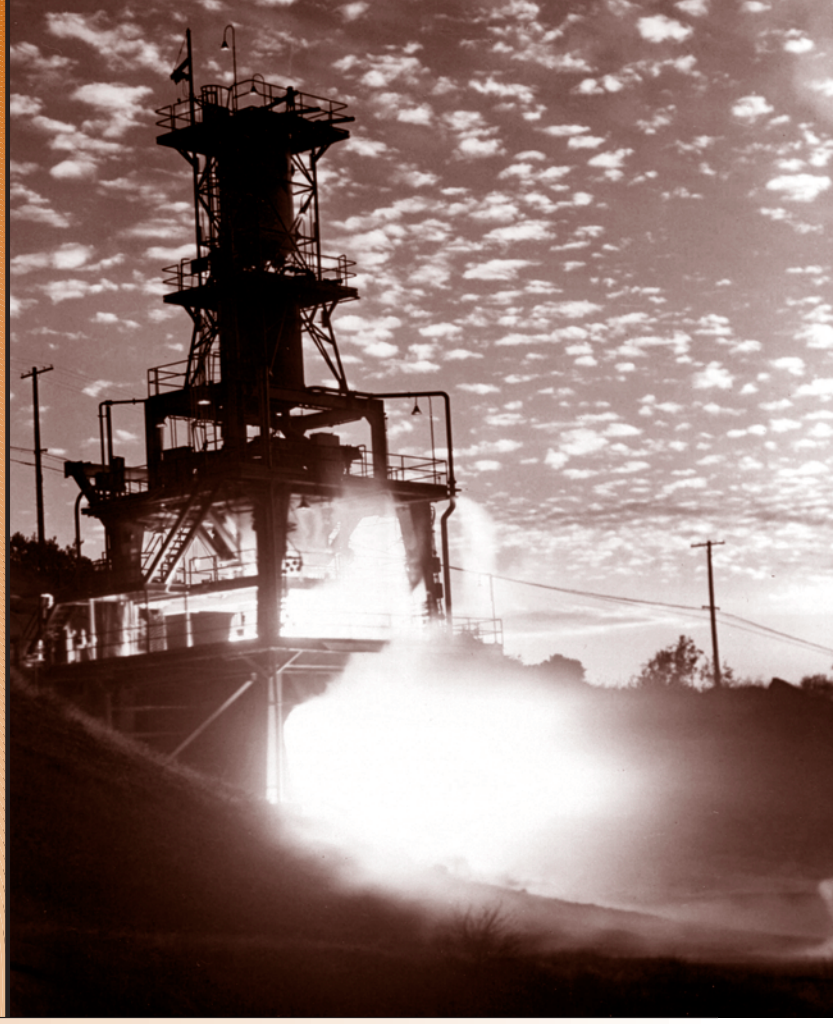
Interpreting the Rocketdyne Follow-on Worker Health Study



Many Rocketdyne workers raised questions about the results of the Rocketdyne Worker Health Study completed in the 1990's by the University of California at Los Angeles (UCLA). In response to these questions, the Boeing Company (Boeing), in partnership with the United Aerospace Workers (UAW), sponsored this follow-on health study of Rocketdyne workers.

April 2005

This summary was prepared cooperatively by the Science Committee, the IEI Research Team, United Aerospace Workers (UAW) and The Boeing Company.

STUDY SIZE.
The ability of a study to reveal adverse health effects depends upon many things, including the size of the population, the number of years of observation after exposures have occurred, and the size of the risk to be detected. The additional years of observation in the follow-on study results in more deaths among the population, which could then be evaluated for possible links to workplace exposure. Further, the additional 5 years of observation would reveal whether the patterns of risk suggested in the UCLA study continued into the future or not.

