The Sound of Silence Project™

Fighting for Cold War Veteran Nuclear Weapons Technicians

Recognition and Compensation for America's Cold War Era Veteran Nuclear Weapons Technicians

Nuclear Weapons Ionizing Radiation and Toxic Substance Exposure

Inclusive dates: September 2, 1945 – December 26, 1991

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Wide dissemination of this document is encouraged

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Prologue

U.S. Military Veteran Nuclear Weapons Technicians' Contributions to the Nation

> Since World War II, tens of thousands of military men and women have served our Nation in sustaining its nuclear defense. In the course of their work, they overcame previously unimagined technical and personal challenges. Thousands of these courageous Americans, however, paid a high price for their service, developing disabling or fatal illnesses as a result of their exposure to ionizing radiation, toxic chemicals, and other hazards unique to nuclear weapons maintenance and testing. Too often, these military veterans were neither adequately protected from, nor informed of, the occupational dangers to which they were exposed.
>
> Existing veterans' compensation programs have failed to provide for the needs of these veterans and their families. Veterans' compensation programs have generally not included these Nuclear Weapons Technicians from the Cold War period. Further, because of long latency periods, the uniqueness of the dangers to which they were exposed, and inadequate exposure data, many of these individuals have been unable to obtain compensation benefits. This problem has been exacerbated by the policies of the Department of Veterans Affairs that discourage many legitimate claims of veterans who sought, and continue to seek, those benefits.
>
> While the Nation can never fully repay these veterans or their families, they deserve recognition and compensation for their sacrifices. [1]

The preceding statement was adapted from an excerpt of United States Presidential Executive Order (EO) 13179, December 7, 2000, "Providing Compensation to America's Nuclear Weapons Workers", Section 1, Policy. It is provided to demonstrate the distinct similarities of dangers faced by military Nuclear Weapons Technicians and civilian Nuclear Weapons Workers—the subjects of the Executive Order—during the Cold War.

Few changes were made to the statement except for references to Nuclear Weapons Technicians (military veterans) replacing Nuclear Weapons Workers (civilian employees); "maintenance" replacing "production"; difficulties with Department of Veterans Affairs claims replacing Department of Energy (DOE) opposition to civilian claims; the number of veterans compared to civilian DOE workers and contractors; and the addition of toxic chemicals.

Nuclear Weapons Technicians—U.S. military veterans—served our Nation during the Cold War period, helping to maintain a strong, reliable nuclear weapons defense and deterrence.

While we kept the "secrets" of our profession from our families, they also served the Nation by providing support and enduring the hardships brought by these conditions.

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[1] The wording is adapted from an excerpt of Executive Order 13179, December 7, 2000, "*Providing Compensation to America's Nuclear Weapons Workers*", Section 1, Policy. Original wording is in italics. https://www.govinfo.gov/content/pkg/FR-2000-12-11/pdf/00-31692.pdf

National pride and dedication, coupled with the critical nature of our military duties, often masked the risks and dangers we encountered—whether on land or at sea. Many of these risks were never disclosed to us by those responsible for our safety, health, and lives.

Nuclear Weapons Technicians, due to the immediate and sustained impact on national security and the secrecy surrounding their missions, form an almost unknown group of thousands of U.S. military veterans. Many of these veterans have already passed away, their contributions and sacrifices largely unrecognized.

Our primary duties were to maintain, repair, disassemble, replace components, assemble, modify, test, calibrate, transport, and store live nuclear weapons in the care and custody of the U.S. Army, Navy, Marine Corps, and Air Force. These routine tasks exposed veterans to ionizing radiation every time we worked on or near a live nuclear warhead, weapon, or weapon system.

Nuclear Weapons Technicians also worked without adequate respiratory and other personal protection from toxic and carcinogenic chemicals, organic solvents, compounds, and metals during nuclear weapons and associated equipment maintenance.

According to current federal law, Title 38, U.S.C., Veterans' Benefits, the Department of Veterans Affairs (VA) does not consider the duties of U.S. military veteran Nuclear Weapons Technicians to be a "Radiation-Risk Activity," nor does it recognize our exposure to ionizing radiation and toxic substances as occupational causes of cancers, other diseases, or debilitating illnesses.

The Department of Defense (DOD) defines occupational exposure to radiation as: "Routine exposure of DOD personnel to radiation associated with DOD operations during performance of their official duties." [2] This definition confirms that the duties of U.S. military veteran Nuclear Weapons Technicians, as described in this document, constitute a "Radiation-Risk Activity" and "Exposure to Radiation during Military Service."

The VA does not grant "presumption of exposure" to veteran Nuclear Weapons Technicians, unlike several other categories of veterans. This is despite the fact that hundreds of thousands of civilian DOE Nuclear Weapons Workers and contractors receive such presumptions under the Energy Employees Occupational Illness Compensation Program Act of 2000.

This document provides examples of the duties and risks faced by veteran Nuclear Weapons Technicians. While we are a proud group, many of us face a sobering and uneasy reality. We were exposed to significant dangers and ionizing radiation without our knowledge or consent, lacking both adequate warning and protection. As a result, many suffer from serious, preventable medical and health issues, and some have tragically lost their lives.

We are simply asking for the same recognition, support, health care, and related benefits that other military veterans receive.

[2] DODI 6055.8, Occupational Radiation Protection Program, 31 March 1989, Definition, Occupational Exposure

Introduction

The Sound of Silence Project was created to address decades of problems related to veterans' exposure to nuclear weapons intrinsic radiation (INRAD)—ionizing radiation emitted through the nuclear weapon surface or directly from exposed weapon components[3]—and the routine use of toxic and carcinogenic chemicals and other substances. These exposures have resulted in illnesses, diseases, debilitating medical conditions, and deaths.

This document outlines the project's goals and objectives, historical practices in nuclear weapons maintenance, and evidence of decades of negligence at the highest levels of the Department of Defense regarding personnel ionizing radiation safety programs and practices, as well as unsafe work practices and conditions involving toxic and carcinogenic chemicals, organic solvents, and compounds or metals.

It addresses shortcomings due to the Department of Veterans Affairs' (VA) lack of comprehension regarding the radiation-risk activities in routine nuclear weapons maintenance procedures and the absence of ionizing radiation dose data due to the military's failure to adequately monitor and manage exposures to live nuclear weapons.

The Department of War/Department of Defense (DOD), in its treatment of military Nuclear Weapons Technicians during the Cold War, shares a regrettable distinction with the Atomic Energy Commission/Department of Energy (DOE) in its treatment of employees during the same period. DOE was rebuked in the "Findings, Sense of Congress" paragraph 3602(a)(1) of the *Floyd D. Spence NDA Act for FY 2001*:

> "*Since the inception of the nuclear weapons program and for several decades afterward, a large number of nuclear weapons workers at sites of the Department of Energy and at sites of vendors who supplied the Cold War effort were put at risk without their knowledge and consent for reasons that, documents reveal, were driven by fears of adverse publicity, liability, and employee demands for hazardous duty pay*."
>
> "*Many previously secret records have documented unmonitored exposures to radiation and beryllium and continuing problems at these sites across the Nation, at which the Department of Energy and its predecessor agencies have been, since World War II, self-regulating with respect to nuclear safety and occupational safety and health. No other hazardous Federal activity has been permitted to be carried out under such sweeping powers of self-regulation.*"[4]

The DOD failed to protect Nuclear Weapons Technicians and, through secrecy, shielded itself from responsibility for contributing to—and arguably causing—cancers, other illnesses, and deaths among thousands of veterans. The DOD, through individual military services, continues to provide information that contradicts and harms veterans' legitimate VA claims and is not forthcoming with the facts and circumstances regarding the absence of detailed written documentation of veterans' duties and actual radiation and toxic chemical exposures. Much of this information was classified as Secret or Top Secret during the Cold War period, depending on location and mission. Generally, veterans have not received written or other formal confirmation relieving them from the secrecy requirements.

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[3] Nuclear weapons emit intrinsic radiation (INRAD): "*Ionizing radiation emitted through the weapon surface or directly from exposed weapon components.*" DOE-DTRA TP 4-1, Army TM 39-4-1, Navy SWOP 4-1, Air Force T.O. 11N-4-1 IC1 30 July 2016, Glossary of Nuclear Weapons Material and Related Terms.

[4] Title XXXVI-EEOICP, Findings https://www.govinfo.gov/content/pkg/COMPS-10420/uslm/COMPS-10420.xml

Nuclear Weapons Technicians and Similar Job Classifications, Titles, Ratings, MOS, Specialty, etc.

Thousands of Nuclear Weapons Technicians and those with synonymous military specialty titles in the U.S. Army, Navy, Marine Corps, and Air Force performed maintenance and other tasks on numerous series of live nuclear weapons and warheads during the Cold War period, defined as September 2, 1945, through December 26, 1991. [5] For this project and the formal processes to follow, those are the specific beginning and ending dates.

The term "Nuclear Weapons Technician" is used throughout this project to represent:

> "U.S. military veterans whose primary duties and responsibilities included operations working on, with, and in close physical proximity [6] to live nuclear weapons or exposed radioactive nuclear weapon components in the operational or custodial control of the Department of Defense. The term includes nuclear weapons technical inspectors, supervisors, and managers whose duties routinely required them to be in close physical proximity to live nuclear weapons and exposed to INRAD." The term "nuclear weapon" is synonymous with "nuclear warhead" herein.

Nuclear weapons operations included handling, transport, disassembly, limited life component exchange, assembly, testing, repair, calibration, modification, storing, and other directly related hands-on maintenance or inspection tasks conducted primarily on land, ships, and submarines.

> "Disassembly is the process of taking apart a nuclear warhead and removing one or more subassemblies, components, or individual parts. Disassembly may be required to support quality assurance inspection, reliability testing, or subassembly/component exchange as part of scheduled maintenance or refurbishment; it is normally done in a manner that permits re-assembly with either the original or replacement subassemblies/components." [7]
> "Dismantlement is the process of taking apart a nuclear warhead and removing all subassemblies, components, and individual parts for the purpose of the physical elimination of the nuclear warhead..." [8]

Nuclear Weapons Technicians routinely worked with toxic and carcinogenic chemicals, organic solvents, compounds, and metals during nuclear weapons operations and related maintenance of nuclear weapons test, handling, and support equipment.

The scope of this project does not apply to administrative staff whose duties did not require them to actively participate in maintenance activities or remain in intrinsic radiation-risk areas. It also excludes work with nuclear weapon trainers; and missile launch crews, air crews, and other job specialties, classes, MOS, ratings, and AFSCs where ionizing radiation exposure from nuclear weapons and their components was both minimal and infrequent.

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[5] The Cold War period was established as September 2, 1945, to December 26, 1991, by the 1998 National Defense Authorization Act. https://www.congress.gov/105/bills/hr1119/BILLS-105hr1119enr.pdf

[6] *Close physical proximity,* as used in this and related project documents, is specific to nuclear weapon maintenance bays, storage structures, compartments, rooms, torpedo rooms, vaults, aircraft, and other "Two-Person Rule" areas where live nuclear weapons were stored, maintained, tested, inspected, or transported.

[7] DOD, Nuclear Matters Handbook 2020 (revised), Glossary. https://www.acq.osd.mil/ncbdp/nm/NMHB2020rev/

[8] Ibid.

Project Goals

Priority One Goals of The Sound of Silence Project

Introduce and Pass Legislation as Outlined In The Proposed Bill Draft: An Act to amend Title 38 of the United States Code, may be cited as the "Cold War Veteran Nuclear Weapons Technician Act" or the "Cold War Veteran Nuclear Weapons Technician Ionizing Radiation and Toxic Exposure Act." This Act will:

- Designate the duties of each Nuclear Weapons Technician as a "Radiation-Risk Activity" and each Nuclear Weapons Technician as a "Radiation-Exposed Veteran."
- Presume service-connection for ionizing radiation exposures.
- Designate the duties of each Nuclear Weapons Technician as a "Toxic Exposure Risk Activity" and each Nuclear Weapons Technician as a "Toxic-Exposed Veteran."
- Presume service connection based on toxic exposures.

Subsequent to Legislation Passed and Signed (Veterans Administration):

- Set aside, without prejudice, previous denial(s) of related claims and appeals.
- Accept/grant related claims and appeals submitted prior to, during, and after this process.
- Provide all due consideration, benefits, and compensation.

Priority Two Goals of The Sound of Silence Project

Release From Secrecy Agreements:

Request: The Secretary of Defense (SECDEF) should publicly provide a document to formally and permanently release veteran Nuclear Weapons Technicians from secrecy agreements signed or otherwise sworn to during the Cold War period. The document should include, at a minimum, the following or similar language:

> "For any period of U.S. military service through December 26, 1991, I hereby authorize veteran Nuclear Weapons Technicians as well as those with equivalent military specialty titles in the U.S. Army, Navy, Marine Corps, and Air Force to disclose the name, location, and period of their commands, organizations, duties performed, dates of service, and related information necessary to validate exposure to ionizing radiation from live nuclear weapons and toxic chemicals. They may share this information with family members and others as desired."

Recommendation: A Presidential Executive Order should be issued to release veteran Nuclear Weapons Technicians from their secrecy agreements and requirements. This order should include historical information similar to that found in Executive Order 13179 of December 7, 2000, "Providing Compensation to America's Nuclear Weapons Workers," which acknowledged radiation and toxic exposures among DOE civilian employees and contractors.

Additional Goals (Formal Acknowledgement)

Regarding Ionizing Radiation Exposures, acknowledge the following:

- Exposures to ionizing radiation emitted from live nuclear weapons and related components.
- The continuous emission of ionizing radiation through live nuclear weapon cases.
- Nuclear Weapons Technicians were neither informed about nor protected from those ionizing radiation sources.
- Ionizing radiation exposures from live nuclear weapons caused or may cause the development of cancers, certain other diseases, mutagenic changes, and chronic or debilitating medical conditions.
- Nuclear Weapons Technicians, unaware of their exposure to dangerous ionizing radiation, were not given the opportunity or option to decline such exposure.
- The risks of unknowingly transporting radioactive alpha particles on their clothing to their living quarters, thereby exposing family members and others to ionizing radiation.
- The risks of ionizing radiation exposure to fertility, unborn children, and the potential to cause birth defects.

Regarding Toxic Chemicals and Other Substances, acknowledge the following:

- Numerous carcinogenic and other toxic chemicals, organic solvents, and volatile organic compounds were required for use on nuclear weapons and related equipment as directed by technical manuals published under the direction of the Department of Defense; the Defense Nuclear Agency; and the Atomic Energy Commission/Department of Energy.
- Nuclear Weapons Technicians used carcinogenic and other toxic chemicals, metals, and substances, generally without adequate personal protective equipment or restrictions.
- The risks of carcinogenic and other toxic chemicals, metals, and substances to reproduction, unborn children, and their potential to cause birth defects.

Regarding Ionizing Radiation and Toxic Chemical Exposures in Aggregate:

- Acknowledge the chronic health risks from aggregate exposures to both ionizing radiation and toxic chemicals.

Regarding Secrecy, acknowledge:

- **Secrecy in the Workplace:** Secrecy agreements and related requirements, generally expected to be honored for the life of the veteran, prevented Nuclear Weapons Technicians from being informed of, asking about, and discussing exposures to ionizing radiation from nuclear weapons
- **Secrecy Restrictions:** Secrecy prevented veterans from voicing concerns about potential dangers from toxic chemicals and other substances that were generally used without restrictions or adequate personal protection.
- **Impact on VA Claims:** Veterans were unable to submit detailed claims to the VA. Among those who filed, large numbers of claims and appeals were denied (including posthumously) as a result.
- **Lack of Notification:** Veterans have not been officially and publicly relieved of these secrecy requirements nor notified accordingly.

