



# National Institute for Occupational Safety and Health Announcement of Findings

November 2002

## Glossary of Terms

**C.I./Confidence Interval:** A range that serves as a rough guide to the uncertainty in a value such that one can be 95% sure that the true value is within that range.

**Confounders:** Factors that distort or mask the true effect of exposure in an epidemiologic study.

**International Labour Organization Profusion Scoring System:** A chest x-ray classification system used by doctors to systematically record lung abnormalities that are due to the inhalation of workplace dust and fumes.

**Plutonium/<sup>239</sup>Pu:** A heavy, fissionable, radioactive, metallic element produced as a by-product of the fission reaction in a uranium-fueled nuclear reactor and can be recovered for future use.

**Pulmonary/Lung Fibrosis:** Scarring of the lung tissue.

**Retrospective Study:** Study design in which past exposures of individuals who have had an outcome event in question are compared with those of unaffected individuals.

**Sievert (Sv):** The unit of equivalent absorbed dose equal to 100 rems.

## Lung Fibrosis in Plutonium Workers

**Principal Investigator:** Lee S. Newman, MD, MA, Division of Environmental and Occupational Health Sciences, National Jewish Medical and Research Center, Denver, Colorado, Department of Medicine and Department of Preventive Medicine and Biometrics, University of Colorado School of Medicine, Denver, Colorado.

**Study Population:** A total of 520 production workers who were employed at Rocky Flats.

**How This Study Was Done:** We conducted a retrospective study of nuclear weapons workers. Our study population consists of 326 workers exposed to <sup>239</sup>Pu with absorbed lung doses from 0 to 28 Sv and 194 workers who had no known <sup>239</sup>Pu exposures based upon systemic deposition calculations. Absorbed lung dose was calculated as part of an internal dose assessment. We compared severity of chest x-ray abnormalities consistent with pulmonary fibrosis between the two groups using the International Labour Organization (ILO) profusion scoring system.

**Study Findings:** There was a significantly higher proportion of abnormal chest radiographs among plutonium workers (17.5%) as compared to non-plutonium workers (7.2%),  $p = <0.01$ . The plutonium workers were significantly older at time of x-ray than were unexposed workers, possibly accounting for the differences. Of those plutonium workers with absorbed lung doses of 10 Sv or greater, 37.5% had an abnormal chest x-ray compared to other plutonium workers (16.5%). When we controlled for effects of age, smoking, and asbestos exposure we found that plutonium lung dose of 10 Sv or greater conferred a 5.3-fold risk of having an abnormal chest x-ray when compared to employees with no plutonium exposure (95% C.I. = 1.2 to 23.4).

Inhaled plutonium may cause lung fibrosis in humans at absorbed lung doses above 10 Sv. It is important to note that few employees at this plant had such high lung exposures. Fewer than 5% of plutonium exposed employees in this study had exposures of 10 Sv or greater. Plant personnel in the medical and dosimetry departments felt that most individuals with high lung doses would have been captured in this study.

**Study Limitations:**

- The difference in the proportion of chest x-ray abnormalities between plutonium-exposed and unexposed individuals was confounded by age at time of chest x-ray. Plutonium-exposed individuals were likely to be part of a radiation surveillance project on plantsite that brought them back after termination and retirement for lung counting and clinical evaluation which included chest x-ray. Unexposed individuals were not eligible for this radiation surveillance project.
- The study was limited by missing smoking data among the unexposed group. Smoking data were available for 92% of the plutonium-exposed individuals but for only 43% of the unexposed individuals. Since most exposed individuals came in for lung count evaluation, smoking data were updated on each visit. Older medical records from the plant did not indicate smoking status on many individuals.
- Not all individuals with absorbed lung doses were included in this study, though plant personnel in medical and dosimetry departments felt that most individuals with high lung doses would have been captured in this study.
- Other important confounders such as workplace exposures other than asbestos and medical exposures to radiation could not be evaluated.
- Calculated estimates for lung dose are potentially subject to error because the model used to calculate absorbed lung dose is unable to distinguish whether lung count data represent lung tissue deposition of plutonium via inhalation or deposition in the mediastinal lymph nodes from contaminated wounds.
- All individuals with lung deposition of plutonium in our study had acute inhalational exposures to plutonium readily traced back to accidents or equipment failure. We do not know if lower-level chronic exposure or repeated low-level inhalation exposures would produce the same radiographic evidence of fibrosis.

***Further NIOSH Information:***

For a copy of the final report, call:

1-800-356-4674

For a summary of NIOSH research involving Department of Energy workers, visit on-line at:

<http://www.cdc.gov/niosh/2001-133.html>

**Important Announcements:**

For more information, please contact DOE site representative, Karen Lutz at (303) 966-4546. Copies of the complete report, **Lung Fibrosis in Plutonium Workers** can be found in the DOE Reading Room at Front Range Community College, 3705 112th Avenue, Westminster, Colorado, 80030, (303) 469-4435. Questions concerning this study should be directed to the principal investigator, Lee Newman, M.D. at (303)398-1983 or E-mail at [newmanl@NJC.org](mailto:newmanl@NJC.org).

***NIOSH/HERB Contact Points for Further Information...***

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