Background

The first health study of Rocketdyne workers was initiated in 1991 at the request of California state legislators responding to community concerns about the use of radioactive material and hazardous chemicals at the Santa Susana Field Laboratory (SSFL). The study, conducted by UCLA, focused on workers who may have been exposed to radiation during the development of nuclear energy technologies or to chemicals during the testing of rocket engines. While the study concluded that Rocketdyne workers had an overall lower risk of dying compared to the United States population, the UCLA researchers reported that a small number of Rocketdyne workers exposed to the highest levels of radiation had a slight increased risk of cancer of the blood and lymph system and lung cancer. The report also concluded that Rocketdyne workers assumed to have worked with hydrazines had a small increased risk for cancers of the lung, blood and lymph system, bladder and kidney. The UCLA researchers concluded that, due to the small number of cancer deaths in their study, the results required "confirmation through further follow-up" of the Rocketdyne worker population.

Why was the follow-on study done?

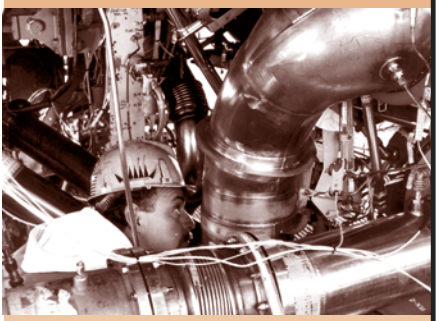
Like the original UCLA study, the objective of this follow-on study was to determine whether any particular groups of Rocketdyne workers have an increased risk of dying from cancer because of exposure in the workplace. In order to address questions raised by the UCLA study, the follow-on study placed special emphasis on developing detailed understandings of workers' radiation and chemical exposures. In addition, since 5 years had passed since the UCLA study, the follow-on study would include more years of observation, which improves the ability of the follow-on study to determine whether adverse health effects are related to exposures in the workplace.

Who did the follow-on health study of Rocketdyne Workers?

Boeing and UAW agreed on an approach to conduct the study independently of either group. To oversee the study, the Rocketdyne Worker Health Science Committee (the Science Committee), comprised of outside experts from six prestigious universities, was selected jointly by Boeing and the UAW. The Science Committee independently developed the scope of the study and requested bids from qualified researchers. Based on proposals submitted by four bidders, the Science Committee selected the International Epidemiology Institute (IEI) to conduct the follow-on study. The IEI team includes a wide-range of internationally known scientists from Oak Ridge National Laboratory, Oak Ridge Associated Universities and Vanderbilt University. The IEI/Vanderbilt team began the follow-on study in January 2001, and the research was completed in early 2005. Ten different Institutional Review Boards and Human Subjects Review Committees reviewed and approved the study protocol.

How was this follow-on study done?

The follow-on study looked at the number and causes of death of Rocketdyne workers employed from 1948 through 1999. Job history records, personnel files and radiation monitoring records were used to assign Rocketdyne workers to three groups: (1) workers monitored for radiation exposure; (2) workers potentially exposed to chemicals; and (3) a comparison or reference group of workers who were not monitored for radiation and did not work at SSFL and were less likely to have been exposed to chemicals used during the testing of rocket engines. The study team conducted extensive research to learn which employees had died, and from what cause, and were able to track the status of more than 99 percent of the workforce. Researchers estimated radiation doses and potential chemical exposures to hydrazines and trichloroethylene (TCE). Phone books and employee lists from the 1950's, 1960's and 1970's were used to place workers at certain test stands during their employment. The researchers also contacted both retired and active Rocketdyne workers. Group discussions were held with over 100 current and former employees to learn about work activities in order to help estimate workers' exposures to chemicals. The discussions with workers and the use of phone books and personnel lists supplemented other employment records to estimate employee exposures.



The risk of dying from 43 different causes of death was evaluated and compared to risk for the same causes of death seen in the general California population. Comparisons among Rocketdyne employees also were used to determine if exposures to higher doses of a chemical or radiation increased the risk of dying from a particular cancer. For example, deaths among workers with relatively high radiation doses were compared to those with lower doses (or no radiation exposure); employees who worked many years on test stands where hydrazines were used were compared to workers who worked fewer years and at other test stands where hydrazines were not used.

