unauthorized initiation of the main-charge explosive at multiple points within the main charge.
- m. Normal Environment.
 - (1) In Department of Energy operations, the environment in which nuclear explosive operations and associated activities are expected to be performed.
 - (2) In Department of Defense operations, the expected logistical and operational environments, as defined in a weapon's stockpile-to-target sequence and military characteristics, that the weapon is required to survive without degradation in operational reliability.
- n. Nuclear Explosive. An assembly containing fissionable and/or fusionable materials and main charge high-explosive parts or propellants capable of producing a nuclear explosive detonation (e.g., a nuclear weapon or test device).
- o. Nuclear Explosive Area (NEA). An area that contains a nuclear explosive or collocated pit and main charge high-explosive parts.
- p. Nuclear Explosive Detonation. An energy release in a nuclear explosive (as defined in this directive) through a nuclear process, during a period of time on the

order of one (1) microsecond, in an amount equivalent to the energy released by detonating four (4) or more pounds of trinitrotoluene (TNT).

- q. Nuclear Explosive Operation (NEO). Any activity involving a nuclear explosive including activities in which main charge high-explosive parts and pit are collocated.
- r. Nuclear Explosive Safety (NES). The application of positive measures to prevent or mitigate the possibility of unintended or unauthorized nuclear explosive detonation or high explosive violent reactions in a nuclear explosive area.
- s. Nuclear Explosive Safety (NES) Consequence. An inadvertent nuclear explosive detonation or a main charge high explosive violent reaction. NES consequences are the consequences of concern for nuclear explosive safety evaluations.
- t. Nuclear Explosive Safety Evaluation. A formal evaluation of nuclear explosive operations to determine if the DOE nuclear explosive safety standards and other NES criteria are met.
- u. Nuclear Explosive Safety Study Group (NESSG). The group established to evaluate nuclear explosive operations using the formal processes and certified personnel specified in NA SD 452.2, *Nuclear Explosive Safety Evaluation Processes*.
- v. Nuclear Security Enterprise. The collection of DOE laboratories, Nevada National Security Site, production plants, and processing facilities involved in the design, production, and testing of nuclear weapons.
- w. Nuclear Weapon. A nuclear explosive configured for Department of Defense use.
- x. Nuclear Yield. The nuclear energy released in the detonation of a nuclear explosive measured in terms of the weight of trinitrotoluene (TNT) required to produce the same amount of energy release.
- y. One Point Safety. The nuclear safety design principle that states that the probability of achieving a nuclear yield greater than 4 pounds of TNT equivalent in the event of a one-point initiation of the main charge high explosive must not exceed one in a million (1E-06).
- z. Pit. A fissile component or set of fissile components designed to fit in the central cavity of an implosion system.
- aa. Positive Measures. Process or facility design features, safety rules, procedures, or other controls used individually or collectively to provide nuclear explosive surety. Positive measures are intended to ensure a safe response in applicable operations. Some examples of positive measures are verification of strong-link switches; verification of other safety devices; administrative procedures and

controls; general and specific nuclear explosive safety rules; design control of electrical equipment and mechanical tooling; and physical, electrical, and mechanical restraints incorporated in facilities and transport equipment.

- bb. 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.
- cc. Refurbishment. Any nuclear weapon alterations or modifications including life extension, modernization, and revised military requirements. Refurbishments will be assigned a new alteration or modification number for stockpile management purposes.
- dd. Site. A geographical area consisting of a DOE-controlled land area including DOE-owned facilities (e.g., the Nevada National Security Site).
- ee. Surety. Safety, security, and use control of nuclear explosives and nuclear weapons.
- ff. Technical Safety Requirements (TSRs). The limits, controls, and related actions that establish the specific parameters and requisite actions for the safe operation of a nuclear facility and include, as appropriate for the work and the hazards identified in the documented safety analysis for the facility: Safety limits, operating limits, surveillance requirements, administrative and management controls, use and application provisions, and design features, as well as a bases appendix.
- gg. Unauthorized Act. Any action that has not been authorized and approved by proper authority. In the context of the Nuclear Explosive Surety Standards, an unauthorized act 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 in a nuclear explosive area. Unauthorized acts may be characterized as deliberate or unintended, and as either malevolent or non-malevolent.
 - (1) From a NES perspective, an unauthorized act is of interest if performed without intent to compromise nuclear explosive surety (i.e. non-malevolent). This includes cognitive errors (errors of omission or commission) and accidental or inadvertent acts.
 - (2) From a use control perspective, an unauthorized act is of interest if it is both deliberate and malevolent. More specifically, one performed with intent to create an unauthorized nuclear explosive detonation or to gain unauthorized control of a nuclear explosive.