Project Objectives (Recommended "Findings of Congress")

Ionizing Radiation: Provide the public with awareness of the substantial dangers of ionizing radiation exposure from live nuclear weapons during maintenance and other routine operations. Inform them that, in general, during the Cold War period:

- Nuclear Weapons Technicians routinely maintained, repaired, disassembled, assembled, modified, tested, transported, and conducted other hands-on tasks on the Nation's nuclear weapons stockpile. Tasks were completed with hands, arms, and face in the weapons; and torsos pressed against the exterior; exposed to ionizing radiation from multiple angles.
- Nuclear Weapons Technicians worked without time or distance restrictions or adequate shielding from ionizing radiation sources during nuclear weapons operations.
- Nuclear Weapons Technicians worked without established ionizing radiation dose limits.
- Nuclear Weapons Technicians were not consistently, continuously, and accurately monitored for individual ionizing radiation doses, e.g., with personal dosimeters. Nuclear Weapons Technicians worked without knowledge of individual real-time or cumulative monthly, annual, or lifetime ionizing radiation doses.
- Nuclear Weapons Technicians' ionizing radiation exposure records are incomplete or nonexistent due to the inconsistency or absence of radiation dose monitoring.
- Nuclear Weapons Technicians were routinely exposed to ionizing radiation without personal safety restrictions such as current ALARA [9] and INRAD safety programs.
- A 1983 Department of Energy "Intrinsic Radiation Intercomparison Workshop" [10] report acknowledged decades of problems with inconsistent and inaccurate radiation measurements and measurement diversity that was not understood.
- Nuclear Weapons Technicians developed occupational chronic and debilitating medical conditions, cancers, other diseases, and lost lives due to ionizing radiation.
- Nuclear Weapons Technicians may have had offspring with health issues, diseases, and chronic, debilitating, or fatal medical conditions due to ionizing radiation.

Toxic Exposure: Provide the public with an awareness and comprehension of our routine and frequent use of toxic and carcinogenic substances during the Cold War period. For example:

- Nuclear Weapons Technicians routinely used toxic and carcinogenic chemicals, organic solvents, compounds, and toxic metals without adequate personal protective equipment or restrictions. Most of those substances are known toxins, carcinogens, mutagens; harmful to the central nervous system, peripheral nervous system, and numerous other organs; and/or toxic to reproduction (fertility and unborn children) and offspring.
- Nuclear Weapons Technicians developed occupational health issues, chronic and debilitating medical conditions, cancers, and other diseases.
- Nuclear Weapons Technicians may have had offspring with medical/health issues due to the use of toxic and carcinogenic chemicals, compounds, metals, and other substances.

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[9] ALARA (As Low As Reasonably Achievable) via time, distance, and shielding. A philosophy of ionizing radiation protection practices in DOE Guide to ALARA, April 1980; adopted by DOD, Army, Navy, Air Force and Marine Corps, e.g., DODI 6055.08 C2, 8 Aug 2018; AR 40-14 15 Mar 1982; NAVMED P-5055 Feb 2011; AF PD 91-1 21 May 1993.

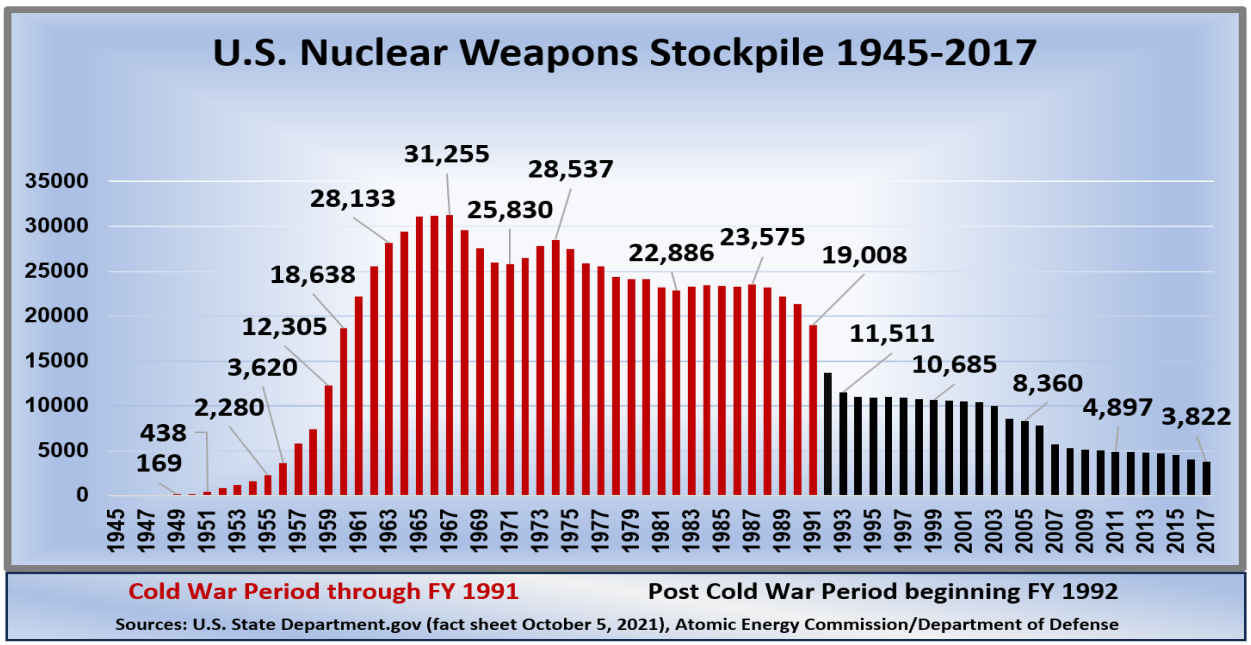
[10] Holt, J., Holton, R., Nelson, R., Riel, G., & Robinson, R. (1983). *Intrinsic Radiation Intercomparison Workshop. Summary report by the Weapon and Environment Sub-Group of the Intrinsic Radiation Working Group* (No. UCRL-53386). Lawrence Livermore National Lab., CA (USA). Abstract: https://www.osti.gov/biblio/6195704

Nuclear Weapons Deployed to the Department of Defense During the Cold War Period – Maintained by Nuclear Weapons Technicians

Information about the various designations, types, and quantities of nuclear weapons maintained by Nuclear Weapons Technicians during the Cold War provides a unique perspective on the scale and complexity of their tasks. The weapons in the U.S. stockpile from 1947 to 1991 are listed in the table below. The terms "warhead" (W), "bomb" (B), and "weapon" are used interchangeably. Some weapons, such as "atomic demolition munitions (ADM)," are referred to as bombs, although they were not designed or used in the traditionally accepted configuration. MADM refers to Medium Atomic Demolition Munition, SADM to Special Atomic Demolition Munition, and AFAP to Artillery Fired Atomic Projectile. The number of nuclear weapons in the U.S. stockpile is indicated in the subsequent chart.

MK-I Littleboy, Strategic Bomb	W31 Nike-Hercules/Honest John SSM/ADM	B54 SADM
MK-III Fatman, strategic Bomb		W54 Falcon AAM/Davy Crockett
B3/MKIII Strategic Bomb	W25 Genie AAM/Little John Missile/ADM	
B4/MKIV Strategic Bomb		W56 Minuteman II ICBM
T-4 Atomic Demolition Munition	W33 8-inch AFAP	B57 Tactical Depth Charge/Strike Bomb
B5 Strategic Bomb	W34 Astor ASW/Hotpoint Tactical Bomb/Lulu Depth Bomb	
W5 Matador/Regulas Missiles		W58 Polaris A3 SLBM
B6 Bomb	W35 Atlas ICBM/Titan ICBM/Thor IRBM	W55 SUBROC
B7 Tactical Bomb/Depth Charge		W59 Minuteman Y1 ICBM
W7 Corporal SSM/Honest John/BOAR ASM/Betty Nuclear Depth Bomb (NDB)/Nike-Hercules SAM/ADM	B36 Strategic Bomb	B61 Strategic/Tactical Bomb
	W38 Atlas ICBM/Titan ICBM	
	B39 Strategic Bomb	W62 Minuteman III ICBM
B8 Penetrator Bomb	W39 Redstone Tactical Missile	W63 Lance SSM
W9 280mm AFAP	W40 Bomarc Strategic SAM/Lacrosse Tactical Missile	W65 Sprint SAM
B11 Hard Target Penetrator Bomb		W66 Sprint SAM
B12 Tactical Bomb	B41 Strategic Bomb	W68 Poseidon C3 SLBM
B14 Strategic Bomb	W42 Hawk/Falcon	W69 SRAM ASM
B15 Strategic Bomb	B43 Strategic/Tactical Bomb	W70 Lance SSM
B17 Strategic Bomb	W44 ASROC Missile	W71 Spartan SSM
B18 Strategic Bomb	W45 MADM/Little John	W72 Walleye Tactical Bomb
B19 280mm AFAP	SSM/Terrier SAM/Bullpup ASM	
B21 Strategic Bomb	W47 Polaris A1/A2 SLBM	W76 Trident II SLBM
W23 16 in. AFAP	W48 155mm AFAP	W78 Minuteman III ICBM
B24 Strategic Bomb	W49 Atlas/Thor ICBMs, Jupiter/Titan IRBMs	W79 8 inch AFAP
B27 Strategic Bomb		W80 ALCM/SLCM
W27 Regulus SLCM	W50 Pershing 1a SSM	B83 Strategic Bomb
B28 Strategic/Tactical Bomb	W51 Falcon/Davy Crockett	W84 GLCM SSM
W28 Hound Dog ASM/Mace Ground Launched Cruise Missile	W52 Sergeant SSM	W85 Pershing II SSM
	B53 Strategic Bomb	W87 Minuteman III ICBM
W30 Talos AAW/TADM (T=Tactical)	W53 Titan II ICBM	W88 Trident II SLBM

Source: Nuclear Matters Handbook 2020 Revised https://www.acq.osd.mil/ncbdp/nm/NMHB2020rev/chapters/chapter4.html



Ionizing Radiation

Live nuclear weapons (unexploded – for VA clarification)[11] in the custody of the Department of Defense during the Cold War period contained weapons-grade plutonium and/or uranium. These weapons emitted four primary types of ionizing radiation: Alpha, beta , gamma, and neutron. Ionizing radiation impacts the immune system, damages DNA cells in our body, and kills cells.[12] Note: Neutron radiation was largely unknown to Nuclear Weapons Technicians throughout our time in service and for decades afterward.

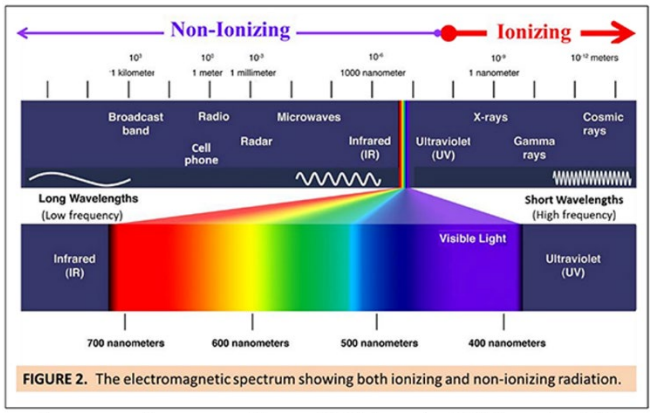


Chart source: Department of Energy, EHSS Information Brief, December 2017

Electromagnetic (EM) Spectrum

Electromagnetic radiation is energy that travels as particles or waves, spreading out as it goes.

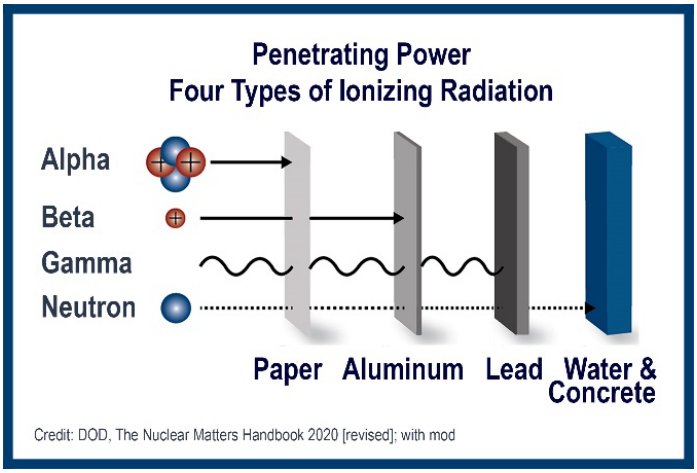
Radiation can be categorized into two types: non-ionizing and ionizing. As depicted in the chart, radio waves, microwaves, and infrared radiation are non-ionizing. Ionizing radiation, on the other hand, can break molecular bonds, causing serious damage to cells. With its shorter wavelengths, ionizing radiation damages structures inside cells, such as DNA and proteins, and can cause mutations. These mutations can result in various problems for cells, including cancer and other diseases or illnesses. Mutated DNA can be passed to offspring through the reproductive process, potentially leading to genetic disorders, congenital defects, and/or cancer.

[11] Denied VA claim/appeal decision(s) included incorrect and irresponsible comments stating unexploded nuclear weapons were not radiation risks because they were "*sealed and shielded*".

[12] Low dose IR effects on the immune system. Reviewed 6-15-24. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8784945/pdf/nihms-1768466.pdf

Penetrating Power of Various Types of Radiation

Alpha Particles (α-particles)



Alpha particles have the least penetrating power and can be stopped by a sheet of paper or human skin. However, if inhaled, ingested, or introduced into the body through a scrape or cut, alpha particles become extremely dangerous. In these situations, they can damage sensitive living tissue and cause severe harm to cells and DNA. The biological damage caused by alpha particles is as much as 20 times greater (weighting factor, or relative biological effectiveness [RBE]) than that caused by gamma and beta radiation.[13]

Nuclear Weapons Technicians often had to rub off radioactive material that separated ("spalled") from the surface of internal uranium or plutonium components as a result of the normal radioactive decay process. Much of this spalling material consisted of alpha particles that subsequently became airborne or contaminated clothing. Significant portions of these radioactive particles ended up (undetected) on the uniforms of the Technicians, making it easy for the dangerous particles to be transported to their barracks, homes, and family members.

Alpha Particle Facts Unknown to Most Cold War Veteran Nuclear Weapons Technicians

"Plutonium predominantly emits alpha particles—a type of radiation that is easily stopped with a short range—and also neutrons, beta particles, and gamma rays. *The alpha radiation makes it a serious internal hazard, made worse by its immobility in the body where it can remain for decades—as much as 80% of any amount absorbed will remain 50 years later.* Just a few micrograms distributed through the lungs, liver, or bones can statistically increase the likelihood of cancer. This has contributed to its reputation as one of the most toxic substances known— the Department of Energy's limit of occupational concentration in air is about a million times lower than for lead..." [14]

Beta Particles (β-particles)

Beta particles are lighter than alpha particles and can penetrate the skin more deeply, traveling several feet in the air. However, they can be stopped by a fraction of an inch of metal or plastic.

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[13] Centers for Disease Control and Prevention (CDCP) (2015): European Nuclear Society, "Learning from Fukushima: Nuclear power in East Asia, 2017." https://press-files.anu.edu.au/downloads/press/n3873/pdf/ch08.pdf, p. 222.

[14] Los Alamos National Laboratory, "A History of Plutonium", Properties, by Owen Summerscales, September 21, 2022. https://discover.lanl.gov/publications/actinide-research-quarterly/first-quarter-2022/shining-light-on-a-dark-element/ . Retrieved 11-21-23, reviewed 1-6-24.