Who was included in the follow-on study?

The follow-on study included over 46,000 Rocketdyne workers. Only workers who were employed for at least 6 months (from 1948 to 1999) at SSFL or at nearby facilities, including Canoga Park and De Soto Avenue, were included. The specific groups studied were:

- 5,801 workers monitored for radiation exposure;
- 8,372 SSFL workers, including 1,651 test stand mechanics, evaluated for potential chemicals exposures; and
- 32,979 other workers employed at the other Rocketdyne facilities (used as a comparison group).

RADIATION.
Radiation exposure is measured in two ways. External exposure occurs when the radiation source is outside the body. Most of the external radiation exposure at SSFL was to gamma radiation, and was measured using badges worn by employees. The second type is internal exposure which occurs when radioactive materials are inhaled or swallowed. Internal exposure is monitored by collecting and analyzing body fluids such as urine.

How were the estimates of radiation exposure made?

The study based worker exposure to radiation on extensive monitoring records. Exposure measurements had been analyzed by outside laboratories and a radiation database maintained by Rocketdyne. All workers who could have been exposed to radiation on the job were monitored. External radiation is directly measured using film badges or other types of dosimeters worn by workers. These devices measure the radiation accumulated over a period of time (for example, quarterly) and the results are documented to maintain a record of an individual's cumulative external radiation exposure. In addition, external radiation doses for workers exposed prior to or after employment at Rocketdyne were derived from national databases using employee names, social security numbers and dates of birth. Internal radiation exposures while at Rocketdyne were measured via bioassays (such as urinalysis or fecal analysis) or using whole body counters. In this follow-on study, the data on internal exposure was evaluated using biological models to estimate radiation doses to specific organs.

How were the estimates of chemical exposures made?

Estimates of chemical exposures to test stand workers were based on known industrial practices and the worker employment records. Direct measurements of airborne concentrations were not available because outdoor monitoring of chemicals was infrequent during the early years of rocket engine testing. The researchers estimated chemical exposure of SSFL workers based on job histories and time spent at specific test stands. Given the "hands-on" nature of test stand mechanic and technician activities, this group was identified as having the greatest potential exposure to chemicals such as TCE (trichloroethylene) and hydrazines. Hydrazines were used only at specific test stands from 1961-1999, and in some research areas. TCE was used to flush (or clean) large engines after testing, as well as for incidental cleaning of parts. Using phone books, job titles and discussions with workers and retirees, workers were classified as to their likelihood of exposure. The categories were "likely" or "possible but unlikely", hydrazine exposure based on the jobs they had at specific test stands over specific time periods. For TCE a similar approach was used that included the number of years workers may have been exposed to TCE, and their category of exposure: "large" amount (from flushing engines) or "small" amount (from incidental cleaning with the solvent). Medical records were available for many workers to confirm their potential chemical exposure category.

HEALTHY WORKER EFFECT.
People who work typically enjoy lower death rates than those who don't. So it is no surprise that Rocketdyne workers are healthier than the general California population. However, this difference tends to disappear in older populations of retired workers. In the follow-on study the exposed groups were compared to both the California population as well as other Rocketdyne workers.

DRAWING CONCLUSIONS BASED ON A SMALL NUMBERS OF WORKERS.
The number of cancer deaths determines whether a study has the ability to conclude that the results represent an increase over the comparison group. This is called a "statistically significant increase". It is harder to determine a "statistically significant increase" in studies involving small numbers of workers compared to studies with large numbers. The results of studies of small numbers of workers often have estimates of risk that are very imprecise which means that chance often cannot be ruled out as an explanation for the findings. This does not mean that there was no increase in risk, just that the ability of the study to detect the risk was limited.

Overall, what did the follow-on study find?

