PROGRESS AND PLANS OF NATIONAL NANOTECHNOLOGY INITIATIVE (NNI) AGENCIES

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Department of Health and Human Services (DHS)[1]

National Institute for Occupational Safety and Health (NIOSH)

Summary

NIOSH provides national and world leadership in conducting research on the causes and prevention of work-related illness and injury. NIOSH is a leader in the Federal Government research initiative on understanding the potential health and safety implications of nanotechnology, and in addressing worker health and safety needs related to nanotechnology. NIOSH research advances the understanding of nanotechnology-related toxicology and workplace exposures, so that appropriate risk-management practices can be implemented during the discovery, development, and commercialization of engineered nanomaterials along their product life cycles. Through strategic planning, research, collaborating with stakeholders, and making information widely available, NIOSH develops guidance that supports and promotes the safe and responsible development of nanomaterials.

Plans and Priorities by Program Component Area (PCA)

PCA 5. Environment, Health, and Safety

NIOSH will continue to conduct toxicology studies to evaluate biomarkers of exposure and disease using proteomic, metabolomic, and bioinformatic approaches; to develop innovative *in vitro* methodology to better predict *in vivo* outcomes; and to evaluate pulmonary and dermal exposure and toxicity, and systemic toxicity that results from occupational exposures, including effects in the cardiovascular, reproductive, neurological, and immune systems in response to wide variety of nanomaterials and nanotechnology-enabled products along the life cycle of the materials.

NIOSH plans to develop, test, and evaluate direct-reading instruments capable of detecting and measuring airborne nanoparticles. Additional plans include continuing field tests of the portable aerosol multielement spectrometer developed by NIOSH at nanomaterial producer and user facilities, as well as efforts in detection of airborne nanoparticles, including in biological systems, to evaluate and predict biological behavior and translocation between organ systems. NIOSH will also explore the feasibility of applying advanced sensing technology to biomarkers as a means of evaluating nanomaterial exposure and possible early response.

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NIOSH will continue to develop occupational safety and health guidance that can be incorporated into business plans to both protect worker safety and promote application development and commercialization.

NIOSH plans to release a draft Current Intelligence Bulletin (CIB), *Approaches to Developing Occupational Exposure Limits or Bands for Engineered Nanomaterials*.

NIOSH and the Consumer Product Safety Commission will continue collaborations to study the release of engineered nanomaterials from laser printer toner and from three-dimensional (3D) printers. NIOSH will also work with universities and industry to promote safe practices in nanotechnology and advanced manufacturing, including organizing a technical conference session on this topic. NIOSH plans to work with industry to develop practical, "real world" evaluation of hazard and risk represented by nanomaterials through their life cycles, focus the NIOSH field research effort on outputs that support the Sustainable Nanomanufacturing Nanotechnology Signature Initiative,[2] and collaborate with industry to assess the toxicology of carbon-based, metal-based, and nanoclay-enabled materials.

NIOSH plans to continue collaborations with trade unions and industrial partners to evaluate nanotechnology-enabled spray coatings, composites, and other nanomaterials in construction and manufacturing.

Key Technical Accomplishments by NNI Goal

Goal 4. Support Responsible Development of Nanotechnology

Understanding and mitigating potential impacts in the workplace

As nanomaterials and nanotechnology-enabled products make their way into commerce, NIOSH works to fully understand the potential health and safety impacts of nanotechnology in occupational settings. NIOSH researchers develop hazard and safety assessments using key classes of engineered nanomaterials, including different forms of carbon nanotubes (CNTs); metals and metal oxides; high-aspect-ratio materials including boron nitride nanotubes, carbon nanofibers, silver and titanium nanowires, and nanocellulose crystals and nanofibers; and two-dimensional nanomaterials including graphene, graphene oxide, and nanoclays. NIOSH has performed "real-world" evaluations of hazard and risk represented by various nanomaterials through their life cycles, including the characterization of aerosols generated in spray coating of paints, sealants, and disinfectants. Environmental chambers are being used to evaluate sanding, sawing, and cutting of nanotechnology-enabled polymer composites and construction materials, as well as sanding of coated surfaces, in a controlled environment. NIOSH also has collaborated with over 20 national and international universities and numerous industrial partners in the characterization of toxicological effects of pulmonary and dermal exposure to a wide range of industrially relevant nanoparticles and nanotechnology-enabled materials.

Agencies participating in the NNI are also actively engaging with industry to share nanotechnology-related environmental, health, and safety knowledge and best practices. NIOSH field research teams visit nanomaterials producers and users and conduct industrial hygiene evaluations. NIOSH has used its research findings to develop guidance documents to protect workers from occupational injury and illness.

NIOSH provided a second draft of the CIB on *Occupational Exposure to Silver Nanomaterials* for public review[3] and held an open public meeting to solicit comment.

[2] https://www.nano.gov/node/831

[3] https://www.cdc.gov/niosh/docket/review/docket260a/pdfs/260-A-Draft-Silver-NM-CIB_8-24-18_1.pdf

NIOSH published three workplace design solutions and one poster (see Figure 1 below), to provide options to companies for controlling possible exposure of their workers to nanomaterials on the job.

