Appendix A

Standard Operating Procedures (SOP)

For the Laboratory Use of Engineered Nanomaterials

Instructions: Review the ***Quick Guide: Risk Levels and Control Measures for Nanomaterials***. Use this template to develop a Standard Operating Procedure for your experiment / process.

OVERVIEW

PROCEDURE TITLE:		
DATE OF CREATION / REVISION:		
LOCATION: *(Building, Room #)*		
PRINCIPAL INVESTIGATOR (PI) OR LABORATORY SUPERVISOR NAME:	PHONE:	EMAIL:
DESCRIPTION. PROVIDE A 1-2 SENTENCE BRIEF DESCRIPTION OF THE PROCESS. INDICATE IF AEROSOLS ARE LIKELY TO BE CREATED.		

MATERIAL STATE AND CONDITIONS OF USE	FREQUENCY (check one):	DURATION PER EXPERIMENT:
Nanomaterials are handled in/as: ☐ **DRY PARTICLES** (POWDERS / PELLETS) ☐ **SUSPENSION / GELS** ☐ **GASEOUS PHASE**	☐ **ONE TIME** ☐ **DAILY** ☐ **WEEKLY** ☐ **MONTHLY** ☐ **OTHER:**	_____ MINUTES; OR _____ HOURS

HAZARDS

RISK LEVEL:

☐ **CATEGORY 1**: LOW POTENTIAL FOR EXPOSURE
☐ **CATEGORY 2**: MODERATE POTENTIAL FOR EXPOSURE
☐ **CATEGORY 3**: HIGH POTENTIAL FOR EXPOSURE

POTENTIAL HAZARDS. IDENTIFY POTENTIAL CHEMICAL AND SAFETY HAZARDS USING THE MATERIAL SAFETY DATA SHEET (MSDS) FOR THE NANOMATERIAL OR PARENT COMPOUND. THE TOXICITY OF THE NANOMATERIALS MAY BE GREATER THAN THE PARENT COMPOUND. SPECIAL CONSIDERATION SHOULD BE GIVEN TO THE HIGH REACTIVITY OF SOME NANOPOWDERS WITH REGARD TO POTENTIAL FIRE AND EXPLOSION, PARTICULARLY IF SCALING UP THE PROCESS. CONSIDER THE HAZARDS OF ANY PRECURSOR MATERIALS IN EVALUATING THE PROCESS. FOR MORE INFORMATION, REFER TO THE SECTION ON "PLANNING YOUR RESEARCH".

INSTRUCTIONS: INDICATE THE ENGINEERING, WORK PRACTICE, AND PERSONAL PROTECTIVE EQUIPMENT (PPE) CONTROLS YOU WILL BE IMPLEMENTING TO REDUCE THE HAZARDOUS EFFECTS OF WORKING WITH YOUR NANOMATERIALS. BASE YOUR SELECTION ACCORDING TO THE "QUICK GUIDE" SECTION.

CONTROLS

ENGINEERING CONTROLS. INDICATE ENGINEERING DEVICE(S) TO BE UTILIZED. NOTE: IF WORK CANNOT BE CONDUCTED WITH APPROPRIATE ENGINEERING CONTROLS, CONSULT WITH AN EH&S PROFESSIONAL.

- ☐ **FUME HOOD** *(laboratory-type)*
- ☐ **BIOSAFETY CABINET** *(must be ducted if used in conjunction with volatile compounds)*
- ☐ **ENCLOSED SYSTEM** *(i.e., glove box, glove bag, or sealed chamber)*
- ☐ **POWDER HANDLING ENCLOSURE**
- ☐ **OTHER:**

WORK PRACTICE CONTROLS. THE FOLLOWING CONTROLS WILL BE IMPLEMENTED *(check all that apply):*

☐ Category 1 work practices

- **STORE** in sealed container with secondary containment with other compatible chemicals
- **LABEL** chemical container with the identity of contents and include term "nano" as descriptor
- **TRANSFER** in sealed container with secondary containment
- **PREPARE** work space by lining with absorbent materials
- **CLEAN** all surfaces potentially contaminated with nanoparticles (e.g., benches, glassware, apparatus) at the end of each operation using a HEPA vacuum and/or wet wiping methods.
- **WASH** hands frequently. Upon leaving the nanomaterial work area, remove any PPE worn and wash hands, forearms, face, and neck.
- **NOTIFY** in advance of animal facility and cage labeling / management requirements if dosing animals with nanomaterial

☐ Category 2 work practices

- **FOLLOW** all work practices listed for Category 1.
- **RESTRICT ACCESS.**
- **POST** signs in area
- **USE** antistatic paper and/or sticky mats with powders.

☐ Category 3 work practices

- **FOLLOW** all work practices listed for Category 2.

☐ **Approvals Required**. IDENTIFY TASKS THAT REQUIRE PRIOR APPROVAL BY THE PRINCIPAL INVESTIGATOR / LABORATORY SUPERVISOR BEFORE PERFORMING:

☐ **Other**. DESCRIBE ANY ADDITIONAL WORK PRACTICES SPECIFIC TO THE EXPERIMENT / PROCESS:

PERSONAL PROTECTIVE EQUIPMENT (PPE). INDICATE THE PPE TO BE UTILIZED *(check all that apply):*

