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SUBJECT: RHSB INFORMATION REPORT\* #9: EPIDEMIOLOGIC STUDY OF  
CIVILIAN EMPLOYEES AT THE PORTSMOUTH NAVAL SHIPYARD

Recently, the National Institute for Occupational Safety and Health (NIOSH) completed its retrospective cohort mortality study of workers at the Portsmouth Naval Shipyard. The NIOSH study was undertaken in response to Congressional directive, after a study by Najarian and Colton, published in May, 1978, reported a five-fold increase in proportionate mortality due to leukemia and a two-fold increase due to all cancers among workers employed in the maintenance of nuclear submarines at the shipyard. We previously have reported (RHSB Information Reports #3 & #7) on the results of a reanalysis of the proportionate mortality data which Colton claimed "lend some support to the notion that there may be a small but measureable increase in cancers as a consequence of low level industrial radiation exposure."

The NIOSH study, which investigated mortality among 24,545 male workers ever employed at the shipyard between January 1, 1952 and August 15, 1977, considered a larger group of workers and used more generally acceptable analytic methods than the earlier study. NIOSH compared the mortality experience of 7,615 radiation workers with that of the United States general population and that of 15,585 nonradiation workers at the shipyard. Standardized Mortality Ratios (SMR) were calculated by taking the ratio of observed deaths to deaths expected, based on the mortality rates of either the U.S. population or the nonradiation workers.\*\* The data analysis also examined mortality patterns by latency period and duration of employment.

\*RHSB prepares these Information Reports on a periodic basis. The discussions usually cover recent publications on controversial subjects in the field of radiologic health. The subjects previously mentioned are listed below.

- #1. Radiation-Induced Chromosome Aberrations in Nuclear Shipyard Workers
- #2. Rocky Flats Nuclear Weapons Plant
- #3. Update on Cancer Mortality Among Portsmouth Shipyard Workers
- #4. Update on Report by C.J. Johnson, MD, Regarding Cancer Incidence Near Rocky Flats
- #5. Update on TMI Health Research Studies
- #6. Reported Increase in Lung Cancer Incidence, Durango, Colorado
- #7. Update on Epidemiologic Studies of Portsmouth Naval Shipyard Workers
- #8. Cytogenetic Changes in the Nuclear Workers at Rocky Flats

\*\*A value of 100 would indicate that the measured effects in the exposed study population is the same as the effect in the comparison or normal population.

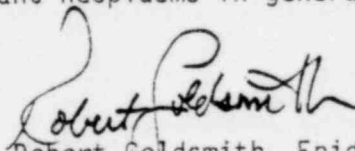
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The study, which achieved a 96% ascertainment of vital status, found neither excess mortality from malignant neoplasms nor from neoplasms of the blood and blood-forming organs noted in the earlier proportionate mortality study, although as performed, the study had more than a 99% probability of detecting the five-fold increased risk of mortality from leukemia found in the first study, if it had existed, and an 80% probability of detecting a two-fold risk.

Among the total shipyard population, 4,762 deaths were observed compared to 5,361 expected from U.S. rates, for an SMR of 89. No specific cause of death was statistically significantly in excess; most causes showed a deficit. This deficit was apparent for both radiation and nonradiation workers. Furthermore, no trends or excesses were noted for the hematologic diseases which were found in excess in the earlier study.

Although these results disagree with those from the earlier study, NIOSH states that "these findings must be interpreted with caution as they neither vindicate nor imply a relationship between low-level radiation and cancer." The principal reasons for this are that an insufficient period of time may have elapsed for currently latent cancers to manifest themselves, the number of workers with radiation exposure was relatively small (making it unlikely that a small excess might have been detected), and effects other than mortality were not yet studied.

One other factor should be taken into account in interpreting the results of the NIOSH study: the so-called healthy worker effect. This effect occurs when a standard population, such as all U.S. males, is used to generate expected numbers of deaths for an employed population. Since most populations of workers are healthier than the general population because the latter includes chronically ill or otherwise unemployable persons, SMRs for workers will usually be less than 100 (i.e., workers will have a deficit of mortality). Although the Portsmouth workers demonstrated a particularly strong healthy worker effect, this phenomenon does not have as much effect on neoplastic diseases as on other causes of mortality. The comparison of radiation workers directly with non-radiation workers partially controls for this effect, although other biases may have been introduced. One also can compare the overall SMR with disease-specific SMRs to partially control the healthy worker effect. This analysis shows that for both radiation workers and nonradiation workers the ratio of the SMR for lymphatic and hematopoietic neoplasms to that for all causes of death is 108. Thus, based on its mortality experience to date, there appears to be no significant association in this population between exposure to low-level ionizing radiation and mortality from malignant neoplasms in general, nor from hematologic diseases.



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