Like the previous study, the follow-on study found that, overall, Rocketdyne workers had significantly lower death rates than the general population. However, hourly workers experienced some excess risk of lung cancer, and while it is plausible that their smoking patterns explain this entirely, there might be other factors involved. While there was little evidence of cancer risk for the vast majority of workers in the radiation and chemical groups, there were hints of possible excess risks in some subgroups, as indicated below.

What did the follow-on study find for the radiation group?

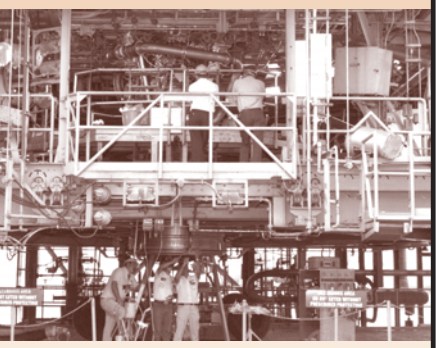
For workers monitored for radiation exposure, there were no significant increases in risks of dying for Rocketdyne workers compared to the general California population for the 43 causes of death evaluated. The results did suggest a tendency for leukemia to be increased as radiation dose increased. The most highly exposed radiation-monitored workers may have experienced a small excess risk of leukemia, perhaps accounting for a handful of cases. However, this possible increase was based on small numbers of deaths, was not statistically significant, and therefore could be due to chance. While other studies of radiation-exposed workers have reported increased risks of leukemia, those studies included much larger numbers of workers exposed to much higher levels radiation than those generally seen in Rocketdyne workers. Further, in the Rocketdyne workers, chronic lymphocytic leukemia, which is not thought to be caused by radiation, was increased to a greater extent than the types known to be caused by radiation, and this increases the likelihood that it was not a true causal association in the Rocketdyne workers. Overall the Rocketdyne radiation workers had lower exposures to radiation than workers at other nuclear facilities and these lower exposures are much lower than those known to cause leukemia.

What did the follow-on study find for the chemical group?

The death rates did not differ between SSFL workers potentially exposed to test stand chemicals and the general California public for any of the specific causes of death evaluated. In addition, the SSFL workers as a whole exhibited similar patterns of disease to other Rocketdyne workers. The only possible exception was that hydrazine-exposed test stand workers may have experienced a small excess risk of lung cancer. No such excess was seen for workers exposed to TCE. While exposure measurements were unavailable, it is plausible that the outdoor nature of the work at the test stands implied that usual exposure levels to hydrazines and TCE were quite low compared with workers in other industries who used these agents. If true, this would make it less likely that there would have been any effects on Rocketdyne test stand workers.

SMOKING ADJUSTMENT

Because tobacco use is one of the most important causes of ill health, efforts were made to learn whether Rocketdyne workers smoked more than the general California population, and whether smoking habits differed by job or pay category. Smoking information from medical records suggested that hourly workers were more likely to smoke cigarettes than salaried workers. This tendency was confirmed in a small smoking survey conducted among 140 randomly selected workers. The data also suggested that hourly workers smoked more than the general California population. Thus it was important that the follow-on study incorporate pay type as an adjustment factor in the analyses to control for potential differences in smoking habits.



What are the limitations of this new study?

Every study of workers has limitations, and this study is no different. A major limitation is that there is no direct way to measure chemical exposure among Rocketdyne test stand workers. Therefore, the researchers used years of employment within exposure categories as a substitute for chemical exposure with job titles and locations used to estimate potential hydrazine and TCE exposures. There was no chemical exposure assessment for radiation workers or Rocketdyne workers employed at locations other than SSFL.

Many factors other than the workplace play a role in the development of disease in humans. These include genetics, diet, lifestyle and environment. The follow-on study used some indirect methods to evaluate the possible impacts of these factors on the results, but detailed information such as workers' diets and lifestyles were unavailable. Insofar as lung cancer results are concerned, the absence of individual data on workers' smoking habits has left us with some unanswered questions about the possible excess risks in some subgroups of workers.

