

# Overview of the Draft NIOSH Current Intelligence Bulletin (CIB): Occupational Exposure to Carbon Nanotubes and Nanofibers

Public Meeting  
February 3, 2011  
Cincinnati, Ohio

**Charles L. Geraci, Ph.D., CIH**  
Centers for Disease Control and Prevention  
National Institute for Occupational Safety and Health



The findings and conclusions in this presentation have not been formally disseminated by the National Institute for Occupational Safety and Health and should not be construed to represent any agency determination or policy.



# Welcome

## Meeting logistics

- The meeting is being recorded and a transcript will be placed on the NIOSH Docket.
- When you speak, please indicate your name, and affiliation.
- Use the microphone so we may accurately record your comments and attribute all remarks for the record.
- NIOSH Panel and Experts

**NIOSH**  
**Current Intelligence**  
**Bulletin**

**Occupational Exposure to  
Carbon Nanotubes and Nanofibers**



DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Centers for Disease Control and Prevention  
National Institute for Occupational Safety and Health

Today's Objectives

- Summarize the Document
- Review key elements
- Comments
- Discussion
- Next steps

# Agenda – Page 1

## The Draft Document: NIOSH Current Intelligence Bulletin: Occupational Exposure to Carbon Nanotubes and Nanofibers

Millennium Hotel  
Grand Ballroom A  
Cincinnati, Ohio  
February 3, 2010

- 9:00 Welcome**  
Charles Geraci, Jr., PhD, CIH  
Coordinator, Nanotechnology Research Center, NIOSH
- 9:10 Background of the Current Intelligence Bulletin**  
Charles Geraci, Jr., PhD, CIH  
Coordinator, Nanotechnology Research Center, NIOSH
- 9:30 Summary of Toxicologic Data**  
Vincent Castranova, PhD  
Chief, Pathology and Psychological Research Branch, Health Effects Laboratory  
Division, NIOSH
- 9:50 Risk Assessment and Development of REL**  
Eileen Kuempel, PhD  
Senior Research Health Scientist, Nanotechnology Research Center, NIOSH
- 10:10 Break**
- 10:30 Exposure Measurement and Control**  
Ralph Zumwalde, M.S.  
Principal Scientist, Education and Information Division, NIOSH
- 10:50 Medical Screening and Surveillance**  
Douglas Trout, M.D.  
Associate Director for Science, Division of Surveillance, Hazard Evaluations and  
Field Studies, NIOSH
- 11:10 Recommendations and Research Needs**  
Charles Geraci, Jr., PhD, CIH  
Manager, Nanotechnology Research Center, NIOSH
- 11:30 Lunch**

# Agenda – Page 2

**12:30 15 minute presentations by interested parties**

Michael J. Ellenbecker, Sc.D., CIH  
Professor, Department of Work Environment  
Director, Toxics Use Reduction Institute  
University of Massachusetts Lowell  
600 Suffolk Street  
Wannalancit Mills  
Lowell, MA 01854

Jay Feitshans  
21 Walnut Street  
Haddonfield New Jersey USA 08033  
on Behalf of :  
International Safety Resources Association, Inc. (ISRA)  
1400 N. Harbor Blvd. #130-117 Fullerton, CA 92870 US

**1:00 Public questions and comments**

**4:00 Adjourn**

## Rationale for Development of CIB

- Several animal studies showed pulmonary fibrosis (early onset, persistent) and granulomatous inflammation from carbon nanotube (CNT) exposure
- Associated with both unpurified and purified CNT (raw metal contaminated)
- Effects occurring at relatively low doses
- Ability of CNT to persist and migrate to pleura
- Other adverse effects (e.g. aneuploidy)

## Rationale for Development (Cont'd)

- Many similarities between CNT/CNF and asbestos
- Increasing frequency of production and use and worker exposure
- No studies of adverse health effects in workers producing CNT or carbon nanofibers (CNF)

