SANTA SUSANA FIELD LABORATORY EPIDEMIOLOGICAL STUDY:

REPORT OF THE OVERSIGHT PANEL

SEPTEMBER 1997

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Background

The epidemiological study of Santa Susana Field Laboratory (SSFL) workers was triggered out of two concerns: that workers on-site may have been affected by workplace exposures to radioactive and chemically hazardous materials and that releases of such materials from the facility may have harmed members of the neighboring community. SSFL operated nuclear reactors, handled plutonium and conducted rocket-engine tests. The events leading up to the establishment of the study included disclosures of a number of accidents involving nuclear reactors on the property, radioactive and chemical contamination affecting both on- and off-site areas, and a preliminary study suggesting elevated incidences of certain cancers in census tracts closest to the facility which, although not definitive, pointed to the need for a full-scale investigation. Since SSFL workers were expected to have higher exposures to the relevant radioactive and chemical materials than the nearby general population, it was decided that the appropriate next step was a detailed epidemiological study of the workers. If the study concluded there was no risk to workers, the issue of potential impacts on the neighboring community could also be put to rest. If the study did find deaths among the workers attributable to their exposures, additional follow-up study of the neighboring community might be in order.

The first phase of the worker study, dealing with potential impacts from exposure to radiation, is now complete. The second part of the worker study, dealing with chemical exposures, will be released at a later time. (Some analyses of chemical exposures are contained in the current study, but they are restricted to assessing whether such exposures could be a confounding variable with regard to radiation.)

The Oversight Panel

The study was performed by a team of researchers from UCLA and was overseen by an Oversight Panel. Five members of the Oversight Panel were selected by local legislators as community representatives. Four of the community representatives have technical backgrounds in safety engineering, physics, nuclear policy, and medicine. An additional seven members of the Panel were selected by the California Department of Health Services (DHS). Their backgrounds include community medicine, environmental science, industrial hygiene, and epidemiology. DHS had and has certain regulatory involvement in the site. The U.S. Department of Energy (DOE) – for whom part of SSFL was operated by Rocketdyne – provided a (non-voting) representative as well. An additional member of the Panel, British radiation epidemiologist Dr. Alice Stewart, was added to the Panel after its formation, upon the suggestion of the Panel itself. The Panel is co-chaired by Daniel Hirsch of the Committee to Bridge the Gap and David Michaels of the City University of New York Medical School. A complete list of the Panel members is included on page *i* of this report.

The Study's Findings

The primary question the study was designed to answer was whether workers at Rocketdyne/AI's nuclear sites have experienced excess deaths from cancer associated with their work-related exposures to radiation. The answer is yes.

The study found:

- Exposure of workers at SSFL to external (penetrating) radiation was associated with an elevated rate of dying from cancers of the blood and lymph systems and from lung cancer.

- Cancer death rates for all cancers and for "radiosensitive" solid cancers were found to increase as external radiation dose increased.

- Increased doses of internal radiation (i.e. from radioactive materials that were inhaled or ingested) similarly resulted in increased mortality rates for blood and lymph system cancers and for cancers grouped together by the investigators as the upper-aero-digestive tract, including cancers of the oral cavity, pharynx, esophagus, and stomach. 27.3% of the cancer deaths among workers with measurable internal radiation exposures were attributable to their workplace exposures to radiation.

The study results were primarily obtained by comparing higher exposed groups to lower exposed groups of the same worker population, which provides substantial power to the conclusions. Furthermore, although it isn't possible to completely rule out the possibility of confounding effects, the study found no evidence of any factor such as smoking or chemical exposure that could be responsible for the radiation impact seen.

The study also examined several issues of broader implication regarding risks associated with radiation exposure, making the following important findings:

- Although the cancer deaths at SSFL attributable to radiation exposure were dose-related, they occurred at doses substantially below those considered permissible by official U.S. and international regulatory bodies, thus raising questions about the adequacy of current regulations.

- The excess relative risk of "low-dose" radiation was at least 6 to 8 times greater than risks previously assumed on the basis of atomic bomb survivor data.

- There is an age effect – *e.g.*, older adults (over 49 years old) are more at risk from radiation than younger ones for all cancers and for "radiosensitive" solid cancers, including lung cancers.[1]

The SSFL study lends support on many of these points to recent work by Steve Wing, and George Kneale and Alice Stewart. It is noteworthy that many of the important findings of the SSFL study could be made because of the long follow-up period – permitting the detection of long-latency cancers that appear

many years after radiation exposure, which might have been missed in studies with shorter follow-up times, as well as permitting a better view of any age effect. This strongly argues for continued follow-up not only of the SSFL workers but of all radiation-exposed cohorts at other nuclear-related facilities, including many in which no or few effects had been found in studies of shorter follow-up duration.