- hh. Use Control. The application of systems, devices, or procedures that allow timely authorized use of a nuclear explosive while precluding or delaying unauthorized nuclear explosive detonation.

7. REFERENCES.

- a. DOE O 151.1C, *Comprehensive Emergency Management System*, dated 11-0-05, provides the framework for development, coordination, control, and direction of all emergency planning, preparedness, readiness assurance, response, and recovery actions.
- b. DOE O 243.1B Chg 1, *Records Management Program*, dated 03-11-13, provides a framework for managing information and National Archives and Records Administration approved DOE or site-specific records schedules.
- c. DOE O 410.1, *Central Technical Authority Responsibilities Regarding Nuclear Safety Requirements*, dated 08-28-07, establishes Central Technical Authority and Chief of Nuclear Safety/Chief of Defense Nuclear Safety responsibilities and requirements directed by the Secretary of Energy in the development and issuance of Department of Energy regulations and directives that affect nuclear safety.
- d. DOE O 414.1D Chg 1, *Quality Assurance*, dated 04-25-11, requires the implementation of quality assurance criteria.
- e. DOE O 425.1D Chg 1, *Verification of Readiness to Startup or Restart Nuclear Facilities*, dated 04-16-10, establishes the requirements for startup of new nuclear facilities and for the restart of existing nuclear facilities that have been shut down.
- f. DOE O 426.2 Chg 1, *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities*, dated 7-29-13, established selection, training, qualification, and certification requirements for contractor personnel who can impact the safety basis through their involvement in the operation maintenance, and technical support of Hazard Category 1,2, and 3 nuclear facilities.
- g. DOE P 450.4A, *Integrated Safety Management Policy*, dated 04-25-11, describes DOE's commitment that safety management systems be used to integrate safety into management and work practices at all levels so that missions are accomplished while protecting the public, the worker, and the environment.
- h. DOE O 452.2D Chg 1, *Nuclear Explosive Safety*, dated 7-10-13, establishes requirements and responsibilities for ensuring the nuclear explosive safety of routine and planned DOE NEOs.
- i. NA SD 452.2, *Nuclear Explosive Safety Evaluation Processes*, dated 11-17-14, detailing administrative and procedural requirements for nuclear explosive safety

evaluations of nuclear explosive operations conducted by the DOE/NNSA, and its respective contractors.

- j. DOE O 452.4B, *Security and Use Control of Nuclear Explosives and Nuclear Weapons*, dated 1-22-10, establishes DOE requirements and responsibilities to prevent the deliberate unauthorized use of U.S. nuclear explosives and weapons.
- k. DOE O 452.6A, *Nuclear Weapon Surety Interface With the Department of Defense*, dated 4-14-09, establishes DOE/NNSA requirements and responsibilities for addressing joint nuclear weapon and nuclear weapon system surety activities in conjunction with the DoD.
- l. DOE O 461.1B, *Packaging and Transportation for Offsite Shipment of Materials of National Security Interest*, dated 12-16-10, establishes DOE requirements and responsibilities for the Transportation Safeguards System Program.
- m. DOE O 227.1, *Independent Oversight Program*, dated 08-30-11, establishes requirements and responsibilities for DOE Independent Oversight that provides DOE and contractor managers, Congress, and other stakeholders with an independent evaluation of the adequacy of DOE policy and the effectiveness of line management performance in safeguards and security and other critical functions.
- n. DOE O 470.4B Chg 1, *Safeguards and Security Program*, dated 2-15-13, establishes roles and responsibilities for the Department of Energy Safeguards and Security Program.
- o. DOE O 471.1B, *Identification and Protection of Unclassified Controlled Nuclear Information*, 3-1-10.
- p. DOE O 471.2 Chg 1, *Identifying and Protecting Official Use Only Information*, dated 4-9-03.
- q. DOE M 471.3-1 Chg 1, *Manual for Identifying and Protecting Official Use Only Information*, 4-9-03.
- r. DOE O 475.2A, *Identifying Classified Information*, dated 2-1-11.
- s. 10 CFR Part 712, *Human Reliability Program*.
- t. 10 CFR Part 820, *Procedural Rules for DOE Nuclear Activities*.
- u. 10 CFR Part 830, *Nuclear Safety Management*.
- v. 10 CFR Part 1017, *Identification and Protection of Unclassified Controlled Nuclear Information*.
- w. 10 U.S.C. Sec. 179, *Nuclear Weapons Council*.

