

**FACING  
REALITY**

**“STOCKPILE STEWARDSHIP”  
OF  
NUCLEAR WEAPONS**

**The Deal  
to Subsidize  
Nuclear Weaponneers**

This report is published under the auspices of the Project for Participatory Democracy, an initiative of the Tides Center. *“Stockpile Stewardship” of Nuclear Weapons* is eighth in the series of *FACING REALITY* documents, preceded by:

*FACING REALITY: The Future of the U.S. Nuclear Weapons Complex*; a companion

*Citizens’ Guide to the Future of the U.S. Nuclear Weapons Complex*;

*BEYOND THE BOMB: Dismantling Nuclear Weapons and Disposing of their Radioactive Wastes*;

*Nuclear Weapons “CLEANUP:” Prospect Without Precedent*;

*OFFICIAL USE ONLY: Ending the Culture of Secrecy in the U.S. Nuclear Weapons Complex*;

*CITIZEN LAW ENFORCEMENT: Fighting Environmental Crime at Facilities of the U.S. Departments of Energy and Defense*; and

*REPROCESSING: The U.S. Department of Energy’s Wasteful, Dangerous Scheme to Resume Plutonium Separation.*

*Planned annual spending on nuclear weapons research and design, adjusted for inflation, is now more than twenty percent higher than average spending for nuclear arms research, development, testing and manufacture during the Cold War.* Under the guise of “Stockpile Stewardship and Management,” this array of costly projects has little to do with any real need to maintain leftover nuclear warheads. Instead, the program poses serious hazards to peace and international security by undermining treaties essential for slowing the spread of dangerous technology and by providing excuses, and possibly the means, for other countries to obtain weapons of mass destruction.

Along with the great majority of the world’s citizens, numerous strategic experts, scientists, and high-ranking former military officers now recognize that nuclear arms are a threat to peace and security. Plans by the United States to extend its nuclear weapons design capabilities will aggravate the hazards and complicate global nuclear disarmament efforts.

# **“STOCKPILE STEWARDSHIP” OF NUCLEAR WEAPONS**

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This report is based upon published government documents and the research efforts of independent experts and organizations. While this document has been reviewed by the persons listed below, who have made valuable suggestions and corrections, their review does not imply unqualified endorsement of all parts of the report. Responsibility for the completed document rests with the author.

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## I. Introduction

With strong support from Congress and the Clinton Administration, the United States Department of Energy (DOE) has embarked on a nuclear weapons **Stockpile Stewardship and Management Program** (SSMP) that is expected to cost taxpayers at least \$60 billion by the year 2010.<sup>1</sup> In addition to its high cost, this collection of facilities and projects could spark a renewed arms race, aggravate international tensions, impede further reductions in nuclear arsenals, undermine treaties essential for slowing the spread of dangerous nuclear technology, provide excuses for other countries to obtain nuclear weapons, and cause unnecessary environmental damage.

Supporters argue that this costly, dangerous program is necessary to “maintain the safety and reliability” of the U.S. nuclear arsenal. As long as the United States stores or deploys nuclear arms, the need for warhead safety is undeniable. Safety involves minimizing the risks of an unintended explosion or the accidental dispersal of dangerous materials such as plutonium. Weapons “reliability”—related to the probability that, if it is used, a warhead or bomb will detonate with its intended explosive power—is also necessary. However, the level of reliability “needed” depends on the nuclear arsenal’s military and political purposes, rather than on clear-cut engineering analysis. Most of the current and planned SSMP is not essential for maintaining the U.S. arsenal, particularly if the only role of these weapons is to deter nuclear attack by threatening retaliation.

Leftover Cold War nuclear arsenals, research and production facilities, and stockpiles of nuclear materials are the sources of serious hazards. Deteriorating Russian military warning and control systems could generate faulty or misinterpreted information and cause an “inadvertent” holocaust. The “proliferation” of crucial nuclear materials and technologies also poses the risk that additional countries or subnational groups might obtain nuclear weapons and use them for coercion or terrorism.

.....  
*The great majority of the current and planned “stockpile stewardship” program is not essential for maintaining the U.S. arsenal.*

The United States has acknowledged these threats by signing several arms agreements and treaties, including a series of Strategic Arms Reduction Talks (START treaties) with Russia, the nuclear Nonproliferation Treaty (NPT), and the Comprehensive Test Ban Treaty (CTBT). The purpose of this collection of agreements is to strengthen international security, diminish the “balance of terror” inherited from the Cold War, and eventually eliminate nuclear arsenals.

The former Cold War enemies have ended mass production of new nuclear arms, and both have been gradually dismantling thousands of surplus warheads. At least for now, they have also ended their rapid and continuous development of new-design nuclear weapons. As the strategic and military importance assigned to nuclear arsenals declined, the size of those stockpiles also diminished.

These reductions, along with the end of mass production of new kinds of weapons, should mean that the burden of maintaining the nuclear arsenal would be dramatically smaller than it was during the Cold War.

Instead, ***inflation-adjusted annual spending on nuclear weapons research and design activities is now more than twenty percent higher than average spending for nuclear arms research, development, testing, and manufacture<sup>2</sup> during the Cold War.<sup>3</sup> SSMP alone is expected to cost more than \$60 billion by the year 2010.*** Most SSMP projects are geared toward continuing the flow of public money to “nuclear weaponeers” (lab scientists and contractors), rather than to satisfy realistic arsenal maintenance requirements.

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The SSMP will maintain the capacity to design, develop, and produce new nuclear weapons at a time when the United States is trying to persuade other nations to forego those pursuits.

The program explicitly prepares the United States to resume explosive nuclear testing on short notice, even though the United States has conducted more nuclear tests than all other nations combined. Nuclear research and production facilities constructed and operated under the SSMP will add to environmental problems at DOE sites at a time when the country struggles to deal with contamination and radioactive waste left by nuclear weapons production since the 1940s.

In contrast to the DOE's overblown version of stockpile stewardship, an alternative has proven itself through decades of experience, and it has not relied on nuclear testing. The practical version of stockpile stewardship consists of "surveillance" along with remanufacture of warheads or of some of their components when needed. This established method will continue to do the real work of arsenal maintenance. Surveillance is the inspection and disassembly of representative samples of each weapon design in the arsenal, with some destructive testing of components.

Warheads and their components can be remanufactured according to known specifications and tolerances, as in any other modern industrial production process. By using this approach, the nation would not require exotic new research facilities, it could save tens of billions of taxpayer dollars, and it would avoid the risks of proliferation or of inciting a new arms race that stem from the DOE's activities and plans.

