


SUBJECT AREA CONTENT

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Management System: Worker Safety and Health			
Subject Area: Nanoscale Particle ESH			
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Effective Date: Apr 1, 2016 (Rev 1.3) Periodic Review Due: Apr 1, 2019	Subject Matter Expert: Wai Lin Ng	Management System Executive: Ed Nowak	Management System Steward: Gail Mattson

Introduction

This subject area provides an overview of the Nanoscience ESH program and describes the procedures for implementing the regulatory requirements of DOE Order 456.1 and DOE Policy 456.1.

The following procedure sets forth practices for managing environmental, safety and health (ES&H) hazards associated with unbound engineered nanoscale particles (UNP). Exposures to these materials during research and development may occur through inhalation, dermal contact, injection, and ingestion. Animal studies indicate that low-solubility ultrafine particles might be more toxic than larger ones on a mass-for-mass basis. Because of their size, they can possibly reach deep into the lungs and may be trans-located to other organs following pathways not demonstrated by previous studies with larger particles with potential for unknown health hazards.

Every effort should be made at the planning stage to minimize UNP exposure. The hazard potential of a given exposure depends on: the type of material; chemistry; morphology; physical state; and intensity, frequency, and duration of exposure. Each of these factors, and others, is considered in determining which exposures are hazardous.

When controlling workplace hazards, the process for determining feasible and effective controls is to be based on the following hierarchy of controls:

- Substitution;
- Engineering controls;
- Administrative controls;
- Personal protective equipment.

The best controls are those that eliminate the hazard, followed by those that control the source or shield the worker from the source. Next in the hierarchy is work planning that limits workers exposure

to the source. The least desirable approach is controlling exposure at the worker's location, relying solely on the use of personal protective equipment worn by the worker.

Contents

Section	Overview of Content (see section for full process)
<u>1. Planning to Use Unbound Engineered Nanoscale Particles (UNP)</u>	<ul style="list-style-type: none">• Determine if nanomaterial is UNP or if UNP will be generated during the work.• Identify all UNP purchases in purchase requisition.• Maintain electronic list of all UNP projects.• Exposure Assessment• Determine need for exposure monitoring, capture requirements in ESR, and conduct monitoring.
<u>2. Training for Unbound Engineered Nanoscale Particles (UNP) Workers and Staff, Subcontractors, Users, and Guests</u>	<ul style="list-style-type: none">• Ensure all UNP workers are identified.• Complete UNP Worker Training.• Ensure Ancillary Worker Training (support staff) is provided and JTAs are updated.• Ensure users, guests, or visitors working with UNPs complete BNL UNP Worker web class or receive appropriate information in department level training.
<u>3. Handling Unbound Engineered Nanoscale Particles (UNP)</u>	<ul style="list-style-type: none">• Designate and post areas where UNP are handled.• Ensure minimum PPE requirements for entry to lab areas are posted.• Ensure ESR is available for review.• Conduct work using HEPA-filtered exhaust.• Manage waste in accordance with the BNL Waste Management procedures.
<u>4. Medical Surveillance for Unbound Engineered Nanoscale Particles (UNP) Workers</u>	<ul style="list-style-type: none">• Identify UNP workers.• Update UNP workers' JTA to ensure they receive mandatory medical evaluation through OMC.• Maintain electronic UNP worker list.

[5. Transportation of Unbound Engineered Nanoscale Particles \(UNP\)](#)

- Contact Transportation POC or BNL TSO for determination of UNP.
- Handle hazardous materials in accordance with designated subject areas.
- Follow graded approach for transportation of UNP not otherwise classified as hazardous or dangerous goods.
- Place the UNP in container with closure that prevents leakage.
- Package and label container with UNP.
- Include MSDS in packaging for materials produced at BNL or contact the Chemical Hygiene Officer for assistance.
- Allow off-site transport with a private vehicle provided the UNP are packaged, marked, labeled, and documented properly.

[6. Waste Handling and Disposal of Unbound Engineered Nanoscale Particles \(UNP\)](#)

- Collect all UNP waste and UNP contaminated waste in accordance with Hazardous Waste Management Subject Area.
- Determine if UNP hazards require additional protective measures for disposal.
- Waste Management maintains an electronic file.

[7. Spill Response for Unbound Engineered Nanoscale Particles \(UNP\)](#)

- Notify event categorizer.
- Notify a facility contact person for all uncontrolled spills.
- Determine the need for and assist in selecting appropriate clean-up PPE and methods for clean up.
- Handle all materials used to clean up the spill as UNP hazardous waste.
- Refer all personnel potentially exposed to UNP to OMC for medical evaluation.