- x. Title XXXII of P.L. 106-65, National Nuclear Security Administration Act, as amended, establishes the National Nuclear Security Administration.
 - y. National Security Presidential Directive–28, *United States Nuclear Weapons Command and Control, Safety, and Security*, dated June 20, 2003.
8. CONTACT. Questions concerning this Order related to use control, security, or nuclear enterprise assurance should be addressed to the Assistant Deputy Administrator for Stockpile Management, 202-586-4879. Questions concerning this Order related to nuclear explosive safety and all other matters should be addressed to the Associate Administrator for Safety and Health, 202-586-3885.

BY ORDER OF THE SECRETARY OF ENERGY



ELIZABETH SHERWOOD-RANDALL
Deputy Secretary of Energy

CONTRACTOR REQUIREMENTS DOCUMENT
DOE O 452.1E, NUCLEAR EXPLOSIVE AND WEAPON SURETY PROGRAM

Nuclear Security Enterprise contractors, including National Nuclear Security Administration (NNSA) contractors that conduct Department of Energy (DOE) Nuclear Explosive and Weapon Surety (NEWS) Program activities must comply with the requirements in this Contractor Requirements Document (CRD).

Regardless of the performer of the work, contractors are responsible for compliance with the requirements of this CRD. Contractors are responsible for flowing down the requirements of this CRD to subcontracts at any tier to the extent necessary to ensure the contractors' compliance with the requirements. Contractors must not flow down requirements to subcontractors unnecessarily or imprudently. That is, contractors will ensure that they and their subcontractors comply with the requirements of the CRD and incur only those costs that would be incurred by a prudent person in the conduct of competitive business.

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

1. All nuclear explosives and nuclear explosive operations require special safety, security, and use control consideration because of the potentially unacceptable consequences of an accident or unauthorized act; therefore, contractors must support the NNSA NEWS program established to prevent unintended/unauthorized detonation and deliberate unauthorized use of nuclear explosives.
2. Ensure adequate nuclear explosive surety for all nuclear explosives and nuclear explosive operations under their purview based on evaluation against the following qualitative DOE surety standards.
 - a. For all nuclear explosive operations, there must be a positive measure that will effectively interrupt each credible scenario that leads to an unintended nuclear explosive detonation or main charge High Explosive Violent Reaction (HEVR).
 - b. For all nuclear explosive operations, there must be a second independent positive measure that will effectively interrupt each credible scenario that leads to an unintended nuclear explosive detonation or main charge HEVR given the first measure fails.
 - c. There must be positive measures to prevent unauthorized access, intentional physical damage, misuse, and theft of nuclear explosives.
 - d. There must be positive measures (a combination of site, facility, or nuclear explosive operation-specific as appropriate) to prevent malevolent acts that could lead to deliberate unauthorized use.
 - e. New and refurbished nuclear weapons must have design attributes to prevent nuclear explosive detonation and main charge high explosive violent reaction, given an adverse environment or unauthorized act.