Gamma and Neutron Radiation

"Gamma rays (γ-radiation) are a radiation hazard for the entire body. They can easily penetrate barriers that can stop alpha and beta particles, such as skin and clothing. Gamma rays have so much penetrating power that several inches of a dense material like lead, or even a few feet of concrete may be required to stop them. Gamma rays can pass completely through the human body; as they pass through, they can cause ionizations that damage tissue and DNA." [15]

Gamma (and neutron) radiation is continuously emitted through the exterior cases of live nuclear weapons endangering personnel during maintenance, disassembly, internal limited-life component exchange, handing, modification, transport, and storage.

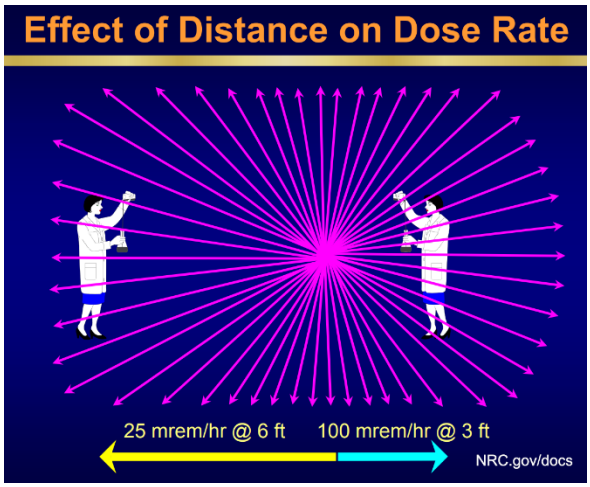
Neutron radiation also causes surrounding items, including hardware and materials inside or near the nuclear weapon, to become radioactive through a process called "neutron activation." Shielding against neutron radiation requires thick layers of materials rich in hydrogen, such as water or concrete.[16] The radiation weighting factor [W^R or W_R] of ionizing neutron radiation is 5 to 20 times greater than that of gamma and beta ionizing radiation, depending on neutron energy.[17] Radiation tissue weighing factors (W_T) "…allow for variations in radiation sensitivity of different organs and tissues to the induction of stochastic effect." [18]

CDC, NIH, and NRC provide a recommended weighting factor of 5 or 10 if the neutron energy is not known.[19] Per DOE: "*When spectral data are insufficient to identify the energy of the neutrons, a radiation weighting factor of 20 shall be used*." [20] Ionizing radiation weighting factors must be considered when calculating the effective dose of ionizing radiation exposure to ensure an accurate assessment of potential health risks.

Emissions of the four types of nuclear radiation persist through the natural process of radioactive decay. Materials used in nuclear weapons typically have half-lives ranging from 24,000 years to approximately 700 million years (U^{235}).[21]

[15] Radiation Basics, EPA. https://www.epa.gov/radiation/radiation-basics#ioniandnonioni Reviewed 6-18-24
[16] DOD Nuclear Matters Handbook 2020 (revised), Ch 11, p. 134
[17] CDC (2015). Table 8-1, Radiation weighting factor. Note: https://www.nrc.gov/reading-rm/doc-collections/cfr/part020/part020-1004.html. Includes "Quality Factor" of 10 for "Neutrons of unknown energy"
[18] Fisher DR, Fahey FH. Appropriate Use of Effective Dose in Radiation Protection and Risk Assessment. Health Phys. 2017 Aug;113(2):102-109. doi: 10.1097/HP.00000674. PMID: 28658055; PMCID: PMC5878049.
[19] Ibid. CDC (2015)
[20] U.S. Department of Energy, PNNL-15750 Rev. 1.1 PNL-MA-842 May 1, 2010
[21] Nuclear Weapons Technology 101 for Policy Wonks, B. Goodwin, Lawrence Livermore National Lab, 2021, p10.

Inverse Square Law Applied to Intrinsic Radiation Exposure



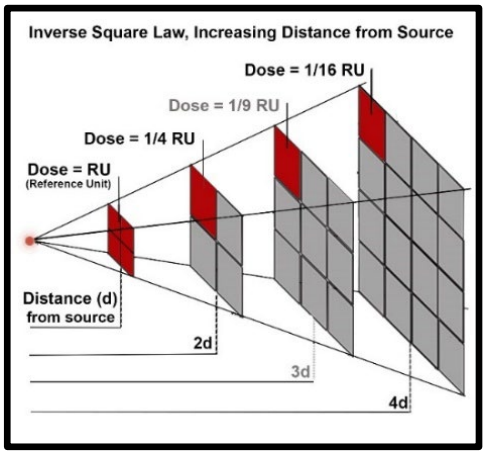
Understanding the inverse-square law as it applies to ionizing radiation is crucial for grasping the dangers that thousands of Nuclear Weapons Technicians were unknowingly exposed to during their daily tasks with nuclear weapons in the Cold War period.

While many government-sponsored or conducted workshops, studies, and research on ionizing radiation were based on measurements taken from one meter away, Nuclear Weapons Technicians were routinely in close and direct physical contact with the exterior surfaces of live nuclear weapons for extended periods. We leaned on, handled directly, and had our hands, arms, faces, and heads inside the interior compartments of live nuclear weapons during disassembly and maintenance. These tasks are described throughout this document.

Nuclear Weapons Technicians worked on live nuclear weapons, generally without knowledge or training regarding the actual dangers of ionizing radiation emitted from these weapons. This included gamma radiation, which could pass through metal and a few layers of lead, and neutron radiation, which not only permeated the exterior cases of nuclear weapons continuously but also passed through lead shielding.

The intensity of energy is inversely proportional to the square of the distance from the source

Inverse Square Law—relative to radiation:

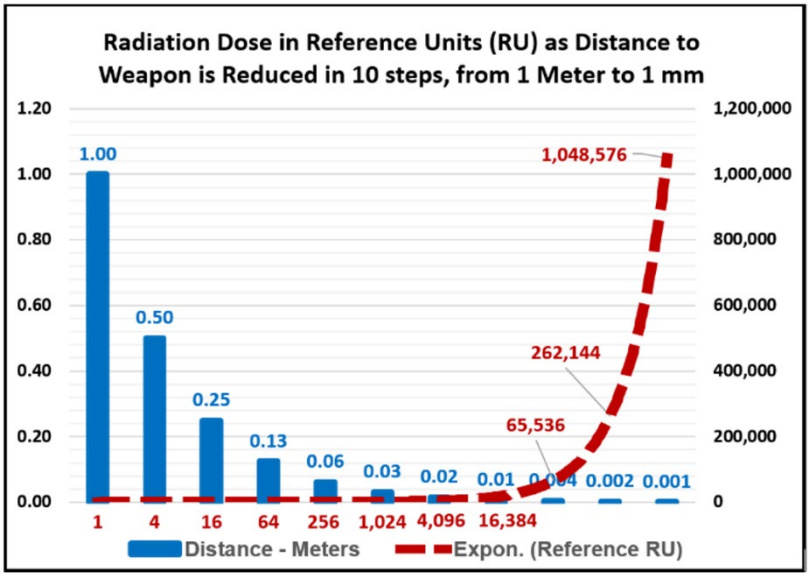


As described by the Department of Energy, Defense Threat Reduction Agency (former Defense Nuclear Agency), and Department of Defense: "The law which states that when radiation (thermal or nuclear) from a point source is emitted uniformly in all directions, the amount received per unit area at any given distance from the source, assuming no absorption, is inversely proportional to the square of that distance." [22]

For example, consider a radiation level of 1 reference unit (RU) measured at 1 meter from the exterior surface of a weapon. Doubling the distance from 1 meter to 2 meters results in the amount of energy received per unit area being reduced to 1/4th of the initial amount, or 0.25 RU. Doubling the distance again, to 4 meters, reduces the energy received to 1/16th of the original amount (0.0625 RU). The relative amount of emitted radiation per unit area drops significantly after just a few meters.

[22] DOE-DTRA TP 4-1/TM 39-4-1/SWOP 4-1/T.O. 11N-4-1, Glossary of Nuclear Weapons Material and Related Terms, 30 July 2016, IC 1-1 10 October 2018.

Chart: Inverse Square Law, Decreasing Distance from the Source



Conversely, reducing the distance from the source by half—from 1 meter to 0.5 meters—increases the radiation received by four times per unit area (4 RU). Halving the distance again, to 0.25 meters, results in an energy increase to 16 times that at the original 1-meter distance. Continuing closer and reducing the distance by half four more times, to 0.02 meters (2 cm),[23] the inverse square law indicates an increase in radiation by 4,096 times (4,096 RU), assuming no absorption, as stated in DOE-DTRA Technical Procedure 4-1.[24] Note: Some numbers have been rounded to two decimal places for spacing and legibility on the chart.

Considering the biological damage from neutron radiation, which is approximately five to twenty times greater than that of gamma radiation, the implications of the inverse square law become significantly more severe. When factoring in three-dimensional exposures from multiple weapons positioned within inches of each other and the Nuclear Weapons Technician simultaneously, the exposure to the silent dangers of ionizing radiation increases exponentially.

Challenges to the Inverse Square Law at Close Distances

Studies from various organizations, including those in the film and lighting industries, have highlighted challenges to the inverse square law at close distances. These studies indicate potential error rates of 5% to 25% when the distance is 10 cm or less. However, the direction of these suspected errors, particularly concerning live nuclear weapons, was not specified.

A DOE training program, "*Basic Radiation Theory and Protection*" at Los Alamos National Laboratory, described the use of the inverse square law and included worksheet data. It did not mention potential errors—regarding close distances—in its application.

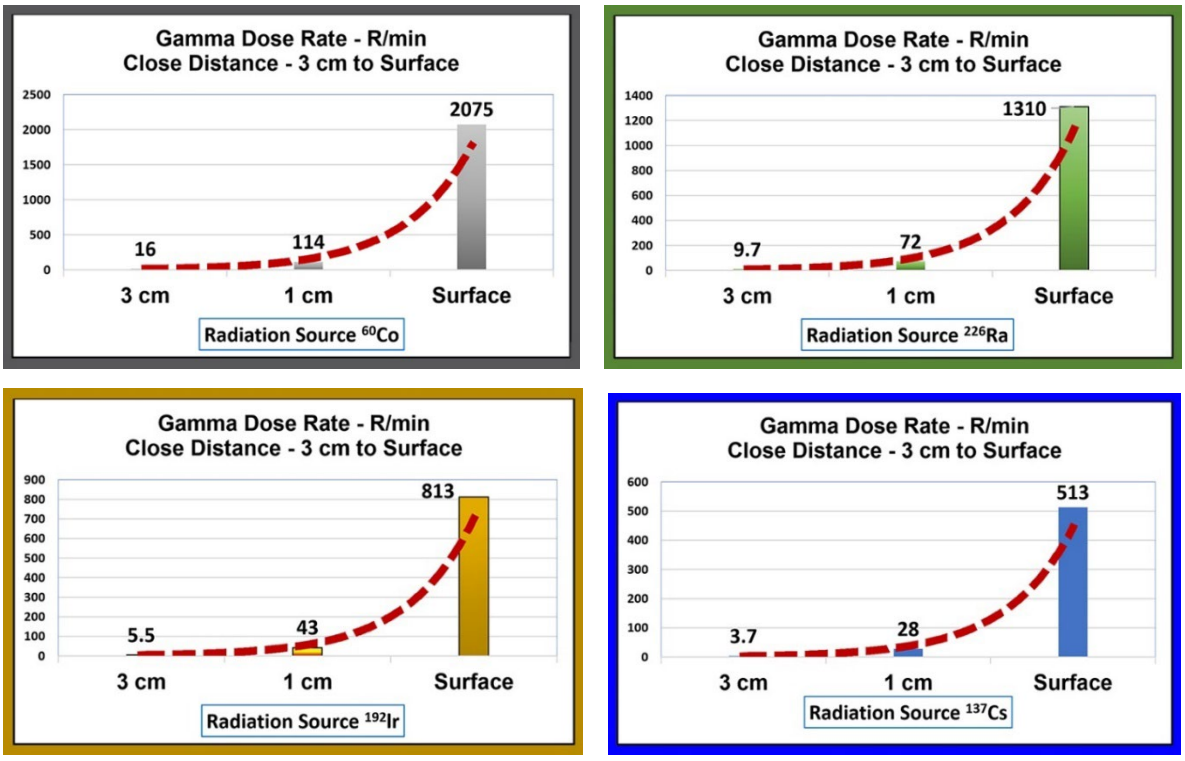
The Nuclear Regulatory Commission (NRC) conducted training on “3 cm-to-surface” radiation external dose calculations for Health Physics radiology. This training, which included the application of the inverse square law at very small distances, aimed to provide the approximate gamma dose rate to the hand from a 1 Ci sealed source.” [25] [26] The training involved four

[23] Rounded up from 0.0156 meters
[24] Ibid. DOE-DTRA TP 4-1 Glossary of Nuclear Weapons Material and Related Terms. July 2016, IC 1-1 10 Oct 2018
[25] Nuclear Regulatory Commission, NRC Instruction H-117, Chapter 5 External Dose Calculations. https://www.nrc.gov/docs/ML1121/ML11210B521.pdf Reviewed 7-23-23
[26] Sealed source: “Radioactive material that is permanently bonded or fixed in a capsule or matrix designed to prevent release and dispersal of the radioactive material.” https://ehs.unl.edu/sop/s-sealed_sources.pdf

radioactive isotopes that produce gamma radiation, commonly used in medical radiation therapy, industrial gauges, passive illumination of aircraft gauges, and the calibration of radiation-detection equipment. The Department of Energy and Department of Defense used two of the isotopes, ^{60}Co and ^{137}Cs, as calibration sources for their 1981 intrinsic radiation workshop.

In this project, the NRC demonstrated—through direct measurement and calculation—that gamma radiation doses at the surface increased significantly. Specifically, the dose rates increased by an average of 13,680 percent (136.8 times) from an initial distance of 3 cm to the surface. An average dose rate of 8.7 R/min at 3 cm increased to an average of 1,177 R/min at the surface.

Close Distance Project Results Using Four Different Gamma Sources – Radiation Doses at 3 cm, 1 cm, and the Surface



Weighting factors: "Multipliers of the equivalent dose to an organ or tissue used for radiation protection purposes to account for different sensitivities of different organs and tissues to the induction of stochastic effects of radiation..." [27] Ionizing gamma radiation has a weighting factor of one. Neutron radiation has Weighting Factors five-to-twenty-times that of gamma radiation, depending on neutron energy,[28] with ten used (by the Nuclear Regulatory Commission) when the neutron energy is unknown.[29]

[27] Source: U.S. Nuclear Regulatory Commission (NRC), Units of radiation dose, U.S. Nuclear Regulatory Commission (NRC), https://www.nrc.gov/reading-rm/basic-ref/glossary/weighting-factor-wt.html reviewed 26 June 24.
[28] Hanford External Dosimetry, Technical Basis Manual, PNL-MA-842, prepared for the U.S. Department of Energy, p21, https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-15750rev1.1.pdf
[29] Source: NRC, Units of radiation dose, § 20.1004 Units Of Radiation Dose. | NRC.gov, reviewed 26 June 24.

Stochastic effects: "Effects that occur by chance, generally occurring without a threshold level of dose, whose probability is proportional to the dose and whose severity is independent of the dose. In the context of radiation protection, the main stochastic effects are cancer and genetic effects." [30]

Deterministic effects: "The health effects of radiation, the severity of which varies with the dose and for which a threshold is believed to exist. Radiation-induced cataract formation is an example of a deterministic effect (also called a non-stochastic effect)." [31]

Nuclear Weapons Intrinsic Radiation (INRAD) Exposures

Many Nuclear Weapons Technicians worked on a variety of nuclear weapon types at the same location or in different assignments. Each was required to train, become proficient, and attain certification in one or more of the numerous types of warheads, bombs, artillery shells, atomic demolition munitions, torpedo, rocket or missile systems. The weapons ranged widely in yield, from sub-kiloton to multi-megaton, depending on the location and mission of the organization. Many of the same weapon series and types were maintained by multiple military services.

