

The Boice Report #7



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Study of Atomic Veterans Who Participated at U.S. Aboveground Atmospheric Nuclear Weapons Tests, 1945–1962

It seems fitting that I am completing this column on atomic veterans on 11 November 2012, the day we honor all veterans. Last Friday my wife and I also attended a performance of *War Horse* at the Kennedy Center, a vivid portrayal of the drama and horrors of the First World War, which officially ended in Versailles some 94 years ago on 11 November 1918 (Armistice Day). One group of veterans who until somewhat recently received little recognition, however, is the 220,000 U.S. military personnel (atomic veterans) who participated in 236 aboveground atmospheric nuclear weapons tests conducted in 1945 through 1962 (Ball 2012, Hasson 2011, VBDR 2011). Testing stopped in 1963 with the signing of the Limited Nuclear Test Ban Treaty. Most of the testing occurred at the Nevada Test Site and the Pacific Proving Grounds. The National Academy of Sciences, funded by the U.S. Department of Defense (DOD), and the U.S. Department of Veterans Affairs (VA) have conducted mortality studies of atomic veterans, but the last follow-up was over 20 years ago (Johnson et al. 1996, Thaul et al. 2000, Dalager et al. 2000, Watanabe et al. 1995). Vanderbilt University, supported by a cooperative agreement from the National Cancer Institute, is extending the follow-up of over 115,000 veterans with detailed dose reconstructions for individuals (Boice 2011, 2012a). Participants at eight test series are included, with the code names Crossroads, Greenhouse, Upshot-Knothole, Castle, Redwing, Plumbbob, Hardtack I, and Trinity. Notable scientists in the study include J. Robert Oppenheimer, Enrico Fermi, and Hans Bethe, who were at the first nuclear test (Trinity) in 1945 at Alamogordo, New Mexico.

The Atomic Veterans Study is part of the One Million U.S. Radiation and Veterans Study, a national effort whose goal is to provide relevant, timely, and needed health data on the radiation risks derived from U.S. populations who received relatively high cumulative radiation doses, but delivered over many years and up to 70 years ago (Boice 2012b). The aim is to learn more about radiation risks following chronic low-dose-rate exposures and to contrast findings with the acute high-dose-rate exposures received by Japanese atomic bomb survivors. Study collaborators include colleagues from Vanderbilt University, Risk Assessment Corporation, International Epidemiology Institute, University of Southern California, Fred Hutchison Cancer Research Center, M.H. Chew and Associates, the National Cancer Institute, the VA, the Defense Threat Reduction Agency (DTRA), L-3 Communications, and Harvard University (see photo on page 8 of participants at the October 2012 meeting at Vanderbilt).

- **Aims of the Atomic Veterans Study.** Just over 115,000 soldiers, sailors, airmen, and marines present at one or more of the 230 aboveground detonations will be followed for an additional 20 years since last studied. All cancers and other causes of death, including heart disease, will be evaluated. A comprehensive dose-reconstruction methodology is being applied to estimate doses for specific cancers previously found to be increased, e.g., leukemia (Caldwell et al. 1983, Thaul et al. 2000), and for a representative sample of the cohort for comparison. External radiation exposures have been estimated for all atomic veterans, but are uncertain and require validation; dose reconstruction also includes intakes of radionuclides from inhalation or ingestion. Dose-response analyses will evaluate whether cancer and other outcomes are related to the radiation exposures received during participation at the nuclear weapons tests.