[Definitions](#)

Exhibits

[Nanomaterial Safety Labels](#)
[Nanomaterial Safety Reference Card](#)

Forms

None

Training Requirements and Reporting Obligations

This subject area contains the following training requirements for UNP workers and support staff (see the [BNL Training and Qualifications](#) website):

- Nanotechnology in the Workplace-Nano Workers (TQ-NC-HS2)
- Nanotechnology I the Workplace-Support Personnel (TQ-NC-HS1)
- For UNP workers, medical surveillance must be checked on the JAF by supervisor.

This subject area does not contain reporting obligations.

External/Internal Requirements

Requirement Number	Requirement Title
10 CFR 851	Worker Safety and Health Program
20 CFR Parts 1 and 30 (EEOICPA)	Interim Final Rule Implementing the Energy Employees Occupational Illness Compensation Program Act (EEOICPA)
29 CFR 1910	Labor/Occupational Safety and Health Standards
BSA Contract No. DE-SC0012704 - Clause C.4	Statement Of Work
BSA Contract No. DE-SC0012704 - Clause H.27 (ACT)	Non-Federal Agreements for Commercializing Technology (Pilot) (ACT)
O 231.1B Admin Change 1 (Nov 28 2012)	Environment, Safety and Health Reporting
O 456.1A (Jul 15, 2016)	Safe Handling of Unbound Engineered Nanoparticles
P 456.1	Secretarial Policy Statement on Nanoscale Safety

References

Approaches to Safe Nanotechnology, National Institute for Occupational Safety and Health, Publication No. 2009-125, March 2009

[BNL Training and Qualifications](#) website

Department of Energy Nanoscale Science Research Centers Approach to Nanomaterial ES&H, Revision 3a - May 2008

[Exhaust Ventilation](#) Subject Area

[Movement by Vehicle of Hazardous and Radiological Materials On-site](#) Subject Area

[Personal Protective Equipment and Respirators](#) Subject Area

[Spill Response](#) Subject Area

Standard Guide for Handling Unbound Engineered Nanoscale Particles in Occupational Settings, ASTM E2535-2007

Standard Terminology Relating to Nanotechnology, ASTM E2456-06

[Transportation of Hazardous and Radiological Materials Off-site](#) Subject Area

[Waste](#) Subject Area

[Work Planning and Control for Experiments and Operations](#) Subject Area

Standards of Performance

All staff, users and guests shall assure that only appropriately authorized individuals have access to facilities, information, resources, and assets.

All staff, users and guests shall comply with applicable Laboratory policies, standards, and procedures, unless a formal variance/waiver is obtained.

All staff, users shall maintain records necessary to substantiate results and processes of research, operational, or administrative activities; protect records from loss or damage; refer requests from non-BNL staff through proper channels; and retire records to approved record storage areas.

All staff, users shall clearly and completely specify appropriate requirements for purchased goods and services consistent with project needs.

All staff, users and guests shall appropriately protect accountable materials, classified matter, sensitive information, resources, and assets.

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PROCEDURE: PLANNING TO USE UNBOUND ENGINEERED NANOSCALE PARTICLES (UNP)

Management System: Worker Safety and Health		
Subject Area: Nanoscale Particle ESH		
1. Planning to Use Unbound Engineered Nanoscale Particles (UNP)		
Effective Date: Apr 1, 2016	Subject Matter Expert: Wai Lin Ng	Management System Executive: Ed Nowak

Applicability

This information applies to BNL staff, users and guests who plan operations that use or generate unbound engineered nanoscale particles (UNP), and facilities that store or use UNP.

The following types of UNP are beyond the scope of this subject area:

- Biomolecules (proteins, nucleic acids and carbohydrates);
- Nanoscale forms of radiological materials;
- Nanoscale Particles incidentally produced by human activities or natural processes;
- Ultrafine particles such as those produced by diesel engines and forest fires.

Required Procedure

Step 1	Line management ensures all work with nanomaterials is planned and reviewed for ES&H concerns following the procedures outlined in the Work Planning and Control for Experiments and Operations Subject Area.
Step 2	The researcher and departmental ESH staff determine if the nanomaterial to be used is a UNP or if UNP will be generated at any time during the work.
Step 3	The researcher ensures all known, unique hazards specific to the UNP are included in the ESR.
Step 4	Line management ensures that all UNP purchases are identified in the purchase requisition.

