Summary of Project No. CH-AT(11-1)-3428
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Study of the Lifetime Health and Mortality Experience of Employees of AEC Contractors

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I. PURPOSE:

The main purpose of this study is to ascertain whether or not any detectable life-shortening or increase in mortality has occurred among atomic energy workers, especially those exposed to occupational ionizing radiation compared to non-exposed employees selected from appropriate control populations.

II. APPROACH:

The approach developed has depended upon (1) abstracting and reconstructing personal identification data, work history data, and radiation exposure and other environmental exposure data from files normally retained by AEC Contractors; (2) converting the data to suitable ADP format for computer processing, (3) following deaths of employees, former as well as current, through Social Security records; (4) obtaining death certificates from the states for those who have died; (5) comparing gross mortality, as well as deaths by specific causes, for various population subgroups versus mortality experience of several independent control populations. The largest control populations, the 1% sample of covered workers available from Social Security Administration, can be matched for each employee for many pertinent characteristics other than radiation exposure.[1] The larger controls will be selected twice,[2] and independent controls selected from siblings and intra-plant comparisons will be utilized, to ensure that any differential findings of differences, or absences of differences, are consistent from one analysis to another.[3] Supplementary indices of health status utilizing employment status, causes of disability, and earnings have also been devised.[4] The total study populations at present comprise 170,000 atomic energy workers and about 800,000 controls.[5]

III. PROGRESS TO DATE (FEBRUARY, 1972):

After approximately eight years of project design and data collection, this study has just presented in November, 1971, its first paper, "Study of the Lifetime Health and Mortality Experience of Employees of AEC Contractors, Part I: Methodology and Some Preliminary Findings Limited to Mortality for Hanford Employees," at the Radiation Protection Standards Symposium of the Health Physics Society, Richland, Washington. This paper is now in publication[6] as part of a monograph[7] that summarizes the methodology and preliminary analysis of mortality of Hanford employees of 1944-1970, using only a limited number of our planned controls. The preliminary analysis of Hanford mortality shows that at least the risk of employment within the atomic energy program at Hanford is not grossly different from comparable populations not employed in atomic energy work, over its period of operation to date.

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However, the ultimate sensitivity of our project for detection of any mortality or health differences has not yet been realized.[8] The employees have not yet been compared to the larger, matched control populations to be obtained from the 1% sample of workers covered by Social Security. Moreover, the data have not yet been analyzed according to cause of death, levels of exposure to radiation and/or other environmental agents, length of employment, and work history. Thus, although no gross difference in mortality is seen between Hanford employees and presently available controls, these preliminary results cannot yet be taken to prove or disprove the presence of effects of low-level chronic radiation or other environmental agents in subgroups of the population, or at incidence levels below the current sensitivity of the analysis.

In brief, other specific accomplishments to date include:

1. Computerization of personal data, radiation exposure data,[9] and other pertinent data from Hanford, Oak Ridge, and some feed materials plant populations.

2. Development of automatic data recording and processing systems useful for future follow-up of study as well as other management uses.

3. Development of several independent ways of evaluating both gross mortality and mortality by specific cause of death, including statistical methods of testing the significance of any differences in mortality between employees and controls--both for entire plant populations as well as subgroups.

4. Pilot studies comparing average occupational exposure with medical x-ray exposures at Hanford, showing that medical radiographic doses, when averaged over the whole body, do not drastically change exposure categories according to external occupational exposures. The average somatic dose from medical x-rays was about 39 millirem versus 188 millirem occupational exposure from 1946-56 records.

5. Arrangements with the Social Security Administration for mortality data and additional criteria for analysis and with State Offices of Vital Statistics to follow up deaths and causes of death.

Essentially the project has now reached the point where the basic methodology and organization is complete.[10] The methodology that has been developed is such that these observations can be periodically repeated most economically[11] and quickly, since it solely requires the reprocessing by computer of the same magnetic tapes of the AEC population, study and control groups, which are kept on file and updated on a current basis to determine the additional data on deaths and disability that have occurred since the last processing. The statistical analyses can be readily performed by merely updating the data input to the tapes, utilizing the same

computer programs for repeated sequential analyses year after year. The unique advantage of the methodology of the AEC study is that it utilizes the elapsed time, since 1942 to present, to meet the requirements of the latent period for the development of biological effects, in contrast to initiating a study now and waiting 30 years to make the same observations.[12]

It is advisable and necessary to follow up all the employees and the control groups to the end of their life span in order to increase the person-years involved and to detect any biological effects that may be associated with a markedly prolonged latent period.

Moreover, experience to date indicates the continued pursuit of the project in atomic energy facilities will serve as a *modus operandi* for organized, uniform, and efficient methods of data retrieval for many other management purposes.

IV. SIGNIFICANCE OF PRESENT FINDINGS:

The findings to date have demonstrated the soundness of the epidemiological approach and sensitivity of the methods.[13] Under certain assumptions,[14] the discernible difference in life span detectable (at a 95 percent confidence level) is 41 days out of 70 years life span, if both the employee and control populations are enlarged to totals of 200,000 each. If the study is extended to all AEC facilities, with an estimated total population of 500,000 individuals employed since 1942, then the discernible difference would be less than one month.[15] Further, the planned methodology includes additional criteria of health such as differential mortality, disability and causes of disability, which all further increase the sensitivity of the study for detection of any possible health effects of radiation and/or other environmental exposures in the atomic energy program.[16] This would allow the confirmation or refutation of many of the current hypotheses regarding the risks of atomic energy and nuclear power.[17]

V. FUTURE PLANS:

We are continuing to gather data on causes of death and on suitable control populations to allow a finer examination of the population by specific causes of death in relation to specific areas of work within the plant, and other factors including exposure to radiation and/or other agents. In pursuing this course, we have found a need to expand the study to all principal atomic energy facilities,[18] not only to increase the population size but also to more completely fill in the exposure records of personnel who have transferred between AEC facilities. The ultimate results of the study of Hanford and Oak Ridge are unique to these facilities,[19] and cannot be generalized or projected to the experiences of any other or all of the AEC facilities relative to the biological effects of low-level ionizing radiation. Although the Hanford and Oak Ridge data will be important in defining scientifically the experience of these particular facilities, it would be invalid to conclude or extrapolate, if they experience no adverse effects, that this is the answer to the question of the biological effects of low-level ionizing radiation in all other AEC installations.[20]