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## II. Key Components of the DOE's "Science-Based" Plan

The United States still possesses dozens of models of extensively tested nuclear weapons. It has performed more than 1,000 nuclear explosive tests, and it has abundant evidence that stockpiled warheads can be maintained through careful surveillance and periodic component replacement. The DOE argues that despite all this, the nation must spend billions of dollars per year for the indefinite future on what it calls "Science-Based" Stockpile Stewardship. Supposedly, this approach is necessary to gain a better understanding of the microscopic details of nuclear explosions and to "exercise" an army of physicists in case they should ever be called upon to design new nuclear arms. The DOE's three nuclear weapons laboratories—the Lawrence Livermore National Laboratory in California, and the Sandia and Los Alamos National Laboratories in New Mexico—receive most of the funding for stockpile stewardship. Major elements of the DOE's current stewardship and management plans include:

- **Underground sub-critical testing** - The DOE has begun a series of test explosions at the Nevada Test Site, at a cost of about \$20 million for each of about four tests annually. These tests will detonate chemical explosives with nuclear materials such as plutonium and uranium, but they are not intended to result in self-sustaining nuclear chain reactions ("criticalities"). The DOE is conducting these tests underground to avoid environmental regulations by using an already contaminated site and to provide a rationale for maintaining test site "readiness." Even though the United States says that these tests do not violate the test ban, they set a precedent for underground experiments of a kind that are difficult to detect and that will complicate treaty verification. If there is a valid scientific or military justification for using sub-critical experiments to assess the reliability of remanufactured copies of established warhead designs, they should be conducted above ground on existing equipment, using methods that ensure sub-criticality.

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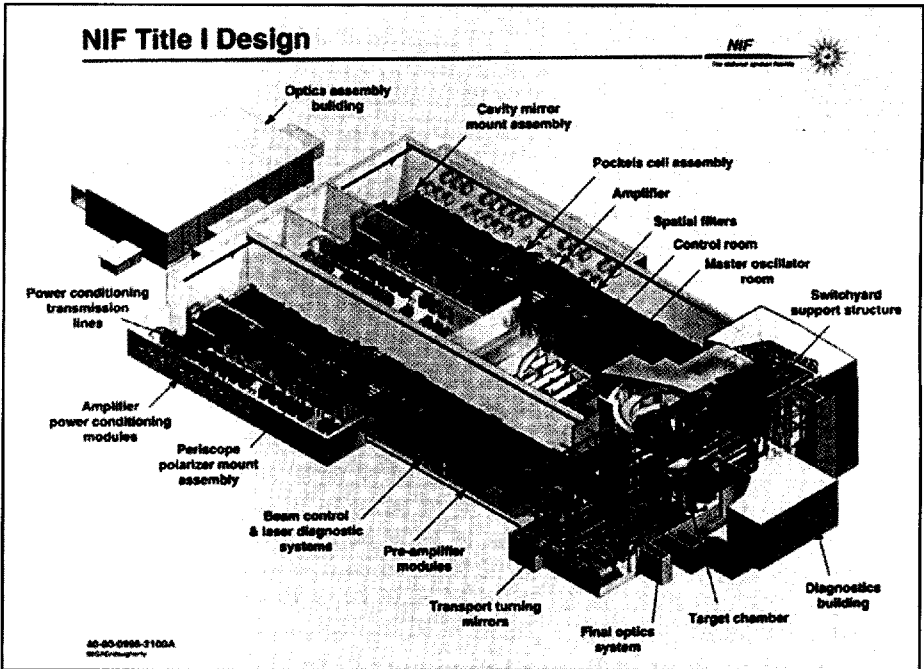


- **Accelerated Strategic Computing Initiative (ASCI)** - The goal of this program is to provide each of the three DOE labs with extremely fast computers, at a total cost of more than \$1 billion during the next seven years. A radical increase in computing power available to the nuclear weapons program—to thousands of times the performance of current supercomputers—is said to be necessary for designing nuclear weapons without testing and with high confidence in their performance.

The DOE plans to share crucial nuclear design programs and data with a wide array of scientists within and outside the labs, and its computers will run on standard operating systems. Information from ASCI will thus be difficult or impossible to keep secret, and it could ease the task of other countries that seek to build advanced nuclear weapons.<sup>4</sup> An aggressive new program for modeling nuclear weapons on computers will have serious international implications by creating an impression that the United States is trying to evade its treaty obligations.

- **Academic Strategic Alliances Program (ASAP)** - This program, announced in July 1997, awards about \$20 million to each of five universities for nuclear weapons-related research.<sup>5</sup> ASAP is intended to further SSMP work such as computer architecture, “virtual testing,” and explosives simulation. The DOE also plans to use the program to recruit new nuclear weapons scientists. ASAP raises serious questions about open scientific inquiry. If research results are classified, graduate students will be effectively prevented from having careers in anything but nuclear weapons. On the other hand, open publication would create proliferation risks.<sup>6</sup>

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*National Ignition Facility - Lawrence Livermore National Laboratory, California (artist's conception). The NIF building will be 704 feet long and 403 feet wide. The planned facility will contain 192 large lasers with 33,000 square feet of glass optics.*

- **National Ignition Facility (NIF)** - This facility will consist of a huge building containing 192 very powerful lasers designed to focus on a pellet of thermonuclear fuel and “ignite” a small nuclear fusion explosion (a process called Inertial Confinement Fusion, or ICF). Under construction at Lawrence Livermore National Laboratory in California, the NIF is expected to cost \$1.7 billion to build and bring into operation, and roughly \$5 billion in total during its lifetime. That figure does not include the costs of eventual dismantlement of the site or the inevitable cost overruns associated with large government projects.

Many DOE scientists are skeptical about the NIF’s chances of achieving ignition, and there is no realistic prospect of its becoming a useful step toward civilian fusion energy. These scientists have called the NIF a “billion-dollar boondoggle” with an “absolutely overblown” nuclear weapons mission that has had “virtually no internal peer review.” One Sandia Lab physicist said: “[The NIF] has almost nothing to do with stockpile stewardship,” and a Livermore scientist has been quoted as saying: “It’s the basic science community that should have blown the whistle on this. They’re the ones perpetuating the myth.”<sup>7</sup>

The NIF could present a proliferation hazard because some of the computer codes used in its research will be similar to the programs used to design nuclear weapons.<sup>8</sup> Other countries perceive the NIF as useful to the United States for designing new generations of weaponry; that perception alone creates a proliferation risk. However, the NIF will have nothing to do with the safety of existing warheads, and it will have only marginal relevance to their performance or reliability.

- **Other Planned Research Facilities** - These projects include the Dual-Axis Radiographic Hydrodynamic Test facility (DARHT) at Los Alamos (\$250 million), the Contained Firing Facility (\$50 million) at Livermore, the proposed Advanced Hydrotest Facility (at least \$400 million), the X-1 Advanced Radiation Source (\$300 million), and next-generation pulsed-power systems such as the "Ranchero" facility (\$70 million). None of these projects is essential for maintaining a nuclear weapons stockpile.
- **Plutonium pit manufacturing** - The DOE plans to spend more than \$1 billion on expanded facilities for a capability to annually remanufacture or modify up to 500 plutonium core components, or "pits" for nuclear weapons. This program is grossly in excess of any plausible requirements for supporting the current or expected future arsenal. After mass production of pits suddenly ended in 1989 at the Rocky Flats Plant in Colorado, the DOE discovered that many pits from retired warheads could be used in new ones, thus precluding the need for plutonium fabrication.<sup>9</sup> Following the arms reductions of recent years, the inventory of retired warhead components is much larger, the active arsenal is smaller, and pit reuse should therefore be even more practical. For at least the next several decades, the existing Los Alamos production capacity of about 20 pits per year should be more than adequate.

