

RESEARCH ON ADVERSE HEALTH EFFECTS RELATED TO ROCKY FLATS

Introduction

This paper summarizes past research on health effects in workers and members of the public who may have been exposed to toxic materials from the former Rocky Flats Nuclear Weapons Plant, now known as the Rocky Flats Environmental Technology Site.

Epidemiologic studies that have been conducted to assess the health effects of toxic substances at the Rocky Flats Plant can be grouped into two major categories: (1) those that focus on members of the public who lived near the plant and (2) those that assess health problems in plant workers.

Exposures to contaminants may be substantially different for workers than for members of the public. Finding elevated rates of disease in workers does not necessarily mean that there will be increased risk of disease in the public. Conversely, finding increased disease rates in the public does not necessarily mean that workers have increased risk for disease.

The following summaries provide limited detail about previous studies of Rocky Flats workers and the public. Complete references are listed at the end of this paper.

STUDIES OF WORKERS

Completed epidemiologic studies

Researchers at the Los Alamos National Laboratories conducted epidemiologic studies of cancer death rates (mortality) in Rocky Flats workers from the 1970s through the mid-1990s.

Voelz et al. conducted a study of 7,112 white male workers employed at Rocky Flats between 1952 and 1979. Deaths in workers were compared with those in the U.S. white male population. Fewer deaths were observed than expected based on rates in the U.S. population from most causes. The only cause of death significantly elevated in these workers was brain cancers. There were eight deaths in the Rocky Flats group. Six of the total eight cases of brain tumors occurred in workers exposed to external radiation. Two occurred in those exposed to plutonium.

To investigate whether the excess brain tumor mortality observed was associated with exposure to internally deposited plutonium or external radiation, Reyes et al. conducted a case-control study of all primary brain tumor deaths that occurred among white males who had been employed at Rocky Flats between 1952 and 1977, and died between 1952 and 1980. No statistically significant association was found between brain tumor mortality and exposure to plutonium or cumulative external radiation exposure. No significant dose-response trends were observed for any job or work area. However, the study was limited by the small number of brain cancer cases.

Tietjen then looked at workers who had exposures greater than 74 Bq (2.0 nCi). No excess mortality was observed, with significantly fewer deaths from all causes and from lung cancer than expected with U.S. rates.

Wilkinson et al. then studied white males employed at least two years at Rocky Flats between 1956 and 1980, and analyzed records of cancer deaths for this group. Among workers with higher plutonium concentrations in urine, they found higher rates of death overall, and, in some analyses, deaths from leukemia. Among workers with higher levels of cumulative external radiation, some excess of brain and liver cancer and leukemia were observed, but the findings were not conclusive, which again might be due to the small number of workers in the study.

Gilbert et al. conducted a study of white male workers at Hanford, Oak Ridge and Rocky Flats who had worked at one of these sites for at least six months and had been monitored for external radiation. Similar to the earlier study by Reyes et al., an increased risk of benign neoplasms of the brain and central nervous system was observed for Rocky Flats workers, but no association with external radiation exposure was detected.

An international study was undertaken that included previously collected data on Rocky Flats workers, as well as workers at Hanford and Oak Ridge in the U.S. and other radiation worker populations in Canada and Britain. This study included 95,673 workers, many more workers than in any previous study. There was no evidence of an association between external radiation dose and mortality from all causes or from all cancers. There was a significant dose-response relationship between external dose with leukemia and multiple myeloma, the latter reflecting previous reported associations in the Hanford, Washington and Sellafield, United Kingdom, studies, not Rocky Flats.)

William Brandom and co-researchers conducted one of the largest radiation cytogenetic studies in the world. They studied chromosome abnormalities in blood samples of more than 2,000 plutonium workers at Rocky Flats. They divided this group according to cumulative doses of plutonium and found more chromosome aberrations for those with high doses. In 1990, a group of 18 workers were studied for evidence of sister chromatid exchange from both radiation and chemical exposures. They found no differences between groups classified by exposures to chemicals.

Studies currently underway

As these epidemiologic studies of the Rocky Flats work force suggested some elevated risks for workers, but the results were not definitive, epidemiologists from the Colorado Department of Public Health and Environment decided that additional analyses might clarify risks to workers. They began a study of cancer incidence and mortality in Rocky Flats workers in the fall of 1993 in collaboration with scientists at the University of Colorado Health Sciences Center and the National Institute for Occupational Safety and Health. This study is scheduled for completion in late 2000. Researchers will expand the scope of previous studies as well as the number of years for which cancer data will be analyzed. They will study cancer incidence and mortality and relate these data to estimates of radiation and chemical exposure to the workers.

The University of Colorado is conducting a sentinel exposure event (SSE) surveillance/evaluation of former workers at the Rocky Flats Plant. A sentinel event is a condition for which objective documentation of an associated agent or occupation exists in the scientific literature. This study will develop a SSE surveillance and evaluation system for exposures to chemicals and both ionizing and non-ionizing radiation. The pilot started at Rocky Flats in 1997.

The National Jewish Center for Immunology and Respiratory Medicine is conducting a study of lung fibrosis in plutonium workers at Rocky Flats.

Rocky Flats workers can volunteer to participate in the U.S. Transuranium and Uranium Registries, operated by Washington State University. The registry offers a post-mortem tissue donation program so that workers who had been exposed to plutonium and other radionuclides can volunteer to have their tissues analyzed. The data from these analyses are used to improve the models scientists use to predict the retention and health risks of radioactive chemicals in the body.