Step 5	<p>Line management maintains an electronic listing of all UNP projects and UNP workers within their purview. The listing must include</p> <ul style="list-style-type: none"> • Name; • Title; • Brief description of the UNP; and • Area in which the activity is located. <p>The listing will be provided to the SME or designee upon request.</p>
Step 6	<p>Line management ensures nanoscale particle ESH requirements are reviewed by users, visitors, or guests prior to working with UNPs on-site or sending UNPs to or from the site. Users, visitors, or guests ensure materials brought on-site meet the minimum packaging requirements as detailed in the transportation section of this subject area.</p>
Step 7	<p>A Safety & Health Representative (SHR) assists the line in conducting a qualitative exposure assessment, using best available hazard information, for all work activities involving UNP. The exposure assessment includes</p> <ul style="list-style-type: none"> • The need for exposure monitoring based on preliminary, qualitative exposure assessments and guidance provided by the most recent version of the DOE NSRC Approach to Nanomaterial ES&H; • The hazardous properties of the precursor materials as well as those of the intermediate materials and resulting nanomaterial products in conducting the hazard assessment; • The potential for dispersion/aerosolization of the material throughout the process.
Step 8	<p>The SHR determines the need for exposure monitoring, captures any requirements in the ESR, and conducts monitoring in accordance with BNL-prescribed procedures.</p> <p>Note: Qualified personnel use direct-reading, particle-measuring devices (or appropriate methods, as developed) to characterize workplace conditions, estimate exposures of UNP workers, and to screen for suspect emissions and atypical conditions that may require further investigation.</p>

References

[Work Planning and Control for Experiments and Operations](#) Subject Area

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PROCEDURE: TRAINING FOR UNBOUND ENGINEERED NANOSCALE PARTICLES (UNP) WORKERS AND STAFF, SUBCONTRACTORS, USERS, AND GUESTS

Management System: Worker Safety and Health		
Subject Area: Nanoscale Particle ESH		
2. Training for Unbound Engineered Nanoscale Particles (UNP) Workers and Staff, Subcontractors, Users, and Guests		
Effective Date: Apr 1, 2016	Subject Matter Expert: Wai Lin Ng	Management System Executive: Ed Nowak

Applicability

This information applies to BNL staff, users and guests who plan operations that use or generate unbound engineered nanoscale particles (UNP), and facilities that store or use UNP.

Required Procedure

Step 1	BNL supervisors ensure all UNP workers are identified in the Work Planning and Control documents (e.g., ESR, Work Permit) and JTAs are updated to include UNP Worker training (GE-96).
Step 2	All BNL UNP workers and their supervisors must complete Nanotechnology for Nano Workers (TQ-NC-HS2) prior to purchasing or handling UNP.
Step 3	Supervisors ensure all BNL support staff with potential for working in UNP work areas (e.g., police, fire/rescue, custodians, electricians, plumbers, carpenters, etc.) are identified and JTAs are updated to include training to a hazard awareness level through completion of Nanotechnology for Support Personnel (TQ-NC-HS1) .
Step 4	UNP workers and their supervisors will receive refresher training when new information and changes in requirements, policies or procedures dictate as directed by the SME. At a minimum, refresher training is required as scheduled by the Office of Training and Qualifications.

Step 4	<p>Users, guests, or visitors working with UNPs complete the BNL UNP Worker web class Nanotechnology for Nano Workers (TQ-NC-HS2), or are instructed through facility specific training including the following</p> <ul style="list-style-type: none">• Uncertainties of properties and hazards of UNP;• Differences in reactivity and toxic potential of nanoscale and macro forms of the same materials;• Exposure routes and transport of UNP within the body;• Limitations on available information, including materials safety data sheets (MSDS), for evaluating the significance of exposures and environmental releases;• The importance of minimizing exposure to UNP and their release into the environment;• Hazard controls including the limitations of their effectiveness; permissible and recommended exposure limits for UNP;• The location and availability of reliable reference material, including MSDS and other references, on the hazards, safe handling, storage and disposal of UNP;• Site specific policies, procedures and hazard controls for UNP;• BNL medical monitoring requirements.
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References

[BNL Web Training Center \(Web Courses\)](#), [BNL Training and Qualifications](#) website

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PROCEDURE: HANDLING UNBOUND ENGINEERED NANOSCALE PARTICLES (UNP)

Management System: Worker Safety and Health		
Subject Area: Nanoscale Particle ESH		
3. Handling Unbound Engineered Nanoscale Particles (UNP)		
Effective Date: Apr 1, 2016	Subject Matter Expert: Wai Lin Ng	Management System Executive: Ed Nowak

Applicability

This information applies to BNL staff, users and guests who plan operations that use or generate unbound engineered nanoscale particles (UNP), and facilities that store or use UNP.