Individual Technicians worked different series of nuclear weapons at varied intervals, and our radiation (and toxic chemical) exposures depended on what team member "position" was filled for a particular task on a given day. In a typical scenario, it was common for one person to stand or sit adjacent to an open weapon, reading the checklis t items and verifying completion of steps, while one or two others "operated" inside the open nuclear weapon. Another managed the tools and parts and inspected, cleaned, and prepped items in preparation for installation. Positions often rotated. Nuclear weapons maintenance supervisors/managers observed and monitored the operations, and quality control inspectors routinely participated.

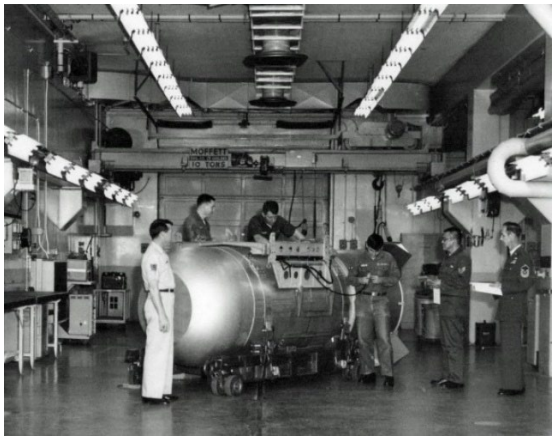
One of the primary dangers that affected Nuclear Weapons Technicians was Intrinsic Radiation. The Department of Energy and Department of Defense described intrinsic radiation (INRAD) as "ionizing radiation emitted through the nuclear weapon surface or directly from exposed weapon components." [32]

Nuclear Weapons Technicians were not made aware of the presence of intrinsic radiation or the dangers of ionizing gamma radiation that permeated the exterior cases of nuclear weapons. Few, if any, were informed about ionizing neutron radiation and its substantially higher biological effect on humans. The continuous emission of neutron radiation from the exterior of nuclear weapons, which was not blocked by lead shielding, was a well-kept secret. Those critical facts were typically unknown to the technicians who disassembled, maintained, reassembled, transported, and stored those weapons worldwide.

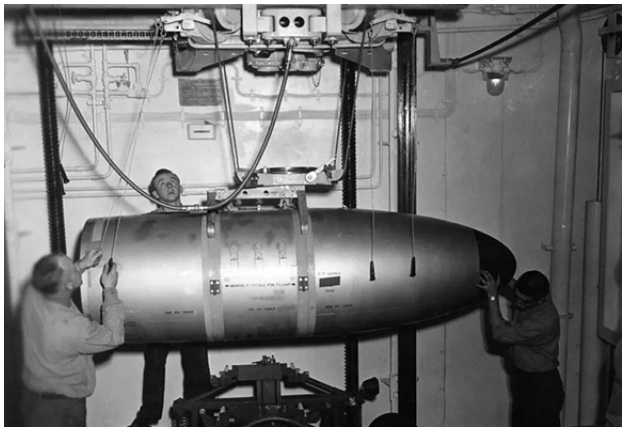
[30] Stochastic effects, https://www.nrc.gov/reading-rm/basic-ref/glossary/stochastic-effects.html
[31] Deterministic effect, https://www.nrc.gov/reading-rm/basic-ref/glossary/deterministic-effect.html
[32] DOE-DTRA TP 4-1, Army TM 39-4-1, Navy SWOP 4-1, Air Force T.O. 11N-4-1 IC1 30 July 2016, Glossary of Nuclear Weapons Material and Related Terms. Nuclear weapons emit intrinsic radiation (INRAD): "*Ionizing radiation emitted through the weapon surface or directly from exposed weapon components."*

They operated in close physical proximity to nuclear weapons without training or requirements regarding time, distance, and shielding from intrinsic radiation sources, concepts now known as ALARA (As Low As Reasonably Achievable). Specific training and radiation safety requirements—unique to each weapon series and configuration—were extremely limited or non-existent.

Most tasks involving nuclear weapons required direct physical contact. Technicians often leaned on, reached over, and had our hands, arms, face, and head inside the interior of open or disassembled weapons, with our torso and legs frequently in direct contact with the weapon's exterior surfaces.



B53 Thermonuclear Bomb in the multi-megaton range. First produced in 1962, retired in 1997. Ionizing radiation emitted through the external surface, in every direction. Photo credit: unknown.



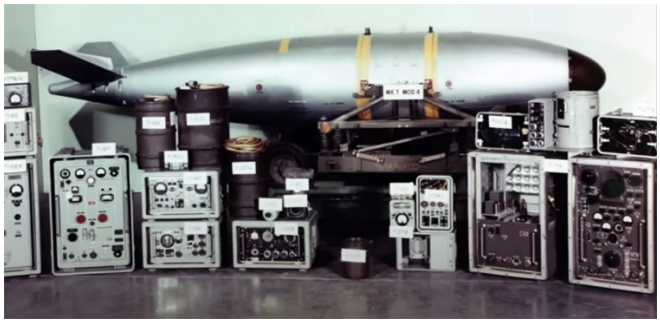
MK7 Bomb (warhead without rear section) - Hoisting operation for maintenance tasks on a ship. The MK7 could be carried by Navy and AF aircraft. Photo credit: unknown.

Examples of Ionizing Radiation Exposures (Alpha, Beta, Gamma and Neutron) to U.S. Military Nuclear Weapons Technicians During the Cold War:

- Nuclear weapons handling, maintenance and repair, disassembly, limited life component exchange, assembly, calibration, status checks, transport, storage, and other tasks.
- Nuclear Weapons Technicians removed and replaced critical components and radioactive hardware such as bolts, nuts, washers, and clamps. In some weapons, lead foil tape was temporarily placed over holes—where bolts had been removed near the physics package—and later disposed of in the trash. Although neutron radiation is now known to induce radioactivity in items (the process known as "neutron activation"), radioactive components, hardware, tape, cleaning materials, and other expendables were rarely handled or treated as radioactive materials/hazards.
- A multi-service technical manual used for all nuclear weapons maintenance stated: "If a vacuum cleaner is used to clean components or areas where there are possible loose radioactive materials, monitor the bag of the cleaner periodically. If found to be contaminated, dispose of the bag in a paper bag labeled 'Contaminated Waste'." [33]

[33] AEC-DNA TP/Army TM-39/Navy SWOP/AF T.O. 11N-35-51, section 3-4.8, 26 Nov 1962, Change 6, 7 Jun 1972

- Nuclear Weapons Technicians removed radioactive alpha particles/spalling [34] material by vigorously rubbing the target rings and other internal components of gun-type weapons, as well as capsule balls, spheres, cores, etc., in early nuclear weapon series. This created hazardous conditions for inhalation, ingestion, and absorption through cuts and abrasions.
- Alpha particles are 20 times more dangerous in terms of biological damage than beta and gamma radiation. Technicians were often “dusted” with radioactive particles on their clothing and any unprotected areas of their head and face, particularly during the removal of spalling material containing alpha particles (that cannot be seen with the human eye). Uniforms were brushed off afterward (sometimes vacuumed), potentially leaving radioactive particles on clothing to be taken home to family members, the barracks or quarters. The use of a portable Radiac meter or similar device to scan the technician with a wand to "ensure" all particles were removed was often met with skepticism. Technicians stated that the decontamination procedure was typically rushed and not thorough, but few dared to question the conduct of the scans.



Left: MK 7 nuclear bomb with related test equipment. Right: Many nuclear weapons tasks required hands, arms, head or entire body to be inside. Images: SN Lab, “Early Nuclear Safety” video.

Risk Management and Dosimetry

Risks associated with ionizing radiation exposure were not effectively managed to keep exposures ALARA (As Low As Reasonably Achievable) according to modern-day standards. Some ionizing radiation dosimetry activities related to naval nuclear propulsion apparently evolved into limited weapons-related dosimetry programs, which were arguably poorly managed. Few, if any, fully operational nuclear weapons-related ALARA and INRAD programs were established by the individual military services prior to 1991.

Neither the Nuclear Weapons Technicians nor our organizations knew our actual monthly, annual, or lifetime ionizing radiation exposure doses. We generally worked without restrictions regarding time, distance, or shielding (required components of ALARA) from radiation sources. The risks were exacerbated by multiple factors, with radiation dose directly related to the type of nuclear weapon and the operations performed. Key factors included the assembled or

[34] DOE-DTRA TP 4-1. Spalling. “A process of flaking in which pieces of uranium oxide spontaneously separate themselves (pop off) from the surface of the oxidized nuclear material.”

disassembled status of the weapon, time spent near or on the weapon, the number of nuclear weapons in the same space, and the distance from the radiation sources.

Other than limited or questionable Navy dosimetry programs and a few Army and Air Force short-term or abbreviated studies or "experiments," [35] ionizing radiation exposure monitoring and management programs were rare exceptions to the norm. Many Nuclear Weapons Technicians rarely, if ever, wore a dosimeter during their careers. Initial programs involving dosimeters were often discontinued, and the devices were frequently limited, ineffective, and/or inaccurate. Potentially thousands of exposure dose records, such as DD Form 1141 Record of Exposure to Ionizing Radiation, were misplaced, incomplete, error-ridden, falsified, and/or destroyed (notably in the 1973 National Personnel Records Center fire). [36]

Department of Energy/Military Services Intrinsic Radiation Research

Carter-Reagan Transition Briefing Book (U), December 1980, Defense Nuclear Agency [37]

> "Intrinsic Radiation (INRAD) Study: A growing public awareness of and concern for the hazards of low level, intrinsic radiation inherent in nuclear weapons has been increasing. The number and size of legal claims based upon exposure to alleged radiation has risen sharply. Previous risk estimates were minimal for low level exposure to stored nuclear materials. While the general view remains that the effects are insignificant, DOD has decided to verify a variety of associated aspects. A joint DOD/DoE study has been initiated to review the impact of intrinsic radiation…" to include "Identification of personnel who receive INRAD doses; INRAD output of current stockpile; Evaluation of Service programs, regulations, and procedures; INRAD implications to DOD (fiscal, manpower, operational, etc.); Impact on weapon design**…**" "The recommendations to be developed should be approved and implemented by September 1981".

Intrinsic Radiation Intercomparison Workshop – Acknowledgement of Decades of Radiation Measurement Data Issues and 1981 Workshop Practical Test Failures [38]

On January 25, 1983, the Department of Energy (DOE) published a report documenting an Intrinsic Radiation (INRAD) Intercomparison Workshop hosted by the Los Alamos National Laboratory (LANL) from March 24-26, 1981. The workshop included thirty-three attendees from various organizations, such as the DOE, LANL, Sandia National Laboratories, Lawrence Livermore National Laboratory, Air Force Weapons Laboratory, Air Force Occupational Environmental Health Laboratory, Naval Surface Weapons Center, Chief of Naval Operations, Army Nuclear and Chemical Agency, Army DARCOM, HQ USMC, and FCDNA. A key workshop goal was: "…compiling the available INRAD data on stockpiled weapons."

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[35] A scientific procedure undertaken to make a discovery, test a hypothesis, or demonstrate a known fact.
[36] National Personnel Records Center Fire: https://www.archives.gov/personnel-records-center/fire-1973
[37] Defense Nuclear Agency, Carter-Reagan Transition Briefing Book, December 1980 https://www.esd.whs.mil/Portals/54/Documents/FOID/Reading%20Room/Other/Carter_Reagan_Transition-6.pdf
[38] Holt, J., Holton, R., Nelson, R., Riel, G., & Robinson, R. (1983). *Intrinsic Radiation Intercomparison Workshop. Summary report by the Weapon and Environment Sub-Group of the Intrinsic Radiation Working Group* (No. UCRL-53386). Lawrence Livermore National Lab., CA (USA). Abstract: https://www.osti.gov/biblio/6195704

The group reported significant problems with previous data and encountered difficulties in consistently and reliably measuring radiation one meter from a single source, even in a controlled laboratory environment. Several issues were revealed, including:

- "A review of **over 20 years of data showed that, in general, measurements made at different times on any particular weapon type could differ significantly** [emphasis added]. This workshop was seen as a first step in quantifying the measurement variability, identifying its probable causes where possible, and, where not, outlining the future work needed to clarify these causes of variability."
- "As this report shows, **all the causes underlying the measurement diversity are not yet clearly understood** [emphasis added], and this provides a basis for future necessary action by the participating agencies."
- "A general comment applies to all of the gamma series: **an unknown portion of the measurement-range variability results in the various ways in which source energies and intensities are translated into dose rates.** [emphasis added] …Identifying the conversions used may explain some of this wide variability and reduce it significantly."
- **Regarding Neutron Sources:** "It is difficult to judge instrument quality because **the same type of instrument in the hands of different participants performed differently**. Without resolving the questions raised above, **it is impossible to decide whether better or poorer performance is due to the instrument or to the procedures and calibration techniques used**. [emphasis added] It is clear, however, that **high-quality standardized calibration techniques will be needed to get close interagency agreement**."
- "**The range of results was excessive for warhead measurements**." [emphasis added]

Challenges and Misconceptions in Dose Reconstruction or Estimation for Veterans' Ionizing Radiation Exposure Claims: A Critical Analysis of DOD Contributions and VA Decisions

Several agencies that participated in the workshop later provided data, conclusions, and advice to the Veterans Administration (VA) for decisions on claims related to cancers, other diseases, and deaths caused by ionizing radiation exposure from nuclear weapons. Ostensibly, these agencies were also expected to visit field units worldwide to determine INRAD levels or teach others how to do so.

The problems described in the workshop report raise serious questions about dose reconstruction for VA claims and subsequent decisions on radiation exposures to Nuclear Weapons Technicians. The 2-year study appears to have been used as a false premise to justify the denial of veterans' claims, as exemplified in the section "VA Claim and Appeal Denials."

Due to the routine and prolonged close physical proximity and direct contact of Nuclear Weapons Technicians with various live nuclear warheads, most of which no longer exist, and the absence of dosimeter monitoring and time/distance restrictions, it is impossible to accurately reconstruct or determine our actual individual radiation exposure doses.

The reasonable assumption is that it is highly probable that Nuclear Weapons Technicians exceeded the maximum permissible ionizing radiation doses on a monthly, quarterly, annual, and/or lifetime basis, based on standards set by today's well-established and well-managed ionizing radiation safety programs.

Nuclear Weapons Ionizing Radiation Safety Programs and Formal Requirements

Substantial evidence from official regulations, manuals, instructions, meeting summaries, approved work practices, and shared knowledge demonstrates that INRAD exposure safety education and procedures, and the concept now known as ALARA (As Low As Reasonably Achievable) via time, distance, and shielding, were essentially nonexistent during the Cold War period. Many who were aware of the limited benefits of shielding gamma radiation with lead were unaware, until many years later, that lead was not effective for blocking neutron radiation. Most technicians did not realize the continuous presence and danger of neutron radiation emitting from the weapon surfaces (INRAD).