## Conclusion from Early Review of Published Studies

- While there are many information gaps, there is sufficient animal data to indicate that a **precautionary approach** to controlling CNT/CNF exposure is warranted.
- To enable a precautionary approach an occupational exposure limit (OEL) based on a quantitative risk assessment (QRA) was needed.
- To facilitate good risk management, workplace practice recommendations are needed.
- Conclusion: Develop a CIB



# Document Development Timeline

- 
- Mar 2009**
- Document concept approved by the NIOSH Leadership Team.
- 
- Apr 2009**
- Notice published in the Federal Register on April 8, 2009, requesting information on carbon nanotubes (CNTs) including single-walled carbon nanotubes (SWCNTs) and multi-walled carbon nanotubes (MWCNTs).
  - No submissions received in response to this request (see <http://www.cdc.gov/niosh/docket/archive/docket161.html>).
- 
- Nov 2010**
- Draft document cleared for peer review and public comment by the Office of the Director, NIOSH.
- 
- Nov 2010**
- Draft document forwarded to National Nanotechnology Coordinating Office, Clayton Teague, for preview and for internal distribution only to NNI participating agencies for their information.
- 
- Dec 2010**
- Peer review plan posted to the NIOSH Peer Review Agenda website (see <http://www.cdc.gov/niosh/review/peer/HISA/nano-pr.html>).
-

# Document Development Timeline (Cont.)

- 
- Dec 2010**
- Notice published in the Federal Register inviting public comment on the draft document and attendance at a public meeting on February 3, 2011.
  - Draft document posted for public comment on the NIOSH website (see NIOSH docket 161-A) . Written comments due February 18, 2011
  - <http://www.cdc.gov/niosh/docket/review/docket161A/default.html>).
- 
- Jan 2011**
- Publication summary presented to Nanotechnology Environmental Health Implications Working Group (NEHI).
- 
- Feb 2011**
- Public comment meeting planned for Cincinnati, Ohio.
-

## Goals of the Document

- Review relevant evidence on adverse lung effects seen in animals exposed to CNT and CNF.
- Conduct a quantitative risk assessment
- Develop a rationale for a REL
- Disseminate information about potential respiratory hazard to workers and employers
- Provide risk management guidance to employers

# Focused Presentations

- Dr. Vincent Castranova
  - Summarize the hazard evaluation (toxicology)
- Dr. Eileen Kuempel
  - Summarize the risk assessment
- Mr. Ralph Zumwalde
  - Current knowledge of exposure assessment and controls
- Dr. Douglas Trout
  - Summarize medical recommendations

# Summary and Wrap Up

# Summary of Recommendations

- Identify and characterize processes and job tasks
- Characterize exposure
- Establish procedures for using engineering controls
- Train workers about sources of exposure and how to use controls

## Summary of Recommendations (Cont'd)

- Provide facilities for hand washing
- Develop procedures to clean up spills
- Follow OSHA respirator protection standard
- Consider implementing medical surveillance and screening

# Exposure Assessment

- NIOSH Method 5040
- Evaluation of worker personal exposure to CNT/CNF
  - Regular and systematic
  - Use activity pattern data
  - Identify high exposure jobs and tasks
  - Use same Industrial Hygiene principles as developed for exposure to other types of aerosols



# Engineering Controls

- Use engineering control techniques developed for fine dusts and powders
- Where possible use source enclosure
  - Otherwise use local exhaust ventilation with HEPA filters
- Selection of exposure control
  - Physical form of material
  - Task duration and frequency

## Work Practices

Develop guidance and training for good work practices

## Clean-up and Disposal

Develop procedures to protect workers during clean-up of spills and contaminated surfaces

# Personal Protective Clothing

- Health effects to skin from CNT are not known
- Prudent to wear protective clothing and gloves
  - When all technical measures to eliminate or control release of exposures have not been successful
- In emergency situations

# Respirators

- When engineering controls and work practices cannot reduce CNT/CNF exposure below REL
  - Workers should be provided with respirators
  - Follow OSHA respiratory protection standards
  - N-95 and N-100 should provide adequate protection when properly fit tested
  - Use appropriate filter change out schedules
  - Follow NIOSH respirator decision logic

