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The Case for Resumed Nuclear Testing

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Executive Summary

Introduction

The United States faces an unprecedented threat environment. Even the Biden Administration, which came into office with the intent of reducing U.S. reliance on nuclear deterrence, by 2024 had recognized that: 1) “Russia, the PRC and North Korea are all expanding and diversifying their nuclear arsenals at a breakneck pace – showing little or no interest in arms control”; 2) the United States must be able “...to deter Russia, the PRC [China], and the DPRK [North Korea] simultaneously in peacetime, crisis, and conflict”; and 3) there was a possible need to increase the number of U.S. nuclear weapons. However, it left the decision on increasing U.S. nuclear weapons to the incoming Trump Administration.

The United States faces a serious potential problem – the decline in the reliability of U.S. nuclear weapons resulting from more than 30 years without nuclear testing. Yet, the U.S. nuclear arsenal has been certified as “reliable.” What this means, as former Director of the Lawrence Livermore National Laboratory (LLNL) Dr. George Miller wrote in 2022, is that, “The directors of the three National Nuclear Security Administration (NNSA) laboratories and the commander of the United States Strategic Command (USSTRATCOM) have assessed the nuclear stockpile each year since 1996 and assured the U.S. president that the country’s nuclear forces remain safe, secure, and effective.” This is expert opinion (possibly true) but unproven.

If the president of the United States is ideologically committed to ending nuclear testing, which has been true with one exception since January 1993, these officials and the Secretaries of Energy and Defense who send the certifications to the president, have little choice in their assessments. If they believe that the president will not

resume nuclear testing, failure to certify the stockpile could result in a crisis in nuclear deterrence with no benefit from it.

The 1958-1961 Nuclear Testing Moratorium

The 1958-1961 nuclear testing moratorium was the first and only time that nuclear weapons were stockpiled by the United States without nuclear testing of the finished product *and*, after the moratorium ended, nuclear tests of these weapons were conducted. The 1958-1961 testing moratorium was a national security disaster for the United States. The Soviet Union broke the moratorium in 1961 and closed much of the gap in nuclear weapons technology. Worse yet, during the testing moratorium, the United States deployed important strategic and tactical nuclear weapons, a high percentage of which did not work, including the Polaris SLBM. The nuclear testing moratorium also prevented the development of an inherently safe nuclear warhead ("one-point safe") in some of the warheads deployed without testing. A "one-point safe" nuclear weapon, according to the Department of Energy is, "A nuclear explosive that, in the event a detonation is initiated at any one point in the high explosive system, presents no greater probability than one in a million of producing a nuclear explosive yield of greater than 4 pounds of TNT equivalent."

Post-Moratorium Nuclear Testing, Nuclear Testing Limits and the CTBT

In the aftermath of the testing moratorium failures, efforts to negotiate a Comprehensive Test Ban Treaty (CTBT), other than giving it lip service in the context of disarmament, ended. In 1971, Dr. Carl Walske, Assistant to the Secretary of Defense for Atomic Energy, stated in Senate testimony

that a CTBT would result in "...large arsenals of nuclear weapons and decreased reliability, which could be destabilizing."

President Jimmy Carter attempted to negotiate a CTBT but he backed down in the face of concerns that continued testing was necessary to maintain reliability, to develop new weapons, and for other purposes. A 1978 report by Senator Dewey P. Bartlett, published by the Senate Armed Services Committee, concluded that: 1) design changes, particular to the small fission triggers of modern U.S. nuclear weapons, "...often produce unexpected results, which may lead to a catastrophic failure"; 2) less optimized Soviet weapons were less vulnerable to these factors; and 3) there were serious verification problems.

In 1978, Hamilton Jordan, then-White House Chief of Staff, wrote to President Carter, "In CTB[T], we will be adhering to an agreement that is very difficult to verify and that the American people will expect the Soviets to violate." He noted that "...we will have the Joint Chiefs and the lab directors officially opposing our position and Jim Schlesinger's [Secretary of Energy] lukewarm support, which will be interpreted in the Congress as private opposition." The reason was, as the late Dr. John Foster stated, "When the Soviets broke the [1958-1961 testing] moratorium and we also went back to testing, we found out how badly we had fooled ourselves. We had made lots of mistakes." The same thing happened in the United Kingdom.

The campaign to end U.S. nuclear testing was revived in the 1980s. There was some focus on a one-kiloton threshold treaty (to replace the existing 150-kiloton Threshold Test Ban Treaty [TTBT]). In response, the Director of LLNL sent the Senate Armed Services Committee a report which revealed that one-third of U.S. nuclear weapons types deployed after 1958, "required and received post-deployment nuclear tests to resolve problems." It judged

that “exact replication, especially of older weapons, is impossible” and that testing was important because it provided “...our only data on the performance of the whole nuclear weapons package.”

In response to congressional pressure, President George H.W. Bush limited nuclear testing to reliability and safety concerns. Congress mandated in Public Law 102-377 a temporary nuclear testing moratorium in 1992. President Bush stated that, “We must ensure that our forces are as safe and reliable as possible. To do so, we must continue to conduct a minimal number of underground nuclear tests, regardless of the actions of other countries.”

