

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

ORDER

DOE O 456.1B

Approved: 08-05-2026

SUBJECT: THE SAFE HANDLING OF UNBOUND ENGINEERED NANOPARTICLES

1. PURPOSE. This Order ensures that activities involving unbound engineered nanoparticles (UNP) are conducted using a risk-informed, performance-based approach that protects workers, the public, and the environment while eliminating redundant and low-value administrative requirements.
2. CANCELLATION. Department of Energy (DOE) Order 456.1A, *The Safe Handling of Unbound Engineered Nanoparticles*, dated July 15, 2016.
 - a. Cancellation of a directive does not, by itself, modify or otherwise affect any contractual or regulatory obligation to comply with the directive.
3. APPLICABILITY.
 - a. Departmental Applicability.
 - b. This Order applies to DOE elements, including the National Nuclear Security Administration (NNSA), that conduct, manage, or oversee activities involving UNP at DOE-owned or DOE-controlled facilities.
 - c. The administrator of NNSA must ensure compliance by NNSA employees consistent with Section 3212(d) of Public Law 106-65.
 - d. DOE Contractors.
 - (1) This Order applies to contractors performing work involving UNP where DOE directives are incorporated into the contract pursuant to 48 Code of Federal Regulations (CFR) 970.5204-2, Laws, regulations, and DOE directives, or equivalent mechanisms.
 - (2) Contractor requirements are contained directly within this Order. No Contractor Requirements Document is issued.
 - e. Scope and Limitations.
 - (1) This Order applies only to occupational safety and health risks associated with unbound engineered nanoparticles. The following are excluded:
 - (a) Biomolecules (proteins, nucleic acids, carbohydrates).

- (b) Nanoscale radiological materials regulated under nuclear safety or radiological protection requirements (e.g., 10 CFR § 835, Occupational Radiation Protection).
 - (c) Incidentally produced nanoparticles.
 - (d) Ultrafine combustion particles.
- (2) For non-DOE-specific hazards, compliance must be achieved through applicable external regulatory frameworks. This Order does not restate or duplicate regulatory requirements.
- (3) Equivalencies/Exemptions for DOE O 456.1B.
- (a) Equivalencies and exemptions are processed in accordance with DOE O 251.1, *Departmental Directives Program*, current version.
 - (b) Equivalency. In accordance with the responsibilities and authorities assigned by Executive Order 12344, Naval Nuclear Propulsion Program, codified at 50 USC § 2406, Deputy Administrator for Naval Reactors, and 2511, Naval Nuclear Propulsion Program, 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. Policies and Procedures.

- (1) Safety and health policies and procedures for activities involving UNP must be established that identify how DOE and contractors will comply with the requirements of this Order. These policies and procedures should be an integral part of the Worker Protection Program and compliant with 10 CFR § 851, Worker Safety and Health Program. To the extent such steps have not occurred, they should be effectuated immediately.
- (2) Organizations conducting UNP activities must establish written procedures that:
 - (a) Define hazard identification and control processes for UNP.
 - (b) Integrate UNP activities into existing safety management systems.
 - (c) Provide mechanisms for review and update as scientific knowledge evolves.

b. Training.

- (1) Workers with potential exposure to UNP must receive training prior to assignment.
- (2) Training must include, at a minimum:
 - (a) Uncertainties of properties and hazards of UNP;
 - (b) Differences in reactivity and toxic potential between nanoscale and bulk forms of the same material;
 - (c) Potential exposure routes and transport of UNP within the body;
 - (d) Limitations of available hazard information, including Safety Data Sheets, for evaluating exposures and environmental releases;
 - (e) The importance of minimizing exposure and environmental release;
 - (f) Hazard controls and their limitations;
 - (g) Applicable exposure limits or recommended exposure guidance, when available; and
 - (h) Site-specific policies, procedures, and hazard controls for UNP.
- (3) Refresher training must be provided as appropriate when significant hazard information or procedural changes occur.
- (4) Training must remain commensurate with the risk and complexity of the work activity.

c. Exposure Assessment and Monitoring.

- (1) An exposure assessment program for UNP must be established to include preliminary qualitative exposure assessments for airborne and dermal exposure and consideration of quantitative air monitoring.
- (2) The best available hazard information must be used when conducting an exposure assessment for all activities involving UNP.

d. Medical Surveillance.

- (1) Workers with occupational exposure to UNP must be evaluated for medical surveillance enrollment consistent with 10 CFR § 851.
- (2) Medical evaluations must be determined by an occupational medicine provider and may include:
 - (a) Occupational and medical history,
 - (b) Focused physical examination,
 - (c) Diagnostic testing as appropriate.

e. Hazard Communication and Labeling.

- (1) Post signs indicating UNP hazards, at entry points into areas where UNP are handled. An area may be an entire laboratory, an area of a laboratory, specific equipment, or a containment device such as a laboratory hood or glovebox.
- (2) Label storage and transfer containers to plainly indicate the contents include UNP and associated hazards in accordance with applicable federal, state and local regulations. If affixing a label is impractical, alternative labeling schemes may be used in lieu of affixing labels.

f. Waste Management. Waste containing UNP must be managed in accordance with applicable federal, state, and local disposal regulations.5. RESPONSIBILITIES.a. Departmental Elements Responsible for Program Direction.

Ensure implementation of this Order within their programs and establish risk-based oversight.

b. DOE Field Elements. Ensure that:

- (1) Contractor UNP activities comply with this Order,
- (2) Oversight plans address UNP hazards where present,
- (3) Approval authority is aligned with hazard and consequence.

c. Contracting Officers. Incorporate this Order into applicable contracts and ensure contractual mechanisms support implementation.

- d. Contractors Performing UNP Activities. Ensure that:
 - (1) Hazards are identified and controlled,
 - (2) Training, exposure assessment, and posting/labeling are implemented.
6. INVOKED STANDARDS. This Order does not invoke any DOE technical standards or industry standards as required methods. Note: DOE O 251.1, current version, provides a definition for “invoked technical standard.”
7. DEFINITIONS.
 - a. Engineered nanoparticle. Intentionally created material with one or more dimensions between 1 and 100 nanometers.
 - b. Unbound engineered nanoparticles. Particles that are not contained within a matrix under normal temperature and pressure conditions that would reasonably be expected to prevent the particles from being separately mobile and a potential source of exposure. An engineered primary nanoscale particle dispersed and fixed within a polymer matrix, incapable, as a practical matter, of becoming airborne, would be “bound” while such a particle suspended as an aerosol would be “unbound.”
 - c. UNP worker. A worker with potential inhalation or dermal exposure to UNP due to assigned duties or work in areas where UNP may become dispersed.
8. REFERENCES.

This Order implements worker protection obligations established under 10 CFR § 851.

 - a. 10 CFR §851, Worker Safety and Health Program.
 - b. 48 CFR (DEAR) 970.5204-2, Laws, regulations and DOE directives.
 - c. DOE O 440.1B, *Worker Protection Program for DOE (Including NNSA) Federal Employees.*
 - d. DOE P 450.4A, *Integrated Safety Management Policy.*
 - e. DOE O 251.1, *Departmental Directives Program.*
 - f. Other applicable federal regulations governing occupational health, medical qualification standards, transportation, or biological materials where relevant to the specific UNP activity.

9. CONTACT. Questions concerning this Order should be addressed to the Office of Worker Safety and Health Policy.

BY ORDER OF THE SECRETARY OF ENERGY:



JAMES P. DANLY
Deputy Secretary