- f. New and refurbished nuclear weapons must have design attributes to prevent deliberate unauthorized use, given a malevolent act.
3. Application and Intent of the Surety Standards. Contractors must use the following guidance in interpreting and applying the Surety Standards of paragraph 2.
 - a. The term “prevent” implies an absolute assurance, which cannot be guaranteed and is rarely achievable. Nonetheless, prevention of unintended/unauthorized nuclear explosive detonation and unintended main charge high explosive violent reaction is a primary goal in the design and performance of nuclear explosive operations.
 - b. A primary target of nuclear explosive surety positive measures is to protect nuclear explosive main charge high explosive (HE) from environments capable of initiating it, including those environments to which main charge detonator cable assemblies are exposed. Adequacy of positive measures must be established through application of the concept of defense-in-depth and demonstrated through their effectiveness and independence from other positive measures in all stages of nuclear explosive operations.
 - c. “Environment” means the aggregate of surrounding conditions, circumstances, objects, and influences. An “adverse environment” is one that is capable of producing an unwanted response. The adverse environments of interest for the Surety Standards are those that, if unmitigated, might lead to nuclear explosive detonation or main charge high explosive violent reaction. Examples include anything that introduces unintended or unauthorized energy hazardous to a nuclear explosive such as human error; deliberate acts; equipment malfunction; other accident initiators, precursors, or sequences; and the conditions those events create.
 4. Nuclear Explosive Safety (NES). All NEOs conducted by contractors must have adequate nuclear explosive safety based on evaluation against the NES Standards in paragraphs 2a and 2b above and NNSA approval as specified in this directive (DOE O 452.1E directive paragraph 4c above). Contractors conducting NEOs have the authority and responsibility to disallow NEOs that in the contractor’s judgment lack adequate nuclear explosive safety. .
 - a. It is desirable for the first positive measure to be as early in the scenario sequence of events as practical, and the second as late in the sequence as possible. It is also desirable to interrupt the scenario with positive measures as often as practical, and as reliably as reasonable to raise confidence in the overall effectiveness of the positive measures. Continuous improvement of nuclear explosive safety is a goal for any nuclear explosive operation. However, satisfaction of the NES Standards is achieved by having at least two independent positive measures to effectively interrupt each credible scenario that could lead to nuclear explosive detonation or main charge HEVR.

- b. The term “positive measure” as used in paragraphs 2a and b above may refer to a single positive measure or a suite of positive measures. A single positive measure meets the requirement of 2a or b above if that positive measure can by itself effectively interrupt the scenario. A suite of positive measures (two or more) are necessary if the positive measures are dependent on each other to interrupt the scenario.
 - c. Nuclear Explosive Safety Study Groups (NESSG) are convened to evaluate NEOs to determine if positive measures are adequate to meet these Standards as specified in DOE O 452.2E, *Nuclear Explosive Safety*, and NA SD 452.2, *Nuclear Explosive Safety Evaluation Processes*, or their successor directives.
 - d. Hierarchy of Positive Measures.
 - (1) Elimination of the Hazard. Unless impossible or impractical, the hazard will be eliminated.
 - (2) Engineered Positive Measures. If the hazard cannot be eliminated, engineered positive measures, such as design features, should be implemented. Passive engineered positive measures are preferential to active ones. Unless impossible or impractical, engineered positive measures will be in place to prevent NES consequences.
 - (3) Administrative Positive Measures. Administrative positive measures should be incorporated when engineered positives measures cannot and as positive measures to provide defense-in-depth.
 - e. “Effectively interrupt” means that each sequence of credible causes and effects that begins with an initiating event and eventually leads to the NES consequence, is prevented or stopped at some point, so that the NES consequence does not occur. Similar to 3a above, prevention of unintended/unauthorized nuclear explosive detonation and unintended main charge high explosive violent reaction is a primary goal in the design and performance of nuclear explosive operations. As used in this paragraph, the term “initiating event” means an initial event or unauthorized (non-malevolent) act that potentially leads to a NES consequence.
 - f. “Failure of a positive measure” means that during the scenario sequence of events, a positive measure meant to prevent the initiating event or prevent the scenario from progressing toward a NES consequence has failed to perform that function.
5. Nuclear Explosive Security. The Security Standard, paragraph 2c, above, must be met to ensure adequate nuclear explosive security for all NEOs conducted by contractors.
6. Nuclear Explosive Use Control. The Use Control Standard, paragraph 2d above, must be met for all NEOs conducted by contractors to ensure adequate use control measures.