The DOE's plans for an 80 to 500 pit per year capability appear to be a ploy for soaking up federal funds rather than a response to any conceivable need. Part of the plan for Los Alamos is a factory for making components for warhead "secondaries." These parts are even less susceptible to aging than are plutonium pits, and they can already be produced at the DOE site in Oak Ridge, Tennessee. Between July 1996 and August 1997, the DOE's cost estimates for component manufacturing at Los Alamos escalated from \$310 million to \$1,080 million, *more than tripling the cost in 13 months*. The actual cost of the project is likely to be about \$1.4 billion.<sup>10</sup>

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### III. Origins of a Misguided Policy

The current Administration has viewed an extravagant nuclear arms research effort as the necessary price for a higher objective: U.S. ratification of the Comprehensive Test Ban Treaty. While this is arguably true in the current political climate, that environment is based on the powerful lure of tens of billions of federal dollars, on too little skepticism toward scientists with obvious conflicts of interest, and on unrealistic strategic assumptions. The result is a “package” that might (or might not) lead to treaty ratification in the U.S. Senate, but that could induce other nations not to ratify the treaty, thus severely weakening its implementation.

#### **The Political Deal**

The political power of the DOE labs and their backers in Congress is exemplified by the enormous subsidy they have received as “compensation” for the end of nuclear testing. The promise of open-ended, poorly overseen research funding has been used by the Administration to gain support for the CTBT in the Senate, where the treaty will be considered for ratification. In exchange for their grudging acquiescence to the test ban, the labs have been assured of virtually everything on their wish list for new facilities and projects. In its effort to avoid controversy and political losses, the Administration failed to consider the consequences, for the CTBT and for arms control and nonproliferation in general, of the DOE program. The essence of the political deal with the labs is outlined in a White House press release about treaty “safeguards” (see page 19, “U.S. Policy Contradicts Treaty Commitments.”).

Lab directors and scientists argued strenuously against any restrictions on nuclear testing during the 1950s and early 1960s before President Kennedy negotiated a ban on above-ground tests. Although superpower testing was driven underground in 1963, it continued until 1992, when a testing moratorium was passed by Congress and signed by President George Bush. When the United States finally agreed to a more complete testing moratorium that had been advocated by Soviet President Gorbachev for the previous seven years, the labs resisted again, and in 1993 they argued for renewed testing.<sup>11</sup> On those earlier occasions, as in recent debates over the CTBT, nuclear weaponeers have opposed arms control measures and have then demanded compensation when treaties or agreements were achieved.

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## **A bargain to be broken?**

To support their continued multi-billion-dollar annual funding, the labs have emphasized the supposed risks to national security of losing their nuclear weapons development capabilities. In this view, the United States must continue to support thousands of nuclear weapons scientists and engineers for the foreseeable future, and it must “exercise” those “nuclear weaponeers” with an endless program of warhead modifications or even complete warhead designs.

Despite the breakup of the Soviet Union, exaggerated notions about the utility of nuclear arms form the basis for this version of reality. The excesses of SSMP can only fuel perceptions by other nations that the United States is attempting an “end run” around the CTBT. Thus, a bargain that was ostensibly necessary to support the treaty could lead to its failure to be fully ratified and enforced, which in turn will exacerbate nuclear proliferation dangers.

The political deal for an overblown version of stockpile stewardship might have been necessary for bringing the CTBT to the U.S. Senate for ratification, but it provides weak support at best for the treaty. Implicitly, the bargain says: “The CTBT is bad for the country, but for \$4.5 billion per year, we can live with it...if we’re lucky.” Even that compensation appears not to be enough for the labs. Part of the bargain is that the DOE must annually reaffirm its “confidence” in the nuclear arsenal. Without such confidence, lab officials can argue that the United States must resume testing, regardless of whether any other nation has broken the treaty.

Some weaponeers have begun quietly, and sometimes publicly, to undermine the CTBT. For example, Kathleen Bailey, an analyst at the Livermore Lab, recently wrote in *The Washington Times*:<sup>12</sup>

Administration officials argue that we are ready for the test ban because the U.S. Stockpile Stewardship program gives us the information necessary to assure that our nuclear weapons are safe and reliable. They do not mention that *key portions of the program entail complex technologies that have not been proven and facilities that will take a decade or more to build.*

*Top scientists involved in the stewardship program agree that success of the program is not guaranteed; some say that the odds are only 50-50. These odds would be significantly improved with a concurrent testing program to enable scientists to better calibrate the stewardship technologies, making it more likely that the program would reliably reduce the need for testing in the future....*

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Testing is also required for any new nuclear weapon design. Currently, we don't need a new design, but this may change. ...*the United States must remain prepared to generate new nuclear weapons designs.* [emphasis added]

This argument against the test ban, while it is not an official lab position, reveals the fallacy and hypocrisy of the overblown SSMP. Tens of billions of dollars are supposedly needed to "maintain" (actually, continue the development of) nuclear arms without nuclear explosive testing. Yet the DOE's own experts do not give the program a better-than-even chance of "success." The reference to an unspecified future "need" for new warhead designs ignores the fact that the United States already has the world's most sophisticated weapons, both nuclear and conventional.

### ***The mystique of science***

Citizens and their elected representatives often fail to exercise skepticism when public policy questions involve exotic science and technology. In part, this results from a general increase in specialization and an often necessary reliance on "expertise." Military secrecy tends to magnify this failure of oversight. The DOE nuclear weapons scientists have used their "expert" status to help make their version of strategic reality into national policy, even though they have the obvious conflict of interest of wanting to preserve their jobs.

The Administration and a majority of Congress have too easily accepted the weaponeers' self-serving arguments about the centrality of their work to national security. The result is a political bias that emphasizes the supposed risks of not enhancing U.S. capabilities to develop nuclear arms while ignoring the hazards of a national strategy that relies on and legitimizes further R&D on weapons of mass destruction. This perpetuates the idea that such weapons are desirable, thus encouraging other nations to obtain them.

### ***Outdated reliance on nuclear weapons***

In its support of arms control and nonproliferation treaties, the United States has shown a growing understanding of the dangers of nuclear weapons. Many high-level military officers, other strategic analysts, and civilian leaders have recognized that nuclear arms have no plausible utility in war. Nuclear weapons have ostensibly served the political role of preventing their own use, but even this "deterrent" function is debatable. The United States, with the world's most powerful and technologically advanced conventional forces, has the least to lose and perhaps the most to gain from any progress toward eliminating nuclear arsenals. Despite those benefits, the government has failed to consider seriously the possibility that nuclear arms have outlived any usefulness they might have once had.