- **Dosimetry.** A unique aspect of the ongoing study is that individual dose assignments will be “best estimates” and not based on veteran-favorable assumptions or approaches used in compensation programs. New developments in statistical methodology also will be applied to account for the uncertainties in the reconstructed radiation doses (NCRP 2008, 2009, 2010, NRC 2003, Raine et al. 2007, Boice 2012a). The Nuclear Test Review and Information System (NuTRIS) database contains all available physical dosimetry information for every nuclear weapons test participant. Over 300 million dollars have been spent over the past three decades in developing the complex exposure scenarios used in individual dose reconstructions.
- **Exposure Scenarios.** Military unit exposure scenarios include direct gamma and neutron radiation from the detonation, gamma exposure from activated soils or deposited fallout, inhalation of descending fallout or resuspended fallout and activated soils, and ingestion of contaminated water or foodstuffs. Individual dose reconstruction for a particular veteran begins with the standard scenario common to all members of his unit and then takes into account any unique exposure situations the veteran may have encountered, such as maintenance of cloud-penetrating aircraft, reboarding target ships, or operating small boats in contaminated lagoons. Nearly 1,000 scenarios have been developed for use in dose reconstruction.
- **Castle Bravo.** Operation Castle involved shot Bravo, a thermonuclear detonation (15 megaton) that exceeded yield expectation (4-6 megaton) (DTRA 2007). The weather changed unexpectedly and exposed 28 Army and Air Force personnel stationed on Rongerik Atoll (the so-called weathermen) to the highest levels of radioactive fallout of all U.S. nuclear weapons test participants, estimated to be over 300 mSv (30 rem). It may be possible to conduct special biodosimetry studies of these personnel who are still alive. Other unique populations exposed during this test were the Rongelap Island population who developed high rates of thyroid cancer and Japanese fishermen on a tuna boat named Daigo Fukuryū Maru (Robbins and Adams 1989). The English translation of the name of the Japanese tuna fishing boat is the “Lucky Dragon.” Fuku is the Japanese word for luck. Similarly, Fukushima means “Lucky Island.” Neither the fishing boat nor the island were “lucky” with regard to radiation events.
- **Veterans’ Board for Dose Reconstruction (VBDR).** An overview of the Study of Atomic Veterans is presented at meetings of the VBDR (Boice 2011, Boice 2012a). The VBDR was formed in 2005 in response to a congressional mandate to provide guidance and independent oversight of the VA claims compensation program for atomic veterans (NRC 2003 and VBDR 2011). The compensation program includes a dose-reconstruction process to estimate the radiation dose the veteran may have received during military service. The VBDR exists to improve the overall process and to listen to veterans testify about their illnesses and any problems with the dose-reconstruction process or the VA claims decisions. Atomic veterans and their families can and should find out more about available compensation and benefits by calling their local VA Regional Office, by calling 1-800-827-1000, or by accessing websites such as www.publi-chealth.va.gov/exposures/radiation or <http://www.vbdr.org>. (See also Hasson 2011 and VBDR 2011). Recently, the New York State Senate passed a resolution proclaiming 15 July 2012 as Atomic Veterans’ Day in the state of New York (Ball 2012).
- **Operation Tomodachi.** The Operation Tomodachi Registry was developed after the Fukushima nuclear reactor accident that followed the Great East Japan earthquake and tsunami of 11 March 2011 (<https://registry.csd.disa.mil/registryWeb/Registry/OperationTomodachi/DisplayAbout.do>). It provides location-based radiation dose estimate reports for DOD-affiliated members who were in Japan during the nuclear reactor crisis, many responding to humanitarian needs. The NCRP is providing a peer review of the radiation dose assessments being developed and applied (http://www.ncrponline.org/Current_Prog/SC_6-8.html).

The DOD and VA support for the Atomic Veterans Study, the VBDR, and Operation Tomodachi reflect the appreciation as well as concern about the health and welfare of military personnel who were exposed to radiation during their service to our country.

Atomic Veterans Study Group Meeting, 10–11 October 2012
Vanderbilt University, Division of Epidemiology in Nashville, Tennessee



Front row left to right: Andre Bouville, Harold Beck, Paul Voilleque, Han Kang, John Boice, John Till; back row: David Fu, Ken Kopecky, Dan Stram, Helen Grogan, Justin Mohler, Shawn Mohler, Mike Mumma, Jill Aanenson, Dick Toohey, William Wu, Toy Story Observer

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