Required Procedure

Step 1	The researcher identifies and posts entry points to areas where UNP are handled. The area may be an entire laboratory, an area of a laboratory or a containment device such as a laboratory hood or glove box. Signs will indicate hazards, personal protective equipment (PPE) requirements, and administrative controls.
Step 2	The researcher ensures the minimum PPE requirements for entry to lab areas are posted in accordance with the exhibit Area-Based Personal Protective Equipment (PPE) Requirements in the Personal Protective Equipment and Respirators Subject Area. In addition, the researcher ensures the Experimental Safety Review (ESR), which contains the nanomaterial hazard assessment, required engineering controls, PPE, and administrative control requirements, is available for review within the general workspace.
Step 3	The researcher may de-post areas after cleanup and removal of all UNP as specifically detailed in the work control documents (e.g., ESR).
Step 4	Label any engineering controls where UNP work was conducted and acknowledge there may be residual UNP contamination in the hood ductwork, fan, and filters. This label will remain as long as the potential contamination exists.

Step 5	Label storage and transfer containers to plainly indicate the contents include UNP, e.g., nanoscale zinc oxide particles or other identifiers instead of just zinc oxide.
Step 6	Conduct manipulation of liquid media containing UNP in a HEPA-filtered hood or with another acceptable air cleaning technology for all steps in the procedure when the potential for dispersion/aerosolization is moderate or high.
Step 7	Control exposures to UNP using a risk-based graded approach that considers the toxicological and environmental data for the UNP. See requirements in the exhibit Nanomaterial Safety Reference Card .
Step 8	No benchtop work with UNP without engineering controls is permitted for work having a moderate or high potential for dispersion/aerosolization. The researcher ensures appropriate controls are in place to exclude all exhaust air with the potential to reintroduce UNP to the work space.
Step 9	<p>Conduct work that could generate airborne UNP using the following</p> <ul style="list-style-type: none"> • A ventilated full or partial enclosure designed to protect workers from airborne contaminants such as: an exhaust ventilation hood, glove bag, or glove box. • If the operation cannot be enclosed, use alternate controls such as a HEPA-filtered local exhaust ventilation (“snorkels”) to capture fugitive UNP, at the source. • Small experimental apparatus, which are enclosed systems under positive pressure, are to be used within a negative pressure enclosure such as a HEPA filtered fume hood and exhausted prior to opening. • Regularly test and maintain all ventilation systems, used to control worker exposure to UNP, according to the Exhaust Ventilation Subject Area, any prescribed ESR procedures and the manufacturers’ recommendations. <p>Do not use laminar-flow hoods (“clean bench”) to control exposure to UNP if these hoods will direct a flow of HEPA-filtered air into the occupied space.</p>
Step 10	<p>All air exhausted from an enclosure, partial enclosure, or process equipment (reactors, pumps, and furnaces) that might contain UNP must be filtered/cleaned and then exhausted outside the building. Use the following</p> <ul style="list-style-type: none"> • A HEPA filter, bubbler, or burner before releasing exhaust to the environment; • Equipment placed in a HEPA-filtered hood, or a HEPA filter can be placed in the equipment’s exhaust stream. <p>Type II biological safety cabinets, in which UNP are handled, must be HEPA filtered and exhausted outdoors.</p>
Step 11	Store UNP in closed tightly sealed containers.
Step 12	Evaluate equipment that was used to produce, process, or capture UNP for contamination prior to repurposing.
Step 13	The researcher ensures all UNP waste and contaminated materials such as wipes, absorbent materials, etc. are separated from the industrial waste stream and handled in

accordance with the BNL Waste Management procedures. For UNP waste handling procedures, see the section on [Hazardous Waste](#) in the [Waste](#) Subject Area.

References

[Exhaust Ventilation](#) Subject Area

[Personal Protective Equipment and Respirators](#) Subject Area

[Waste](#) Subject Area

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PROCEDURE: MEDICAL SURVEILLANCE FOR UNBOUND ENGINEERED NANOSCALE PARTICLES (UNP) WORKERS

Management System: Worker Safety and Health		
Subject Area: Nanoscale Particle ESH		
4. Medical Surveillance for Unbound Engineered Nanoscale Particles (UNP) Workers		
Effective Date: Apr 1, 2016	Subject Matter Expert: Wai Lin Ng	Management System Executive: Ed Nowak

Applicability

This information applies to BNL staff, users and guests who plan operations that use or generate unbound engineered nanoscale particles (UNP), and facilities that store or use UNP.

Required Procedure

Step 1	<p>BNL supervisors of UNP workers must update the workers' Job Training Assessment Form to ensure they receive a mandatory baseline medical evaluation through the Occupational Medicine Clinic (OMC).</p> <p>Note: The baseline medical evaluation includes the following at a minimum:</p> <ul style="list-style-type: none"> • An occupational and medical history update; • A physical examination with emphasis on the respiratory system; • Baseline chest X-ray; • Specific medical tests (e.g., spirometry) deemed appropriate by the OMC Manager.
Step 2	<p>Contractors, guests, visitors, and users who work with UNP will be informed of the required baseline medical evaluation for BNL workers in the user training, but are not required to have a baseline exam.</p> <p>Note: It is recommended that users/guests consult with their home institutions for guidance. OMC is available to discuss BNL's procedure and give guidance.</p>
Step 3	<p>All personnel involved in any incident that results in an unexpected and/or unusually high exposure to UNP, through any route of entry, must report to the Occupational Medicine</p>

	Clinic for a post-incident evaluation. Follow directions from emergency responders for decontamination when there is potential for transfer of contaminants.
Step 4	The OMC Manager maintains an electronic record of each BNL UNP worker including workers exposed to upset events. This record comprises the UNP worker list. The list is provided to the Safety and Health Services Division Manager or designee upon request.

