



# National Institute for Occupational Safety and Health Announcement of Findings

April 2003

## Glossary of Terms

**Case control study:** A scientific study that compares a group of people with disease (such as lung cancer) to a similar group of people without that disease. This type of study compares the levels of exposure (radiation or chemical) each group had before appearance of the disease.

**Cohort mortality study:** An epidemiology study that observes a large group of people over a period of time. Within the cohort, mortality rates can be calculated for group members with different exposures.

**Confidence interval (CI):** A range of numbers around a mean, proportion, or rate that serves as a measure of the uncertainty in the mean, proportion, or rate. For example, a 95% CI indicates that we are 95% certain that a mean lies within the stated interval.

**Internal dosimetry models:** A set of mathematical estimates of dose. The data input includes a measurement of internal deposition; for example, measurements of radioactivity in urine, and other data such as the chemical form of the compound deposited.

**Internal radiation dose:** Dose to an internal organ from previously deposited radioactive compounds, such as uranium or plutonium.

**Rem:** A unit for measuring absorbed doses of radiation received by the body that includes an adjustment for the intensity of the damage to one or more cells. Rem is the abbreviation of roentgen equivalent man.

**Standard mortality ratio (SMR):** Ratio of the number of deaths observed in the study group to the number of deaths expected based on rates in a comparison population.

**Statistical significance:** The likelihood that an association between exposure and disease risk could have occurred by chance alone.

## Epidemiologic Evaluation of Cancer and Occupational Exposures at the Rocky Flats Environmental Technology Site

### Principal Investigator

A. James Rutenber, Ph.D., M.D., Associate Professor, Department of Preventive Medicine and Biometrics, University of Colorado Health Sciences Center, Denver, Colorado.

### Study Population

A cohort of 16,303 production workers employed at the Rocky Flats Plant for 6 months or more between 1952 and 1989.

### How This Study Was Done

This study examined the causes of death of workers who died between 1952 and 1996, and had three main components:

*Cohort Mortality Study:* The number of deaths for each cause was compared with the number that was expected to occur, based on the mortality experience of the United States population, and of Colorado residents.

*Lung Cancer Case Control Study:* A case-control study was implemented to compare 180 workers who died and had been diagnosed with lung cancer with a control group of 720 workers who had not been diagnosed with lung cancer. Detailed estimates of internal radiation doses to the lung from plutonium and other radionuclides were computed for these subjects with internal dosimetry models. A telephone survey was conducted with next of kin and former co-workers of subjects to estimate the frequency of cigarette smoking among subjects. These data and other variables (certain chemical exposures such as asbestos) were analyzed to determine whether subjects with lung cancer had higher internal lung doses than those who did not have lung cancer, and to determine whether smoking frequency or other variables could have affected this relationship.

*Exposure Assessment:* Plant records were used to estimate annual external penetrating radiation doses, cumulative internal exposure to plutonium, and estimates of annual exposures to asbestos, beryllium, hexavalent chromium, and nickel. This exposure assessment was used to examine potential effects in the lung cancer case-control study.

## Study Findings

***Cohort Mortality Study:*** For most of the causes of death, fewer Rocky Flats workers died than would have been expected. Similar results are commonly found in studies of worker populations and reflect the fact that workers are healthier than the general population. Non-significant elevations were found for cancers of the stomach, rectum, brain and other central nervous system sites, connective and other soft tissue, as well as for unspecified tumors of the nervous system and unspecified anemias. The increase in unspecified tumors of the nervous system was statistically significant (9 observed deaths, SMR = 2.51, 95% CI = 1.14-4.76) when Colorado mortality rates were used to compute the expected number of deaths.

***Lung Cancer Case Control Study:*** In the lung cancer case-control study, there was a statistically significant relationship between internal lung dose and lung cancer for workers who received doses greater than 400 mSv (40 rem) and up to 644 mSv (64 rem). However, statistically significant relationships were not found consistently in all the high dose categories. Although smoking frequency was strongly associated with lung cancer, the associations between internal dose and lung cancer were not due to plutonium-exposed workers having smoked more than non-exposed workers.

The study report and findings were externally peer reviewed.

## Study Limitations

- About 87% of the workers in this study were alive through 1996, the end of follow up in this study. As time passes, different patterns of deaths due to chronic diseases might emerge in this cohort. The increased risk for brain tumors, first described by Wilkinson, et al. and still apparent in this cohort, is continuing to be investigated.
- Dose estimates are inherently uncertain and their further analysis might reveal why plutonium workers in the highest lung dose category appear to have lower risk of lung cancer death than those in the moderate dose category.

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## *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, **Epidemiologic Evaluation of Cancer and Occupational Exposures at the Rocky Flats Environmental Technology Site** can be found in the DOE Reading Room at Front Range Community College, 3705 West 112th Avenue, Westminster, Colorado 80030, (303) 469-4435. Questions concerning this study should be directed to the principal investigator, A. James Rutenber, Ph.D. (303) 315-5627 [jim.rutenber@ucshsc.edu](mailto:jim.rutenber@ucshsc.edu).

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

National Institute for Occupational Safety and Health (NIOSH)  
Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS)  
Health-Related Energy Research Branch (HERB)

NIOSH-HERB MS R-44  
4676 Columbia Parkway  
Cincinnati, OH 45226

Phone: (513) 841-4400  
Fax: (513) 841-4470

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