Searches for formal requirements specifically related to Nuclear Weapons Technicians' ionizing radiation exposure safety during the Cold War period resulted in few publicly available documents. Generally, requirements that specifically addressed ALARA in relation to both nuclear weapons and INRAD were first published in 1990. Examples of search results include:

- **Army FM 55-204, Air Transport of M454 Atomic Projectile, 30 September 1976, and December 1981:** These versions stated that personnel dosimetry badges and exposure time records were not required during nuclear weapons transport operations.
- **Army and Defense Logistics Agency Regulation AR 40-14/DLAR 1000.28, Medical Services, Control and Recording Procedures for Exposure to Ionizing Radiation and Radioactive Materials, 15 March 1982:** This regulation discussed ALARA, personal dosimeters, radiation dose limits, and dose sources. It was apparently intended for NRC-licensed material and did not specifically address nuclear weapons except to exclude any Radiation Control Committee responsibilities for nuclear weapons. It did not discuss INRAD.
- **DOD Instruction 6055.8, Occupational Radiation Protection Program, 31 March 1989:** Included general information on ionizing radiation, personnel dosimetry, bioassay, and ALARA. It was not specifically for nuclear weapons and did not discuss INRAD. It included a definition for Occupational [radiation] Exposure: "Routine exposure of DOD personnel to radiation associated with DOD operations during the performance of our official duties."
- **AFR 122-28, Air Force Nuclear Weapons Intrinsic Radiation (INRAD) Safety Program, 29 October 1990:** [39] Implemented INRAD safety, including ALARA. The regulation applied to "… units and personnel concerned with maintenance, loading, security, transport, or storage of nuclear weapons and associated nuclear material and components." The regulation described ALARA as: "Keeping exposure of persons to ionizing radiation ALARA consistent with operational requirements and not intentionally exposing persons to INRAD levels exceeding the maximum permissible dose (MPD) specified in DODI 6055.8 and AFR 161-8, Control and Recording Procedures—Occupational Exposure to Radiation". It introduced the use of personal dosimetry and listed exposure limits for pregnant females to "500 mrem (50 mrem/month)." The regulation included in A.2.a: "*Implementation of the INRAD safety program and ALARA must not compromise weapons security or operational mission considerations*."

[39] Air Force Regulation 122-28, 29 October 1990, AF Nuclear Weapons Intrinsic Radiation (INRAD) Safety Program

- **Air Force Policy Directive 91-1, Nuclear Weapons and Systems Surety, 21 May 1993.** Addressed ALARA and INRAD.
- **Air Force Instruction (AFI) 91-108, Air Force Nuclear Weapons Intrinsic Radiation (INRAD) Safety Program, 29 Nov 1993:** Replaced AFR 122-28, 29 Oct 1990. Stated implementation of INRAD and ALARA …must not compromise… operational mission considerations."
- Nuclear Task Force investigation report: **"Reinvigorating the Air Force Nuclear Enterprise", Air Force Nuclear Task Force, 24 October 2008:** The report detailed failures in INRAD and ALARA safety programs (described below).
- **AFI 91-108, Air Force Nuclear Weapons Intrinsic Radiation and 91(B) Radioactive Material Safety Program, 21 September 2010 with change 1, 14 October 2011: [40]** Replaced the 1993 version of AFI 91-108 and added the 91(B) Radioactive Material Safety program.
- **DOE-DTRA TP 4-1, Glossary of Nuclear Weapons Material and Related Terms, 30 July 2016**: Included ALARA: "Refers to Service and DOE radiation protection programs to keep radiation doses as low as reasonably achievable," and INRAD: "Ionizing radiation emitted through the weapon surface or directly from exposed weapon components."

2008 Nuclear Task Force Report Cites Failures in Air Force INRAD and ALARA Programs for Nuclear Weapons Personnel [41]

Following incidents in 2006 and 2007, the Secretary of Defense established a Nuclear Task Force to examine various aspects of Air Force nuclear force management and nuclear weapons-related issues. The resulting 140-page report, published in 2008, identified numerous deficiencies and made several recommendations. Among the highlighted issues were the inadequacies in Intrinsic Radiation (INRAD) and ALARA (As Low As Reasonably Achievable) personnel radiation exposure and monitoring practices.

Inadequate Guidance:

- "Air Force documentation was inadequate to demonstrate that current personnel and area radiation exposure and monitoring practices are sufficient to ensure exposure is less than Air Force requirements and maintained as low as reasonably achievable. No evidence or recent oversight of this program by authorities, either external or internal, was found."

Improve Weapons Maintenance and Storage Safety:

- The "Air Force will update and standardize the intrinsic radiation (INRAD) program guidance in AFI 91-108." Note: AFI 91-108, *Air Force Nuclear Weapons Intrinsic Radiation Safety Program*, 29 November 1993 remained until superseded/renamed 21 September 2010.
- The "Air Force Surgeon General as lead, with AF/SE and Air Force Inspection Agency, will develop an INRAD Safety Inspection Checklist and evaluate requirements, training practices, and assessment of intrinsic radiation monitoring programs to ensure that exposure levels are tracked and are as low as reasonably achievable [ALARA]."

[40] Air Force Instruction 91-108 21 September 2010 with Change 1, 14 October 2011, Air Force Nuclear Weapons Intrinsic Radiation and 91(B) Radioactive Material Safety Program.
[41] Reinvigorating the Air Force Nuclear Enterprise, AF Nuclear Task Force, 24 October 2008, pp 38-39, 43. https://apps.dtic.mil/sti/pdfs/ADA488880.pdf

These failures in ionizing radiation exposure monitoring and management practices were disclosed approximately eighteen years after the Air Force had initially implemented detailed INRAD and ALARA programs. This occurred despite a significantly reduced number of nuclear weapons maintenance personnel to train and monitor due to nuclear weapons stockpile reductions. These formal disclosures from the highest levels of the Department of Defense strongly reinforce the arguments and related facts presented throughout The Sound of Silence Project.

Nuclear Weapons Maintenance, Storage, and Transport

Nuclear weapons maintenance spaces and storage locations in structures, ships, and submarines posed significant ionizing radiation risks and subsequent exposures to Nuclear Weapons Technicians. Land-based maintenance facilities varied in size, supporting anywhere from one to over forty live nuclear weapons.

Storage facilities were constructed in different sizes and materials, ranging from earth-covered concrete and steel structures to small concrete wall storage bays with roll-up metal doors, similar in size to a one-car garage. Nuclear weapons were frequently double-stacked and placed side-by-side within inches of one another. Standing or kneeling between double stacks of weapons, being inches from several nuclear weapons simultaneously (all emitting ionizing radiation) was routine, as storage locations were often filled to their physical capacity, frequently in violation of DOE/DOD Technical Publication 20-7, Nuclear Safety Criteria. [42] [43]

Nuclear weapons were routinely stored in ships' magazines, often to full physical capacity. In many circumstances, personnel were authorized to sleep in the magazines with the live nuclear weapons, particularly on deployment in certain areas where the magazines were the coolest spaces on the ship. [44]

Nuclear Weapons Technicians, working in nuclear weapons storage structures and magazines, often drank fluids and ate snacks or lunch while sitting on bolsters (nuclear bomb carts with casters) directly over the warhead section. We kneeled and leaned against various series and configurations of nuclear bombs, often between two double stacks of bombs. Due to the impracticality of securing the structure and returning to the maintenance facility for breaks, improvisation was common.

Nuclear Weapons Technicians, supervisors, and managers were not made aware of the actual intrinsic radiation dangers from the live nuclear weapons. Generally, ionizing radiation safety programs and requirements were neither promulgated nor enforced by the upper echelons.

[42] Defense Nuclear Agency, Carter-Reagan Transition Briefing Book, December 1980, page 24 (written #) https://www.esd.whs.mil/Portals/54/Documents/FOID/Reading%20Room/Other/Carter_Reagan_Transition-6.pdf

[43] SAND99-1308, *The Origins and Evolution of S2C at Sandia National Laboratories*: 1949 to 1996, internal memorandum, September 2001, declassified/redacted copy. Author: William L. Stevens, Director, Surety Assessment Center, Sandia National Laboratories, Albuquerque, NM

[44] James Little, CWO4, USN, Retired. Summary/excerpt from 19 July 2021 written statement.

Military services operated under increased plutonium storage limits from July 1977 to November 1980 without authorization in the joint DOE/DOD Technical Publication 20-7, Nuclear Safety Criteria (classified document). The critical, DOD-wide, nuclear weapon safety violation was reported to the 1980 Carter-Reagan Transition team: [45]

> "Plutonium (Pu) Storage: In July 1977 the Military Liaison Committee approved a recommendation to increase storage limits for plutonium bearing weapons. The joint DOE/DOD Technical Publication, TP20-7, Nuclear Safety Criteria, still contains the original storage limits. DNA has agreed (18 Nov 80) to conduct a comprehensive study of the plutonium hazard…"
>
> "Current status: ***The Services are operating under the increased limits. TP20-7 must be changed to acknowledge current Service positions, or the practice discontinued…"*** [46] [emphasis added] "Alternatives/Rationale… Study: Long term (total evaluation of all aspects of Pu limits for both transportation and storage)." [47] Note: The Department of Energy (DOE) had not agreed to increasing the plutonium limits that were in place without authorization for at least forty months.

In 2001, a DOE representative wrote: "**...that** [unauthorized plutonium increase] **roughly amounted to 300%**" [48] [emphasis added]. Context of that statement includes the following:

The Origins and Evolution of S2C at Sandia National Laboratories: 1949 to 1996
- Section 6.24 The DOD/DOE Plutonium Dispersal Analysis Group, 1977-1981

Author: William L. Stevens, Consultant to Surety Assessment Center, 12300, September 2001, Sandia National Laboratories, Albuquerque, New Mexico, 87185

> After a several-year hiatus, the issue of increasing the limitation on the quantity of plutonium-bearing nuclear weapons allowed to be in an ensemble for logistical storage or transportation was revived. On July 28, 1977, DOD/MLC [Military Liaison Committee] Chairman Don Cotter announced that the MLC had approved an increase for storage "that roughly amounted to 300%. The DOD/DNA Headquarters tasked its Field Command at Kirtland AFB to "take the necessary action to change TP 20-7 to conform..." The TP 20-7 Nuclear Safety Criteria is a technical manual published through the Joint Nuclear Weapons Publication System (JNWPS). Any change to it requires the concurrence of at least three agencies: a military service, the DOD via its DNA, and the DOE via DOE/AL. Obtaining concurrence of the last-named also involves concurrence by the appropriate combination of the DOE's weapons laboratories. I led the process whereby **DOE declined to concur**, and the matter quickly escalated in DOD/DOE management-level attention.
>
> Attempts to accommodate the DOD's desires for operational flexibility and economies and the DOE's concerns about safety continued for about a year, mostly in the form of wordsmithing exercises for the text and footnotes of TP 20-7. The three DOE weapons laboratories held fast to the conviction that the proposed blanket increase was

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[45] Defense Nuclear Agency, Carter-Reagan Transition Briefing Book, December 1980, page 24 (written #) https://www.esd.whs.mil/Portals/54/Documents/FOID/Reading%20Room/Other/Carter_Reagan_Transition-6.pdf
[46] Ibid.: SAND99-1308, *The Origins and Evolution of S2C at Sandia National Laboratories*.
[47] Ibid.: Defense Nuclear Agency, *Carter-Reagan Transition Briefing Book*, December 1980.
[48] Ibid.: SAND99-1308, *The Origins and Evolution of S2C at Sandia National Laboratories*.

ill-advised and suggested as an alternative that each specific situation should "require evaluation of the peculiarities of the particular site by technically qualified persons who consider the hazards both to the individuals at site boundaries and to the general populace." (My words contained in a memo by Jack Howard, Ref. 107). This position was presented to the MLC orally on October 4, 1978, by Jack R. Roeder of DOE/AL and Bob Luna of SNLA. [end quote]

Nuclear Weapons Technicians Worked in Three-Dimensional Ionizing Radiation Fields Without Being Informed of Those Radiation Hazards

B83 bombs and Air Launched Cruise Missiles in an "integrated maintenance facility" (IMF)
Photo: Paul Shambroom, 2009, https://spectrum.ieee.org

B61 bombs, double-stack configuration in a storage structure
Photo: fas.org via https://www.military.com, retrieved 3-31-23

Nuclear weapons consistently emit ionizing radiation in all directions. When multiple nuclear weapons were in close proximity, Nuclear Weapons Technicians were exposed to gamma and neutron radiation from multiple sources simultaneously. During the Cold War, many veteran technicians worked under these conditions, unaware of the continuous radiation emitted through the exterior of nuclear weapons. Even fewer understood the penetration power of neutron radiation or the complex interactions within fissile assemblies. [49]

Technicians familiar with alpha, beta, and gamma radiation were often reassured that any concerns about radiation exposure were unwarranted. However, we were not informed that alpha radiation poses twenty times higher biological damage compared to gamma radiation, and neutron radiation's biological damage can be five to twenty times higher, depending on its energy. There was minimal relevant education, training, or discussion on these topics.

As mentioned previously, Ionizing radiation weighting factors must be considered when calculating the effective dose of radiation exposure to ensure an accurate assessment of potential health risks. Simultaneous exposures from multiple weapons must be addressed.

Thousands of military veteran Nuclear Weapons Technicians felt safe and did not consider the possibility of dangerous levels of ionizing radiation exposure, often avoiding questions or discussions about it. Precautions were rarely required or observed, and any questions or

[49] "*When two or more pieces of fissile material are brought near together, the neutron output of each piece exceeds its output in isolation due to neutron exchange and multiplication between the pieces*."
Neutron Interaction in Fissile Assemblies, https://ncsp.llnl.gov/sites/ncsp/files/2021-11/ref_123.pdf

complaints were discouraged. This silence, arguably deadly, seemed to be condoned and demanded at the highest levels, as the mission was prioritized over personnel safety.

During the Cold War, Nuclear Weapons Technicians were unaware of the neutron interactions, the maximum plutonium limits for maintenance, transportation, and storage of nuclear weapons, or the required separation distances for subcritical units emitting radiation. Studies, such as those conducted under a U.S. Atomic Energy Commission contract and documented in a 1962 Lawrence Livermore National Laboratory report, "*Interaction of Fissionable Units,*" [50] were not communicated to the technicians, leaving them unaware of the actual dangers they faced. That report included: "Although each unit, when isolated, may be subcritical by a substantial margin, the assemblage may be critical if the number of units is sufficiently large and if the units are sufficiently close to each other and to neutron-reflecting materials.

Nuclear Weapons Movement, Transport, Transfer

Nuclear Weapons Technicians were responsible for the movement, transport, and transfer of live nuclear weapons across various platforms, including land-based locations, aircraft, ships, and submarines. They manually lifted nuclear artillery shells, in containers, and certain atomic demolition munitions (ADMs) for transport. Nuclear weapons handling required specialized procedures during submarine on-load/off-load logistics, and on ships during vertical replenishment (VERTREP) and underway replenishment (UNREP) evolutions.

In certain overseas locations, Nuclear Weapons Technicians carried handguns and rifles to fulfill the "close-in-security" requirements for nuclear weapons when entering, occupying, and securing storage structures and maintenance facilities. On various Navy vessels and land-based locations, Marines provided "close-in" and other levels of security. The Army varied by mission.

Routine method of moving nuclear weapons between special aircraft service stores (SASS) and other spaces/levels/decks on ships, and between nuclear weapons maintenance buildings and storage structures on land. Source: Sandia National Lab video "Early Nuclear Safety", 2010

Underway Replenishment (UNREP) between two ships at sea. A common method used to transfer fuel, food, ammunition, parts, personnel, and nuclear weapons. Note the weapon over the water in this photo. Source: Sandia National Lab video "Early Nuclear Safety", 2010

[50] Interaction of Fissionable Units, H.K. Clark, Savannah River Laboratory, Aiken, South Carolina, 9 September 1962. https://ncsp.llnl.gov/sites/ncsp/files/2021-11/ref_121.pdf (Note: ncsp.llnl.gov sites may require copy & paste into URL)

Nuclear Weapons Technicians loaded, flew with, and unloaded nuclear weapons transported by military helicopters and other aircraft. According to the Army Field Manual, FM 55-204, "Air Transport of M454 Atomic Projectile," dated September 30, 1976, …[51]

> "Restrictions listed in TM 39-20-7 will not be exceeded when additional types of nuclear weapons are transported along with the projectile. *No more than three M454 projectiles may be transported in a single group without waiver (TM-39-20-7 and TM 39-45-51A)*." [The italicized emphasis was included in the manual]

The restriction limiting the number of M454/W48 atomic projectiles to three per aircraft, as cited in TM-39-20-7 Nuclear Safety Criteria, [52] indicates a significant level of ionizing radiation emission from these weapons. Additionally, several veterans who worked with these projectiles reported that they always felt warm to the touch.

