Occupational Energy Research Program
Ongoing Research

Public Meeting
October 27, 2005

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Division of Surveillance, Hazard Evaluations, & Field Studies (DSHEFS)
National Institute for Occupational Safety & Health (NIOSH)
Outline

• Review of OERP research goals
• Overview of ongoing NIOSH epidemiologic studies
• Overview of HEDS Database
• NIOSH Chronic Lymphocytic Leukemia (CLL) research initiative
Epidemiologic Research Goals

- **Evaluate possible relationships** between workplace exposures and injury or disease using the best available methodologies.

- **Analyze combined populations** to assess whether certain rare cancers are related to past occupational exposures.

- **Examine** the relationships of mixed exposures and worker health.

- **Provide** research findings which enhance the understanding of the effects of low-level protracted exposure to ionizing radiation in DoE workers and others.
**Exposure Assessment Research Goals**

- **Improve exposure assessment methods** to reduce uncertainty in mortality and morbidity studies.
- **Characterize** the **combined exposures** experienced by Department of Energy workers for use in epidemiologic analyses.
- **Emphasize quantitative** (vs. qualitative) **relationships** between exposure and health outcomes.
- **Evaluate** the **quality and validity** of the available worker exposure **data**.
## Ongoing NIOSH Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leukemia and ionizing radiation multi-site case-control study (LANL, SRS, ORNL, Hanford, PNS)</td>
<td>Early 2006</td>
</tr>
<tr>
<td>Chemical laboratory workers cohort mortality study (ORNL, Y12, K25, SRS)</td>
<td>Early 2006</td>
</tr>
<tr>
<td>Portsmouth Naval Shipyard (PNS) workers lung cancer case-control study</td>
<td>Early 2006</td>
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<tr>
<td>K-25 Site workers multiple myeloma case-control study</td>
<td>2007</td>
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<tr>
<td>Fernald workers cohort mortality study</td>
<td>2007</td>
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</tbody>
</table>
## NIOSH Research Status

<table>
<thead>
<tr>
<th>Title</th>
<th>Exposure Assessment</th>
<th>Epi Analyses</th>
<th>Publish Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leukemia and ionizing radiation multi-site case-control study (2006)</td>
<td>✓</td>
<td>✓</td>
<td>40%</td>
</tr>
<tr>
<td>Chemical laboratory workers cohort mortality study (2006)</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>PNS workers lung cancer case-control study (2006)</td>
<td>✓</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>K-25 Site workers multiple myeloma case-control study (2007)</td>
<td></td>
<td>70%</td>
<td></td>
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<tr>
<td>Fernald workers cohort mortality study (2007)</td>
<td></td>
<td>40%</td>
<td></td>
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## Ongoing Extramural Studies

<table>
<thead>
<tr>
<th>Title and Grantee</th>
<th>Research</th>
<th>Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radon, cigarette smoking and lung cancer at Fernald (Univ. of Cincinnati)</td>
<td>Exposure Assessment</td>
<td>2006</td>
</tr>
<tr>
<td>Susceptibility &amp; occupational radiation risks (Univ. of North Carolina)</td>
<td>Cohort Mortality Study (SRS)</td>
<td>2006</td>
</tr>
<tr>
<td>Paducah Gaseous Diffusion Plant Worker Cohort Mortality Study (Univ. of Kentucky and Univ. of Louisville)</td>
<td>Cohort Mortality Study</td>
<td>2007</td>
</tr>
</tbody>
</table>
Ongoing Study Details
Leukemia & Ionizing Radiation Multi-site Case-Control Study (LCCS)

- Estimate to completion: Early 2006
- Case-control study:
  - Workers \( n=1,269 \) from a cohort \( n=94,517 \) with employment at one of five nuclear facilities
LCCS Study Sites

Acronyms

LANL: Los Alamos National Laboratory
ORNL: Oak Ridge National Laboratory
PNS: Portsmouth Naval Shipyards (Non-DoE site)
SRS: Savannah River Site
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Leukemia & Ionizing Radiation Multi-site Case-Control Study (LCCS)

- Exposures
  - Ionizing radiation (gamma, x-ray, neutron, tritium, and plutonium)
  - Chemicals (benzene, carbon tetrachloride)
  - Smoking

- Outcome – Leukemia all subtypes including CLL
Research Questions:

- Does chronic, low-level radiation exposure cause leukemia among workers?
- What is the dose-response relationship between exposures and leukemia mortality?
- Is chronic lymphocytic leukemia (CLL) associated with radiation?
- Is there a smaller effect at low dose rates (for the same total dose)?
- How does radiation interact with other workplace exposures (High-LET radiations, chemicals, smoking)
LCCS Unique Aspects

• Cohort includes workers from five DoE facilities and one DoD facility for increased statistical power
• More leukemia cases ($n=257$) than in previous studies. (IARC 15 country study has 196 cases)
• Most informative for CLL dose-response. Contributes a relatively large number of CLL cases ($n=43$)
• Examines potential confounding and interactions from competing exposures such as high-LET irradiation and chemical exposures
LCCS - Recent Accomplishments

• Finalized exposure assessments
  – Assessed benzene and carbon tetrachloride exposures
  – Estimated equivalent dose to bone marrow from all occupational ionizing radiation sources.
  – Three methods manuscripts in peer-reviewed scientific journals

• Completed smoking status
• Completed analysis plan
• Conducted Epi analyses
LCCS- Remaining Tasks

• Peer review of Epi analyses
• Communicate study results to workers
• Publish the results in the peer-reviewed literature
• Submit study data to the Comprehensive Epidemiologic Data Resource (CEDR) http://cedr.lbl.gov
Portsmouth Naval Shipyard Lung Cancer Case-Control Study