Guidelines

Reporting to the clinic will be the same day or at most the next day depending on the potential health consequences.

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PROCEDURE: TRANSPORTATION OF UNBOUND ENGINEERED NANOSCALE PARTICLES (UNP)

Management System: Worker Safety and Health		
Subject Area: Nanoscale Particle ESH		
5. Transportation of Unbound Engineered Nanoscale Particles (UNP)		
Effective Date: Apr 1, 2016	Subject Matter Expert: Wai Lin Ng	Management System Executive: Ed Nowak

Applicability

This information applies to BNL staff, users and guests who plan operations that use or generate unbound engineered nanoscale particles (UNP), and facilities that store or use UNP.

The requirements under this heading apply to the movement of UNP materials from building to building, and to or from off-site locations. It provides guidance specific on UNP to supplement the [Movement by Vehicle of Hazardous and Radiological Materials On-site](#), [Transportation of Hazardous and Radiological Materials Off-site](#), and [Hazardous Waste](#) in the [Waste](#) Subject Area.

Required Procedure

Step 1	Contact your Transportation Safety Department/Division Point of Contact (POC) or the BNL Transportation Safety Officer (TSO) for determination of whether the UNP: (1) meets the definition of a U.S. Department of Transportation (DOT) hazardous material or (2) ICAO/IATA dangerous goods
Step 2	Handle hazardous materials in accordance with the Movement by Vehicle of Hazardous and Radiological Materials On-site and Transportation of Hazardous and Radiological Materials Off-site Subject Areas.
Step 3	Follow a graded approach for transportation of UNP not otherwise classified as hazardous or dangerous goods accounting for chemical or hazardous nature and physical form of the material(s) (e.g., solid, liquid, free particle vs. fixed on substrate).
Step 4	

	Place the UNP in a container with a closure that prevents leakage and is constructed of compatible material such as: plastic, earthenware, glass, or metal, and is not liquid-full at 55° C (131°F).
Step 5	Use multiple layers of packaging, label the innermost receptacle or container with a label (see the exhibit Nanomaterial Safety Labels) that communicates an appropriate level of caution and description of the contents: "Nano-particulates can exhibit unusual reactivity and toxicity. Avoid breathing dust, ingestion, and skin contact." Securely enclose the inner package/container to prevent leakage during shipment.
Step 6	Pack around the inner container with cushioning and absorbent material that surrounds the container. The material must not react chemically with the packed material and be capable of absorbing the entire contents (if a liquid) of the inner receptacle or container.
Step 7	Do not place incompatible chemicals in the same packaging (see the exhibit Examples of Incompatible Chemicals in the section Hazardous Waste in the Waste Subject Area.
Step 8	Use a strong outer package such a fiberboard box, metal drum, or equivalent packaging that is securely closed to prevent loss of contents.
Step 9	Mark outer packaging with the common name of the UNP.
Step 10	Include a Material Safety Data Sheet (MSDS) in the packaging for materials produced at BNL. If an MSDS is not available, contact the Chemical Hygiene Officer for assistance in developing an MSDS.
Step 11	Allow off-site transport with a private vehicle provided the UNP are packaged, marked, labeled, and documented properly as described herein and the driver/vehicle meet all state regulations for licensing, registration, and inspection in the state of registration.

References

[Movement by Vehicle of Hazardous and Radiological Materials On-site](#) Subject Area

[Transportation of Hazardous and Radiological Materials Off-site](#) Subject Area

[Waste](#) Subject Areas

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PROCEDURE: WASTE HANDLING AND DISPOSAL OF UNBOUND ENGINEERED NANOSCALE PARTICLES (UNP)

Management System: Worker Safety and Health		
Subject Area: Nanoscale Particle ESH		
6. Waste Handling and Disposal of Unbound Engineered Nanoscale Particles (UNP)		
Effective Date: Apr 1, 2016	Subject Matter Expert: Wai Lin Ng	Management System Executive: Ed Nowak

Applicability

This information applies to BNL staff, users and guests who plan operations that use or generate unbound engineered nanoscale particles (UNP), and facilities that store or use UNP.