Recommendations by the Panel

Based on the results of this phase of the study, the Panel recommends:

1. Follow-Up

a. The chemical phase of the study, examining whether exposure to hazardous materials resulted in deaths among the worker population, should be completed as soon as possible. We urge Rocketdyne and its new Boeing management to undertake every effort to provide all available data that would help to evaluate such exposures.

b. The Rocketdyne workers should continue to be followed. One of the advantages of the current study, giving it enhanced power despite the relatively small numbers of monitored workers relative to other studies, is the long follow-up period. Since only a small fraction of the monitored Rocketdyne workforce has yet died, additional, long-latency effects of the workplace exposures may yet be seen. Continued follow-up of the workers – indeed, both from SSFL and studies at other nuclear sites – should be undertaken.

c. A review of the feasibility of performing a follow-on study of the neighboring community should now be undertaken. As indicated above, one of the reasons for the establishment of the worker epidemiological study, in addition to concern for the workers themselves, was concern expressed by members of the surrounding community about possible harm from releases from the site. Since the worker study found radiation exposures did result in cancer deaths among the worker population, we recommend evaluation of the feasibility of performing a carefully constructed community study. The Panel will meet to explore this issue and report to the community regarding the need and feasibility of such a study. We recommend, if such a study is found feasible,

that it be conducted under the oversight of the Panel and by a contractor selected by the Panel, as was the case with the SSFL worker study.

2. Recommendations of Broader Application

a. The study makes several findings that call into question whether current regulatory exposure limits are sufficiently protective, and we recommend that regulatory bodies revisit their standards in light of the SSFL study and other recent studies that reached similar conclusions.

i. Nuclear workers are currently permitted to receive 5 Rem (also called 50 mSv) each year, the equivalent of 150 Rem (1500 mSv) over a 30-year career. The SSFL study, and several other large recent studies of radiation-exposed workers, have found evidence of cancers occurring from radiation at levels significantly lower than this regulatory limit. In light of these findings, we recommend that the current limits for radiation exposure be reconsidered by all regulatory and advisory bodies responsible for radiation protection.

ii. The SSFL study also found the excess relative risk from "low-dose" external radiation is at least 6 to 8 times greater than that assumed by current official risk factors which are based on extrapolation of the results of A-bomb survivor data to low doses. This finding of the SSFL study is in concordance with similar recent studies by Wing, *et al.*, and Stewart and Kneale and lends support for the premise that extrapolations from the Hiroshima/Nagasaki experience are not the appropriate basis for setting protective standards for workers or the general public.[2] In light of the finding in the SSFL and other recent studies that "low-dose" radiation may be a considerably more potent carcinogenic agent than presumed in current regulatory assumptions, we recommend consideration of these new studies by standard-setting bodies and the potential need to strengthen radiation protection regulations.[3]

iii. The study also confirmed a previously reported age-effect. Current regulatory standards are based on the presumption that radiation risk is essentially constant throughout adulthood. The SSFL study found, for a number of cancer types, that the risk increases with age at exposure. Regulatory

standards based on the assumption of uniform risk throughout adulthood should be re-examined.

b. Finally, we have a comment regarding the process of conducting epidemiological studies in controversial areas such as those involving Department of Energy nuclear facilities. Because of the troubled history of many past DOE studies, which has affected public confidence in their findings, the SSFL study operated under an innovative structure designed to involve the community in the study's oversight and assure the scientific integrity of the work by maintaining independence from either governmental or corporate interests responsible for the exposures and outcomes under investigation. While these efforts have not been entirely successful, nor always easy, we believe that establishment of Oversight Panels such as ours can be a useful model in attempting to enhance public confidence in such studies.

Oversight Panel's Conclusions Regarding the SSFL Study

- The UCLA research team was selected by the Oversight Panel after review of applications from all research groups who responded to an open Request for Proposals. The review included evaluation of the methods to be used and the analysis proposed to be performed.

- The UCLA team conducted the study according to those protocols and generally accepted research methods for studies of this type. The UCLA team reported periodically to the Oversight Panel in writing and in person.

- The principal limitations of the study were shortages of detailed exposure data and delays in access to information. These limitations do not compromise the Oversight Panel's confidence in the findings of adverse effects of radiation exposure.

- The Oversight Panel has confidence in the principal findings of the study.

- The Oversight Panel urges Rocketdyne, the U.S. Department of Energy, the California Department of Health Services, and other appropriate agencies to provide funding and access to data as required for completion of the chemical effects portion of the study, and other work as necessary.

- This study and the Oversight Panel's recommendations that flow from it should be brought to the attention of national and international bodies responsible for setting standards for radiation protection.

ENDNOTES

[1] For cancers of the blood and lymph systems, the study found an age effect in the other direction, with workers under the age of 50 more at risk.

[2] Some researchers have argued that the A-bomb data are skewed by a "healthy survivor" effect that would lead to an underestimate of radiation effects if extrapolated to a general population. The "healthy survivor" argument is that people with weaker immune systems were killed disproportionately by the original atomic explosions, so that the survivors are an unrepresentative group. The effect of radiation on the survivors, thus, would be partially masked by the fact that there was a bias in their selection, *i.e.*, greater resistance. This "healthy survivor" effect could explain why the SSFL study, the Wing et al. study of workers at Oak Ridge, and the Stewart and Kneale studies all indicate a radiation risk about an order of magnitude greater than estimates derived from the A-bomb survivors. We do not here pass judgment on this hypothesis, except to note that it provides a biologically plausible explanation for the finding in this and other recent studies of a larger number of cancer deaths attributable to radiation exposure than would be predicted from official risk estimates based on the A-bomb survivor data.

[3] Some groups have recently proposed relaxing official assumptions about the risks of "low-dose" radiation, arguing that standards that flow from them are too restrictive. See, *e.g.*, January 1996 proposal by Health Physics Society. These proposals appear ill-advised in light of the SSFL and other recent studies that indicate that, if anything, current standards underestimate radiation risks.