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## IV. The DOE Rationale

In its arguments for expensive new projects at its nuclear weapons labs, the DOE relies almost entirely on the claimed need to “ensure the safety and reliability of the nuclear arsenal” in the absence of full-scale explosive testing. The rationale of the weaponeers can be summarized as follows:

1. U.S. defense will rely on an arsenal of thousands of nuclear weapons for the indefinite future.
2. Most warheads will be kept in the “enduring stockpile” for longer than their intended shelf lives of 25 to 30 years, and aging will have unknown but deleterious effects on their performance.
3. Current nuclear weapons must be modified to extend their lifetimes and correct flaws that might be discovered.
4. Unspecified “needs” for new types of nuclear arms are likely to arise.
5. Without test explosions, the consequences of warhead modifications (and the performance of new designs) cannot be fully predicted.
6. Highly sophisticated computer modeling will be necessary to make up for the absence of nuclear testing and to be able to predict the effects on performance of warhead aging and design modifications.
7. Elaborate new facilities and projects will be needed to improve understanding of fundamental nuclear explosion physics and to provide data for computer models. These endeavors will also attract and “exercise” nuclear weapons scientists.
8. A large and heavily funded establishment of scientists and research facilities will be required to perform “stockpile stewardship” for the foreseeable future.

### ***The “Science-Based” Approach***

The DOE argues that the end of nuclear testing requires the pursuit of Science-Based Stockpile Stewardship. *However, nuclear testing has never been essential for maintaining an arsenal of established warhead designs.* Therefore, explosive testing does not need to be replaced by elaborate research projects unless the nation intends to design and produce new weapons that are significantly different from proven models. This would conflict with stated U.S. policies of reducing the nation’s reliance on nuclear arms and foregoing the acquisition of new types of warheads.

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*Nuclear testing has never been essential for maintaining an arsenal of established warhead designs.*

Scientific research and the engineering and testing of prototype weapons have been necessary for creating a large and varied arsenal of sophisticated nuclear weapons. To a small extent, testing has been employed to detect flaws in completed designs after warheads have gone into production.

The DOE asserts that tens of billions of dollars must now be spent to support a small army of scientists capable of designing new kinds of nuclear arms just in case a “need” for them should arise. This claim rests on Cold War assumptions about “nuclear warfighting.” It fails to recognize that:

1. The U.S. arsenal has for several decades been many times larger than necessary to inflict devastating retaliation on any potential attacker.
2. Most strategic experts view the massive U.S. conventional forces as a better deterrent (because its use is more plausible than is the use of nuclear weapons) against “weapons of mass destruction” that might be obtained by the so-called “rogue nations.”
3. Efforts by the United States to build a unique capability for designing weapons without needing to test them will undermine treaties crucial for inhibiting nuclear proliferation and could potentially introduce unproven and thus unsafe and unreliable weapons into the arsenal.
4. A “science-based” focus is likely to distract attention and resources away from the relatively mundane, but crucial, activities that have successfully maintained the nuclear arsenal throughout the Cold War and since.

To design new kinds of nuclear bombs without testing, or even significantly modify their “physics packages” (crucial nuclear components), while meeting the DOE’s extremely high performance standards, would probably require a monumental investment in supercomputers, massive lasers, particle accelerators, and other facilities. Even with that expenditure, success is far from certain. The key question is whether the United States should attempt to maintain and in some areas enhance its current level of expertise in nuclear weapons design.

The DOE’s argument for “science-based” stockpile stewardship rests on assumptions (actually, myths) that are not supported by current or historical evidence. One myth is that nuclear warheads will suffer “safety and reliability” problems as they age. A second myth is that the nation will somehow lose its ability to manufacture warheads under established specifications and tolerances for manufacturing errors.

.....  
*The key question is whether the United States should attempt to maintain or enhance its current level of nuclear weapon design expertise.*



Another assumption on the part of the labs and their supporters is that new weapons and modifications of existing ones must be designed and proven for the indefinite future. Finally, the DOE argues that vast new programs must be undertaken to make up for the role of nuclear testing in arsenal maintenance. In fact, testing was used almost exclusively for creating new weapons, not for checking old ones. No aging-related safety problems, and very few flaws that affect reliability, have been discovered.

The DOE has certified the safety and reliability of stockpiled weapons for many years, and it has established methods for sampling and evaluating each type of warhead and bomb. This kind of "stockpile surveillance" does not require additional, costly experimental physics facilities. Instead, it involves relatively mundane engineering work and the remanufacture of components if a problem is discovered during surveillance. There is no reason that this method of stewardship cannot be continued as long as the United States possesses a nuclear arsenal. In fact, as nuclear arsenals shrink and become less central to military strategy, stockpile surveillance and remanufacture will also become a smaller burden.

### **Warhead Safety and Reliability Myths**

The DOE has consistently certified as safe and reliable all the warhead models in the remaining arsenal.

Safety and reliability sound similar, and nuclear weapons proponents commonly cite them together. In the nuclear arms context, however, they have very different meanings and implications. Stated simply, safety involves making sure nuclear warheads do not explode or disperse their dangerous contents by accident. Reliability has to do with weapons producing their designed explosive power and other effects if they are used.

The potential for accidents should not be taken lightly, but the problems of nuclear weapon safety were solved decades ago to a very high degree of confidence. No serious accidents (i.e., explosions or fires) involving U.S. nuclear weapons have occurred since the late 1960s, and not one person is known to have died as a result of the accidents before then.

Even less risk is expected in the future. After 50 years of experience and study, *no further cost-effective safety improvements have been identified for application to the future U.S. nuclear arsenal.* In addition, *none of the safety problems discovered in the past have been attributed to the aging of a warhead's nuclear components.*<sup>13</sup> Finally, none of the DOE's extravagant new facilities and programs will have a plausible role in nuclear weapon safety.

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The reliability of U.S. nuclear arms has been demonstrated by more than 1,000 test explosions. While only two types of reliability defects have been discovered that were related to the aging of nuclear components, the great majority of such problems have been minor, and most have involved non-nuclear components or systems.<sup>14</sup> Every warhead model in the arsenal has been explosively tested and certified (typically with at least seven nuclear tests per model).<sup>15</sup>

Experience and technical analysis indicate that the aging of nuclear components or high explosives does not lead to warhead safety problems. Moreover, the great majority of reliability defects can be resolved by replacing parts that can be thoroughly tested, such as electronic circuits, batteries, neutron generators, and tritium reservoirs. The nuclear parts that cannot be fully tested under the CTBT have yet to exhibit flaws due to aging that would limit their service life, but if doubts arise, those components can be remanufactured as needed or that model could be removed from the arsenal. With careful maintenance and periodic component replacement, nuclear weapons can be made to last for many decades, and the evidence suggests indefinitely. The DOE's vast and intricate plans for a capability to predict the effects of warhead aging on nuclear weapons performance—in order to precisely schedule the replacement of components and warheads—are a costly solution for a nonexistent problem.

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*With careful  
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## V. Continuing Struggle for a Test Ban

The Comprehensive Test Ban Treaty represents the culmination of half a century of effort on the part of concerned citizens and scientists to restrain the nuclear arms race. This work began shortly after World War II and reached its first major milestone in 1963, when the Limited Test Ban Treaty required its signatories to stop above-ground nuclear tests. That agreement stopped a major source of atmospheric contamination with radioactive fallout, inhibited testing in general, and pledged its signatories to pursue “the discontinuance of all test explosions of nuclear weapons for all time....”

The Threshold Test Ban Treaty, signed in 1974, set a 150 kiloton maximum on the explosive power of underground nuclear tests, thus restraining further development of extremely destructive weapons. This treaty also helped establish a seismic monitoring network that has provided verification for more than 20 years.