Required Procedure

Step 1	Collect all UNP waste and UNP contaminated waste in accordance with the section Hazardous Waste in the Waste Subject Area.
Step 2	Waste Management determines if UNP hazards require additional protective measures for disposal. If required, Waste Management revises the subject area and handles materials accordingly. BNL will follow all applicable Federal, State, and Local disposal regulations for waste containing UNP
Step 3	Waste Management maintains an electronic file containing the quantity and final disposition of all UNP waste and contaminated waste. The file is provided to the Safety and Health Services Division Manager or designee upon request.

References

[Waste](#) Subject Area

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PROCEDURE: SPILL RESPONSE FOR UNBOUND ENGINEERED NANOSCALE PARTICLES (UNP)

Management System: Worker Safety and Health		
Subject Area: Nanoscale Particle ESH		
7. Spill Response for Unbound Engineered Nanoscale Particles (UNP)		
Effective Date: Apr 1, 2016	Subject Matter Expert: Wai Lin Ng	Management System Executive: Ed Nowak

Applicability

This information applies to BNL staff, users and guests who plan operations that use or generate unbound engineered nanoscale particles (UNP), and facilities that store or use UNP as well as emergency response personnel.

The procedures under this heading apply to the response, control and clean-up specific to UNP spills to supplement the [Spill Response](#) Subject Area.

The researcher documents the use of control techniques to address drips of liquid UNP or small sprinkles of dry UNP inside engineering controls in the Work Planning document (e.g., ESR, work permit, or SOP). This could include: absorbent towels, wetted towels in secondary containers, etc. These are not considered spills for this section.

Required Procedure

Step 1	The researcher or facility personnel must report all spills to the event categorizer. Note: Trained facility personnel (e.g., research staff) may perform cleanup when they occur inside engineering controls such as chemical fume hoods using methods defined in the work planning.
Step 2	For all uncontrolled spills, i.e., not in engineering controls, move personnel away, leave engineering controls operational in laboratories, shut off ventilation systems that have return air systems or where the ventilation system may disperse/aerosolize the spilled materials, isolate and control access to the work area and notify a facility contact person.
Step 3	Environment, Safety and Health (ESH) personnel who respond to an incident determine the hazard class of the material spilled with available information.

Step 4	ESH personnel use the nature of the spill and conditions to dictate the need for enhanced work planning and how best to proceed with attention to environmental release and worker exposure.
Step 5	ESH personnel responding to an incident determine the need for and assist in selecting appropriate clean-up personal protective equipment (PPE), respiratory protection, and other controls, as well as clean-up methods, based on compatibility with all identified hazards.
Step 6	The preferred method of clean-up is wet wiping. Do not dry wipe, dry sweep, or use compressed air to clean UNP spills. Note: ESH personnel may consider HEPA vacuums if they are surveillance tested by the Safety and Health Services Division.
Step 7	Handle all materials used to clean up the spill (PPE, walk-off mats, absorbent material, wipes, etc.) as UNP contaminated hazardous waste.
Step 8	Refer all personnel potentially exposed to UNP to the Occupational Medicine Clinic for medical evaluation.

Guidelines

Note 1: Typically, nitrile, PVC, Natural Rubber, and Polyethylene disposable gloves all provide adequate resistance to penetration by particulates. Other gloves may be necessary for cut or abrasion resistance and disposable gloves may be worn underneath. Double gloves are recommended.

Note 2: Cleaning methods must be compatible with the physical and chemical properties of the UNP and any solutions to preclude introducing other hazards, e.g., reactions with cleaning materials and other materials in the locations where the waste will be held.

Note 3: Nanoscale particles in liquid media, which may otherwise not be considered UNP are determined to be UNP for spills.

References

[Spill Response](#) Subject Area

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DEFINITIONS

Definition: Nanoscale Particle ESH

Term	Definition
engineered nanoparticle	Particles intentionally created (in contrast with natural or incidentally formed) particles with one or more dimensions greater than 1 nanometer and less than 100 nanometers.
nanoscale	Having one or more dimensions from 1 to 10 nanometers.
Safety & Health Representative (SHR)	An individual assigned by the Safety and Health Services Manager to assist line organizations with safety and health related matters.
SHR Emergency Responder	An individual assigned by the Safety and Health Services Division Manager to respond to emergency situations requiring technical safety and health expertise.
unbound engineered nanoscale particle (UNP)	Those nanoscale 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”.
UNP Worker	A worker who performs any of the following activities: <ul style="list-style-type: none"> • Has the potential for inhalation or dermal exposure to UNP; • Routinely spends time in an area in which engineered UNP have the potential to become dispersed in the air or on surfaces; • Works on equipment that might contain or bear UNP and that could release UNP during servicing or maintenance.

The only official copy of this file is the one on-line in SBMS.