# Medical Screening and Surveillance

- Workers exposed to CNT/CNF may benefit from inclusion in a medical screening program
- Initial evaluation
- Periodic evaluation
- Written reports to the worker and employer
- Maintain confidentiality of workers medical records

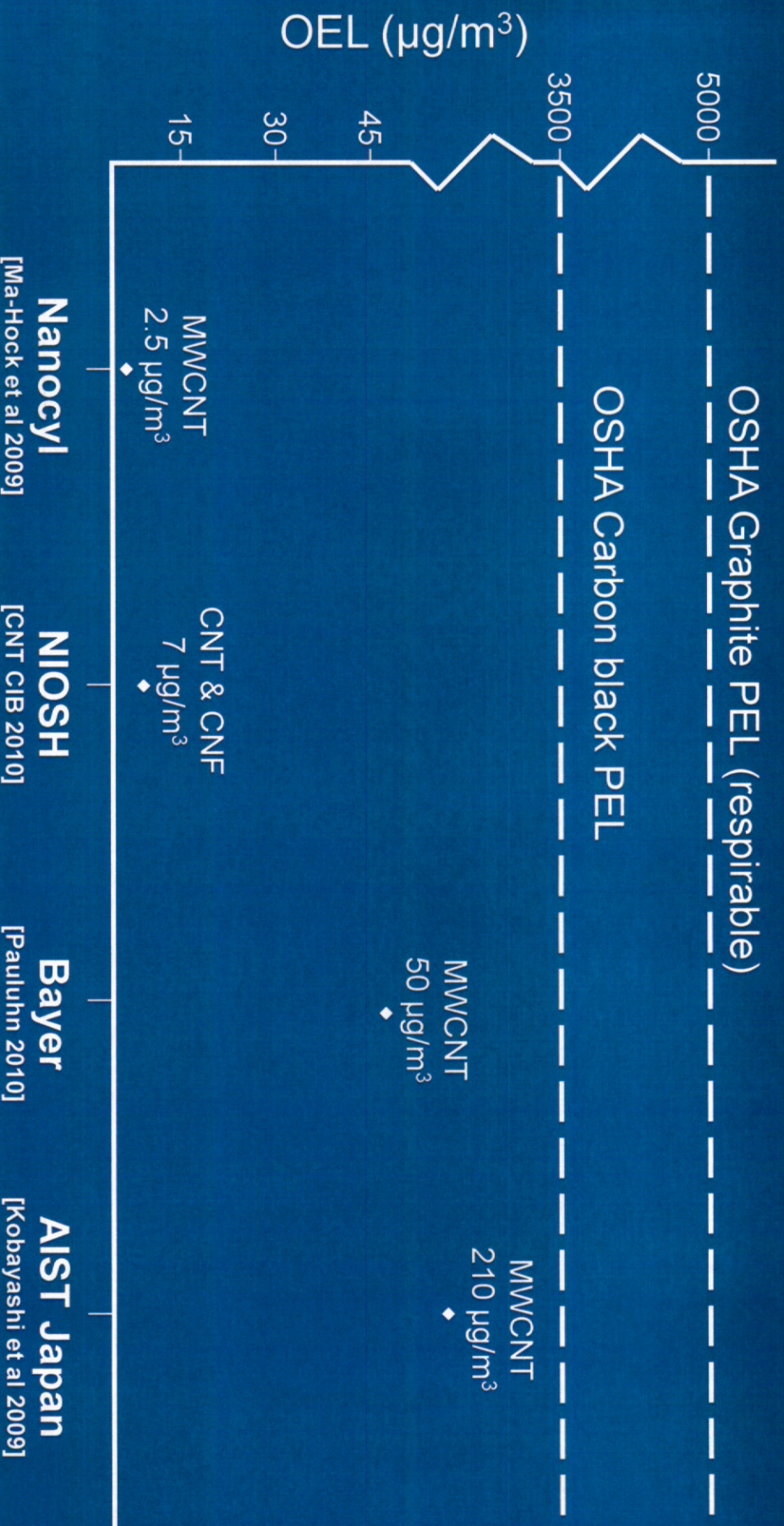
# Worker Training

- Provide sufficient information to allow workers to understand:
  - Nature of potential exposure
  - Routes of exposure
  - Instructions for reporting health symptoms
  - Purpose of medical screening