In response to a unilateral testing moratorium declared by Soviet President Gorbachev in 1991, along with the imminent collapse of communism, the U.S. Congress passed legislation establishing a 9-month U.S. nuclear testing moratorium that allowed up to 15 tests before 1996, but for safety or reliability purposes only. This law also prohibited U.S. nuclear testing after 1996 unless another nation were to conduct a test first. President Bush reluctantly signed the legislation in 1992. In July 1993, President Clinton extended the moratorium, began CTBT negotiations at the 61-nation Conference on Disarmament, and directed the DOE to develop a more robust stockpile stewardship program.

On September 10, 1996, after more than two years of negotiation, the United Nations General Assembly adopted the language of the CTBT by a vote of 158 to 3, with 5 abstentions. Two weeks later, the treaty was opened for signature, and President Clinton was the first to sign it. As of late 1997, 148 nations, including all five nuclear weapons states, had signed.

.....  
*After more than two years of negotiation, the United Nations General Assembly adopted the language of the CTBT by a vote of 158 to 3.*

The CTBT could be implemented as early as September 1998 if it is ratified by all 44 nations that have military or civilian nuclear programs. As with earlier treaties, however, signatory nations are unlikely to violate it in the interim, even if the treaty does not enter into force for several years. Without formal entry into force, however, the treaty's far-reaching monitoring and on-site inspection system might not be fully operational, making potential violations more difficult to detect.

The current U.S. stockpile stewardship program also threatens the viability of a test ban. Five years after the beginning of a bilateral nuclear test moratorium with Russia, and one year after signing a CTBT, the U.S. government still refuses to consider shutting down the Nevada Test Site. The DOE plans to keep the site ready indefinitely to resume testing on short notice. It operates costly facilities and programs there that might comply with the legal limitations of the treaty, but not with its purpose. The United States spends about 180 million tax dollars annually just to keep the test site ready to resume testing, and another \$80 million on underground sub-critical testing. This expenditure is rationalized by the notions that if: a) the CTBT should "fail"; b) if any other nation performs a nuclear test; or c) serious flaws are discovered in stockpiled warheads, then the United States would need to immediately resume testing. History, common sense, and DOE's own data contradict these assumptions.

The DOE has already begun a series of "sub-critical" underground tests. These tests use plutonium and/or uranium in ways that do not lead to a self-sustaining nuclear reaction. The DOE claims that sub-critical tests comply with the letter of the CTBT, that they are needed to provide data for computer models that simulate nuclear explosions, and that they will "exercise" the technicians and scientists who might someday be needed to carry out full-scale nuclear tests. Critics, including several non-nuclear countries, argue that sub-critical testing violates the purpose of the CTBT by improving capabilities for designing nuclear weapons and offsetting the effects of the treaty on the nuclear weapons program.

.....  
*The United States spends about 180 million tax dollars annually just to keep the test site ready to resume testing.*



***The Nevada Test Site** - Aerial view of the north end of Yucca Flat, showing scores of subsidence craters left by underground nuclear explosions. Such testing ended in 1992 following Congressional legislation requiring the United States to join a moratorium initiated by the Soviet Union. However, many nuclear weapons scientists continue to oppose a global test ban, and the DOE plans to continue a series of "sub-critical" experiments at the Nevada Test Site. This program calls into question the nation's commitment to abide by the restrictions it would impose on other countries.*

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## ***Purposes of the Comprehensive Test Ban***

Although environmental contamination from underground nuclear explosions is of some concern, the main reasons for ending testing have to do with proliferation, both “vertical” (the development of new types of nuclear weapons by countries that already have them) and “horizontal” (the spread of crucial nuclear technology to additional nations). The primary purposes of the CTBT are described in the following excerpts from its preamble:

The States Parties to this Treaty [are]...

Convinced that the present international situation provides ***an opportunity to take further effective measures towards nuclear disarmament and against the proliferation of nuclear weapons*** in all its aspects, and declaring their intention to take such measures,

Stressing therefore ***the need for continued systematic and progressive efforts to reduce nuclear weapons globally, with the ultimate goal of eliminating those weapons***, and of general and complete disarmament under strict and effective international control,

Recognizing that the ***cessation of all nuclear weapon test explosions and all other nuclear explosions, by constraining the development and qualitative improvement of nuclear weapons and ending the development of advanced new types of nuclear weapons, constitutes an effective measure of nuclear disarmament and non-proliferation in all its aspects***,

Further recognizing that ***an end to all such nuclear explosions will thus constitute a meaningful step in the realization of a systematic process to achieve nuclear disarmament, ...***

Affirming ***the purpose of attracting the adherence of all States to this Treaty and its objective to contribute effectively to the prevention of the proliferation of nuclear weapons in all its aspects, to the process of nuclear disarmament*** and therefore to the enhancement of international peace and security... [emphasis added]

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## **U.S. Policy Contradicts Treaty Commitments**

*The following points are extracted from an August 11, 1995 White House description of U.S. "safeguards" required for abiding by the treaty:*

A Comprehensive Test Ban Treaty (CTBT) is conditioned on:

A: The conduct of a **Science Based Stockpile Stewardship** program to insure a high level of confidence in the safety and reliability of nuclear weapons in the active stockpile, including the conduct of a broad range of effective and continuing experimental programs....

C: The maintenance of the basic **capability to resume nuclear test activities prohibited by the CTBT** should the United States cease to be bound to adhere to this treaty....

F: The understanding that **if the President of the United States is informed by the Secretary of Defense and the Secretary of Energy (DOE) — advised by the Nuclear Weapons Council, the Directors of DOE's nuclear weapons laboratories and the Commander of the U.S. Strategic Command — that a high level of confidence in the safety or reliability of a nuclear weapon type which the two Secretaries consider to be critical to our nuclear deterrent could no longer be certified, the President, in consultation with Congress, would be prepared to withdraw from the CTBT under the standard "supreme national interest" clause** in order to conduct whatever testing might be required.

*The following quotes are from recently declassified portions of the DOE's "Green Book" describing its "Stockpile Stewardship and Management Plan".<sup>16</sup>*

"...some problems could necessitate redesign activities and subsequent certification. It is possible that such design, development, and certification programs could require nuclear testing, a possibility acknowledged in the President's speech of August 11, 1995.... Changes in military requirements may lead to new design requirements, and skilled personnel must be available to execute this work."

"Specific efforts in each of these [nuclear weapon component] areas will include advanced development, design, production and assembly activities."

"DOE is maintaining a surge capability to rebuild a larger stockpile."

"...the nuclear weapons laboratories will conduct prototype programs to provide possible future replacement warhead designs for Navy and Air Force systems."

"...this program will...provide present and future weapons scientists and engineers with the opportunity to exercise the complete set of skills required to design and develop a stockpile warhead." [emphasis added]

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## VI. Stockpile Curatorship: A Sound and Sane Alternative

As long as the United States possesses a nuclear arsenal, it will need to put some effort into maintaining those bombs and warheads. However, the extravagant collection of projects under the DOE's version of its post-Cold War mission is not required for the upkeep of existing warheads. As former Livermore nuclear weapons designer Dr. Ray Kidder has argued, the diversion of resources to "science-based" stockpile stewardship (SBSS) is likely to undermine confidence in stockpiled weapons in the long run, because the labs are failing to utilize the expertise of their older, experienced scientists before those people retire. Instead of pouring resources into farfetched research projects, the DOE should employ the personnel most familiar with existing warheads to ensure that stockpiled designs can, if necessary, be reproduced with confidence in the future.