Before using a printed copy, verify that it is the most current version by checking the *effective date*.

Management System: [Worker Safety and Health](#)

Subject Area: [Nanoscale Particle ESH](#)

Nanomaterial Safety Labels

Effective Date: May 12, 2015

Nanomaterial Safety Labels is provided as a [PDF](#) file.

The only official copy of this file is the one on-line in SBMS.

Before using a printed copy, verify that it is the most current version by checking the *effective date*.

[Questions/Comments](#)

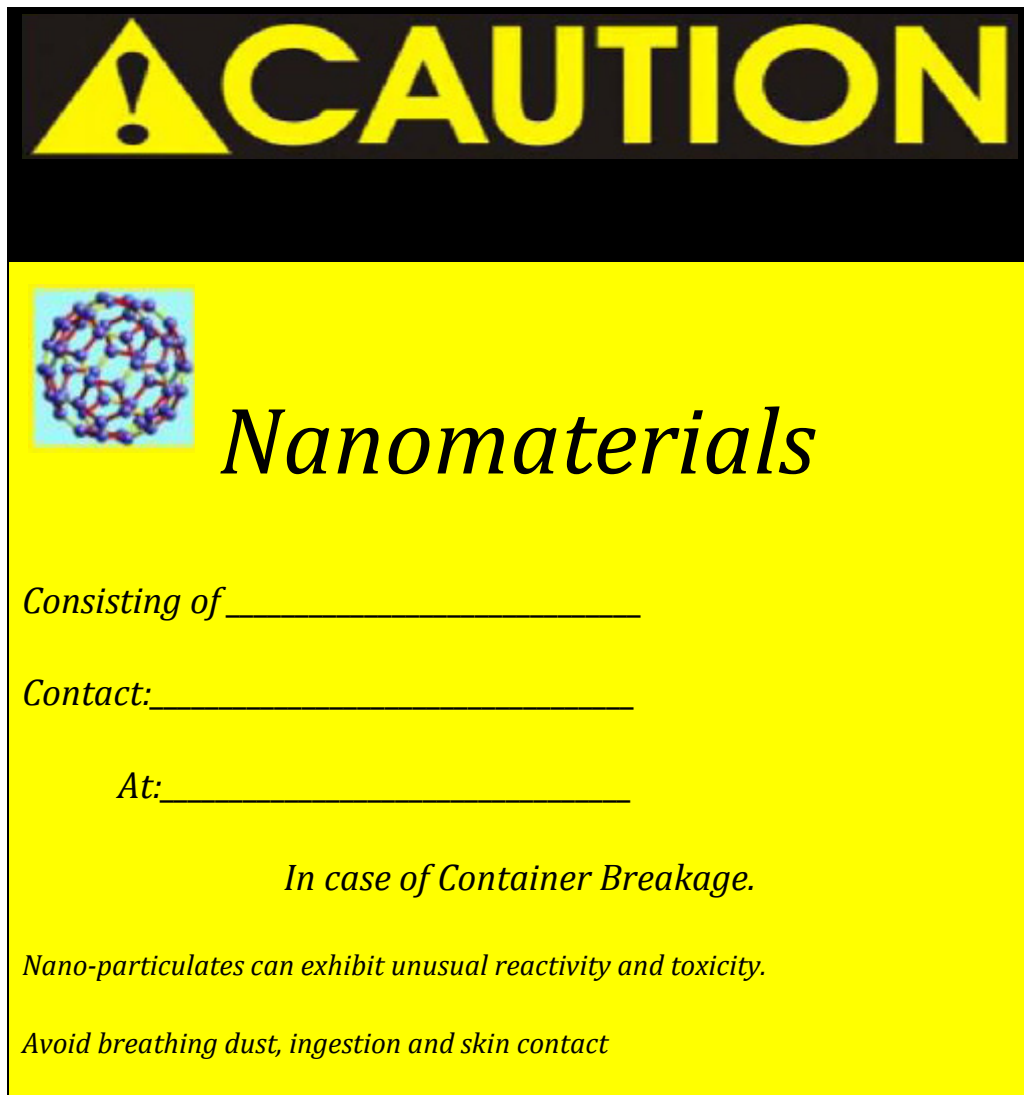
[Disclaimer](#)

Nanomaterial Safety Labels


1. Waste and designated area label



2. Transportation Inner Label



CAUTION



Nanomaterials

Consisting of _____

Contact: _____

At: _____

In case of Container Breakage.

Nano-particulates can exhibit unusual reactivity and toxicity.