7. Nuclear Weapon Design Surety. Surety must be an integral part of the design and development of new weapons and the refurbishment of existing weapons. Contractors operating national laboratories with nuclear weapon design responsibilities must do the following to support meeting the Nuclear Weapon Design Surety Standards, paragraphs 2e and 2f above.
 - a. Document consideration of surety, beginning at the conception phase and continuing throughout all weapon program phases.
 - b. Explicitly consider surety-related surveillance program information in nuclear weapon design and development activities.
 - c. Support NNSA Military Characteristic negotiations by developing the following design features for new or refurbished nuclear weapon.
 - (1) Nuclear Detonation Safety. Nuclear weapons must incorporate design features that minimize the possibility of accidental and/or inadvertent nuclear explosive detonation. The following are design requirements for nuclear weapons.
 - (a) Normal Environment. Prior to receipt of the enabling input signals and the arming signal, the probability of a premature nuclear explosive detonation must not exceed one in a billion (1E-09) per nuclear weapon lifetime.
 - (b) Abnormal Environment. Prior to receipt of the enabling input signals, the probability of a premature nuclear explosive detonation must not exceed one in a million (1E-06) per credible nuclear weapon accident or exposure to abnormal environments.
 - (c) One-Point Safety. Nuclear explosives must be one-point safe without the use of a safing device (i.e. inherently one-point safe). The probability of achieving a nuclear yield greater than four (4) pounds of TNT equivalent in the event of a one-point initiation of the high explosive must not exceed one in a million (1E-06)..
 - (2) Fissile Material Dispersal Safety. Incorporate design features in nuclear weapons for reducing fissile material dispersal from the pit under credible abnormal environments.
 - (3) Use Control. Incorporate use control design features in nuclear weapons that allow timely authorized use of a nuclear weapon while precluding or delaying unauthorized nuclear explosive detonation. The following are requirements for nuclear weapons delivered to DoD.
 - (a) The protection of nuclear weapons must include a combination of administrative (e.g., personnel security) and technical measures

(e.g., physical security and use control) designed to prevent deliberate unauthorized nuclear explosive detonation. These measures must be consistent with DoD operational requirements and must continually be assessed against existing and emerging threats as well as technological opportunities for improvement.

(b) Use control capabilities must be upgraded during weapon refurbishment.

(4) Inadvertent Criticality. Design nuclear weapons to preclude inadvertent criticality in both normal and abnormal environments.

(5) Multipoint Safety. Incorporate design features in new and refurbished nuclear weapons to achieve multipoint safety for credible abnormal environments. These features must complement use control features of paragraph 7c(3) above and must also allow for timely authorized use.

d. Surety Research and Development (R&D).

(1) R&D on a broad range of safety and control methods and devices must be conducted to improve the surety of nuclear weapons and nuclear weapon systems significantly by accomplishing the following:

(a) Identify and characterize physical processes that can lead to unacceptable nuclear explosive response.

(b) Identify and address surety issues.

(c) Identify areas to improve surety.

(2) R&D must provide use control options with delay or denial capability that, at a minimum, are equivalent to that associated with current non-violent disablement systems.

(3) R&D must pursue technologies that render the unauthorized use of U.S. nuclear weapons impossible without their remanufacture.

8. Nuclear Weapon Surveillance Program. Evaluate the stockpile continually to ensure that safety and use control devices and components meet specified requirements and are performing effectively.

9. Training and Qualification of Personnel. Each organization responsible for and/or involved in NEOs and activities that may affect the safety and use control of a nuclear explosive or nuclear weapon must implement training and qualification programs for personnel.

a. Training and qualification requirements must be commensurate with the particular responsibilities assigned.

- b. NEWS training must include specific training on the specific nuclear explosive and weapon hazards and controls for the responsibilities assigned.
 - c. Training and qualification programs, as a minimum, must be based on the following.
 - (1) 10 CFR Part 712, *Human Reliability Program*, final rule.
 - (2) DOE O 426.2 Chg. 1, *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities*, dated 7-29-13, as applicable.
10. Nuclear Security Enterprise Support. Provide qualified personnel to participate in readiness reviews; preparation and/or reviews of NEO hazards analysis reports and safety analysis reports; military Nuclear Weapon System Safety Groups; nuclear weapon surveillance program; nuclear explosive safety evaluation activities; and provide other specialized nuclear explosive technical support and assistance.
11. Records. Records must be maintained in accordance with National Archives and Records Administration-approved DOE or site-specific records retention and disposition schedules per DOE O 243.1B, *Records Management Program*, dated 3-11-13, or successor directive, as applicable.