Physicist J.I. Katz of Washington University distinguishes between the DOE's stewardship plans and the "curatorship" required for maintaining the arsenal:<sup>17</sup>

In *stewardship* the human resources required to design and develop weapons are maintained, with skills honed on classified and unclassified experiments conducted at facilities such as NIF and in hydronuclear tests. In *curatorship* these facilities are not built, and design and development skills are allowed to atrophy; only those skills required to remanufacture weapons according to their original specifications are preserved.... The chief nuclear danger in the present world is that of proliferation, and stewardship will exacerbate this danger, while curatorship will mitigate it while preserving our existing nuclear forces.

Because of its irrelevance to real security needs, its cost, and, most importantly, its proliferation hazards, the SBSS approach to managing the nuclear arsenal should be abandoned. The alternative is not exotic or speculative. It is a simple, systematic approach that has proven itself through decades of experience. In fact, this method will undoubtedly continue to perform the real work of stockpile stewardship in the future, with SBSS as a costly, dangerous distraction.

.....  
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Dr. Kidder has described the essence of genuine stockpile stewardship:

The U.S. nuclear weapons stockpile could be maintained certifiably reliable and safe for decades (or even centuries) by continuing the assiduous and perceptive surveillance that has been practiced for many years. Warheads would be removed from the stockpile when such surveillance indicates this to be advisable or necessary. They would be replaced by new warheads that have been remanufactured within the tolerances and specification of their predecessors.<sup>18</sup>

### **Stockpile Surveillance**

The United States has regularly inspected its nuclear weapons for many years. Typically, about ten individual warheads of each type are annually withdrawn from the stockpile, disassembled, and inspected. This surveillance consists of visual inspection for signs of corrosion or deterioration of materials, plus electronic and mechanical checking of components. For about one warhead per model, sub-assemblies are tested destructively (not with nuclear explosive testing) and replaced.

Stockpile surveillance has provided a wealth of information about the effects of long-term storage on nuclear weapons. This experience shows that the great majority of aging effects occur in the testable and more easily replaced non-nuclear components, and in general, deterioration does not happen suddenly. Moreover, all of the aging effects detected so far have had to do with reliability, with the great majority leading to very small losses in performance. According to DOE documents, aging has never been associated with warhead safety problems.<sup>19</sup>

Surveillance should continue as in the past, as a modest and regular program that cannot arouse fears that the United States is developing new weapons. This kind of inspection is relatively inexpensive, requires no cutting edge scientific prowess, and will become even less costly as some warhead models are retired.

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## **Component Remanufacture**

Obviously, none of the individual warheads now in the arsenal has been fully tested by being detonated. Instead, as with any other product, nuclear weapons are built from blueprints—or three-dimensional “computer solid models”—to sets of clear specifications and tolerances. Materials and components meeting these requirements can be produced in the future if current parts become unreliable due to aging. The weaponeers have argued that future remanufacture would be dependable. This is contradicted by a 20-year record of nuclear “stockpile confidence tests” that have shown currently stockpiled nuclear weapon designs to be tolerant of the small variations that occur in any practical manufacturing process.

Test ban opponents have long claimed that the original materials in warheads, such as some plastics and adhesives, might not be available in the future. This might become a problem, but it will be a minor one, and facilities such as the NIF will have nothing to do with solving it. In reality, replacement materials need not be exactly the same as the originals; they only need to perform the same functions, within established tolerances for error. That performance can be evaluated under stockpile surveillance and, occasionally, full-scale dynamic testing short of nuclear detonation.

As for nuclear components such as plutonium cores (pits), the DOE is preparing to remanufacture them at the Los Alamos lab on a scale far larger than necessary to support an appropriate post-Cold War arsenal. To make necessary replacements of aging pits in a reduced future arsenal, the existing pit production capabilities at Livermore and Los Alamos appear sufficient.

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## VII. The Bigger Picture: Realistic Post-Cold War Planning

On December 4, 1996, a former Commander-in-Chief of the U.S. Strategic Air Command, retired Air Force General Lee Butler, spoke to the National Press Club in Washington, DC, along with retired Army General Andrew J. Goodpaster, former Supreme Allied Commander in Europe. Butler, who had served for 27 years at the highest levels of strategy involving nuclear arms, made an impassioned plea for the elimination of those weapons. Butler said:<sup>20</sup>

“...I am compelled to speak, by concerns I cannot still, with respect to the abiding influence of nuclear weapons long after the Cold War has ended. I am here today because I feel the weight of a special obligation in these matters, a responsibility born of unique experience and responsibilities....

“I came away from that experience deeply troubled by what I see as the burden of building and maintaining nuclear arsenals: the increasingly tangled web of policy and strategy as the number of weapons and delivery systems multiply; the staggering costs; the relentless pressure of advancing technology; the grotesquely destructive war plans; the daily operational risks; and the constant prospect of a crisis that would hold the fate of entire societies at risk....

“...I could see for the first time the prospect of restoring a world free of the apocalyptic threat of nuclear weapons. Over time, that shimmering hope gave way to a judgement which has now become a deeply held conviction: that a world free of the THREAT of nuclear weapons is necessarily a world DEVOID of nuclear weapons.

“Many strategists hold to the belief that the Cold War was well served by nuclear weapons,...either as fearsome weapons of last resort or simply because their elimination is still a Utopian dream. I offer in reply that for me the Utopian dream was ending the Cold War. Standing down nuclear arsenals requires only a fraction of the ingenuity and resources as were devoted to their creation. As to those who believe nuclear weapons desirable or inevitable, I would say these devices exact a terrible price even if never used. Accepting nuclear weapons as the ultimate arbiter of conflict condemns the world to live under a dark cloud of perpetual anxiety. Worse, it codifies mankind’s most murderous instincts as an acceptable resort when other options for resolving conflict fail....”

.....  
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who believe  
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- General  
Lee Butler  
(USAF, ret.)

“I believe that a swelling global refrain will eventually bring the broader interests of mankind to bear on the decisions of governments to retain nuclear weapons. The terror-induced anesthesia that suspended rational thought, made nuclear war thinkable and grossly excessive arsenals possible during the Cold War is gradually wearing off. A renewed appreciation for the obscene power of a single nuclear weapon is coming back into focus as we confront the dismal prospect of nuclear terror...”

The next day, an international group of 61 retired admirals and generals, mostly from Russia and the United States, issued a “Statement on Nuclear Weapons.” Its first paragraph said:

We, military professionals, who have devoted our lives to the national security of our countries and our peoples, are convinced that the continuing existence of nuclear weapons in the armories of nuclear powers, and the ever present threat of acquisition of these weapons by others, constitute a peril to global peace and security and to the safety and survival of the people we are dedicated to protect.