Avoid breathing dust, ingestion and skin contact

Management System: [Worker Safety and Health](#)

Subject Area: [Nanoscale Particle ESH](#)

Nanomaterial Safety Reference Card

Effective Date: May 12, 2015

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[Questions/Comments](#)

[Disclaimer](#)

Nanomaterial Safety Reference Card


Lower



RISK



Higher

Material Form Requirements	NP embedded or fixed to substrate	UNP in liquid	UNP Dispersible Dry/Powder
PPE Requirements for Handling	PPE: See postings in lab or area for appropriate PPE.	Standard PPE required for the work and area plus: <ul style="list-style-type: none"> Select gauntlet-type nitrile gloves when using a hood “or” wrist length disposable nitrile gloves with extended sleeves and lab coat. Eye protection: Safety glasses with side shields when handling liquids with low aerosolization and dispersion potential. Chemical splash goggle for handling/manipulating liquids or powders with moderate to high potential for aerosolization. 	
Handling Requirements	Ensure all substances are identified in the ESR for review and determination of potential for aerosolization/dispersion <ul style="list-style-type: none"> No Mechanical abrasion. No thermal stresses. Cover samples when practical to protect the sample, e.g., (slide cover), samples/container must be labeled if not to be used immediately. 	<ul style="list-style-type: none"> Use IH approved methods for control of solvent exposure. Have an SHR evaluate each task and determine aerosolization/dispersion potential of UNPs. Store in sealed container when not in use. Label the container identifying contents as nanomaterial plus material identifier. (e.g., “Nanoscale Zinc Oxide”) Low Potential to Aerosolize/Disperse <ul style="list-style-type: none"> Use secondary containment Line space with absorbent materials Medium to high potential to aerosolize or disperse <ul style="list-style-type: none"> Follow requirement for Dry/Powder. 	<ul style="list-style-type: none"> Must be manipulated within a HEPA filtered laboratory exhaust hood or enclosure. Exhaust hood work surfaces must be wiped with dampened absorbent wipes at the completion of the experiment. Nano-scale materials transferred between laboratories must be: Sealed within a closed sample holder, capillary tube, or with at least two layers of Kapton, Mylar, or cellophane tape. Experiments that involve gas flowing over particles must include a scrubber or HEPA filter for the gas exhaust to provide a final barrier to capture any potential particle loss; or exhaust into a HEPA filtered hood.
Spill Response	N/A	<ul style="list-style-type: none"> For large spills call x 2222. Use wet wiping methods for small spills inside engineering controls. If you feel competent to handle the spill or call x 2222. For spills outside of an exhaust hood, control access to the area and immediately notify the ES&H Staff. 	
Laboratory Posting Requirements	No UNP Posting Requirements	Post a sign at each designated UNP work area. This can be an entire lab or workstation (i.e., laboratory exhaust hood, glove box).	 Contains Nanomaterials

Nanomaterial Safety Reference Card

Lower



RISK



Higher

Material Form	NP Embedded or fixed to substrate	UNP in liquid	UNP Dispersible Dry/Powder
Requirements			
Labeling of Containers	No UNP Posting Requirements	Follow the labeling requirements list below in the “Transportation & Labeling Requirements” section. See your ESH Coordinator for labels	
Transportation & Labeling Requirements	Any nanomaterial that meets the definition of hazardous material according to 49 CFR 171.8 or has known hazardous properties (toxic, flammable, reactive) must be shipped according to the SBMS Transportation of Hazardous Material Subject Area.	<p>UNPs may be carried in private vehicles when labeled and packaged as follows</p> <p>Labeling:</p> <p>Packaging:</p> <ol style="list-style-type: none"> 1. Inner containers must be tightly sealed, rigid, and leak proof. Use tape on the cap to prevent the container from being unintentionally opened. 2. Place the inner container in a plastic bag 6 mil or greater. <p>The outer package (sealed cardboard box or sealed plastic container) must be filled with absorbent materials to protect the inner container and absorb liquids in the event of an inner container failure.</p>	
Waste Management Requirements	Follow the section on Hazardous Waste in the SBMS Waste Subject Area for more information.	<p>All waste in contact with UNPs must be disposed as hazardous waste (e.g., gloves, lab coats, swabs, Kimwipes, blotter paper, beakers, flasks, tape, sample holders). Chemicals containing UNPs must NOT be released to the sink or disposed in the regular trash.</p> <p>Waste containers and labeling:</p> <ul style="list-style-type: none"> ○ Liquids must be stored in a rigid leak proof container. ○ Particulates must be stored in a rigid leak proof container or plastic bag of 6 mil or greater. ○ Spell out the chemical name (do not use formulas or trade names) on the RED Hazardous Waste Label. ○ The contents line on the label must contain the chemical composition and “Nanomaterials” <p>A second label, in addition to the Red Hazardous Waste Label, is required on the outside container/bag stating “Contains Nanomaterials”; see ESH Coordinator or 90-day area manager for labels.</p>	