Contrary to the advice provided by the National Laboratories (and even the subordinate officials he appointed), President Bill Clinton sought and obtained a zero-yield CTBT, despite the fact that the Department of Defense supported allowing half-kiloton nuclear tests. Absent testing, the reliability of U.S. nuclear weapons is uncertain. Zero-yield even prohibits one-point safety testing.

The Clinton Administration’s disregard for the expert technical advice was one of the most important reasons for the Senate rejection of the CTBT by a majority vote. Other issues included the impossibility of verifying a zero-yield CTBT and the likelihood of violation of the Treaty by other nations.

Science-Based Stockpile Stewardship (SBSS)

The Clinton Administration conceived a flawed concept for maintaining the effectiveness of the U.S. nuclear capability, the so-called Science-Based Stockpile Stewardship (SBSS).¹ In 1997, then-Los Alamos National Laboratory (LANL)

¹ It is now called the Stockpile Stewardship Program. Since most of the literature calls it Science-Based Stockpile Stewardship, the original formulation, this will be used in this paper.

Director Siegfried S. Hecker explained, “The premise of SBSS is that we can offset the loss of confidence in the safety and reliability of existing weapons without nuclear testing by demonstrating improved understanding of the underlying science and technology.” Yet, aside from nuclear weapons, almost nothing is put into service without testing the finished product, which SBSS bans.

The Obama Administration, in its 2010 *Nuclear Posture Review Report* (NPR), mandated: 1) no nuclear testing; 2) minimal changes in the life-extended warheads; 3) the “reuse of nuclear components from different warheads”; 4) no “new military missions” or providing for “new military capabilities”; and 5) no “new nuclear warheads.” Moreover, under President Obama’s direction, some of the most important technical decisions would be made by people who knew little or nothing about nuclear weapons.

SBSS sought to substitute advanced computational and diagnostic capabilities for nuclear testing. This included understanding: 1) fusion ignition; 2) pre-ignition materials behavior; 3) behavior of plutonium under shock conditions; and 4) advanced simulations. All of these have relevance. However, as Dr. John C. Hopkins (the retired leader of the entire nuclear weapons program at LANL) and nuclear weapons designer Dr. David Sharp wrote, “During the nuclear testing era there were generally significant discrepancies between the output of these simulations and the nuclear test data with which they were compared.” Furthermore, they continued:

...the only unequivocal way to demonstrate that predictions made with simulations meet expected standards of confidence is by establishing a track record of correct and reliable predictions that have been made using that simulation. However, the ability to make such predictions of the nuclear performance of weapons in their current state has

not been demonstrated, and cannot be demonstrated, without a nuclear test program.

In the more than 30 years without U.S. nuclear tests, the level of risk has been increasing exponentially as design changes have been made in the stockpile and experienced designers have retired or died. U.S. political leadership has created a situation in which the central element of the scientific method – testing – has been replaced by a process that resembles an odd combination of science and historical research.

The Impact of Covert Nuclear Testing

Concerns about Soviet compliance with nuclear testing prohibitions date to the Eisenhower Administration. Later Russian disclosures confirmed that the Soviets conducted nuclear tests that were not detected. Nuclear tests ranging from sub-kiloton yields to up to 10 kilotons (and possibly more with earthquake masking) are technically possible without detection or at least without conclusive detection. The Soviet Union/Russia violated all of the nuclear testing treaties.

New Russian and Chinese Nuclear Warheads

Russia has been developing and deploying new types of nuclear weapons with new warhead designs since supposedly ending nuclear testing and is improving their technical performance. Such technical advances require nuclear testing. The Trump and Biden Administrations determined that Russia was conducting yield-producing nuclear tests (supercritical tests) contrary to their obligations under the CTBT, their own testing moratorium and the TTBT. Post-Cold War Russian weapons ranged from very low-yield, high-precision nuclear weapons to high-yield strategic nuclear weapons. A now declassified

CIA report from 2000 stated, “Moscow’s military doctrine on the use of nuclear weapons has been evolving and probably has served as the justification for the development of very low-yield, high-precision nuclear weapons.” These new weapons had characteristics that President Barack Obama prohibited for the United States. Additionally, China may also be conducting covert low-yield nuclear tests and is expanding and modernizing its nuclear forces, including low-yield and low-collateral damage fusion nuclear weapons. Russian development of fission free or pure fusion weapons would constitute a revolutionary development. They generate nuclear yield without fission fallout, and represent the ultimate in clean, low-collateral damage nuclear weapons—a super low-yield neutron bomb.

The CTBT and Nuclear Nonproliferation

Contrary to its supposed objectives, the CTBT has not prevented nuclear proliferation. India, Pakistan and North Korea have overtly tested nuclear weapons since the CTBT. Pakistani nuclear weapons scientist A.Q. Kahn proliferated detailed design information about a Chinese nuclear bomb. Since 2006, North Korea has tested nuclear weapons. Moreover, North Korea is of particular concern because it has tested a thermonuclear weapon and because of its relationship with Russia, China and Iran.