On February 2, 1998, 117 leaders from 46 nations, including 47 former or current presidents and prime ministers, issued a statement on nuclear disarmament, observing that:

...the long-sought prospect of a world free of the apocalyptic threat of nuclear weapons is suddenly within reach. This is an extraordinary moment in the course of human affairs, a near miraculous opportunity to realize that noble goal. But it is also perishable: the specter of nuclear proliferation cannot be indefinitely contained.

Leaders of the nuclear weapon states, and of the *de facto* nuclear nations, must keep the promise of nuclear disarmament enshrined in the Non-Proliferation Treaty of 1970 and clarified and reaffirmed in 1995 in the language codifying its indefinite extension. They must do so by commencing the systematic and progressive reduction and marginalization of nuclear weapons, and by declaring unambiguously that their goal is ultimate abolition.

The world is not condemned to live forever with threats of nuclear conflict, or the anxious, fragile peace imposed by nuclear deterrence.... The sheer destructiveness of nuclear weapons invokes a moral imperative for their elimination....

These opinions are based on long military and political experience and often close association with military nuclear operations, and they are in accord with large, consistent majorities of the world’s citizens. Even some DOE officials see nuclear arms abolition as desirable—but not any time soon.

.....  
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Meanwhile, programs undertaken in the name of stockpile stewardship are delaying progress toward relieving the threat of nuclear holocaust. With the end of the Cold War, the nation and the world face a rare opportunity to achieve lasting peace and security. Humanity should not be beholden to narrow perspectives and interests left over from the Cold War.

The nation should not leave its most critical life-and-death policies hostage to outdated assumptions and the narrow self-interest of the nuclear weapons labs and their government and corporate allies. Instead, the United States should:

- 1. Create and follow a coherent post-Cold War nuclear policy** - This requires a realistic and open evaluation of the current and future role of nuclear weapons. An essential part of that assessment is a clearer understanding of the risks of nuclear deterrence in the long term. The nation should publicly debate questions about when, how, and against whom the last-resort tool of a nuclear strike might be used by or against the United States or its allies. Absent this fundamental insight, there can be no clear limit on the "requirement" for large numbers of extremely sophisticated and reliable warheads. Pending the elimination of nuclear weapons, the role of the U.S. arsenal should be limited to deterring the use of nuclear arms against the U.S. or other nations that might be threatened by nuclear attack.

In cooperation with the other four nuclear powers (Britain, China, France, and Russia), nuclear forces should no longer be operated so that they can be launched on a moment's notice.<sup>21</sup>

- 2. Support and fulfill the purposes of crucial treaties** - Both the NPT and CTBT commit their signatories to pursuing further steps toward nuclear disarmament. With its plans to remain prepared for the resumption of underground nuclear testing, its continued pursuit of new warhead versions, and its maintenance of an ambitious research and development (rather than custodial) role for the labs, the United States violates the stated purposes of both treaties. All nuclear warhead designs currently in the U.S. arsenal have been certified by the DOE as safe and reliable. Further "improvements" in these arms will provide marginal benefits at best, and their price in terms of undermining arms control and nonproliferation is too high. In addition, the reliability and possibly the safety of new warhead designs would be questionable. The great majority of weapon defects have been discovered within four years after their entry into the arsenal.

.....  
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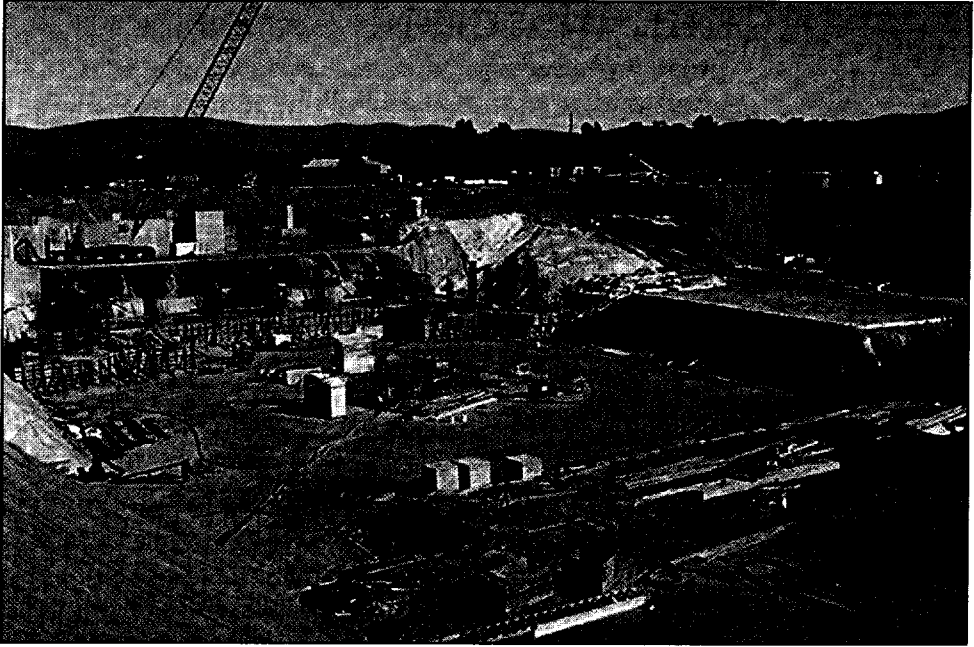
.....

*For the United States to put its resources into evading the purposes of the treaty, while expecting other nations to forego nuclear weapons development, is nothing short of hypocrisy.*

**3. End the DOE's destabilizing and unnecessary projects -**

Whether or not they will actually be used to evade the CTBT and design new warheads, the projects now planned under the SSMP are intended to create an enhanced capacity to do both. The program will also exacerbate proliferation of nuclear weapons design skills by generating new computer codes and information that will be published or will leak into the unclassified literature. For the United States to put its resources into evading the purposes of the treaty, while expecting other nations to forego nuclear weapons development, is nothing short of hypocrisy.

Nuclear weapons are sophisticated devices that require special materials and carefully crafted components. However, stockpiled warheads have been mass-produced like any other modern product—according to detailed specifications and within allowable tolerances for error. The notion that warhead performance must inevitably become unpredictable with age is a myth promoted by the DOE labs as a justification for their ambitious projects. This notion is unsupported by the DOE's own experience and research, and the SBSS approach is a distraction from the task of maintaining the arsenal. While veteran nuclear weapon designers are still employed, they should be assigned to making sure that the chemical compositions of warhead materials and the tolerances for warhead components are understood and recorded. The DOE's role should focus on established methods of stockpile surveillance, along with a modest capacity for remanufacturing components when necessary.



**Construction Site** - National Ignition Facility, Lawrence Livermore National Laboratory, CA . The expected total cost of the NIF is roughly \$5 billion, but many physicists who are experts in the field of nuclear fusion and lasers do not expect it to achieve its primary goal of "igniting" small pellets of fusion fuel. The likelihood that the NIF will contribute to civilian energy progress or to nuclear arsenal maintenance is even more remote.

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## VIII. What Citizens Can Do

For half a century, the nuclear weaponeers at DOE laboratories have been immensely successful in obtaining public funds for an open-ended nuclear arms race. While the Cold War served to justify these activities, the collapse of the Soviet Union did not stop the weaponeers from wanting to continue their work. In setting the United States on a post-Cold War course, Congress and the Clinton Administration have continued to defer to the “expertise” of the weapons scientists.

