

The Boice Report #37



*John D. Boice, Jr., NCRP President
ICRP Main Commissioner
UNSCEAR U.S. Alternate Representative
Vanderbilt Professor of Medicine*

The Million Worker Study—From Whence It Came

The dosimetry group for the Million U.S. Radiation Worker and Veteran Study (MWS) met 28–29 April 2015 in Oak Ridge for the fifth time. The worker populations have been assembled over the past 70 years by the U.S. Department of Energy (DOE), the U.S. Nuclear Regulatory Commission (NRC), the U.S. Department of Defense (DOD), the U.S. Department of Veterans Affairs (VA), and Landauer, Inc. This collection of worker rosters and dosimetry information forms the core of the MWS, which has been in the making for the last 30 years. The purpose of the MWS, as I often extol, is to provide new and critically needed information about low-level radiation risks when the exposures are received gradually over time and not instantaneously, as was the case for the 1945 atomic-bomb exposures in Japan. The need for this knowledge is reflected in [H.R. 35](#), a bill that is currently in the U.S. Senate, calling for the United States to develop a national strategy to meet the societal needs associated with the [ever-increasing population exposures](#) in medicine, nuclear waste and facility cleanups, nuclear power generation, increased air travel and cosmic-ray exposures, technologically enhanced naturally occurring radioactive materials ([TENORM](#)) in the environment from hydraulic fracturing, worker compensation, and the possibility of terrorist events.

Million Worker Study. The MWS includes 360,000 DOE workers starting with the Manhattan Project, 150,000 early nuclear power plant workers, 130,000 industrial radiographers, 115,000 nuclear weapons test participants, and over 240,000 medical workers. A pilot study completed in 2010 demonstrated feasibility and secured the cohort populations. Initial funding and support came from the DOE [Low-Dose Radiation Program](#) and Vanderbilt University. Interagency support then followed from NRC, the U.S. Environmental Protection Agency, the National Aeronautics and Space Administration, and the Centers for Disease Control and Prevention. The [atomic veterans](#) component is supported by a grant from the U.S. National Cancer Institute (NCI), with additional resources provided by DOD and the VA. The National Council on Radiation Protection and Measurements (NCRP) coordinates the multifaceted aspects of the MWS. The cost to provide new and essential knowledge on the risks of radiation under low-dose and low-dose-rate circumstances is only a tiny fraction of the costs that were expended to assemble the various cohorts by the various agencies over the past 70 years.

Department of Energy Workers. Since the early 1940s, DOE (and its predecessors) supported [health and mortality studies](#) of workers at over 20 nuclear weapons and nuclear material processing plants. One overarching goal was to combine these various uranium and plutonium worker populations to increase [statistical confidence](#) in observed health effects. These worker populations are being extended as a cost-effective way to enhance the information available on disease risk from exposures experienced in the workplace. Our most recent publication was on the [Mound facility](#) in Dayton, Ohio, where polonium was used in the development of the triggers necessary for the first atomic weapons. (Interestingly, [polonium biokinetic](#) models developed at Oak Ridge were used in the [British inquiry](#) into the poisoning of the Russian dissident Alexander Litvinenko.) An update of the [Rocketdyne](#) study also was published, and the [Mallinckrodt](#) chemical workers cohort update should be out this year. One uniqueness of these populations is the computation and incorporation of organ-specific doses from [intakes of radioactive elements](#) in assessing cancer risk. Attempts to combine these diverse worker populations have begun for heart disease.

Nuclear Regulatory Commission. By law, NRC is required to record [radiation dosimetry information from its licensees](#) to assure that they are in compliance with existing regulations. These data have been collected since the late 1950s, but it wasn't until 1994 that the reporting requirements changed and it was possible to make these data available for [epidemiologic study](#). Utility companies

also provided information back in time so there is relative completeness for workers employed from 1968 on. Gil Beebe and I, both at the NCI, had composed a letter that was sent by NCI Director Vincent DeVita, MD, to NRC Chairman Lando Zech in 1986 requesting the changing of the reporting requirements in order to develop a registry that would be [valuable for health studies](#). The wheels of government grind slowly, but in this case effectively, and the reporting requirements were changed (noted in a letter from NRC Chairman Kenneth Carr to NCI Director Samuel Broder in 1991), the registry was created, and we were able to identify and currently study 150,000 of the early nuclear utility workers as well as approximately 130,000 industrial radiographers who in those early years were reported to NRC and in the Radiation Exposure Information and Reporting System (REIRS).

Department of Defense/Department of Veterans Affairs. The United States conducted 230 aboveground nuclear weapons tests from 1944 through 1962. There were over 250,000 military participants at these tests, of which we are studying 115,000 who were involved in the relatively higher-dose detonations. DOD, in response to public laws, created a database of these veterans that could be and has been used for epidemiologic study. DOD funded the National Academy of Sciences to conduct several large studies of atomic veterans who participated at [Operation Crossroads](#) and at [five other series](#), and the VA conducted its own investigations at [Operation Hardtack I](#) among Navy veterans at the Pacific Proving Grounds. These assembled cohorts allowed us, again, to extend the follow-up for atomic veterans and conduct more accurate and comprehensive [dosimetry](#).

Landauer, Inc. In the early 1980s, NCI asked Landauer, Inc., to help with the dosimetry issues surrounding an early study of [x-ray technologists](#). At that time we recognized that the Landauer dosimetry information was potentially valuable for [assessing medical exposures](#) and later for identifying worker populations that could be studied for health effects. The Landauer database has millions of records that have been used to identify additional nuclear utility workers and industrial radiographers as well as workers in the medical profession.

Scientific challenges for the MWS remain but are being addressed effectively and efficiently. Challenges include obtaining information on the cause of death for workers who died before 1979 when the National Death Index became available; obtaining and processing [dosimetry information](#), including internal intakes of radionuclides; addressing dosimetric [uncertainty](#) in the statistical analyses (interestingly, since there appears to be minimal [shared errors](#) in these measurements, the estimates of the dose-response relationship appear not to be biased in a meaningful way, although errors in the width of the confidence intervals remain); addressing the challenges of combining the diverse datasets initially within the Rocketdyne, Mound, atomic veterans, and now Mallinckrodt datasets for heart disease; and finally, securing the funds necessary to complete the complex array of investigations. If full funding was received, the study could be completed in four to five years. At current levels, unfortunately, it will take much longer, although we are striving to publish completed segments along the way.

Million U.S. Radiation Worker and Veteran Study in Oak Ridge, April 2015



Front row, left to right, Andre Bouville (NCI, retired), Stephen Balter (Columbia University), John Boice (NCRP), Kathryn Pryor (Pacific Northwest National Laboratory), Rich Leggett (Oak Ridge National Laboratory), and Derek Hagemeyer (Oak Ridge Associated Universities); back row, left to right, Owen Hoffman (Oak Ridge Center for Risk Analysis), Cary Zeitlin (Southwest Research Institute), Marvin Rosenstein (NCRP Staff Consultant), Bruce Napier (Pacific Northwest National Laboratory), Terry Brock (NRC), Harold Beck (DOE, retired), Richard Toohey (M.H. Chew and Associates), Dan Stram (University of Southern California), R. Craig Yoder (Landauer, Inc.) Photo courtesy of Steve Simon