Health surveillance

The Medical Monitoring of Former Rocky Flats Radiation Workers Program is a surveillance program for former Rocky Flats workers whose documented radiation exposures were high compared with those for the rest of the work force. Participants receive periodic physical exams and tests for radionuclides in their bodies.

In addition, the Department of Energy conducts a surveillance program for workers and former workers from all of its sites who were exposed to the toxic metal beryllium, which was used in weapons production

at Rocky Flats and other DOE facilities. The program is designed to identify and locate all exposed workers and to provide periodic examinations for chronic beryllium disease, an incurable lung disease.

DOE's Epidemiologic Surveillance Program monitors the health of current workers. This program evaluates the occurrence of illness and injury in the work force on a continuing basis. Results are issued in annual reports. This program facilitates an ongoing assessment of the health and safety of the Rocky Flats' workforce and helps to identify emerging health issues.

STUDIES OF THE PUBLIC

In 1981, Carl Johnson used cancer diagnosis data for 1969-1971 from the National Cancer Institute's Third National Cancer Survey to examine the relation between cancer rates and exposures to plutonium. Plutonium exposures were based on analysis of a group of soil samples collected in 1970 from the region around Rocky Flats. The Johnson study found increases in many cancer types for persons in exposed areas, as compared with those for unexposed areas.

A feasibility study for an epidemiologic study of persons who lived near the plant was reported by Nancy Dreyer and co-workers in 1982. They assumed exposure to plutonium began in 1967 and concluded that, based on the environmental data they analyzed, exposures were not high enough to be evaluated with statistical analyses in an epidemiologic study.

In 1982, John Cobb and co-workers measured plutonium concentrations in autopsy samples from more than 500 persons who died in Colorado. They compared those who lived near Rocky Flats with those who lived far from the plant, and found a weak relation between plutonium concentrations in autopsy samples and distance from Rocky Flats. However, these researchers concluded that the evidence was not strong enough to link the elevated concentrations to emissions from Rocky Flats.

In 1987, Kenneth Crump and others replicated the study design used by Carl Johnson and re-evaluated cancer diagnosis data for 1969-1971 and for 1979-1981. Although they confirmed Johnson's findings, they could draw no conclusions about an association between plutonium concentrations in the soil and cancer rates after considering distance from the Denver metropolitan area. They also found no increase in cancer rates for all cancers combined, for radiation-sensitive cancers, or for cancers of the respiratory system in the region within ten miles of Rocky Flats for both study periods.

In 1990, researchers at the National Cancer Institute completed a study of cancer incidence and mortality around 62 nuclear facilities in the United States. This study compared cancer rates in counties near nuclear facilities including the Rocky Flats Plant with those for counties farther away. The results from this study show slight elevations for some cancers in some age groups, but these data are hard to interpret because of limited information about other cancer-related factors.

In 1998, the Colorado Central Cancer Registry staff at the Colorado Department of Public Health and Environment found that cancer incidence rates for 10 selected regional statistical areas in the general vicinity of the Rocky Flats Plant from 1980-1989 were comparable to those for the rest of the Denver metropolitan area for the same period.

FUTURE RESEARCH RELATED TO ADVERSE HEALTH EFFECTS

The previous studies of public health effects have certain limitations. In most cases, information on smoking habits and other cancer-related factors (called "confounders") were not taken into account, and data on public exposures to Rocky Flats contaminants were limited.

As described previously, epidemiologic studies of persons who lived near the Rocky Flats Plant have yielded conflicting results, mainly because data on exposures to toxic materials from the plant were not sufficient and/or other cancer-related factors were not considered. It is not yet clear whether additional epidemiologic studies of the public would provide clarification.

Epidemiologists face two major problems: 1) it is difficult to determine who has been exposed to toxic materials from the Rocky Flats Plant and to what extent they have been exposed; and 2) there may not be sufficient numbers of individuals with enough exposure to produce results with scientific validity.

In other words, if a new epidemiologic study of the public is conducted and the results show a relation between exposures from Rocky Flats and cancer, it will be difficult to exclude the possibility that exposures to toxic materials from other sources or risk factors, such as smoking, caused the cancer increase. Likewise, if no increased cancer risks related to Rocky Flats exposures are identified, scientists will not be able to exclude the possibility that health effects might have occurred, but were not reported or available for statistical analyses.

The State of Colorado's Historical Public Exposures Studies on Rocky Flats began in 1990 and concluded in 1999 (Grogan et al.). The purpose was to identify the quantities of contaminants that were released off-site and to identify the potential health risks to nearby communities from those contaminants. The Health Advisory Panel members overseeing the two-phase project concluded that based on their current understanding of plutonium risks and the information available at this time, they do not recommend an epidemiologic study.

One of the reasons for undertaking the Historical Public Exposures Studies was to determine if exposures and risks were sufficiently high to be observed in increased cancer rates in the surrounding population. Due to the low levels of exposure, population changes and the fact that no disease can be attributed solely to plutonium, it would be difficult to perform an epidemiologic study.

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Meaning of terms

Dose Reconstruction:

Research and analysis of historical data and information regarding contaminant releases from a facility and calculation of doses, or amounts of contaminants received by an exposed population group. This information is used to assess the risks of potential health effects related to past exposure to contaminants.

Epidemiology:

The study of specific health effects or diseases and their distribution in a population group; the determination of potential causes of the observed health effects.

Risk Assessment:

A study process involving identification of a source of toxic substances, evaluation of conditions under which a population group could have been exposed, analysis of the toxicity of the specific substances and calculation of increased risks of adverse health effects related to the exposure.

Statistical Analysis:

Collection, organization and interpretation of data and the application of mathematical techniques to identify trends or characteristics in a population or study sample group.