Body Protection:	☐ Long pants (no cuffs) ☐ Laboratory coat *made of standard materials* ☐ Laboratory coat *made of non-woven fabrics with elastics at wrists (i.e., Tyvek®)* ☐ Coveralls (disposable) with head coverage *(i.e., Tyvek®)*
Eye / Face Protection:	☐ Safety glasses with side shields ☐ Chemical splash goggles ☐ Face shield
Hand Protection:	☐ Latex ☐ Nitrile ☐ Neoprene ☐ Vinyl ☐ Other:
Foot Protection:	☐ Closed toe shoes ☐ Over-the-shoe booties
Other:	☐ Respiratory Protection* ☐ Other:

* Consult with your institution on respiratory program requirements

ACCIDENT AND SPILL PROCEDURES

LOCATION OF NEAREST EMERGENCY EQUIPMENT:

Item:	Location
Eyewash / Safety Shower	
First Aid Kit	
Chemical Spill Kit	
Fire Extinguisher	
Telephone	
Fire Alarm Manual Pull Station	

DESCRIBE INSTITUTION'S EMERGENCY PROCEDURES:

Personnel Exposure procedures

1. Flush contamination from eyes/skin using the nearest emergency eyewash /shower for a minimum of 15 minutes. Remove any contaminated clothing.
2. Take copy of MSDS(s) of chemical(s) when seeking medical treatment.
3. Report potential exposures to your Principal Investigator/Laboratory Supervisor.
4. File an incident report with your institution.

Spill Response procedures

1. **Notify.** Alert workers near spill to avoid entering the area. Post signs in area or on door of lab. Eliminate sources of ignition. Report spill to your Principal Investigator/Lab Supervisor.
2. **Assess.** Are you able to cleanup spill yourself?
   - ☐ YES
     *Proceed with **Spill Cleanup** if it is a small spill (i.e., 30 mL), you are knowledgeable about the hazards of the spill, it can be cleaned up within 15 minutes, and an appropriate spill kit is available.*
   - ☐ NO
     Obtain spill assistance. Contact your institution's hazardous materials unit.
3. **Cleanup Spill.** Wear existing PPE (NOTE: Respiratory protection may be required if spill / release is outside the engineering control device).
   For powders:
   - *Use a dedicated, approved HEPA vacuum whose filtration effectiveness has been verified.*
   - *Do not sweep dry nanoparticles or use compressed air.*
   - *Consider possible pyrophoric hazards associated with vacuuming up nanoparticles.*
   - *Wet wipe using damp cloths with soaps or cleaning oils, or commercially available wet or electrostatic microfiber cleaning cloths. Consider possible reactivity of nanoparticles with the wipe solvent..*

   For liquid dispersions:
   - *Apply absorbent material (appropriate for the solvent in the dispersion) to liquid spill.*
4. **Dispose.** Dispose of used cleaning materials and wastes as hazardous waste.
5. **Report**. File incident report with your institution.

TRAINING

GENERAL SAFETY TRAINING. DESCRIBE YOUR INSTITUTION'S GENERAL LABORATORY SAFETY TRAINING.

LABORATORY-SPECIFIC TRAINING. (CHECK ALL THE APPLY)

☐ **REVIEW** THIS NANOTOOL

☐ **REVIEW** THE MSDS FOR THE NANOMATERIAL(S), *if available*

☐ **REVIEW** THE MSDS FOR OTHER CHEMICALS INVOLVED IN THE EXPERIMENT / PROCESS

☐ **REVIEW** THIS SOP

☐ **OTHER:**

DISPOSAL

INDICATE THE NANOMATERIAL WASTE MANAGEMENT PROCEDURES TO BE UTILIZED.

	Waste Stream	Management Method
☐	**Solid** • Dry ENM product • Filter media containing ENMs • Debris / dust from ENMs bound in matrix	1. Manage according to hazardous waste program requirements at your institution. 2. Label nanomaterial waste containers at all times. Specify the nanomaterial and its hazard characteristic (or the hazard characteristic of the parent material) on container labels; label information to contain the word "nano" as a descriptor. 3. Keep containers closed at all times when not in use. 4. Maintain containers in good condition and free of exterior contamination. 5. Collect waste in rigid container with tight fitting lid.
☐	**Liquid** • Suspensions containing ENMs	1. Manage according to hazardous waste program requirements at your institution. 2. Label nanomaterial waste containers at all times. Specify the nanomaterial and its hazard characteristic (or the hazard characteristic of the parent material) on container labels; label information to contain the word "nano" as a descriptor. 3. Keep containers closed at all times when not in use. 4. Maintain containers in good condition and free of exterior contamination. 5. Indicate both the chemical constituents of the solution and their hazard characteristics, and the identity and approximate percentage of ENMs on container labels. 6. Use leak proof containers that are compatible with all contents. 7. Place liquid waste containers in secondary containment and segregate from incompatible chemicals during storage.
☐	**Laboratory trash with trace nanomaterials** • PPE • Sticky mats • Spill clean-up materials	1. Manage according to hazardous waste program requirements at your institution. 2. Label nanomaterial waste containers at all times. Specify the nanomaterial and its hazard characteristic (or the hazard characteristic of the parent material) on container labels; label information to contain the word "nano" as a descriptor. 3. Keep containers closed at all times when not in use. 4. Maintain containers in good condition and free of exterior contamination. 5. Dispose of in double clear plastic bags, folded over and taped at the neck. 6. Avoid rupturing the bags during storage and transport.
☐	**Solid Matrix** embedded with nanomaterials (intact and in good condition)	1. Consult with your EH&S department, as these materials may be non-hazardous.

DESCRIBE INSTITUTION'S WASTE MANAGEMENT PROCEDURES HERE (IF APPLICABLE):

Acknowledgement. *By signing this form the individual certifies that the information provided is true and correct to the best of their knowledge.*

PRINT NAME / SIGNATURE

DATE: