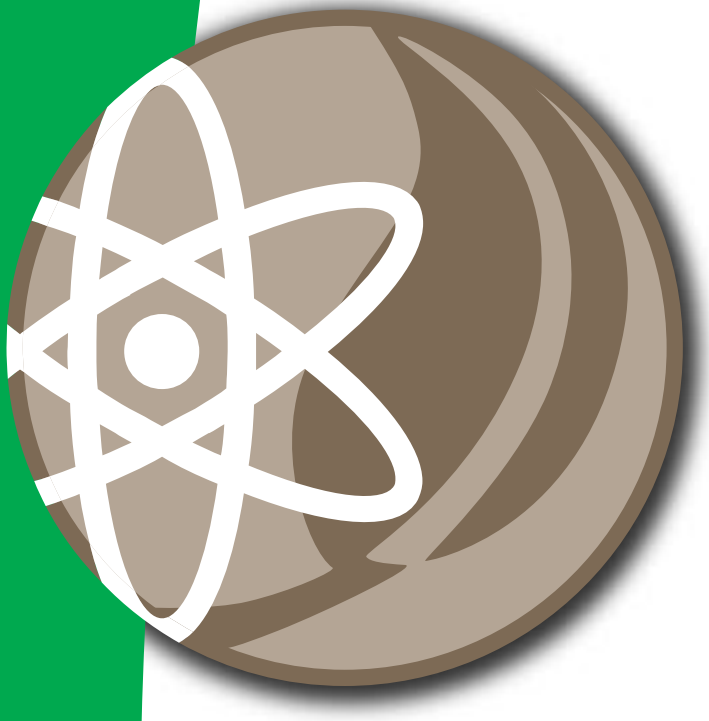
"The Death of a Nuclear Warhead"

The Environmental and Health Impacts of Nuclear Weapons Complex Activities

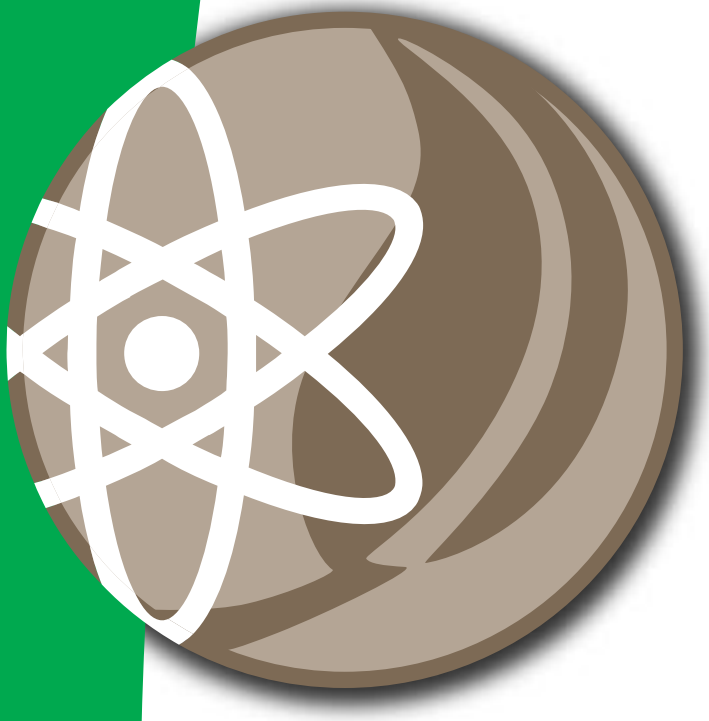
Including a Focus on the Pantex Plant in Amarillo, Texas



A Global Green USA Legacy Program Report

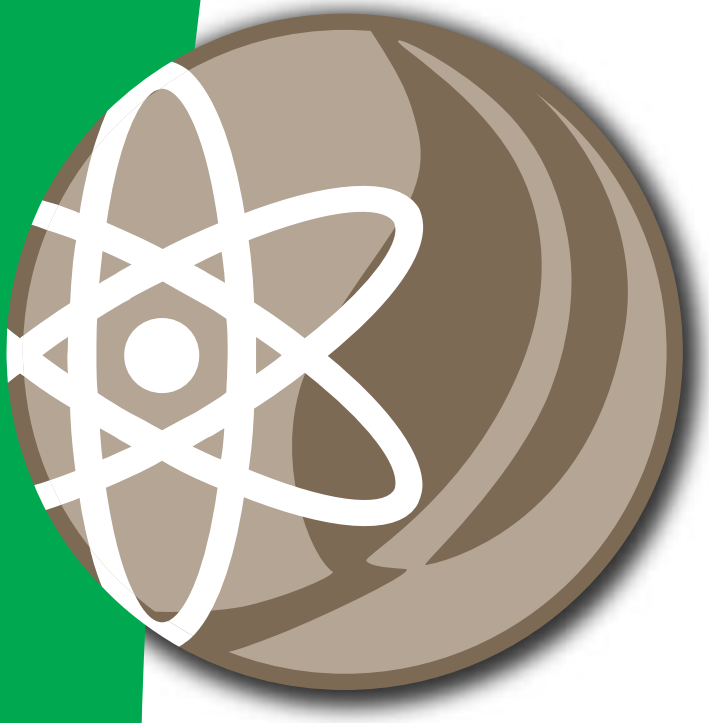
By Dr. Jasmine Aimaq

This project was made possible by a generous grant from the Citizens' Monitoring and Technical Assessment Fund/RESOLVE



Global Green USA, the United States affiliate of Green Cross International, fosters a global value shift toward a sustainable and secure world through education, advocacy, partnerships, and programs focused on the safe elimination of weapons of mass destruction, stemming climate change, reducing resource use, and preventing conflicts over fresh water. Acting as a catalyst, facilitator, and mediator, Global Green encourages collaborative approaches and crosscutting solutions to environmental challenges.

The goal of Global Green USA's Legacy Program is to create a legacy of peace by creating a sustainable and secure future. We accomplish this by facilitating communication and dialogue among stakeholders in the U.S. and abroad to advance the proper, accelerated cleanup of the legacy of military toxic contamination; supporting the safe and sound demilitarization of both conventional and mass destruction weapons, and thereby full implementation of arms control treaties; and promoting the sustainable reuse of affected facilities.



Global Green USA sincerely thanks the Citizens' Monitoring and Technical Assessment Fund (CMTA) for its generous support of this project. Thank you also to individuals who agreed to be interviewed for this report, including those who spoke frankly on the condition of anonymity.

The author also wishes to thank several individuals who were instrumental in bringing this project to fruition. Matt Petersen, President of Global Green USA, and Dr. Paul Walker, Legacy Program Director, contributed both substantive and editorial suggestions to the project and this report. Dr. Wayne Glass and Dr. Bennett Ramberg also provided valuable comments and input. Ian Treacher and Molly Danahy, students of International Relations at the University of Southern California, helped compile some of the research.

The author assumes full responsibility for any errors or omissions in this report.

TABLE OF CONTENTS

"The Death of a Nuclear Warhead"

The Environmental and Health Impacts of Nuclear Weapons Complex Activities
Including a Focus on the Pantex Plant in Amarillo, Texas

EXECUTIVE SUMMARY

It is well known that the use of a nuclear weapon would have devastating effects on human health and the environment. Detonation, however, is not the only process by which the dangers of nuclear weapons are manifested. The production, storage and disassembly of nuclear weapons pose serious risks of their own. Activities at the Department of Energy's Nuclear Weapons Complex (NWC) put the environment and human health in danger.

Global Green USA is committed to the elimination of all weapons of mass destruction, and urges the government to continue disarmament efforts. The disassembly of nuclear weapons must, however, be conducted in a manner that minimizes danger to human health and the environment. There are a number of risks involved in disassembly, some unique, others similar to the dangers of the production of these weapons. Even low doses of fissile and other materials used in nuclear weapons, for instance, have been shown to pose serious risks to human health and the environment. This report examines these and other dangers, taking a particularly close look at the NWC's Pantex Plant (Amarillo, Texas), where nuclear weapons slated for removal from the stockpile are disassembled. Problems include:

- safety and security surrounding the mechanical disassembly of the weapon, raising concerns about potential accidents;
- contamination of the Ogallala Aquifer (the principal freshwater source for the Texas panhandle), with chromium and heavy metals associated with the nearby maintenance and disassembly of nuclear-weapons materials;
- the proximity of the Pantex Plant to Amarillo's Rick Husband International Airport runways at which air-force exercises are conducted, also raising concerns about potential accidents;
- the absence of an abundant water supply near the Plant, raising concerns about the potential of an uncontainable fire that could carry fissile and other materials for miles;
- significant delays in government sponsored safety studies at the Plant;
- government neglect in adequately addressing emerging health problems and citizen concerns near the Plant; and
- potentially serious inaccuracies and inadequacies in the government conducted Baseline Risk Assessment for the Pantex plant, substantiated by an independent report commissioned by a citizen group.

Any resolution of these problems requires the participation of both the affected communities and the local and federal government. Global Green USA encourages key stakeholders to engage in a dialogue about how best to mitigate the dangers associated with the disassembly and storage of nuclear warheads and materials. Community involvement must be accompanied by government commitment and actions.

"The Death of a Nuclear Warhead"

The Environmental and Health Impacts of Nuclear Weapons Complex Activities Including a Focus on the Pantex Plant in Amarillo, Texas

New World Order, Lingering Dangers

The Cold War ended over a decade ago. But its legacy remains, and in some respects is only beginning to manifest itself. The nuclear weapons stockpile of the United States, one of the greatest dangers born of the Cold War, is still here. So are the many risks associated with it.

Some risks are obvious: theft, accident, and the doomsday vision of a war involving the most terrible weapons made by man. A frightening scenario of a different kind is upon us already, however. The environment and health of the American people have been put at risk by activities at the Nuclear Weapons Complex (NWC), run by the Department of Energy (DOE).[1]

The production of nuclear weapons in the United States has ceased, but the environmental and health effects of their production and maintenance continue to be felt. Less commonly recognized is the fact that the disassembly of nuclear weapons, mandated by international arms control agreements, involves many of the same dangers associated with production, as well as additional risks of its own. Global Green USA is committed to the elimination of all weapons of mass destruction in an environmentally safe and sound manner. It is imperative that the public be informed of current controversies surrounding NWC activities, and that the government fulfill its obligation of not only reducing our nuclear weapons stockpile, but also safeguarding the health of the public, DOE workers, and our natural resources.

In This Report

Objective

When nuclear weapons are discussed in the media, the focus is usually on the possibility of their use in war. While some attention has been paid to environmental and health issues surrounding nuclear weapons, the information remains scattered, and draws attention mainly to the production and maintenance process rather than to disassembly and the future operations of Nuclear Weapons Complex sites. Existing research on fissile and other dangerous materials needs to be consolidated into a comprehensive presentation, drawing on recent information and interviews with key players. This report addresses this need, introducing the general reader to the environmental and health concerns surrounding the disassembly of nuclear weapons and the storage of fissile and related materials.

To illustrate the potential effects of these processes, this report includes a discussion on the Department of Energy's (DOE) Pantex Plant in Amarillo, Texas.[2] The Pantex Plant is where all decommissioned nuclear weapons are disassembled and where fissile materials are either stored or begin their journey to other NWC facilities. The magnitude of the disassembly process and its consequences is quite staggering. Currently, the United States and Russia must dispose of some 100 tons of plutonium recovered from dismantled nuclear warheads.[3] In the United States, all plutonium pits from disassembled weapons are, to our knowledge, currently stored at the Pantex facility.

Questions and Approach

The central question in this report is thus: What is the scope of known and potential environmental and health dangers of fissile and related materials, and what information can be gleaned from studying the disassembly and storage process at the Pantex Plant? To address these issues, the report is structured as follows.

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[1] The Nuclear Weapons Complex comprises eight sites. For site locations and activities, see the table on page 8.

[2] The disassembly of nuclear weapons is currently on hold. Since 2000, no nuclear weapons have been retired from the US stockpile and none are slated for further disassembly. Information obtained from interviews with Tom Cochran, Nuclear Research Director, Natural Resources Defense Council (NRDC); and Arjun Makhijani, Director, Institute for Energy and Environmental Research (IEER); and DOE official who declined to be identified, January 6-7, 2003.

[3] Interview with DOE official who declined to be identified. See also "Getting Rid of Military Plutonium," by Nuclear Control Institute (NCI), November 27, 2002.

First, we provide an introduction to the general environmental and health effects of fissile and other materials. Second, an outline of NWC activities is given, including a description and diagram of "the death of a nuclear warhead" from the moment it is decommissioned to the time its materials are disposed of. Third, we present an analysis of problems linked to the Pantex Plant, including: security; environmental contamination; public and worker health safeguards; the government's lack of focused attention to these problems; and worrisome shortcomings with government sponsored analyses of environmental and health issues at the facility. The report closes with policy ideas that could aid affected communities and serve the general public interest.

A combination of primary and secondary sources, including oral interviews, was used to develop this report. In many cases, interviewees spoke on the condition of anonymity. Citations are provided whenever possible.

The Health and Environmental Effects of Nuclear Weapons Materials

Fissile materials are materials that can be "split," or subjected to the division of its atoms, a process known as "fission." It is this "fission" process that produces the atomic explosion that we recognize from footage of Hiroshima and nuclear testing. (Fusion is an additional process that helps account for the greater explosive power of hydrogen, or thermonuclear, bombs compared with atomic bombs. Fusion bombs still require a fission trigger to create the nuclear explosion. The US stockpile today is composed almost entirely of fusion bombs.)

The fissile materials used in the production of nuclear bombs are Highly Enriched Uranium (HEU) and plutonium. Without at least one of these materials, no nuclear bombs can be made or maintained. Currently, all nuclear weapons in the United States stockpiles contain both materials.[4]

Outside the human body, neither plutonium nor uranium poses a great danger to humans. The principal type of radiation from both materials, alpha radiation, is short-range, meaning it can be kept at bay by the outer layer of your skin. If it does enter the body, however, the situation changes dramatically. The alpha radiation can then begin to damage cells, causing cell mutation. The destruction of an electron, for instance, is a cell change of sufficient magnitude to cause cancer.

Fissile materials normally enter the body via the inhalation of tiny particles, as well as via absorption through cuts or wounds. In other cases, the materials can be swallowed, for example through contaminated water. Animal studies suggest that only a millionth of an ounce of plutonium lodged into a lung will probably cause cancer.[5] Uranium, while less radioactive than plutonium, is more easily absorbed through the gastrointestinal tract, and is likely to cause acute damage to the kidneys by heavy metal poisoning before the actual effects of radiation are noticeable.

Plutonium

Plutonium, a silvery white metal that exists as a solid, is produced when uranium absorbs an atomic particle—a process that can be orchestrated by human beings. Plutonium is also subject to radioactive decay; in the decay process, energy is released and a new product is formed. The energy released is called radiation, and it is here that some of the dangers to nature and humans occur. Plutonium is a highly hazardous, carcinogenic material. In fact, it is one of the most dangerous materials known, and is especially insidious because it is difficult to detect once it is outside secure facilities, or once it has been incorporated into the body. It is not difficult for plutonium to enter the body, since it can easily be inhaled. It can also be ingested accidentally

[4] Interview with DOE official who declined to be identified.
[5] Reported in "Fissile Materials Health and Environmental Dangers," IEER, 1996, p.1.

through contaminated food and water, or ingestion of plutonium-containing soil. Once absorbed into the body, plutonium typically deposits itself on soft tissue, most notably the liver and on bone surfaces, particularly in bone marrow.

While the hazardous nature of plutonium has long been recognized, it was until recently not believed that plutonium was dangerous at very low doses, nor that any negative health effects of radiation could be passed on to future generations. A groundbreaking 1991 study suggests otherwise. Responding to anecdotal reports that cancer rates were excessively high for children who live near the Sellafield plutonium reprocessing plant in Great Britain, British epidemiologist Martin Gardner and several colleagues launched a detailed scientific study. The group concluded that the increased incidence of leukemia and non-Hodgkin's lymphoma among children in the vicinity of Sellafield was clearly correlated with paternal employment at the plant. The results indicated that a father's exposure to routine low-level radiation on the job at Sellafield increased six- to eight-fold his children's risk of contracting leukemia or lymphoma. The Gardner findings were unprecedented, and quite dramatic, since they implied that exposure to very low levels of radiation – levels well within accepted safety standards – were sufficient to cause cancer in offspring.

The Gardner study generated angry opposition primarily from the nuclear industry, which maintained that Gardner's contention was impossible because there were no known biological mechanisms for it, and because it was not observed in the data from survivors of the nuclear attacks on Hiroshima and Nagasaki. (Most research on radiation safety draws heavily from data obtained from the aftermaths of Hiroshima and Nagasaki.)

Numerous radiation health experts supported Gardner's conclusions, however, arguing that there are several biological reasons why Gardner's results would not be observed among the survivors of Hiroshima and Nagasaki. For example, the Hiroshima and Nagasaki victims received only a single dose at the time of explosion, whereas the Sellafield workers were subjected to continual low-level exposure over a long period of time. Also, the type of radiation in the two cases was different, and most of the parental subjects in the bomb data were pre-pubescent children when exposed, whereas the Sellafield workers were physically mature adults. Gardner's study has since been subjected to a high degree of critical review through numerous scientific studies. The results of the reviews confirm Gardner's hypothesis. [6]

Perplexingly, however, as recently as 1999, the U.S. Agency for Toxic Substance and Disease Registry (ATSDR) claimed that "plutonium has not been shown to cause adverse health effects in people. Animal studies have shown lung diseases from short-term exposure to high concentrations of plutonium. Animal studies have also shown effects on the blood, liver, bone, and immune system from plutonium exposure. Studies in people have found no cancer from plutonium. Animal studies have reported an increase in lung, liver, and bone cancers from exposure to plutonium."

A 2003 report on workers at the Nuclear Weapons Complex (NWC) Rocky Flats site, however, showed that people who inhale plutonium have a higher risk of lung cancer than previously believed. Dr. James Ruttenber of the University of Colorado Health Sciences Center, along with colleagues from Colorado University and the Colorado Department of Public Health and Environment, studied 16,303 people who worked at Rocky Flats for at least six months from 1952 to 1989. The study concluded that individuals who inhaled plutonium were more than twice as likely to develop lung cancer as those who had not. The risk level is equivalent to smoking a pack of cigarettes a day for between 12 and 20 years. Alarmingly, the study concluded that the link between plutonium and lung cancer is evident even at levels currently considered safe by the DOE.

Critics of the study responded that the workers in question actually had lower rates of cancer and other diseases than the general population of both Colorado and the

[6] The study is cited and analyzed in, for instance, William Keepin, PhD, "Children of Plutonium," *Nuclear Guardianship Forum*, #3, Spring 1994.

entire nation. But the comparison is grossly misleading, because the general population includes many who are in poor health, as well as a greater proportion of elderly, who are far more likely to develop cancer in any event. In addition, a comparison of people who died of lung cancer with a sample of other Rocky Flats workers reveals that the 180 lung cancer victims had higher levels of plutonium inhalation than the 718 in the control group. [7]

Uranium

Uranium occurs abundantly in nature. If an individual ingests uranium through food or water, about 99 percent of the material will leave the body. The remaining amount, however small, will enter the bloodstream. While most of this absorbed uranium will also be removed by the kidneys and excreted in the urine within a few days, a small amount will deposit itself on bones, where it will remain for years.

The greatest health risk from large intakes of uranium is damage to the kidneys, because, in addition to being weakly radioactive, uranium is a toxic metal. The Environmental Protection Agency (EPA) has also conceded that uranium exposure increases the risk of cancer due to its radioactivity. Since uranium tends to concentrate in specific locations in the body, risk of cancer of the bone, liver cancer, and blood diseases (such as leukemia) are increased. Inhaled uranium also increases the risk of lung cancer.[8] According to some experts, lung cancer, due to inhaling uranium decay products, is in fact the most serious health hazard associated with this material.[9]

There is evidence of both the dangers posed by uranium, and of the federal government's neglect to adequately address this problem. In 1999, news broke that the US government never investigated reports of leukemia among workers at the uranium enrichment plant in Paducah, Kentucky, although plant and union officials had raised concerns about the disease already in the early 1990s. A team from the National Institute for Occupational Safety and Health spent a week at the Paducah Gaseous Diffusion Plant in 1992 looking for records for a possible study on the health effects of worker exposure to uranium and electromagnetic fields. The researchers found an abundance of employee health data in files and databases, including a file on worker leukemia deaths, and interviewed plant officials and union leaders. Unfortunately, there was no follow-up; the researchers did not return.[10]

Dangerous Non-Fissile Materials

Fissile materials are not the only dangerous substances linked to nuclear weapons. The weapons involve a number of industrial and other chemicals and metals that are harmful to health and the environment. Hexavalent chromium and trichloroethylene (TCE) are often noted as materials of particular concern.

Hexavalent chromium, which can enter the body through inhalation, ingestion or skin contact, is a potential lung carcinogenic. Studies of workers in the chromate production, plating, and pigment industries consistently show increased rates of lung cancer. In addition, direct eye contact with chromic acid or chromate dusts can cause permanent eye damage. Repeated or prolonged exposure is also believed to cause damage to mucous membranes of the nasal passages, which can result in ulcers. In severe cases, exposure causes perforation of the septum. It has also been shown that prolonged skin contact can result in dermatitis and skin ulcers as well as kidney damage.[11] Since TCE affects the central nervous system, exposed individuals may suffer from headache, nausea, dizziness, clumsiness, drowsiness, and other

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[7] Study cited in "Plutonium Might Be Deadlier Than Thought," *Rocky Mountain News*, April 18, 2003. Information confirmed in interview with DOE official who declined to be identified.

[8] Environmental Protection Agency, publication on "Uranium Information."

[9] Arjun Makhijani, IEER, interview with the author, January 7, 2003.

[10] This information was published by James Malone and James R. Carroll, "US ignored leukemia reports," *The Courier-Journal*, September 5, 1999. Confirmed in author interview with DOE official who declined to be identified.

[11] U.S. Department of Labor: Occupational Health and Safety Administration.

effects similar to those of being intoxicated. In some cases, exposure to very high levels for short periods of time has led to unconsciousness and death. [12]

TCE, a manmade solvent used primarily in industrial processes to remove grease from metal parts or to create other chemicals, is another object of concern at the NWC. TCE is found at low doses in a host of household products, including paint thinner and certain cleaners. Because it is very volatile, evaporating quickly, TCE is not usually present in surface soils or in open water. The danger with TCE at sites such as the Pantex Plant, however, is not only that workers are exposed to higher levels, but that the chemical can migrate down through the soil and into groundwater, where it can contaminate private and public drinking water wells. TCE will tend to evaporate during such activities as bathing, washing dishes, or flushing a toilet. As it evaporates into the air, it can be inhaled. Inhalation, especially if combined with consumption from TCE contaminated drinking water, can result in dangerous exposure.

The EPA re-evaluated the scientific information on the toxicity of TCE in fall 2001, and concluded that the chemical could be more toxic than previously believed, and was indeed "highly likely to cause cancer." The assessment also noted that TCE exposure could increase the toxicity of other chemicals. [13]

The Nuclear Weapons Complex

Principal Responsibilities of the DOE – and an Alarming Trend

Like the Department of Defense (DOD), the Department of Energy (DOE) is a federal body, its Secretary appointed by the President of the United States. The environmental clean-up of the Nuclear Weapons Complex (NWC) is listed as one of the Department's three overarching missions. The link between environment, health and national security is explicit. The Department lists eight principal focus areas, each comprising a number of distinct responsibilities. Of these eight missions, seven speak directly to environment, health or security – National Security; Energy Sources; Energy Efficiency; Environment; Energy Prices and Trends; Health; Safety and Security. The final focus area, Science and Technology, touches on the other seven. In its National Security section, the DOE emphasizes its role in ensuring the non-proliferation of nuclear technology and weapons. The Department's Environment mandate specifically notes the environmental legacy of the Cold War, including the sound disposal of nuclear waste and management of radioactive energy, as a core responsibility. The Health mandate of the DOE directly involves the protection of plant workers from radioactivity, and a commitment to understanding the effects of radioactivity on public and worker health. [14]

It is unsurprising that the DOE's main concern, in both national security and environmental and health protection, is the legacy of nuclear weapons: The Department's original name was, after all, the Atomic Energy Commission.

Things have been changing, however, and an alarming trend is developing at the DOE. In January 2003, discussions between the author and high-ranking DOE officials revealed a growing rift between career DOE staffers and the Bush White House. The reason: widely divergent views on the DOE's environmental mandate. The discord, it seems, does not center on what the nature of that mandate should be, but, more alarmingly, on whether the environment should continue to be

[12] Basic information about the known effects of TCE can also be found on government sites such as the Agency for Toxic Substances and Disease Registry (ATSDR), at atsdr.cdc.gov, or NGOs, such as Clean Water Action at www.cleanwateraction.org/ma/aht/TCE.pdf.

[13] U.S. Environmental Protection Agency (EPA), "Trichloroethylene Health Risks Assessment," August 31, in *Federal Register of Environmental Documents*, September 19 2001, vol.66, no.82. Detailed information on specific health effects of TCE, at various levels of exposure, can be found in Jeanne R. Burg, Ginger L. Gist, "Health Effects of Environmental Contaminant Exposure: An Intrafile Comparison of the Trichloroethylene Subregistry," *Archives of Environmental Health*, July 1999.

[14] For a full description of the DOE's mission and focus areas, see the Department's web site at www.energy.gov.

the Department's concern in the first place. According to one official of long tenure, the current Administration is trying to dismantle the entire environmental mandate of the DOE. [15]

The consequences of this development are nothing short of ominous. If the DOE's mandate for environmental clean-up and sound management of the NWC is removed, or simply minimized, each problem discussed in the rest of this report will be exacerbated. Since safety and caution at the NWC already leave much to be desired, the deletion of the environment as a major DOE priority would prompt a collapse of even basic, essential precautions in place to protect land, air, water – and life.

The Nuclear Weapons Complex Today

The end of the Cold War found the DOE-run NWC in a state of shocking disarray. With the arms race over, the fixation on building and maintaining nuclear weapons eased, and the government began to pay closer attention to the costs of maintaining what was then a 28-site nationwide Nuclear Weapons Complex.

Indications of the human and environmental costs of NWC activities, however, were there much earlier, and were well noted by those close enough to see them first-hand. Already in 1947, before the arms race with the USSR had begun in earnest, an internal Atomic Energy Commission report stated that the management of nuclear waste, "if continued for decades, presents the gravest of problems." The report also warned that researching solutions to the problem "can not be indefinitely postponed." [16] Nearly 60 years later, the problem is still not properly being addressed.

Concerns regarding both costs and safety led to a massive shut-down of the NWC in the 1990s. Clean-up, neglected for half a century, is itself a daunting and costly proposition. In 1996, the DOE acknowledged that it may take up to 75 years to adequately clean up the Nuclear Weapons Complex. The NWC has thus shrunk considerably since its "heyday" during the Cold War. Twenty-eight NWC sites once dotted the nation, compared to today's eight. [17] The eight remaining sites, with principal missions, are listed on the following page.

[15] Interview with DOE official who declined to be identified.
[16] Cited in Douglas Pasternak and Peter Cary, "A $200 Billion Scandal," *U.S. News and World Report*, December 14, 1992, p.41.
[17] Table (excerpted) from Charles R. Loeber, *Building the Bomb: A History of the Nuclear Weapons Complex* (Sandia National Laboratories, 2002), Chapter 11.

The Nuclear Weapons Complex

Site	Mission
Kansas City Plant	Produce, procure non-nuclear components Conduct surveillance testing on and repair non-nuclear components
Pantex Plant	Assemble, maintain and conduct surveillance on warheads Disassemble nuclear warheads being retired Store plutonium components from dismantled warheads
Oak Ridge Y-12 Plant	Maintain capability to produce secondaries and cases Conduct surveillance on and dismantle secondaries Store and process uranium and lithium materials and parts Provide production support to weapons laboratories
Savannah River	Recycle tritium from dismantled warheads Conduct surveillance on and reclaim returned tritium reservoirs Support tritium source projects
Sandia National Labs	Conduct research and engineering activities Conduct experiments on nuclear weapons effects Design non-nuclear components Provide safety and reliability assessments of the stockpile
Lawrence Livermore National Labs	Conduct R&D in basic sciences, mathematics and computing Conduct experiments on physics of nuclear weapons Maintain capability to design nuclear explosive packages Design and test advanced technology concepts Provide safety and reliability assessments of the stockpile
Los Alamos National Labs	Conduct R&D in basic sciences, mathematics and computing Conduct experiments on physics of nuclear weapons Maintain capability to design nuclear explosive packages Design and test advanced technology concepts Provide safety and reliability assessments of the stockpile Manufacture and conduct surveillance on selected non-nuclear components Conduct pit surveillance and modification for reuse; fabricate pits
Nevada Test Site	Maintain capability to conduct underground nuclear tests, and evaluate effects Conduct experiments on physics of nuclear weapons Support emergency response and radiation-sensing activities

The "Death of a Nuclear Warhead"—What Happens to Decommissioned Weapons?

When the DOD decommissions, or retires a nuclear weapon, it separates the warhead from its delivery system, and turns it over to the DOE. All of these warheads are to be transferred to the Pantex Plant, where they will be disassembled—a process that takes at most about one week.[18] The various components of the warhead are in turn transferred to the appropriate DOE plant.

It should be noted that because the number of retired weapons exceeds the capabilities of the DOE's Nuclear Weapons Complex, the DOD retains custody of a number of nuclear warheads slated for disassembly by the DOE. The location—and number—of these DOD-stored warheads is not released to the public, and therefore remains unknown.[19]

The warhead disassembly process takes place at the Pantex facility. The process involves the following steps:

1. The warhead is inspected and subjected to a series of safety checks.
2. The cover and non-nuclear components of the warhead are removed. This includes all electrical components and hardware, as well as tritium (an explosive enhancer). It also includes removal of valuable recyclable materials, such as gold, silver and platinum, used in the construction of the warhead.[20]
3. The high explosives and plutonium and HEU core are removed and separated. This work is conducted in what is known as a "gravel gertie," a gravel structure meant to prevent the dispersal of fissile materials in case of accident.
4. The high explosives are burned outdoors at the Burning Ground, in either open cages or on special metal trays.
5. Plutonium pits are transferred to special bunkers, known as "igloos," built during World War II.
6. The HEU and secondary warhead materials are transferred via truck to the Oak Ridge Y-12 facility for further management and final disposal/storage.
7. The tritium is transferred to the Savannah River site for recycling and replenishment.

A general schema of the process appears on the next page.

The Pantex Plant

Why Focus on the Pantex Plant?

Originally built as a conventional ammunitions plant during World War II, Pantex found a new role as hot war gave way to cold and a new world order emerged. The site's new mission: assembling nuclear weapons and maintaining those already in the stockpile. In the past, nuclear weapons were retired from the DOD stockpile to make room for newer, more modern models; today, they are retired as part of America's commitment to arms control and stockpile reductions.[21] Like many other Nuclear Weapons Complex (NWC) sites, the Pantex Plant is on the EPA's "Superfund" list of most contaminated places in the country.

The Pantex Plant is where all decommissioned nuclear weapons are disassembled. Warheads travel from the DOD's staging bases nationwide to Amarillo, Texas. Technically, the disassembly of a nuclear weapon is no more than assembly in reverse. This means that the risks entailed in the construction of nuclear warheads are repeated when those weapons are disassembled. Other problems are unique to the disassembly process,

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[18] Tom Cochran, NRDC, interview with the author, January 6, 2003.

[19] Arjun Makhijani, Stephen I. Schwartz and Robert S. Norris, "Dismantling the Bomb," *Atomic Audit* (Brookings Institution Press, Washington DC, 1998), p.329. Confirmed in interview with Arjun Makhijani, IEER, January 7, 2002.

[20] Precious metals are used, for instance, to plate warhead components otherwise subject to oxidation. In addition, gold enhances the explosive power of a hydrogen bomb. During the first instants of a nuclear explosion, the gold is irradiated with X-ray; the resulting heat contributes to the fusion of isotopes that provides the H-bomb with its extraordinary explosive power. For details, see David C. Morrison, "Gold Plating," *National Journal*, April 26, 1986, p.1026.

[21] The latest arms control agreement between Russia and the United States, SORT (also known as the Moscow Treaty) stipulates for the storage, rather than destruction, of warheads.

THE DEATH OF A NUCLEAR WARHEAD

What happens to decommissioned weapons?

Warhead deployment site, under jurisdiction of Department of Defense.

Department of Defense warhead staging base.

Department of Energy trucks move warhead to the Pantex Plant.

THE PANTEX PLANT
Amarillo, Texas

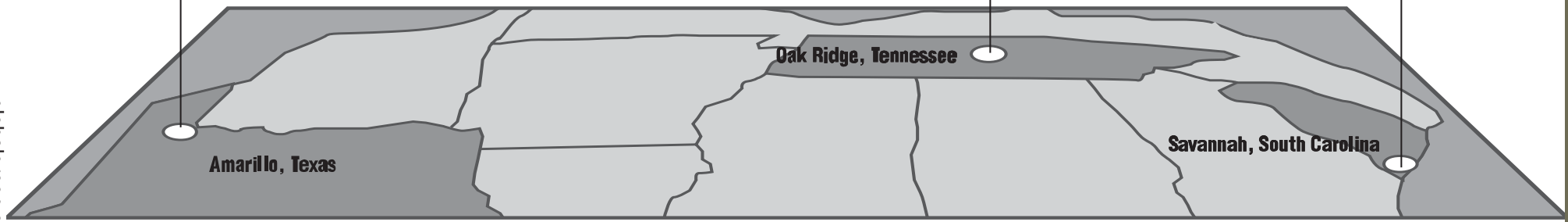
Warhead staging.

Warhead disassembly area – Highly Enriched Uranium and Plutonium, secondaries and titanium removed.

Plutonium pit storage.

Highly Enriched Uranium, secondaries and beryllium transported from Pantex to be processed/disposed of/stored at **Oak Ridge - Y12** facility (Tennessee).

Tritium canisters transported to **Savannah River Site** (South Carolina) for **repurification/repackaging**.



however. The most important difference lies in the fact that to foil theft or accidental detonation, nuclear warheads were built precisely to not be disassembled. Making weapons "dis-assemblable" is in itself a precarious undertaking.

There are currently 12000 plutonium pits stored at Pantex. Five-thousand are to remain as they are and are considered vital to national security. The remaining 7000 are to be converted to mixed-oxide (MOX) fuel.[22] Plutonium pits thus continue to pile up at Pantex. Because the rate of disassembly exceeds the capacity of the NWC to effectively manage the warhead components, many of the plutonium pits currently stored at Pantex may remain in storage for some 15 years.[23] All risks associated with this plutonium are therefore a concern for the populations living in communities adjacent to the Pantex Plant. Workers at the plant also run an increased risk of contamination.

The Pantex Plant has come into the limelight this past year also for another reason. The Bush Administration has proposed that the Pantex Plant become a Modern Pit Facility – a facility for the production of some 500 plutonium pits a year. The government's rationale is this: By about 2020, most of the plutonium pits in the nuclear stockpile will have reached their projected end of life. Pits being stored at Pantex will be deteriorating as well, and are thus not a good replacement option. (Plutonium pits have not been manufactured since 1989, with the closure of the NWC Rocky Flats site.)

The proposed policy astonished many observers. Would the new policy not put the United States in violation of the Non-Proliferation Treaty, which stipulates irreversible reductions in the stockpiles of the world's legal nuclear powers?

And, more importantly to our purposes here, will a new pit facility not dramatically increase the risks to both citizens and the environment? Since the Modern Pit Facility would bring 1000 jobs to the Amarillo community (ca. 287,000 inhabitants), many residents of the area appear to support the policy, despite the environmental and health dangers that have emerged.

Heightened awareness is likely to spur skepticism and concern, however. Pantex is already, in the words of one former DOE official, "one of the most potentially dangerous operations in the world."[24] In fact, according to Robert Alvarez, a former Senior Adviser to the Secretary of Energy, the entire NWC is "a highly scattered and fragmented system with few enforceable rules" that can been likened to "an aircraft carrier where the hydraulic lines between the rudder and the captain's bridge [are] not connected."[25]

Non-Transparent Policies around the Nuclear Weapons Complex

It should be noted that since the attacks of September 11, public access to documents relating to NWC activities has become more restricted. The public has lost access to information necessary for monitoring DOE's compliance with air and water pollution control laws, regulations, and procedures, such as reports required to be made accessible under the National Environmental Policy Act (NEPA). All such documents have been removed from public view due to national security concerns.

In October 2001, for example, every document was removed from the Pantex Plant Public Reading Room serving the Amarillo, Texas community where underground toxic plumes threaten wells and the Ogallala Aquifer. Less than a third of those items have been

[22] Numbers current as of September 2003. Obtained in interview with Tom Cochran, NRDC; confirmed by interview with DOE official who declined to be identified. January 2003. The facility for converting plutonium pits into MOX fuel is currently being built at the NWC Savannah River site.
[23] Interview with DOE official who declined to be identified.
[24] Robert Alvarez, "Energy in Decay", *Bulletin of the Atomic Scientists*, May/June 2000, page 7. Restated in interview with author, January 2, 2003.
[25] Ibid, page 3. Confirmed in interview with author, January 8, 2003.

returned. Efforts made by the author to obtain documents were resisted. Similar materials were removed from the offices of the Pantex Plant Citizens Advisory Board, an official DOE advisory group that has monitored environmental, safety and health issues at the facility. Most recently, the DOE disbanded the Pantex Plant Citizens Advisory Board.

Unsafe, Unsound?

The Pantex site has been designated an "interim" storage facility for plutonium pits. In other words, while the government tries to figure out just what to do with these pits, they will stay where they are. Since other NWC facilities do not have the capacity to adequately manage the pits, however, it is unclear how "interim" is to be defined.

In February 2000, Frank Rowsome, a senior DOE safety expert, produced a report in which he indicted DOE officials for censoring safety reports as well as removing safety experts from nuclear weapons management. Rowsome warned that because of this climate, key safety professionals at the Department felt disempowered, disillusioned, and were preparing to leave. Robert Alvarez shared this experience.[26] Indeed, a number of problems had been surfacing at the Plant in recent years, each raising fears about worker safety and health.

As stated in the step-by-step description above, the dismantlement process begins with an inspection. This work is typically done entirely by hand by three to five technicians using specialized tools. To dismantle the weapon, technicians must disable the safety features intended to prevent accidental detonation. Rowsome reported that in several known cases, the improper tools were used for this step, or the wrong procedures were followed. In a particularly egregious example, technicians connected an electrical tester to an intact nuclear weapon, whereas the instructions called for connecting the tester to a specific component only after it had been safely removed from the warhead.

Rowsome further notes: "We have seen nuclear weapons accidentally destroyed but not exploded at Pantex in recent years." An accidental nuclear detonation, according to Rowsome, would potentially "kill the several hundred workers there, and induce the chemical explosive to go off in a few dozen other nuclear weapons, but probably not detonate them. It would produce radioactive fallout…."[27]

Backed-Up and Delayed: Government Safety Studies

The DOE is well aware of the safety problem at the Pantex Plant. In 2002, a Defense Nuclear Facilities Safety Board report noted that procedural and material movement violations remained a serious problem at Pantex. In one example, production technicians failed to perform a required quality test for the nuclear explosive unit during the disassembly process. The report concluded that "significant effort" was still required in order to address the "site-wide concern with procedural adherence."[28]

A 2003 audit by the DOE's Inspector General was even more alarming. The Inspector General reported a number of serious problems, and reiterated that safety at the Pantex Plant was an ongoing concern for the Defense Nuclear Facilities Safety Board. According to the audit, the DOE's National Nuclear Security Administration (NNSA) had failed to conduct required Nuclear Explosive Safety (NES) tests for six of the nine nuclear weapon types currently in the nation's stockpile. This was due to a number of factors, including delays in obtaining necessary information from supporting laboratories; a lack of personnel skilled in nuclear safety practices; and a lack of personnel familiar with the nuclear explosive system. The failure to perform these tests on a regular basis has led to other delays, including in dismantlement operations: The disassembly of certain retired weapons has been put off due to expired NES studies. Delayed NES tests could mean that the most up-to-date safety processes and procedures for workers and the environment were not in place.[29]

[26] Ibid, p.7, and in interview with author.
[27] Frank Rowsome cited in Alvarez, ibid, pp.7-8.
[28] April 12, 2002, Memorandum to J.K. Fortenberry, Technical Director, Defense Nuclear Facilities Safety Board, on Pantex Plant Activity Report for Week Ending April 12, 2002, from H. Waugh and W. White, Pantex Site Representatives.
[29] January 2, 2003, Memorandum to the Secretary of the Department of Energy, from Gregory Friedman, Inspector General, Department of Energy, "Audit Report: National Nuclear Safety Administration Nuclear Explosives Safety Studies Program."

Don Brunell, the NNSA Assistant Manager for Nuclear Engineering in charge of Pantex safety noted that better safety methods would soon be implemented under the auspices of the "Seamless Safety for the 21st Century" (SS-21) program. The program is intended to reduce or eliminate hazards in the processes of weapons assembly and disassembly. According to Brunell, Pantex had already had begun to implement the audit's recommendations prior to the release of the report.[30] Yet the 2003 Inspector General audit states that implementation of "Seamless Safety" has been slow, and is currently in place for only very few processes. Delays continue because of a combination of unexpected technical obstacles as well as a perpetual lack of qualified personnel.[31]

Don't Drink the Water…in Amarillo, Texas?

A source of fresh water on which hundreds of thousands of people rely is showing signs of contamination. Decades of nuclear weapons production, maintenance, and now disassembly and storage, have left the soil and groundwaters of Amarillo contaminated by high explosives, hexavalent chromium, TCE and a variety of heavy metals and industrial chemicals.

The Pantex Plant sits over the Ogallala aquifer, one of the nation's largest and most well-known freshwater aquifers. Ogallala lies under eight states, including America's breadbasket, the Great Plains. For Amarillo, the Ogallala aquifer is an essential source of drinking water since the area's principal municipal water source, the Lake Meredith reservoir (on the Canadian River), is too saline. The waters of Lake Meredith must be mixed with those of the aquifer to be fit for human consumption. Moreover, although they play an important role in replenishing the aquifer, playas can not alone supply the local community's water needs, since they are frequently dry.[32]

Between the soil surface and the top of the aquifer lie smaller, perched aquifers that can hold limited amounts of water. These "midway" aquifers were first to show signs of contamination. Because less than 100 feet separate these "midway" aquifers from the Ogallala aquifer in many places, the most recent studies reveal significant traces of contamination in the Ogallala itself.[33]

Amarillo's Airport: Too Close For Comfort

The location of the Pantex Plant raises other concerns. The bunkers in which plutonium pits from disassembled weapons are stored are on the primary landing approach for the Amarillo airport, some ten miles from the runway. The airport is used not only for commercial air traffic, but also for airforce training, including practicing takeoffs and landings.

An air traffic accident could result in an aircraft striking a plutonium-containing bunker, with obvious disastrous consequences. The fire and force of a crashing aircraft meeting thousands of plutonium pits could well result in a massive explosion, as well as virtually uncontainable radioactive spread and fallout.

Fireworks

This leads us to another serious problem with the Pantex plant. What would happen in case of fire at the plant? What happens when a fire erupts in a nuclear facility? The potential consequences can be far beyond anything inflicted by an "ordinary" fire. If caught in a fire, uranium and plutonium can not easily be contained. They will most likely be carried by smoke and wind for many miles. And once they fall back to the ground, the best-case scenario, unfortunately, is a major contamination event. Even commercial nuclear power plants, which do not machine or otherwise alter the nuclear materials with which they work, are always

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[30] Jim McBride, "Pantex Safety Studies Incomplete," *Amarillo Globe-News*, January 26, 2003.

[31] January 2, 2003, Memorandum for the Secretary of the Department of Energy, from Gregory Friedman, Inspector General, Department of Energy, "Audit Report: National Nuclear Safety Administration Nuclear Explosives Safety Studies Program."

[32] *Playas* are nearly level areas at the bottom of undrained desert basins that are sometimes temporarily covered with water.

[33] Information on water contamination in Amarillo was obtained from Mavis Belisle, Director, The Peace Farm, Panhandle Greens. Some of the information can be found at www.web.greens.org/s-r/09/09-13.html.

located near large sources of water. They are built on ocean coasts, lakesides and along rivers. If something goes wrong with a nuclear power plant and an explosion or fire occurs, the proximity to large quantities of water is invaluable.

For some, nuclear power generation is an acceptable risk as long as the city in question has abundant water nearby. Without such a supply, however, the possibility of fire must be considered an unacceptable risk by anyone's standards.

If the problem of where to obtain the water is somehow resolved, the next problem is the path that water must take after it is used. Nuclear runoff in the Amarillo region has few places to go. If it is to reach a river basin, it must first travel through hundreds of miles of terrain, near inhabited communities. The Ogallala aquifer would most likely provide any water needed to mitigate a major emergency at the Pantex Plant. This entails yet another risk, since any water used would probably return to the aquifer. To make things worse, uranium and plutonium are among the densest elements on earth, and if they are not carried away, their tendency is to sink. Their downward migration means that any water used to fight a fire at Pantex almost certainly would contaminate the aquifer that sustains our agriculture.[34]

Citizen Steps to Safeguard Health: Going It Alone

The toll of the Cold War on the health of workers in the nuclear weapons industries on both sides of the Iron Curtain continues to rise, and Pantex remains at the heart of concerns. In the United States, mining unions played the lead role in drawing attention to the health impact of the government's activities even before the Cold War was over. Unionists – mostly members of the steelworkers' and oil, chemical and atomic workers' unions – clamored for tighter standards to control ionizing radiation in the mines already in 1972.

In spring 1987, local union leaders demanded that their national organizations take concerted action. Union efforts led to the establishment of a DOE Workers Health Program, which provides medical assistance by physicians not employed by the DOE or its contractors. The DOE was also forced, after legal action, to provide direct health assistance at several NWC sites. With the support of Senator John Glenn and others in Congress, a law was passed requiring the DOE to provide medical surveillance for DOE facilities. Most major DOE facilities now have such programs, but not the Pantex plant in Amarillo. Under the auspices of the Amarillo Health Project, the Metal Trades Council has established its own program to provide medical services to active and former workers and their families. With funds from the National Cancer Institute, Dr. Arthur Frank, a professor at the University of Texas Health Center at Tyler, and a member of the Board of The Ramazzini Institute, is establishing an independent early cancer detection center headquartered in Amarillo, for instance.

At a community meeting in summer 2001, in Amarillo, the need for this program was articulated clearly by local citizens. Martha Brown, the widow of a Pantex worker who succumbed to cancer at the age of 56, called for a study on cancer among both Pantex employees and nearby residents. The study has been launched, but is not led by the DOE.[35]

The DOE's Pantex Baseline Risk Assessment: Inaccurate and Incomplete?

What has the government done to address these problems? In 1998, the Agency for Toxic Substances and Disease Registry (ATSDR) released a publication detailing its monitoring of the Pantex Plant. Soil, groundwater, and air are assessed frequently. Groundwater quality, for instance, is analyzed quarterly, and results are compared to DOE and drinking water standards.

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[34] Greg Sagan, Opinion: "Profits of Modern Pit Facility Not Worth The Risks," *The Amarillo Globe-News*, July 1, 2003.

[35] The Ramazzini Institute for Occupational and Environmental Health Research, "The Amarillo Health Project," *Genes, Ethics and the Environment*, 2001.

ATSDR studies have concluded that the activities of the Plant are essentially irrelevant to environmental and health problems in the Amarillo area. The ATSDR acknowledges, however, in its own studies, "higher than expected" rates of the following conditions in the Amarillo community:

- All types of cancers among females;
- all types of cancer in males, with a particularly high incidence of lymphotic leukemia and fatalities from prostrate cancer;
- children born with birth defects;
- low birth weight for newborns; and
- deaths from muscular dystrophy and multiple sclerosis.[36]

In each case, however, the government concludes that there is no connection to the activities of the Plant, although it acknowledges that further research is needed to establish causes for muscular dystrophy and multiple sclerosis.

Despite government reassurances, citizen concern in the area continued to grow. In response, the DOE conducted a Baseline Risk Assessment (B.R.A) for the Pantex Plant in 2000. The Pantex B.R.A was intended to satisfy the provisions of the Comprehensive Environmental, Response, Compensation and Liability Act (CERCLA), which involves estimating risks to human and ecological receptors based on:

- Determining the type and amounts of contaminants present;
- identifying the individuals that might be exposed;
- identifying the pathways by which individuals might be exposed; and
- evaluating whether the exposures would be expected to result in an unacceptable level of adverse health effects.

Pantex cleanup efforts are also driven by the Resource, Conservation and Recovery Act (RCRA) through the state of Texas' own risk reduction standards. Pantex intended for the Pantex B.R.A to meet the requirements of both CERCLA and the RCRA.

The Texas RCRA allows polluters to clean up to three different standards:

- Risk Reduction Standard 1: Requires cleanup to pre-contamination conditions.
- Risk Reduction Standard 2: Requires cleanup to conditions considered by the Texas Natural Resources Conservation Commission to be protective of human health.
- Risk Reduction Standard 3: Allows contamination to remain in place, but requires that remaining contaminants not pose an "unacceptable" risk to human health or the environment.

Determining what is "acceptable" is, of course, a challenge in itself. Yet at first read, the conclusions of the Pantex B.R.A should appease any concerned citizen. It seems that no serious contamination had – or would – occur. A dramatic challenge to the report has emerged, however: Todd Martin, technical advisor to citizen activist group STAND, evaluated the Pantex B.R.A and released a counter-report, publicizing a number of disturbing conclusions.[37]

First, Martin noted that the Pantex B.R.A fell far short of expectations to produce a comprehensive analysis. The DOE had evaluated 21 of 144 contaminated sites, or Solid Waste Management Units at the plant, but chose only those sites slated for Risk Reduction Standard 3 cleanup – the least stringent of Texas' cleanup standards. It therefore left important Solid Waste Management Units out of its risk calculations. The most obvious of these were the playa lakes, which act as a direct path to groundwater.

Second, an apparent inaccuracy regarding the Ogallala aquifer in the Pantex B.R.A raises concerns about the broader credibility of the report. Not only did the DOE assess that there was no contamination to the aquifer, it

[36] ATSDR and National Institute for Occupational Safety and Health report, available to the public at http://www.cdc.gov/niosh/book4.html.

[37] The subsequent information appears in *A Citizen's Guide to The Baseline Risk Assessment*, prepared by Todd Martin, technical advisor, for STAND. March 2002. Excerpts of the report are cited or paraphrased in the remainder of this section. Mr. Martin was hired as a private consultant with a Technical Assistance Grant awarded to citizen groups by the EPA for studies on contamination at the Pantex Plant.

stated that "…it is not a credible scenario that contamination will reach the Ogallala aquifer since hydrogeological data shows low potential for this to occur."[38] Martin's research, however, has shown that the aquifer is already contaminated with a variety of heavy metals and industrial chemicals, including TCE, high explosives, and hexavalent chromium. The DOE concluded that the Pantex Plant operators did not follow Energy Department reporting procedures, resulting in a nine-month delay in notifying senior managers and the public of groundwater contamination at the site. The DOE has since drafted recommendations to protect these waters.

Third, in analyzing the distribution of contaminants (i.e. through wind, seeping through soil, etc.), Pantex used mathematical models that assumed that contamination would be distributed evenly throughout the source zone. It thus failed to take into consideration the presence of "hot spots," or areas likely to be the receptors of far greater contamination than others.

Fourth, to evaluate the impact of contaminants on human health, Pantex presumed six categories of individuals, ranging from the facility's mowers/groundkeepers to its industrial workers to offsite residents. The trouble is that models analyzing the impact on off-site human receptors were based exclusively on a hypothetical male farmer living in the surrounding community for 40 years. The impact of contamination on more sensitive populations, primarily the elderly and pregnant women, was not analyzed at all.

Fifth, the analysis assumed a period of 1,050 years, while DOE analysis normally projects a period of over 10,000 years. Given the half-life of certain contaminants, including uranium (whose half-life ranges from 245,000 to 4.5 billion years depending on the isotope) a lengthier period would have been expected. A related point is that the DOE assumed that no one would ever reside on what is today the Pantex Plant, instead stipulating 1,050 years of occupancy and institutional control of the location by the DOE.
Sixth, and perhaps most surprisingly, Pantex rejected its own data when that data yielded results that were considered alarming. Indications of high risk of disease or contamination calculated by the Pantex B.R.A were dismissed through assertions of poor or outdated data.

Possible Policy Directions

1) As we emphasize in our Chemical Weapons abolition work, Global Green USA advocates that all key stakeholders around the Pantex Plant – including activist groups STAND and Peace Farm – engage in a dialogue about their concerns. Global Green USA recommends that a working group be created to address the concerns of these organizations for the purpose of relaying these concerns to Congress.
2) Local leadership in affected communities, such as Amarillo, Texas should engage fully with citizen groups and assist in conveying their concerns to Congress.
3) Given the extensive environmental and human health impacts of the NWC activities, a plan for compensating the victims should be developed and GG USA recommends this be the foremost task of the working group.
4) The federal government must demonstrate its commitment to environmentally intelligent management, in accordance with the DOE's mandate. A fundamental challenge is the current administration's lack of attention to environmental issues. It is imperative that the federal government uphold its responsibility to strengthen and facilitate the DOE's environmental mandate. Only then can the DOE properly fulfill its obligations to make the Nuclear Weapons Complex safe.
5) To substantiate its commitment, the White House should:

- Ask Congress to approve DOE requests for management of the Nuclear Weapons Complex. In the past few years, funding requests have been denied, and existing funds have been cut.[39]
- Select environmentally sound policies whenever the option exists, even at higher financial cost. If no environmentally sound policy is available, then the

[38] Cited in *A Citizen's Guide to the Baseline Risk Assessment*, p.15.
[39] Interview with DOE official who declined to be identified.

Administration must task the DOE with devising such policies. In addition, a commitment should be made to making environmentally intelligent technology cost-effective. Two specific recommendations are:

-Include recommendations related to the effects of the nuclear disassembly process in an Energy Bill.

-Include a request in the Defense Appropriation Bill for appropriate funds to direct the nuclear disassembly process in an environmentally safe manner.

6) Global Green USA is committed to helping preserve the Non-Proliferation Treaty. We therefore recommend that the DOE abandon plans to construct a Modern Pit Facility at the Pantex Plant. The government is expected to respect and honor every clause of the Non-Proliferation Treaty, to which it is party. To that end, the construction of a facility to produce plutonium pits should not be permitted. If, however, the government deems that national security considerations absolutely demand that such a facility exist, we ask that the facility be built in a location that, unlike Pantex, is (a) not already a Superfund clean-up site struggling with decades of contamination; (b) not near an inhabited community such as Amarillo, or any of the existing NWC sites; (c) near a vast and continuous source of water, to mitigate the risks associated with nuclear accident, but not near a solitary water source on which residents rely.