



Centers for Disease Control and Prevention  
National Institute for Occupational  
Safety and Health  
Robert A. Taft Laboratories  
4676 Columbia Parkway  
Cincinnati, OH 45226-1998  
June 21, 2004

Mr. William Knoll  
Naval Sea System Command  
1240 Isaac Hull Ave, SE  
Bldg 104  
Washington Navy Yard, DC 20376-8033

Dear Mr. Knoll:

The analytical epidemiologic study, "Mortality Update for the Portsmouth Naval Shipyard," by the National Institute for Occupational Safety and Health (NIOSH) has been completed with cooperation from the Navy. The study is an update of one published by NIOSH in 1981 that evaluated causes of death among civilian workers at the Portsmouth Naval Shipyard (PNS) and examined relationships between mortality and exposures to external ionizing radiation within this workforce. That previous study did not find an association between ionizing radiation exposure and cancer but the results were somewhat imprecise. Now two decades later, additional vital statistics information is available which provides the opportunity to draw conclusions with greater certainty. The study results summarized in this letter have been peer-reviewed.

The current study expanded the PNS study population (cohort) to include more recent employees. For all workers in the cohort, updated mortality information was received and the numbers of deaths for specific causes were compared with expected numbers of deaths based on the U.S. population. Additionally, statistical analyses to examine the relationship between radiation exposures and lung cancer and leukemia risks have also been completed.

The mortality study includes 37,853 male and female workers of all races ever employed at the Shipyard between January 1, 1952 and December 31, 1992. Three groups (subcohorts) were identified: 11,791 workers who received a recorded dose greater than zero millirem at the Shipyard (exposed radiation workers); 1,677 workers monitored for radiation with recorded lifetime doses of zero millirem (unexposed radiation workers); and 24,385 workers who were never radiation workers at the Shipyard (non-monitored workers).

Approximately two-thirds of the cohort was still alive through the study end date, December 31, 1996. Exposed radiation workers were more likely than non-monitored workers to be male (98% vs. 80%) and alive (71% vs. 60%) at study end date. Unexposed radiation-monitored workers were born earliest, and only 61% were still alive. On average, monitored employees worked almost twice as long as non-monitored workers.

Slightly fewer deaths occurred in the full cohort than would be expected from U.S. population rates. The ratio of the number of deaths observed to the number expected based on general population rates is defined as the Standardized Mortality Ratio (SMR). (An SMR of 1.0 would indicate that the number of deaths

observed for any cause of death is the same as the number expected.) For the updated PNS study, the SMR for all causes of death combined is 0.95. This deficit in overall mortality is statistically significant since the range that indicates the uncertainty in this value at the 95% confidence level is less than one (0.93 to 0.96).

Fewer deaths than expected were observed for tuberculosis, diseases of the heart, circulatory system, digestive system, and for accidents and violence. Slightly more deaths than expected occurred from all cancers combined, and from cancers of the lung and esophagus. Some results differed by subcohort, with excess asbestosis deaths limited to radiation workers and several smoking-related causes of death higher among non-monitored workers.

In the statistical analysis, the lung cancer and leukemia risks for radiation workers with higher doses were compared to those for monitored workers with no dose and lower doses while accounting for other exposures that may be related to these cancers. The lung cancer analyses considered exposures to asbestos and welding fume at the Shipyard as well as socioeconomic status which is often related to smoking behaviors. The leukemia analyses took into account the potential for Shipyard exposures to solvents which also may cause leukemia. Radiation doses were based on dosimetry records at the Shipyard with modifications for administratively assigned dose and offsite dose. Exposures to asbestos, welding fume, and solvents were estimated based on dates of employment, job titles and shop.

Overall, the number of deaths due to leukemia was as expected with an SMR of 1.01. The risk for leukemia rose, however, with increasing external radiation dose in the statistical analysis, though this result is not statistically significant. The estimated excess relative risk for leukemia deaths, which compares the risks for higher exposed workers with the risks for lower exposed and unexposed radiation workers, was 10.9% per rem (10 milliSievert) of radiation dose with an uncertainty range of -0.9% to 38.8% at the 95% confidence level. Lung cancer was elevated in two intermediate radiation dose groups, but was lower in the highest dose group when compared with the lowest dose group. When asbestos, welding fume, and socioeconomic status among monitored workers were included in the analysis, lung cancer risk did not increase with increasing radiation dose.

The findings of this study suggest that welding fume, smoking, and, to a lesser extent, asbestos exposures likely explain the excess lung cancer observed in some of the PNS workforce. The possible increased risk of leukemia observed with external radiation dose remained when solvent exposure and other factors were considered. The estimated excess relative risk of leukemia among PNS workers was within the range of risk estimates in previous epidemiologic studies but higher than the risk estimates from the Life Span Study among the atomic bomb survivors in Japan. These results, however, are limited by a number of factors and subject to considerable uncertainties such as exposure measurements for radiation, asbestos and welding fume. Case-control studies with additional exposure evaluation are underway to clarify the lung cancer and leukemia results seen in this cohort analysis.

The leukemia case-control analysis is scheduled for completion later this summer. We would like to visit to the Shipyard to present the findings of the study, and discuss any additional questions that you may have about the cohort mortality study findings at that time.

As soon as documents are finalized and published, copies will be provided to you. We anticipate the first article reporting the mortality update results will be published before the end of this month. The additional statistical model manuscript should appear later this year. A separate paper on the radiation dosimetry data adjustments has been accepted for publication and should be available soon. Following completion of the

lung cancer case-control study anticipated late this year, all reports and many informative appendices will be combined into a final report technical report. Copies will be made available to you.

NIOSH is providing this information to Mr. William Knoll, Naval Sea Systems Command, and the PNS union representatives: Mr. Arvard Woster, American Federation of Governmental Employees (AFGE); Mr. Donald Shaw, International Association of Fire Fighters (IAFF); Mr. Terry Eleftherion, International Federation of Professional and Technical Engineers (IFPTE); and Mr. Paul O'Connor, Metal Trades Council (MTC).

Please do not hesitate to contact me at (513) 841-4492 or Travis Kubale at (513) 841-4461 if you have any questions or need further information.

Sincerely,



David F. Utterback, Ph.D., C.I.H.  
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Health-Related Energy Research Branch  
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and Field Studies