Apart from these limitations in study methods, the ability to detect possible hazards was also affected by the fact that there were relatively small numbers of workers with high exposure levels to radiation and chemicals.

How does the follow-on study differ from the previous investigation?

The follow-on study differs from the UCLA study in several key ways. The follow-on study included more workers, and followed the workers for a longer period of time. This increases the chances of finding an association between workplace exposures and cancer deaths. Expanding the number of workers considered and extending the study 5 years resulted in the inclusion of nearly 1,200 more workers in the radiation group, and 2,200 additional workers in the chemical group (including 600 more test stand mechanics). Other important differences include how exposures to radiation and specific chemicals were estimated.

The follow-on study used different approaches to quantify radiation and chemical exposures. The follow-on study included pre- and post-Rocketdyne radiation exposures, and found more than 2,100 instances where workers were monitored for radiation exposure during employment prior to or following their tenure at Rocketdyne. This information helped make sure that workers were placed in the correct exposure groups. In the follow-on study, internal radiation doses were estimated for each organ instead of using lung dose as a surrogate for other organs as was done by UCLA researchers. While the previous study assumed that all test stand mechanics were potentially exposed to hydrazines, this study found telephone directories which listed workers at the specific test stands where hydrazine was used.

What do the results from the follow-on study mean to you?

There is no need for special medical surveillance or physical examination beyond those recommended for the general population.

What can you do to protect your health?

All Rocketdyne workers are encouraged to take their health seriously. If you have any symptoms or signs of ill health, talk to your doctor immediately. Lung or heart problems, for example, can cause shortness of breath, cough, or chest pain. Unusual tiredness or lymph gland swelling might indicate a blood or lymph system problem. If you smoke cigarettes or use smokeless tobacco products, you should quit. Smoking can cause lung and other cancers and serious lung diseases such as emphysema. Even if you have been a long-term user of tobacco, stopping now will reduce your risk. The American Cancer Society in your area has programs to help you stop smoking. Finally, if you or your doctor have any questions about the potential for exposures at Rocketdyne to cause disease, call Dr. Craig Conlon at the Rocketdyne Medical Department (818) 586-9303.

How can I find out if I was exposed to radiation or chemicals while employed at Rocketdyne?

If you want to discuss your exposure to radiation while at Rocketdyne/Atomics International or your potential exposure to hydrazines or TCE, you can call Rocketdyne Safety, Health and Environmental Affairs at (800) 808-1160. They will be able tell you if you were in the radiation or chemical study groups. They can provide estimates of the amount of radiation you may have been exposed to, and the number of years you worked with potential exposure to hydrazines and/or TCE.

WORKER COMPENSATION.
As outlined in the Energy Employees Occupational Illness Compensation Act (EEOICPA), if you worked at Atomics International/ ETEC, you may contact the EEOICPA call center at 1-866-888-3322 or visit their web site for further details and eligibility information at http://www.dol.gov/esa/regs/compliance/owcp/eeoicp/main.htm

Are you eligible for medical benefits if you are sick or have cancer?

California has a workers' compensation program to cover medical care, time off work, and other expenses due to an occupational injury or illness. If you think you have a health problem that could be related to your work at Rocketdyne/Atomics International, contact the Rocketdyne Medical Department at (818) 586-9339 for medical consultation. If you would like more information about filing a workers' compensation claim, contact the local Information and Assistance Officer of the State Department of Industrial Relations located in your area (call 800-736-7401 to get the local number in your area). The telephone number for the Van Nuys office is (818) 901-5374.

How can I get more information about this study?

Information will be posted on the SSFL website, or you can call 800-808-1160 with your questions, and we will make sure that you receive additional information. In addition, scientific papers summarizing the research will be published in journals so that other scientists can review the methods used and the conclusions reached. Links to these papers will also be added to the SSFL website as the papers are available.

Environmental Communications
The Boeing Company/Rocketdyne
Attn: Inger Hodgson, MC-T487
6633 Canoga Avenue
PO Box 7922
Canoga Park, CA 91309

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