## Limitations of the REL: Research Needs

- Mass may not be the best metric particle
- Fiber-counts may be better
  - Technical issues need resolution
- Based on limited available exposure data the REL is achievable
- Whether REL can be achieved in all workplaces is not known

# OEL Development Activities for Carbon Nanotubes:



BSI—0.01 f/ml [benchmark exposure limit-BEL] high aspect ratio nanomaterials  
—established at 1/10 asbestos OEL



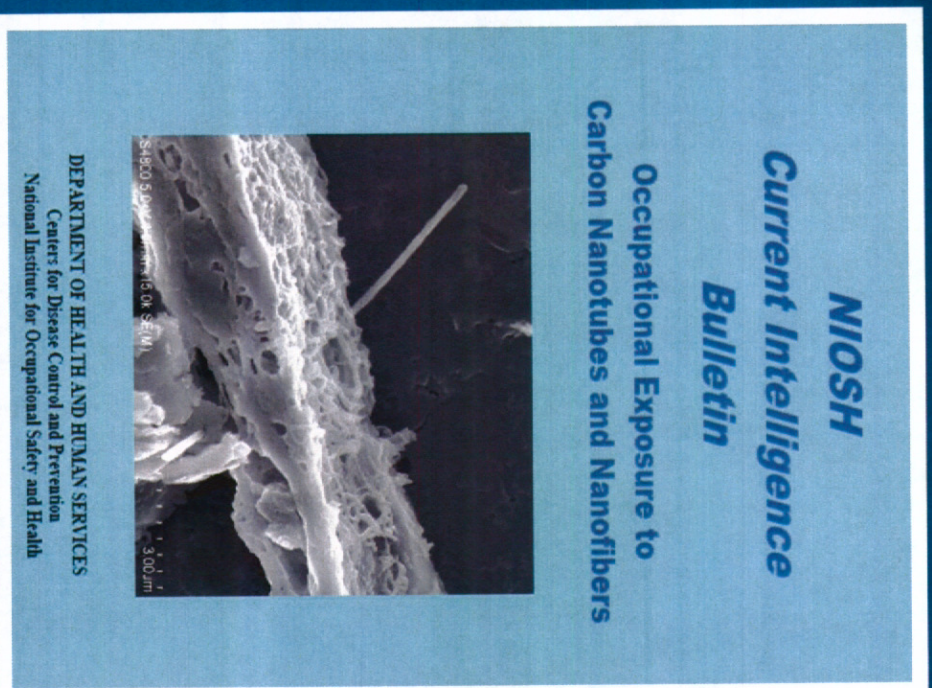
# Research Needs

- Experimental studies
  - Chronic inhalation studies of **different types** of CNT/CNF
  - Mechanistic studies
  - Assessment of early markers of exposure and response
- Human studies
  - Assessment of value of exposure registries for conducting future epidemiologic studies
  - Epidemiologic and surveillance research

## Research Needs (Cont'd)

- Studies of workplace exposures, measurement, and controls
  - Quantification worker exposure to CNT/CNF
  - Evaluation of NIOSH Method 5040 in various workplaces
  - Development of improved sampling and analytic methods that more closely align with animal studies
- Determination of effectiveness of engineering controls to control airborne exposure below 7  $\mu\text{g}/\text{m}^3$

# Thank You



[http://www.cdc.gov/niosh/docket/review/docket161A/pdfs/carbonNanotubeCIB\\_PublicReviewOfDraft.pdf](http://www.cdc.gov/niosh/docket/review/docket161A/pdfs/carbonNanotubeCIB_PublicReviewOfDraft.pdf)