- Scheduled completion: Early 2006
- Case-control study:
  - Workers ($n=4,392$) from a cohort ($n=37,853$) ever employed at the Portsmouth Naval Shipyard (PNS) 1952-1992
- Exposures
  - Ionizing radiation (gamma, x-ray)
  - Chemicals (asbestos, welding fume)
  - Smoking
- Outcome – Lung Cancer
Portsmouth Naval Shipyard Lung Cancer Case-Control Study

Research Questions:

• Does chronic, low-level radiation exposure cause lung cancer among workers?
• How does radiation interact with cigarette smoking in producing lung cancer risk?
• How does radiation interact with other workplace exposures?
• What is the dose-response relationship between exposures and lung cancer mortality?
Mortality of Chemical Laboratory Workers

• Estimate to completion: Early 2006

• Cohort Mortality Study

• Exposures
  – Chemicals (Organic and inorganic)
  – Ionizing radiation (gamma, x-ray, neutron, internal emitters)
  – Outcome – cause-specific mortality
Mortality of Chemical Laboratory Workers

Research Questions:

• Do mortality patterns among Chemical Laboratory Workers (CLWs) differ from the U.S. population?

• What is the dose-response relationship between chemical exposures and cause-specific mortality?

• How do chemical exposures interact with other workplace exposures (ionizing radiation)?
Multiple Myeloma at K-25 Plant

• Estimate of completion: 2007
• Case-control study:
  – Workers \( n=588 \) employed at the K-25 Gaseous Diffusion Plant between 1945 and 1985
• Exposures
  – Ionizing radiation - uranium (internal and external)
  – Chemicals – carbon tetrachloride, fluorides, mercury, nickel, and trichloroethylene
• Outcome – multiple myeloma
Multiple Myeloma at K-25 Plant

Research Questions:

• Does chronic, low-level exposures to internally deposited uranium cause multiple myeloma?

• How do these radiation exposures interact with other workplace exposures to co-carcinogens (external ionizing radiation and chemicals)?

• What is the dose-response relationship between exposures and multiple myeloma?
Fernald Cohort Mortality Study

• Estimate of completion: 2007

• Retrospective cohort mortality study:
  – Workers (approx. 7,300) hired at the former Feed Materials Production Center (FMPC) between 1951 and 1989

• Exposures to:
  – Ionizing radiation (internal and external) from uranium, thorium, radium, and radon
  – Chemicals

• Outcome – All cause-specific mortality
Fernald Cohort Mortality Study

Research Questions:

• Do mortality patterns among Fernald Workers differ from that of the U.S. population?
• What is the dose-response relationship between ionizing radiation exposures and cause-specific mortality?
• How do these exposures interact with other workplace exposures (chemicals)?
NIOSH OERP Epidemiologic Data Management System (HEDS)

• Relational database of all DoE and DoD workers studied under the OERP
  – Demographic and work history data
  – Exposure data
• Workers employed at multiple sites are linked by Master Roster (~300,000 workers currently)
• Powerful tool for future research involving exposure-based cohorts from multiple DoE and DoD sites
## Advisory Committee for Energy-Related Epidemiologic Research (ACERER) Research Principles

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<thead>
<tr>
<th>Research Principle</th>
<th>Ongoing Study</th>
</tr>
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<tbody>
<tr>
<td>Combine Cohorts for Greater Power</td>
<td>LCCS, CLWS</td>
</tr>
<tr>
<td>Improve Exposure Assessment</td>
<td>All ongoing studies</td>
</tr>
<tr>
<td>Include Non-Whites and Females</td>
<td>All ongoing studies</td>
</tr>
<tr>
<td>Consider Previously Unstudied Sites</td>
<td>Paducah (UK &amp; UL)</td>
</tr>
<tr>
<td>Develop Studies of Current Workers</td>
<td>Future research needs</td>
</tr>
<tr>
<td>Increase Morbidity Studies</td>
<td>Future research needs</td>
</tr>
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</table>
NIOSH CLL Research Initiative

• In 2004, Congress directs NIOSH to investigate a possible link between radiation exposure and the occurrence of CLL
  – CLL non-compensable under EEOICPA

• NIOSH conducts Expert Panel Meeting (July 2004) to discuss research strategies for evaluating any relationship between exposure to ionizing radiation and CLL
Expert Panel Meeting, July 2004

• Six experts in epidemiologic and molecular CLL research were invited to provide opinions

• Twenty-five people attended the meeting, including the six panel members, NIOSH and other federal staff, and the public

• Meeting Documentation
  – Proceedings (2005)
  – Annotated bibliography (2004)
NIOSH Research Focus

Based on the panel’s suggestions, NIOSH has:

- Prioritized existing epidemiologic studies with focus on CLL
- Pursued pooled analyses, with examination of alternate lag assumptions, in both the IARC-commissioned CLL analyses and the multi-site leukemia case-control study
- Initiated a systematic review of the previously published literature on the radiogenicity of CLL
NIOSH CLL Research Projects

• Completed Studies
  – Cohort Mortality Study of Idaho National Laboratory (INL) Workers (2005)
  – Portsmouth Naval Shipyards (PNS) Leukemia Case-Control Study (2005)

• Continuing Studies
  – CLL analysis of the International Agency for Research on Cancer (IARC) 15 country study of ~400,000 workers (2006)
  – Multi-site Leukemia Case-Control Study (2006)
Impact of Ongoing OERP Research

• In principle, occupational studies are well suited (and preferred) for the direct estimation of the health effects of worker exposures

• Current risk models and protection standards are derived from the Life Span Study (a-bomb survivors) and medically exposed cohorts

• Ongoing OERP research demonstrates improved study design and increased followup, which is expected to provide a foundation for future policies on worker protection

• Future OERP research will build from ongoing activities for addressing relevant worker protection and public health questions