To challenge this political power can be daunting and discouraging. However, for at least 40 years, 60 percent to 85 percent of U.S. citizens have favored ending the arms race, stopping all nuclear testing, and eliminating nuclear arsenals.<sup>22</sup> Expression of these views during the 1980s led Congress to end U.S. nuclear tests in 1992. During the past decade, pressure from citizens and independent analysts has been crucial to ending mass production of nuclear warheads and turning the DOE’s attention toward the environmental legacy of the arms race.

Unless they receive a clear and powerful message from voters, Congress and the Executive branch are unlikely to exhibit courage in dealing with the weaponeers. National policy will continue to be formed by an “Iron Triangle” of pork-seeking politicians, self-serving DOE lab scientists and contractors, and an Administration fearful of appearing weak on national defense. Informed citizens must rearticulate their commitment to eliminate nuclear weapons, support the CTBT, and oppose the DOE’s version of stockpile stewardship.

DOE’s Stockpile Stewardship is the linchpin of many Pentagon and DOE policy and funding objectives. It is at the core of plans by nuclear weaponeers and their allies to create new generations of nuclear armaments and undermine efforts to ban nuclear weapons globally.

Creating the political climate necessary to limit the Stockpile Stewardship program to only those activities needed for curatorship of the arsenal as it is dismantled will require a multi-year campaign. A broad base of opposition must be built, particularly among groups with policy-making influence.

.....  
*The collapse of the Soviet Union did not stop the weaponeers from wanting to continue their work.*



The White House and Congress, with their budget appropriations process, have the power to rein in the DOE and its weapons labs. Concerned citizens must educate their representatives and the public, and they must strengthen their alliances with groups that focus on peace and arms control in general.

Most Americans know nothing about this \$60 billion program. They know neither that it is a threat to a comprehensive nuclear test ban nor that it is an extremely wasteful use of taxpayer money. Citizens must be informed of the realities and hazards of the DOE's Stockpile Stewardship program. Organizations already committed to fighting this program must agree on a public education strategy, using consistent messages about its dangers and costs. They must also recruit spokespeople known and trusted by the public.

A larger number of organizations must join the campaign against the Stockpile Stewardship program. Members of the business community, taxpayer organizations, religious groups, associations of scientists, economists, university faculties, and retired military personnel should be encouraged to join with organizations already opposing the program to articulate a common strategy of opposition and to present sensible alternatives.

At least six universities will be financial beneficiaries of the DOE's misguided Stockpile Stewardship program. The University of California administers the nuclear laboratories at Berkeley, Los Alamos, and Sandia. Other academic beneficiaries of nuclear weapons research funding are: the California Institute of Technology, Stanford University, the University of Illinois, the University of Chicago, and the University of Utah. Special efforts must be made to encourage faculty and students at these universities to join others in mounting a serious challenge.

This must be undertaken as a long-term effort. There will be no quick and easy victories. Limited resources demand a campaign that is focused and coordinated, one that includes but goes beyond professional communities to include large numbers of citizens. This is the only way to begin motivating those with political influence and responsibility to question and ultimately change national policy, rejecting the DOE's version of Stockpile Stewardship.

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## ENDNOTES

1. *Preserving the Nuclear Weapons Stockpile Under a Comprehensive Test Ban*, Congressional Budget Office, Washington, DC, May 1997 projects total spending of \$61 billion from 1997 through 2010. Since publication of that document, Congress has increased current annual spending on the program by about ten percent.
2. The manufacture of nuclear weapons does not include production of nuclear weapons materials such as plutonium, tritium, and enriched uranium.
3. This comparison with historical spending understates current budgets because the high cost of "waste management," which was included in weapons development and production spending through 1989, is now budgeted through a separate part of the DOE.
4. See *Fourth Affidavit of Christopher E. Paine in Support of Plaintiffs' Motion for Preliminary Injunction*, Natural Resources Defense Council, et al, Plaintiffs, v. Federico Peña [U.S. Secretary of Energy], et al, Defendants, U.S. District Court for the District of Columbia.
5. Currently in the program are the California Institute of Technology, Stanford University, the University of Illinois at Urbana-Champaign, the University of Chicago, and the University of Utah.
6. Natural Resources Defense Council, *Explosive Alliances*, Washington, DC, 1998; available on the Internet at: [www.nrdc.org/nrdcpro/exp/](http://www.nrdc.org/nrdcpro/exp/).
7. "Livermore's costly fusion laser won't fly, scientists say" and "Second thoughts on Livermore's laser." *The Albuquerque Tribune*, May 29 and May 30, 1997, p A8.
8. Kidder, Ray, "Problems with stockpile stewardship," *Nature*, April 17, 1997.
9. Tyler, James V., "Innovative Warhead Design: Pit Reuse," Lawrence Livermore National Laboratory, 1991.
10. Los Alamos Study Group, "Bottomless 'Pits': The Cost of Establishing Plutonium Manufacturing at Los Alamos Has Tripled," December 4, 1997. This press release describes building upgrades that would be required for the project but that were not included in the DOE's cost accounting to Congress.
11. Jonathan Weisman, "Who's minding the store?," *The Bulletin of Atomic Scientists*, July/August 1997.
12. Kathleen Bailey, analyst at Lawrence Livermore National Lab, "Testing Nukes Makes Good Sense," *The Washington Times*, November 16, 1997. The paper noted that "Views expressed are her own."
13. *The Nuclear Safety Smokescreen: Warhead Safety and Reliability and the Science Based Stockpile Stewardship Program*, by Hisham Zerriffi and Arjun Makhijani, Ph.D., Institute for Energy and Environmental Research, May 1996.
14. According to DOE data obtained by Physicians for Social Responsibility and the Los Alamos Study Group, about 95% of "actionable" warhead reliability defect types would lead to less than a 10% loss in reliability (as generously defined by the DOE), and more than 80% did not involve nuclear components.
15. Ray E. Kidder, retired Senior Physicist, Lawrence Livermore National Laboratory, "Problems with stockpile stewardship," *Nature*, April 17, 1997, p 11.
16. From Christopher E. Paine and Matthew G. McKenzie, *End Run: The U.S. Government's Plan for Designing Nuclear Weapons and Simulating Nuclear Explosions under the Comprehensive Test Ban Treaty*, Natural Resources Defense Council, Washington, DC, August 1997.
17. Dept. of Physics, Washington University, St. Louis, MO.
18. Ray E. Kidder, retired Senior Physicist, Lawrence Livermore National Laboratory, "Problems with stockpile stewardship," *Nature*, April 17, 1997.
19. See note 10.
20. Complete text of the statements cited in this section can be obtained from the internet site of the Coalition to Reduce Nuclear Dangers: <http://www.clw.org/pub/clw/coalition/>.
21. Bruce G. Blair gives a detailed exploration of how nuclear weapons can be taken off their "hair trigger" deployment status in *The Logic of Accidental Nuclear War*, The Brookings Institution, Washington, DC, 1993.
22. For a compendium of results from 10 nationwide polls on related topics (1957-1997), see the website of the Coalition to Reduce Nuclear Dangers (note 20).

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March 1998

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