In contrast, the following information from FM 55-204 highlights a dichotomy related to personnel radiation safety:

> "NOTE - Personnel dosimetry (film badge) is not required for personnel engaged in operations prescribed in this manual, nor do the operations require keeping a record of exposure times. However, do not stay within 1 meter of the M454 projectile any longer than is needed to accomplish each operation."

Based on decades of secrecy required by the Department of Defense—and the lack of proper radiation exposure management programs in the separate military services—the note regarding the W48 warhead raises concerns about transparency and the true extent of ionizing radiation exposure from that and other nuclear weapons.

Violent Emergency Destruction – Protecting Nuclear Assets at All Costs

At overseas Theater Nuclear Forces (TNF) bases, Nuclear Weapons Technicians regularly conducted exercises in **"*violent Emergency Destruction (ED) to prevent terrorist or host nation seizure of nuclear weapons*."** These exercises required handling every live nuclear weapon in storage structures, maintenance facilities, and alert aircraft hangars. Technicians were trained in the use of small explosives such as Composition C4, blasting caps, detonating cord, time fuse, shaped charges, and thermite incendiary devices. Additionally, we maintained proficiency with rifles and handguns, which were routinely carried when working in the storage structures.

In an actual emergency, the urgency dictated by potential hostile forces understandably prioritized nuclear weapons security over personal safety. In many areas, protective MOPP (Mission Oriented Protective Posture) [53] gear was not issued to Nuclear Weapons Technicians, as it would have slowed the process and potentially damaged the ED materials, devices, and live nuclear weapons.

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[51] Army FM 55-204, Air Transport Procedures, Transport of M454 Atomic Projectile in M467 Container by US Army Aircraft, 30 September 1976, https://www.bits.de/NRANEU/others/amd-us-archive/FM55-204%2876%29.pdf and

[52] TM-39-20-7 is a subtitle of Joint Nuclear Weapons Publication System (JNWPS) TP 20-7, Nuclear Safety Criteria. The joint DOE/DOD publication establishes nuclear and explosive safety criteria relative to the transportation, storage, handling, and processing of nuclear weapons.

[53] MOPP – Mission Oriented Protective Posture gear for use by U.S. military personnel in a chemical, biological, radiological, or nuclear environment.

THE SOUND OF SILENCE

Nuclear Weapons Technicians played a crucial role in sustaining our nation's nuclear defense and deterrence during the Cold War. Despite being routinely exposed to deadly radiation, toxic chemicals, and other hazardous substances, we were kept in the dark about the true dangers of the radiation from the weapons we maintained. Safety equipment, training, and precautions for handling these toxic substances were generally minimal or non-existent.

For decades, information that directly impacted the safety and lives of Nuclear Weapons Technicians was withheld from us. Thousands were not aware of the true dangers of alpha particles frequently handled with little more than gloves, nor of the intrinsic radiation dangers, especially neutron radiation— the ionizing radiation that was continuously emitted through the weapon surface as a part of the natural radioactive decay process. [54]

Comments or questions about potentially dangerous radiation exposures were quickly dismissed. Through research conducted for The Sound of Silence Project, we are only now discovering—after four to seven decades, depending on when a particular veteran started service—that alpha and neutron radiation are 20 times and 5-20 times more dangerous, respectively, than beta and gamma.[55]

The lack of radiation exposure data, the failure to provide information and training on intrinsic radiation, and the absence of operational radiation exposure monitoring and management programs effectively served to silence critical communications regarding the actual radiation dangers.

In the December 1980 Defense Nuclear Agency (DNA) Carter-Reagan Transition Briefing Book, the DNA disclosed that plutonium storage had exceeded DOE/DOD-authorized limits by approximately 300% since at least July 1977, [56] without authorization.[57] This violation of nuclear safety criteria for maximum radioactive material storage limits increased the risks associated with sub-critical components, with potential catastrophic interactions (critical threshold) between two or more subcritical units, and led to substantially increased ionizing radiation emissions to personnel. This critical information was not provided to the Nuclear Weapons Technicians who worked in those structures, magazines, and similar spaces.

[54] Re: radioactive decay process. DOE-DTRA TP 4-1. Spalling. “A process of flaking in which pieces of uranium oxide spontaneously separate themselves (pop off) from the surface of the oxidized nuclear material.”
[55] Centers for Disease Control and Prevention (CDCP) (2015): European Nuclear Society; https://press-files.anu.edu.au/downloads/press/n3873/pdf/ch08.pdf, *Health implications of ionizing radiation*, p. 222, Table 8.1.
[56] Ibid: SAND99-1308, The Origins and Evolution of S2C at Sandia National Labs: 1949 to 1996, p.141.
[57] Defense Nuclear Agency, Carter-Reagan Transition Briefing Book, December 1980, https://www.esd.whs.mil/Portals/54/Documents/FOID/Reading%20Room/Other/Carter_Reagan_Transition-6.pdf

Secrecy Hampered Ability to File VA Claims

Secrecy restrictions and agreements were signed and placed in permanent records. Many of these agreements prohibited veterans from discussing their specific job details, requirements, and locations with their families and others. Some Nuclear Weapons Technicians referred to these agreements as lifetime oaths, fearing that violating them could result in life imprisonment for treason or other crimes.[58] Others called them the 20/20 rule, implying 20 years in prison or a $20,000 fine. Although the extent of secrecy agreements varied among different military branches, inconsistent and implied secrecy requirements were prevalent throughout. Many veterans, arguably thousands, continue to live under these rules based on their understanding of the secrecy agreements and requirements to this day.

Nuclear Weapons Technicians remained silent about their duties, despite the need to explain their exposure to ionizing radiation and toxic chemicals to the VA. Most never learned of a 13 February 1996 memorandum from the Secretary of Defense that released certain veterans from these secrecy agreements. Many veterans died before its release. Additionally, ambiguities and caveats within the memorandum lead many to believe it does not apply to them. A copy of the text is provided below.

Secretary of Defense Releases (certain) Veterans From Secrecy Agreements

On 13 February 1996, the Secretary of Defense (SECDEF) issued a memorandum to the Joint Chiefs of Staff, Under Secretaries, DOD General Counsel, and other high-level directors.

> SUBJECT: Exposure to Nuclear Radiation and Secrecy Agreements
>
> Inquiries continue to be received regarding the appropriate action that should be taken to release veterans from secrecy obligations so they may justify medical treatment for conditions allegedly arising from exposure to nuclear radiation. Congressman Bill Richardson has specifically requested a public statement be issued announcing personnel are relieved of any security obligation they may have incurred in connection with their military involvement in nuclear testing to establish the validity of a service-connected disability.
>
> In the interest of fairness to the many veterans who have so honorably served our country, in coordination with the Department of Energy, I hereby authorize veterans seeking to establish a medical disability in connection with exposure to nuclear radiation to divulge to the Department of Veterans Affairs the name and location of their command, duties performed, dates of service, and related information necessary to validate exposure to nuclear radiation. This authorization does not relieve veterans of responsibility for continuing to protect specific technical information that could contribute to the development of a weapon of mass destruction or the application of nuclear technology." [59]

The Department of Defense (DOD) did not reach out to veteran Nuclear Weapons Technicians and the memorandum was seen by very few. When veterans learned of the 1996 memorandum

[58] Conversation with GMTC Maurice Cheek, USN Retired, 25 March 2023; and his letter to Pres. Biden, 5 March 2021.

[59] Secretary of Defense Memorandum, "Exposure to Nuclear Radiation and Secrecy Agreements" 13 Feb 1996. Initially obtained from retired GMTC Maurice Cheek, USN Retired, March 2023, subsequently retrieved, 6-18-24 at: https://omb.report/icr/201405-0704-002/doc/47643001.pdf

in 2023 through The Sound of Silence Project, many expressed distrust of it. Others believed the release did not apply to them due to the emphasis on "nuclear testing," a term typically associated with atmospheric and other nuclear weapon development tests, like those involving "Atomic Veterans."

In contrast, the memorandum's statement regarding the protection of "*…specific technical information that could contribute to the development of a weapon of mass destruction or the application of nuclear technology*" may be a reference to veteran Nuclear Weapons Technicians. The applicability remains ambiguous.

Many understandably believe that the "Code of Silence" still applies to an unknown extent, even after decades. Nuclear Weapons Technicians have expressed years of living in fear of saying the wrong thing to the wrong person and continue to live under that cloud. Many veterans have taken their secrets to the grave.

Federal Laws, Executive Orders, and Programs that Exclude Veteran Nuclear Weapons Technicians

- **Atomic Veterans** [60] – A term, when used by VA, includes veterans who:
  - Participated in atmospheric and certain underground nuclear tests;
  - Took part in the American occupation of Hiroshima and Nagasaki, Japan;
  - Certain veterans who were POWs in Hiroshima and Nagasaki; or,
  - Served at gaseous diffusion plants in Paducah, KY., Portsmouth, OH, and area K25 at Oak Ridge, Tenn.
- **VA Ionizing Radiation Registry Examination Program.** Veterans who participated in these radiation-risk activities listed under "Atomic Veterans" above, plus those who received nasopharyngeal—nose and throat—radium irradiation treatments while in service, are eligible to take part in the VA ionizing radiation registry examination program. Veteran Nuclear Weapons Technicians are not included**.**
- **Honoring our PACT Act of 2022 –** The PACT Act "*…expands VA health care and benefits for Veterans exposed to burn pits, Agent Orange, and other toxic substances. The PACT Act adds to the list of health conditions that we* [VA] *assume* (or "presume") *are caused by exposure to these substances. This law helps us provide generations of Veterans—and their survivors—with the care and benefits they've earned and deserve… VA will not rest until every Veteran gets the toxic exposure-related care and benefits they deserve.*" [61]

  The PACT Act also includes:
  - Cleanup of Enewetak Atoll, from January 1, 1977, through December 31, 1980.
  - Cleanup of the Air Force B-52 bomber carrying nuclear weapons off the coast of Palomares, Spain, from January 17, 1966, through March 31, 1967.
  - Response to the fire onboard an Air Force B-52 carrying nuclear weapons near Thule Air Force Base in Greenland from January 21, 1968, to September 25, 1968.

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[60] Source: VA Fact Sheet, September 2002, *VA Programs for Veterans Exposed to Radiation, https://www.cdc.gov/niosh/ocas/pdfs/misc/varadfs.pdf , reviewed 1-17-24*

[61] https://www.accesstocare.va.gov/healthcare/pactact and https://department.va.gov/pactdata/ statement reviewed/confirmed 1-17-24, bold emphasis added to the apparently disingenuous statement.

The PACT Act did not address exposures to ionizing radiation from routine operational tasks completed by Nuclear Weapons Technicians who worked with live nuclear weapons. The Act replaced the phrase "*who was exposed to a toxic substance, radiation, or other conditions…*" with "*who is a toxic-exposed veteran…*" in Title 38 U.S.C. 1710(a)(2)(F). This change removed the broader "exposure" language and implicitly required formal presumption, which is not provided in Title 38. The PACT Act did not include a presumption of occupational ionizing radiation exposures specifically applicable to veteran Cold War period Nuclear Weapons Technicians.

Nuclear Weapons Technicians are required to individually prove to the VA:

1. They worked on live nuclear weapons.
2. Their work on live nuclear weapons actually exposed them to ionizing radiation.
3. The specific amount of their radiation exposures.
4. A formal medical diagnosis of a specific disease.
5. Burden of Proof demonstrated by an experienced medical professional that ionizing radiation "as likely as not" caused the disease, or in certain (fewer) cases "more likely than not."

- **Executive Order 13179, December 7, 2000, Providing Compensation to America's Nuclear Weapons Workers** (does not apply to U.S. military veterans)

  Excerpt:

  "…to compensate DOE nuclear weapons workers who suffered occupational illness as a result of exposure to the unique hazards… Thousands of these courageous Americans, however, paid a high price for their service, developing disabling or fatal illnesses as a result of exposure to beryllium, ionizing radiation, and other hazards unique to nuclear weapons production and testing….these workers were neither adequately protected from, nor informed of, the occupational hazards to which they were exposed…While the Nation can never fully repay these workers or their families, they deserve recognition and compensation for their sacrifices." [62]

- **Energy Employees Occupational Illness Compensation Program Act of 2000 (EEOICPA).** Cancer from ionizing radiation is "presumed" for DOE employees and contractor employees called "Special Exposure Cohorts." [63]
  - Covers civilian DOE employees, contractors, and subcontractors. *"The Act was passed on October 30, 2000, and became effective on July 31, 2001. The Department of Labor (DOL) manages claims filed under the Act."*
  - Specific exposures at those locations are not criteria for compensation, radiation dose reconstruction is not required, and a determination of probability of causation is not required. "*…a covered employee must have at least one of 22 specified cancers and worked for a specific period of time at one of the SEC work sites."* [64]

[62] Executive Order 13179, December 7, 2000, Providing Compensation to America's Nuclear Weapons Workers. *https://www.govinfo.gov/content/pkg/FR-2000-12-11/pdf/00-31692.pdf* reviewed 7-22-23.
[63] https://www.cdc.gov/niosh/ocas/ocaseeoi.html Reviewed 7-22-23
[64] https://www.dol.gov/agencies/owcp/energy/regs/compliance/law/SEC-Employees Reviewed 7-25-23 oh

- **Radiation Exposure Compensation Act (RECA)** [65]

  "The Radiation Exposure Compensation Act ("the Act" or "RECA"), 42 U.S.C. § 2210 note, established an administrative program for claims relating to atmospheric nuclear testing and uranium industry employment. The Act delegated authority to the Attorney General to establish procedures and make determinations regarding whether claims satisfy statutory eligibility criteria." RECA also covers "Downwinders" who had a "physical presence in the [government-defined] Downwinder area for at least two years during the period January 21, 1951, through October 31, 1958.

Department of Veterans Affairs (VA)

VA does not consider Nuclear Weapons Technicians' duties a "Radiation-Risk Activity"

Despite significant exposures to ionizing radiation, the VA frequently denies claims and appeals on the grounds that the duties of Nuclear Weapons Technicians are not considered a "Radiation-Risk Activity." This is a false premise. The VA is well aware of our dilemma, having reviewed claims for ionizing radiation and toxic exposure for decades, often rejecting them due to the lack of necessary language in Title 38, United States Code. Neither the VA nor the DOD has taken steps to amend the laws to support Radiation-Exposed and Toxic-Exposed military veteran Nuclear Weapons Technicians.

VA regulations and procedures discourage many legitimate claims and appeals, requiring individual claims and discouraging group or class certification, even when large numbers of veterans were subjected to similar dangers. For example, the VA states: "Eligibility for disability compensation or survivors' benefits is based on radiation type, radiation dose, and timing of the onset of illness. **VA decides these claims on a case-by-case basis.**" [bold emph. was included]

These policies contrast sharply with the treatment of other veteran groups and civilian DOE employee/contractor groups. Ionizing radiation exposures occurred every time Nuclear Weapons Technicians worked on or near nuclear weapons. Despite this, the VA does not "presume" that our duties constituted a "Radiation-Risk Activity", nor that each Nuclear Weapons Technician is considered a "Radiation-Exposed Veteran", and therefore will not presume service-connection for occupational ionizing radiation exposure.

The VA holds several misconceptions regarding the dangers of ionizing radiation to Nuclear Weapons Technicians. One such misconception states: "*Various military occupations, such as nuclear weapons technicians and dental technicians, include routine and usually safe exposure to radiation.*" [66] This comparison is fundamentally flawed.

X-rays, lower in energy and less penetrating than gamma rays, generally emit energy from 100 eV (100 electron volts) to 1,000,000 eV (one million eV). In contrast, gamma rays emit energy from 100,000 eV (one hundred thousand eV) to over 100,000,000,000 eV (one hundred billion eV). Live (unexploded) nuclear weapons emit alpha, beta, gamma, and neutron radiation continuously, They do not have an on/off switch. They emit ionizing radiation 24/7.

[65] https://www.justice.gov/civil/common/reca Reviewed 1-17-24 oh

[66] Veterans Affairs, Public Health, Exposure to Radiation during Military Service, https://www.publichealth.va.gov/exposures/radiation/sources/index.asp Retrieved 7-21-23, reviewed 6-18-24.

The persistent exposure to ionizing radiation from these weapons significantly increased the risk for Nuclear Weapons Technicians, a reality that the VA's current policies fail to acknowledge and address. This project aims to correct these misconceptions by advocating for the necessary legislative and procedural changes to ensure these veterans receive the recognition, benefits, and support they rightfully deserve.

VA Claim and Appeal Denials

Numerous individual veterans' claims have been denied due to the lack of ionizing radiation exposure dose data. For a significant number of Nuclear Weapons Technicians, such monitoring programs either did not exist or were extremely limited. Consequently, military service branches reported to the VA that specific radiation dose data did not exist in the records.

This tactic forces veterans to provide evidence of actual exposure dose assessment or estimate, or leave it to a VA military partner, lab, or consultant to develop an estimated level of exposure, often based on "assumed facts not in evidence." The veteran must then provide their own arguments and defensible, accepted estimates—a battle seldom won.

Thousands of Nuclear Weapons Technicians worked large portions, or the entirety, of their careers without wearing personal dosimeters. Some groups wore them for short periods without ever receiving the results after a "test program" or an "experiment" was suddenly and inexplicably canceled within a few months of starting. Questions about these cancellations were typically met with nonsensical answers or complete silence. Some technicians received their DD Form 1141 only after leaving the assignment, upon separation or retirement, or not at all. Those who did receive their DD Form 1141s often reported skepticism about the accuracy and reliability of the entries.

Many Nuclear Weapons Technicians who wore dosimeters at some time reported that their military service records—when requested by the VA—often did not include a DD Form 1141. When these forms were present, they frequently contained little to no exposure data or had blatantly obvious errors. These errors were evident when work involved frequent and consistent activities on the same series of nuclear weapons, yet only short periods contained dose data while substantially longer periods with similar duties showed multiple recorded readings of zero ionizing radiation exposure.

One denied claim/appeal included the statement:

> It was unknown whether he was exposed to ionizing radiation from handling these warheads to a degree that would have increased his risk for any disease s**ince the warheads were sealed and shielded, and no public information exists** about whether there is an increased medical risk from handling unexploded shielded nuclear warheads in such a manner.

As explained earlier in this document, live nuclear weapons emit ionizing gamma and neutron radiation continuously through the case of the weapon, penetrating metal and lead. Sealed and shielded or not, is a moot point. This is just one example among many of an uninformed and incorrect opinion from individuals lacking applicable experience and familiarity with warhead designs and sources of ionizing radiation. Any such case decided on this basis must be reviewed and the decision reversed.

Many denied claims/appeals included statements such as: “DD Form 214 reflected that he worked as a Nuclear Weapons Technician during service; however, there was no evidence showing that the veteran was exposed to ionizing radiation or chemicals during service.” It was common practice, often required, for supervisors and managers to exclude this type of information in evaluations and other official written documentation. Including such information may violate requirements for the protection of classified information, depending on location and other circumstances. Many secrecy requirements and agreements related to nuclear weapons activities at operational locations were effective until at least 1996.

Some of the denied claims and subsequent appeals were incorrectly based on lack of exposure data, or recorded readings of 000.000 rem from a DD Form 1141, when a primary exposure risk to the veteran was from alpha radiation. Film badges, to the best of our knowledge, did not record alpha radiation during those reported periods.

The VA frequently relied on incomplete, incorrect, and illogical information as the sole or primary reason to deny service connection for ionizing radiation exposure, such as the claim regarding “sealed and shielded“ warheads. The absence of a presumption of occupational ionizing radiation exposure is directly due to the failure of the Department of Veterans Affairs and the Department of Defense to take responsibility for U.S. military veteran Nuclear Weapons Technicians at their time of greatest need.

Case Study: VA (1996) Citation NR: 96074 [67]

Entitlement to Service Connection for Kidney Cancer with Metastasis to the Lung, Claimed as Secondary to Exposure to Ionizing Radiation

The VA denied an appeal from an Army Nuclear Weapons Technician who was verified as having conducted “hands-on assembly and maintenance of the 8-inch howitzer atomic projectile (M422)” and worked with nuclear weapons from 1957-1965 and 1970-1973.

VA: “The U.S. Army Ionizing Radiation Dosimetry Radiation Center indicated that he was monitored for radiological exposure [*beta/gamma radiation* (whole-body film badge)] on a weekly basis from September 1958 to December 1958 and on a monthly basis from December 1958 to February 1959. All film badge measurements were reported as 000.000 rem… His total exposure recorded within the Army was ‘000.000 rem’.”

Note: A major concern with this weapon was alpha radiation, a type of particle radiation that is not visible to the human eye.

Per VA, the IRDRC stated: “The dose assessment was based on the results of a 2-year study (1981-1983) in which the various services and the Department of Energy conducted exhaustive measurements of ionizing radiation emanating from storing, handling, and maintaining nuclear weapons, excluding radiation exposure from detonation or accident. This ionizing radiation from nuclear weapons was otherwise known as the intrinsic radiation (INRAD) program. This program also included extensive time motion studies and direct personnel monitoring as a part of their assessment of personnel exposures for the most hazardous of these systems.”

[67] Appeal denied by VA, Citation NR: 9607194, 19 March 1996. https://www.va.gov/vetapp96/files1/9607194.txt

The VA's statement in this 1996 claim apparently referenced (in part) the 1981 Intrinsic Radiation Intercomparison Workshop, part of the study alluded to in the 1980 DNA Carter-Reagan Briefing Book. This study is documented in a January 25, 1983, DOE report described previously in this document under "Department of Energy/Military Services Intrinsic Radiation Research."

The 1983 report referred to by the IRDRC acknowledged previous decades of unreliable data and documented many unreliable, confusing, and questionable data resulting from the 1981 workshop. Based on these results, many considered the workshop a failure (arguably a generous assessment).

It is probable that most weapons series maintained during the Cold War period were no longer available for "direct radiation exposure measurements, time motion studies, or direct personnel monitoring" during the period described. Of the approximately 112 operational warheads, bombs, ADMs, and other configurations deployed through 1991, approximately 30 different types/mods existed as late as 1985 and 25 in 1991.

Additionally, no reliable method via "*time motion studies and direct personnel monitoring"*" would have been able, nor safe, to determine the amount of alpha particle radiation veteran Nuclear Weapons Technicians may have inhaled, ingested, or introduced into the body through a cut or abrasion during the routine process of removing (rubbing/wiping) radioactive spalling/alpha particles from internal radioactive components.

Previous Documentation: Routine maintenance on these weapons typically required removing radioactive spalling in the form of alpha particles from internal components. Any alpha particles that were inhaled, ingested or entered through a scrape or cut in the skin would not have been recorded by personal dosimeter nor other devices.

> Alpha radiation is "…a serious internal hazard, made worse by its immobility in the body where it can remain for decades—up to 80% of any amount absorbed will remain 50 years later. Just a few micrograms distributed through the lungs, liver, or bones can statistically increase the likelihood of cancer. This has contributed to its reputation as one of the most toxic substances known—the Department of Energy's limit of occupational concentration in air is about a million times lower than for lead." [68]

Alpha particles are known to be 20 times more dangerous in terms of biological damage than beta and gamma radiation. In some units, a common practice was for more than one technician in the same maintenance area to inspect/examine core components for spalling and alpha particles (that the human eye cannot see) and rub it off using Acetone (AEC Spec O-A-0051e) or Freon, and a wiping cloth.

Often, Nuclear Weapons Technicians worked with these materials without wearing any type of protective "surgical" mask until one of the technicians working in the same area mentioned observing areas of spalling during the process. At that time, the technicians might "mask up." Methods and practices ranged from seldom-used masks to the use of a glove box (albeit

[68] Los Alamos National Laboratory, "A History of Plutonium", Properties, by Owen Summerscales, September 21, 2022. https://discover.lanl.gov/publications/actinide-research-quarterly/first-quarter-2022/shining-light-on-a-dark-element/ See "Properties (approx. 2/3 into the article). Retrieved 11-21-23, reviewed 6-28-24.

scarce). When a glove box was used, the materials were simply placed in a paper sack that was later packaged (outside of the glove box) for disposal.

Nuclear Weapons Technicians were often “dusted” with radioactive particles on their clothing, hair, and any unprotected areas of their head and face during the removal of spalling material. Uniforms were often brushed off before leaving the building (sometimes vacuumed), potentially leaving radioactive particles on clothing or boots to be taken home to family members, the barracks, etc. A portable AN/PDR-54 Radiac set was used to scan the technicians to "ensure" all particles were removed. The effectiveness was often met with skepticism. Technicians stated that the decontamination procedure was often rushed and not thorough, but few dared to question the conduct of the scan.

Argument Against the VA Appeal Panel Ruling to Deny Occupational Exposure to Ionizing Radiation and Related Causation for Kidney Cancer with Metastasis to the Lung

- A primary duty was removing “spalling” that contained radioactive alpha particles from components of the 8-inch atomic projectile (M422).
- The film badge worn by the veteran did not measure alpha radiation.
- There is no method to estimate the alpha particles inhaled, ingested, or introduced into the body through a cut or abrasion.
- Alpha radiation is a serious internal hazard, made worse by its immobility in the body where it can remain for decades—as much as 80% of any amount absorbed will remain 50 years later. Just a few micrograms distributed through the lungs, liver, or bones can significantly increase the likelihood of cancer.
- The VA Appeals decision states: “Primary kidney cancer is potentially radiogenic.”
- Acetone and Freon were used to clean the radioactive components. Acetone is a toxic chemical that may affect the kidneys and liver.
- Due to the inability to recreate or estimate the possible alpha radiation dose from components of the weapon, M422/W33, and the methods used in the maintenance of the weapon, the decision regarding occupational exposure to ionizing radiation and causation for kidney cancer with metastasis to the lung must be reversed to favor the veteran.

Groups and Events VA Considers “Exposure to Radiation During Military Service”

The following groups of Veterans participated in what is called a “Radiation-Risk Activity”.[69]

- Participated in the occupation of Hiroshima and Nagasaki, Japan, 1945-1946.
- Were prisoners of war in Japan during World War II.
- Participated in atmospheric nuclear weapons tests between 1945 and 1962.
- Participated in underground nuclear weapons testing at Amchitka Island, AK.
- Worked in gaseous diffusion plants at Paducah, Kentucky; Portsmouth, Ohio; or K25 in Oak Ridge, Tennessee for at least 250 days before Feb. 1, 1992.

[69] https://www.publichealth.va.gov/exposures/radiation/sources/radiation-risk-activity.asp Reviewed 6-19-24

"Veterans who served in any of the following situations or circumstances may have been exposed to radiation." [70]

- Radiological cleanup of Enewetak Atoll [limited]. VA presumes exposure to radiation.
- U.S. Air Force plutonium cleanup mission near Palomares, Spain (1966), "*VA presumes exposure to radiation*". [Added as the result of a court order in 2020.] The cleanup included approximately 1,418 Air Force, 107 Army, 37 Navy and 38 other individuals.
- Thule Air Force Base in Greenland, response to fire onboard a B-52 carrying nuclear weapons. VA presumes exposure to radiation.
- Fukushima, Japan nuclear accident.
- "Various military occupations, such as **nuclear weapons technicians and dental technicians, include routine and usually safe exposure to radiation**." [emphasis added]
  VA does not presume exposure to radiation.
- *Radiation-risk activity (includes "Atomic Veterans").* Activities include participation in nuclear weapons testing and the American occupation of Hiroshima and Nagasaki.
- Depleted uranium**.** During an explosion, pieces of depleted uranium used in tank armor and some bullets can scatter and embed in muscle and soft tissue.
- LORAN radiation. U.S. Coast Guard Veterans who worked at LORAN (Long Range Navigation) stations from 1942 to 2010 may have been exposed to X-ray radiation from high voltage vacuum tubes.
- Chernobyl - limited to areas of Russia, Ukraine, and Belarus.
- McMurdo Station, Antarctica nuclear power plant.
- Nasopharyngeal (nose and throat) radium irradiation treatments
- Radiation therapy – ionizing radiation can be used to treat disease, most commonly cancer.

VA Ionizing Radiation Registry Health Exam – Excludes Nuclear Weapons Technicians [71]

"Veterans who meet any of the following criteria are eligible: [verified 6-30-24]

- On-site participation in a test involving the atmospheric detonation of a nuclear device, whether or not the testing nation was the United States
- Participation in the occupation of Hiroshima or Nagasaki from August 6, 1945 through July 1, 1946
- Internment as a prisoner of war in Japan during World War II
- Receipt of nasopharyngeal (NP)—nose and throat—radium irradiation treatments while in the active military, naval, or air service
- Involved in the following "radiation-risk activities:
  - Service at Department of Energy gaseous diffusion plants at Paducah, KY, Portsmouth, OH, or the K25 area at Oak Ridge, TN, for at least 250 days before February 1, 1992 under certain conditions
  - Proximity to 'Longshot', 'Milrow', or 'Cannikin' underground nuclear tests at Amchitka Island, AK, before January 1, 1974"

[70] https://www.publichealth.va.gov/exposures/radiation/sources/index.asp Reviewed 7-22-23
[71] VA IRAD registry https://www.publichealth.va.gov/exposures/radiation/benefits/registry-exam.asp Rev.6-19-24

Toxic and Carcinogenic Chemicals, Organic Solvents, and Other Substances

VA Does Not Consider Nuclear Weapons Technicians' Duties a "Toxic Exposure Risk Activity"

Nuclear Weapons Technicians worked without adequate respiratory and other personal protection and with minimal facility safety equipment while handling toxic and carcinogenic chemicals, organic solvents, metals, and other hazardous substances during nuclear weapons and associated-equipment maintenance. Fume hoods were exceptionally rare, and exhaust fans had limited use if installed. It is now known that most of these substances are carcinogens; harmful to the central and peripheral nervous systems, numerous other organs, the reproductive system, and unborn children; toxicologically synergistic with other chemicals and solvents; and may cause other health problems, diseases, debilitating medical conditions, or death.

Over 35 different toxic and carcinogenic chemicals, solvents, and substances	**55-gallon drum and 5-gallon can for chemicals**	**Benchtop "splash can" with spring-loaded screen**	**Chemical mask with filter**
Required/authorized use on live nuclear weapons, internal parts, hardware, and related equipment.	Chemicals were transferred from drums to the 5-gallon cans used in the maintenance bay, then poured into a splash can.	Items were placed on the screen, the screen pushed down to submerge parts, and held in place to clean thoroughly for installation.	Generally, not available or required. Use could cause communications and visibility problems.

Nuclear Weapons Technicians used "splash cans" to place parts on a spring-loaded metal screen, push the screen down into the chemicals/solvents with a gloved hand, and immerse the parts (and fingers/hands) in the solution. In minutes, the latex rubber or "surgical" gloves broke down during nuclear weapons maintenance operations, exposing hands to toxic chemicals. Bulky/thick rubber gloves were seldom used and discouraged during nuclear weapons operations due to dexterity problems. Their use could easily result in dropping (on or inside a live nuclear weapon), losing, or damaging fasteners, connectors, straps, hardware, etc. AFI 91-101, Air Force Nuclear Weapons Surety Program, prohibited the use of *"…cumbersome gloves (to ensure weapons are not inadvertently damaged)."* [72]

Toxic chemicals, organic solvents, volatile organic compounds, paint strippers, primers, etc. were specifically authorized by the Atomic Energy Commission (AEC) and the Defense Atomic Support Agency (DASA), later renamed Department of Energy (DOE) and Defense Nuclear

[72] Air Force Instruction 91-101, Air Force Nuclear Weapons Surety Program, 1 March 1997, Section A, 3.3.2.