NIOSH collaborations with industry to conduct voluntary in situ *assessments of workplace exposures*

NIOSH has established collaborations that evaluate *in situ* workplace processes, and develops methods to identify and quantify worker nanomaterial exposure. Collaborating organizations gain access to NIOSH's expertise in nanomaterial characterization and exposure control technology. NIOSH field research teams visit nanomaterials producers and users, including additive manufacturing and 3D printing facilities. During 2018, NIOSH collaborated with 14 companies and completed 10 field assessments. NIOSH developed an inexpensive (<$75) local exhaust ventilation system for small commercially available thermoplastic 3D printers (>98% reduction in ultrafine particulate emissions) that should be adaptable to many brands. NIOSH field team members evaluated the workplace environment at the largest CNT producer in the United States and made engineering control and work practice recommendations to bring exposure levels down by a factor of ~10. Final results are pending. NIOSH also evaluated the work environment during destructive testing of CNT-enabled concrete. Final results are pending.

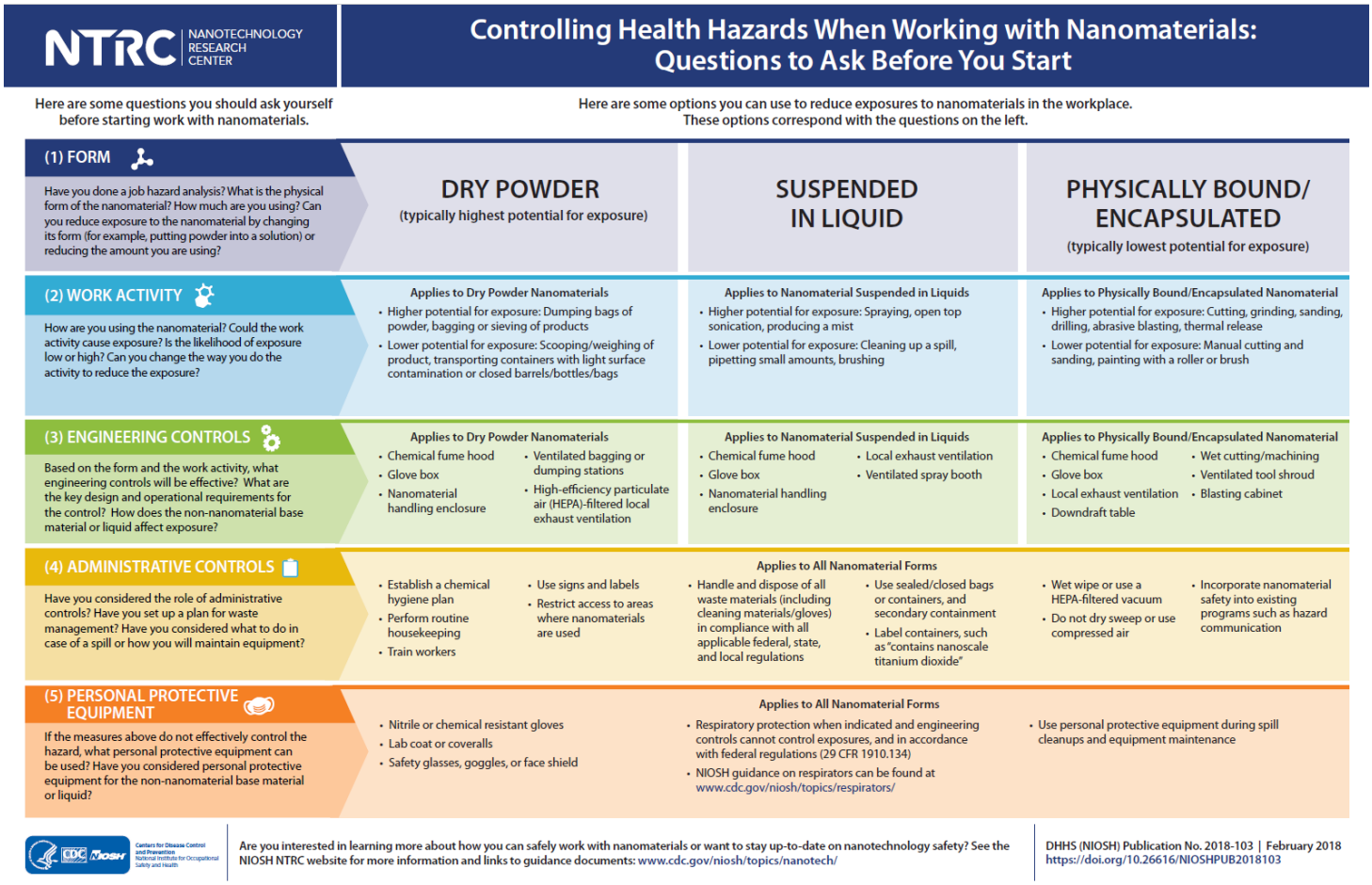

Figure 1. NIOSH workplace poster, *Controlling Health Hazards When Working with Nanomaterials: Questions to Ask Before You Start*. Image credit: NIOSH.[4]

[4] https://www.cdc.gov/niosh/docs/2018-103/default.html