Agency (DNA), respectively, for use on nuclear weapons and related nuclear weapons support equipment. Each had an AEC or DOE part number or specification.

They were listed in one of two Joint Nuclear Weapons Publication System (JNWPS) manuals, required for use with nuclear weapons:

- AEC/DOE-DASA/DNA TP 35-51, Army TM 39-35-51, Navy SWOP (Special Weapons Operations Procedures) 35-51, Air Force T.O. 11N-35-51, "Technical Manual, General Instructions for Cleaning, Preservation, Packaging and Identification Marking."
- AEC-DASA (later DNA) TP 40-54, et. al., "Technical Manual, General Maintenance Instructions".

Detailed procedures for use on specific nuclear weapon series may be referenced in related classified JNWPS AEC/DOE, DASA/DNA, Army, Navy, and Air Force technical procedures. Additional technical publications were used for maintenance of nuclear weapons handling equipment, e.g. bomb clip-in assemblies, etc.

Based on the types of assigned weapon systems, numerous substances were stocked for daily use in nuclear weapons and related equipment maintenance. At many locations, it was routine practice to maintain twelve to twenty or more different essential toxic and carcinogenic chemicals and solvents for routine use. Their use varied depending on the type of warheads, bombs, missiles, rockets, and other nuclear weapons/atomic munitions maintained. Additionally, the specific chemicals and solvents used were influenced by the type of bomb, rocket, or missile rack, weapons clip-in assembly, rotary launcher, and the type and complexity of storage/shipping containers, all of which were determined by the organization and mission requirements.

A list of required/approved substances commonly used, including their related effects, with nuclear weapons and their related support equipment and hardware is provided below. This is not an all-inclusive list.[73]

[73] AEC/DOE-DASA/DNA TP 35-51, Army TM 39-35-51, Navy SWOP (Special Weapons Operations Procedures) 35-51, Air Force T.O. 11N-35-51, "*Technical Manual, General Instructions for Cleaning, Preservation, Packaging and Identification Marking"; and AEC-DASA (later DNA) TP 40-54, et. al., "Technical Manual, General Maintenance Instructions"*

Toxic and Carcinogenic Substances Used During the Cold War Period and Their Related Effects

- **Acetone, Technical (Dimethyl ketone), Atomic Energy Commission Spec O-A-0051e:** Volatile organic compound. Toxicity: dermal, eyes, inhalation. Target organs: Central nervous system, kidney, liver, spleen, blood. Possible risk of Progressive Supranuclear Palsy[74]. Toxicologically synergistic with 1,1,2-Trichloroethane, Trichloroethylene, Carbon Tetrachloride, Chloroform, Bromodichloromethane, Dibromochloromethane, N-nitroso dimethylamine, 2.5 Hexanedione, 1,2-Dichlorobenzene.
- **Alodine, Aluminum Coating Compound, MIL-C-5541/A:** Contains Chromium Trioxide (a carcinogen), Hydrofluoric Acid, and Nitric Acid (all listed below).
- **Asbestos, Fiber, Atomic Energy Commission Spec 803144-00:** Carcinogen Cat 1A, lung cancer, possible genetic defects, skin/respiratory irritation. Used for component packaging.
- **Benzene:** [75] Aromatic hydrocarbon, volatile organic compound. Carcinogen with risk of acute myelogenous leukemia, chromosome aberrations, lymphatic and hematopoietic cancers, neurotoxin, germ cell mutagenicity, bone marrow aplastic anemia, immune system damage. Progressive Supranuclear Palsy risk. Possible Chronic lymphocytic leukemia (CLL) risk. Component of other listed solvents including Naptha.
- **Beryllium:** Carcinogen Cat 1, chronic granulomatous lung disease, cancer by inhalation, chronic beryllium disease or berylliosis. Inflammation and scarring of the respiratory tract. Acute toxicity, oral and inhalation; reproductive toxicity (fertility and unborn child). Skin irritation and serious eye irritation. Toxic dust or residue result of sanding or filing, and cleaning with solvents.
- **Cadmium/Cadmium dust and residue:** Carcinogen 1B. Genotoxin [76]. Germ cell mutagenicity, acute toxicity from inhalation Cat 2, reproductive toxicity Cat 2. Repeated exposure, target organ toxicity Cat 1. Causes mutations and chromosomal deletions. May be fatal if inhaled. Inhibits activity of antioxidant enzymes. Cadmium bone and Itai-itai disease. Causes skeletal demineralization, inhibits collagen production leading to Osteoporosis. Toxic dust or residue result of sanding or filing rough/chipped edges, and cleaning with solvents. Used in corrosion-resistant alloys, coating, and pigments. Extensive use as plating for hardware and hand tools. Plated surfaces of tools often became chipped or flaked off, creating sharp, jagged surfaces.
- **Carbon Tetrachloride (Tetrachloromethane):** A Chlorinated Hydrocarbon solvent. Genetic carcinogen acts directly on DNA, liver cancer (per DOE). Inhalation Cat 1 – liver, kidney.
- **Chromium Trioxide, Technical, O-C-303c (Chromic Acid, Chromium Hexavalent Compound, Chromic Anhydride):** Used to repair magnesium parts and cadmium and zinc-plated parts, also an Alodine component. Carcinogen Cat 1A, paranasal sinus and nasal cavity cancer, lung cancer, germ cell mutagenicity Cat 1B, reproductive toxicity Cat 2, serious eye damage,

[74] PSP. https://pubmed.ncbi.nlm.nih.gov/2611760/, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4861658/

[75] Benzene, Tetrachloroethylene [perchloroethylene] (PCE or PERC), and Trichloroethylene (TCE) were major contaminants listed in the Camp Lejeune toxic water contamination case, recognized by VA as a "presumptive service connection" for certain diseases. Review 2-25-23.

[76] A genotoxin is a chemical or agent that can cause DNA or chromosomal damage. Genotoxicity: damage to DNA and its consequences. https://pubmed.ncbi.nlm.nih.gov/19157059/ Reviewed 6-15-24

damages gastrointestinal tract. Targets: respiratory system, liver, kidney, blood. Causes lung ulcerations, pneumonia, kidney failure. Can be fatal in contact with skin or if inhaled.

- **Cleaning Compound, Phosphoric acid based, MIL-C-5410B Type 1:** Skin corrosion Cat 1B. Burns by all exposure routes, Target organs: respiratory system, gastrointestinal system, eyes, skin. Irreversible eye damage Cat 1.
- **Corrosion Preventive Compound, Solvent-Cutback, MIL-C-16173D Grade I:** Aspiration toxicity Cat 1, Carcinogen 2B, eye irritation Cat 2A, skin irritation Cat 2, respiratory Cat 3.
- **Dry Cleaning Solvent, Stoddard, Type I (P-D-680):** Aspiration toxicity Cat 1, organ kidney toxicity Cat 1, skin corrosion Cat 2, serious eye damage Cat 2A. Volatile organic compound.
- **Epoxy and Vinyl Resins, 837994-00:** Carcinogen Cat 2, skin sensitization Cat 1.
- **Ethylbenzene:** Carcinogen Cat 2. Neurotoxin - central nervous system. Volatile organic compound. Component of Naptha. Possible Chronic lymphocytic leukemia risk.
- **Hydrofluoric acid (Alodine component):** Dermal Cat 1, serious eye damage Cat 1.
- **Kerosine, VV-K-211d:** Contains hydrocarbons. Carcinogen Cat 1A, aspiration toxicity Cat 1, germ cell mutagenicity Cat 1B, neurotoxin. Genetic defects, renal tubular acidosis, hypokalemic paralysis. Reversible dermal toxicity.
- **Magnesium-Thorium Alloy/Magnesium parts, TP35-51:** Toxic by inhalation or ingestion. Radioactive.
- **Methanol, ACS, Technical Grade:** Poison. Nervous system depression. Organ toxicity: eyes Cat 1, central nervous system Cat 1.
- **Methyl Ethyl Ketone (MEK), Technical, TT-M-261b** (**Methyl isobutyl Ketone and Isobutyl Methyl Ketone):** Carcinogen Cat 2. Toxicity: reproductive, developmental effects, central nervous system Cat 3, developmental effects, endocrine disrupter.
- **Methyl Isobutyl Ketone, TT-M-268b:** Carcinogen Cat 2, Toxicity Central nervous system Cat 3. Mixed 1-to-1 with toluene for a thinner.
- **Naptha, Aliphatic Type II, TT-N-95b:** Carcinogen. May cause reproduction or birth defects. Contains N-Hexane, Xylene, Toluene, Cyclohexane, Pentane, Heptane, Ethylbenzene, Benzene, and 1,2,4-Trimethylbenzene Sulfur. Possible Chronic lymphocytic leukemia risk.
- **N-Hexane:** Neurotoxin, reproductive toxicity, specific organ toxicity. Naptha component. Volatile organic compound.
- **Nitric Acid (Alodine component):** Serious eye damage Cat 1, severe skin burns Cat 1A, inhalation toxicity Cat 3.
- **Nitric Oxide (compressed gas):** Acute toxicity, inhalation Cat 1, serious eye damage Cat 1, may be fatal if inhaled. Also known as Nitrogen Monoxide, Nitrosyl Radical, Amidogen.
- **Resin-Acid, MIL-P-15328C:** Carcinogen Cat 1A, toxic to reproduction/unborn child Cat 2.
- **Tetrachloroethylene [77] (PCE, PEC or PERC), 830264-00:** Carcinogen. Toxic to the nervous system, liver, kidneys, reproductive system, unborn. Bladder cancer, multiple myeloma, non-Hodgkin's lymphoma, and Parkinson's disease. Germ cell mutagenicity Cat 2, narcotic

[77] Tetrachloroethylene [perchloroethylene] (PCE or PERC), Trichloroethylene (TCE) and Benzene were listed in the Camp Lejeune toxic water contamination case, recognized by VA as a "presumptive service connection" for certain diseases. Review 2-25-23.

effects. Possible risk of Progressive Supranuclear Palsy. Also known as Perchloroethylene, Perchloro, Tetrachloroethene. Associated occupational diseases per NIH.gov: Kidney cancer, acute toxic poisoning, toxic encephalopathy/chronic poisoning. Latency: years to decades.

- **Tetrahydrofuran:** Carcinogen, Neurotoxin. Targets liver, kidneys, central nervous system. Compounded with vinyl resin adhesive (TP 40-54).
- **Thinner, Dope and Lacquer, Acrylic/Nitrocellulose:** Target organ toxicity, respiratory tract irritation, narcosis, Cat 2; skin sensitization Cat 1; skin corrosion Cat 2.
- **Toluene, Toluene-2,4-Diisocyanate, TT-Y-548c:** Carcinogen, aromatic hydrocarbon. Nerve damage, liver, kidney damage, cardiac arrest, reproductive toxicity, renal tubular acidosis, hypokalemic paralysis. Neurotoxin. Mixed 1-to-1 with Methyl Isobutyl Ketone (MIBK) to thin Zinc Chromate. Inhalation/dermal toxicity. Volatile organic compound.
- **Trichloroethane, Technical, O-T-620c (Methyl Chloroform):** Volatile organic compound. Carcinogen. Toxicity: Oral, inhalation, dermal. Also known as Xythene.
- **Trichloroethylene (TCE)[78] Technical, O-T-634b, Type I:** A chlorinated hydrocarbon solvent. Carcinogen by all routes of exposure. Neurotoxin. Targets: central nervous system, heart, liver, lungs. Parkinson's Disease. Suggested link to Progressive Supranuclear Palsy.
- **Trichlorotrifluoroethane, Freon TF:** Potential dizziness, headaches, and respiratory issues.
- **Triethylenetetramine, 837824-00:** Acute dermal toxicity Cat 4, inhalation toxicity Cat 2, severe skin burns and eye damage, pulmonary edema after exposure to high concentrations, asthma.
- **Varnish, Phenolic Resin Base, TT-V-119b:** Contains Acetone, Methyl n-Amyl Ketone, Acetone, Naptha.
- **Vinyl Resin Adhesive (Vinyl Ester Resin):** Carcinogen Cat 2, skin corrosion Cat 2, eye damage Cat 2A.
- **Xylene, Technical, TT-X-916b (Ethylbenzene 20-30%):** Carcinogen Cat 2. Skin/eyes Cat 2/2A. Toxic to reproduction; toxic to blood, kidneys, liver, mucous membranes, bone marrow, central nervous system, hearing organs; death from exposure in high doses; brain, lung, or other organ injury if inhaled/dermal. Volatile organic compound. Possible CLL risk.
- **Xythene**, **Solvent, Chlorinated, Atomic Energy Commission Spec O-T-620c. See Trichloroethane (Tech):** Carcinogen. Toxic to reproduction (fertility and unborn child), organ toxicity, liver Cat 2, eyes Cat 2, skin Cat 2. Possible risk of Progressive Supranuclear Palsy.[79]
- **Zinc Chromate Primer, MIL-P-8585A:** Carcinogen Cat 1. Reproduction toxicity Cat 1A, germ cell mutagenicity Cat 2, central nervous system depression, harms gastrointestinal tract, liver, kidneys, immune system. Severe skin burns, serious eye damage. Contains phenol formaldehyde polymer (20-25%), Xylenes (20-25%), Zinc Chromate (20-25%).
- **Zinc Potassium Chromate (commonly mistaken for and called Zinc Chromate):** Carcinogen. Can cause a hole in the septum. Irritation of nasal passages and respiratory tract, bronchitis. Eye and skin irritation. Irritation or corrosion of alimentary tract, circulatory collapse and toxic nephritis (kidney).

[78] Ibid.: Tetrachloroethylene [perchloroethylene] (PCE or PERC), *Trichloroethylene (TCE)* and Benzene…
[79] PSP. https://pubmed.ncbi.nlm.nih.gov/2611760/, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4861658/

Epilogue

Throughout the Cold War period, tens of thousands of unrecognized and uncelebrated veteran Nuclear Weapons Technicians quietly maintained our Nation's nuclear deterrence and defense capabilities. Many of these courageous Americans paid a high price for their service, developing disabling or fatal illnesses due to their exposure to ionizing radiation, toxic chemicals, and other hazards unique to nuclear weapons maintenance. Too often, these military veterans were neither adequately protected from nor informed of the occupational dangers to which they were exposed.

Through The Sound of Silence Project, we are working with congressional leaders to pass changes to existing federal laws, or enact new laws, if necessary, to require the Department of Veterans Affairs and other relevant departments and agencies to formally recognize the duties performed by Nuclear Weapons Technicians and the related dangers.

We share the hope and expectation that Nuclear Weapons Technicians will receive certification and recognition as members of a category, class, cohort, or group of veterans with duties designated as a "Radiation-Risk Activity" and a "Toxic Exposure Risk Activity," including service-connection presumption for radiation and toxic exposure.

Such consideration is already provided to other categories of veterans and hundreds of thousands of civilian Nuclear Weapons Workers, as described in this document. We ask for nothing more and nothing less than what others receive in terms of recognition, support, health care, and related benefits.

Similar to the statements in the December 7, 2000, U.S. Presidential Executive Order regarding civilian Nuclear Weapons Workers, existing policies opposing medical care and compensation for veteran Nuclear Weapons Technicians' sacrifices must be reversed.

Time is running short for all of us. It is time for the leaders of the Nation we served to act.

IF NOT NOW, WHEN?

Silence is powerful — for many — Silence is not golden

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