U.S. non-proliferation policy is significantly flawed. It does not distinguish between friendly, hostile or even rogue states. Indeed, President Clinton recognized that the removal of nuclear weapons from Ukraine, part of U.S. non-proliferation policy, contributed to the 2022 Russian invasion.

Self-Denial of a Nuclear Golden Dome

As part of President Ronald Reagan's Strategic Defense Initiative, the United States developed for missile defense a nuclear bomb-pumped X-ray laser in a project called Excalibur. This test was cancelled because of restrictions on nuclear testing by President George H.W. Bush. An article published by the *BBC* observed, "Project Excalibur was, in theory, capable of protecting against a large-scale nuclear attack from the Soviet Union."

The Costs of Nuclear Weapons Under Stockpile Stewardship – Mandated Inefficiency

SBSS is a far more costly and a much less effective way to maintain a viable deterrent compared to nuclear testing. The enormous costs of stockpile stewardship are driving downward the types of nuclear weapons in the U.S. stockpile, which is increasing the risk of a catastrophic impact from an inadvertently stockpiled dud. In 1961, the United States had the capability to replicate the *entire current* U.S. nuclear arsenal in less than a year. In 2019, then-Director of the Defense Intelligence Agency Lieutenant General Robert P. Ashley, Jr. said that, "In contrast to the United States, during the past decade, Russia has improved and expanded its production complex, which has the capacity to process thousands of warheads annually." In 2022, Dr. George Miller, who served as Director of LLNL from 2006-2011, wrote, "Even today the U.S. production capability is woefully lacking and that which exists has limited capability. The U.S. has managed to execute a few modest life extension programs (LEPs), albeit over very long timescales." In 2023, the United States reportedly produced 200 nuclear weapons, the most in decades. Hence, the U.S. ability to fix detected problems has been drastically

reduced since it would take 18 years to replicate the current U.S. arsenal.

Under stockpile stewardship, the development time for the W93, the first new U.S. nuclear weapon in several decades, is 20 years. This is a ridiculously long time to develop a nuclear weapon which is not even pushing technology forward. In a tribute to one of "The Giants of the Nuclear Testing Era," Dan Patterson of LLNL, it was noted that in the 20-year period from 1965 to 1985, the same amount of time in which the W93 will be developed, Patterson contributed to the design of the first two MIRV warheads, the W62 (Minuteman III) and the W68 (Poseidon), both major improvements over previous warheads, the W71 Spartan ABM warhead, the Mark 500 evader multiple warhead designed to penetrate missile defense systems, and the Peacekeeper W87 warhead, which introduced enhanced safety by using insensitive high explosive. Every one of these systems represented a major improvement in performance compared to previous warheads. Under SBSS, productivity has been drastically reduced, contributing to an enormous increase in costs.

Increasing development time from four or five years to 20 years *must result in a comparable increase in costs* notwithstanding inflation over such a long time period. The main reason for increased costs is the prohibition on nuclear testing. When the National Laboratories could test, they were always developing several, often revolutionary, nuclear weapons at any given time. The impact of stockpile stewardship at the National Laboratories has been deleterious. Vested interests have developed in the labs. For example, the National Ignition Facility, a very expensive laser fusion testing device with a \$3 billion annual budget, is being presented as a substitute for nuclear testing. It is not. It is important but it is related more to the development of fusion power than nuclear weapons.

Notwithstanding the startup costs of resumed nuclear testing, the annual cost of operating the laser fusion facility would assure the safety and effectiveness of the U.S. nuclear stockpile and even the development of new and improved nuclear weapons in a fraction of the time and expense currently planned. Science-based stockpile stewardship is a costly self-inflicted wound; it is an ideological rejection of the scientific method which is ultimately based upon testing. The arrogant assertion that U.S. weapons designers know so much about the basic science and materials that there is no need to test weapons is an exercise in self-deception. This approach will fail; the only question is how badly. It will result in a major nuclear advantage for U.S. adversaries.

The Opposition to Resumed Nuclear Testing

The strongest opposition to resumed nuclear testing comes mainly from the Minimum Deterrence advocacy community and pacifist groups. Minimum deterrence is often linked to the unrealistic and dangerous goal of “global zero.”

Opponents of resumed U.S. nuclear testing universally ignore: 1) that Russia and possibly China are assessed by the Department of State to have been conducting low-yield nuclear tests (reportedly for decades); 2) that the military advantages from these covert nuclear tests are considerable; 3) the fact that zero yield prohibits one-point safety tests of U.S. nuclear weapons; 4) the serious potential for an asymmetric decline in nuclear weapons reliability; and 5) that the high costs of stockpile stewardship, and the resulting decline in the types of U.S. nuclear weapons, increase the impact of an inadvertently stockpiled nuclear dud, which could be catastrophic – possibly resulting in the loss of an entire leg of the U.S. nuclear Triad in the 2040s. They assert the success of the stockpile stewardship

program, which is clearly questionable. Recognition of the existence of a serious nuclear threat to the United States is unusual among opponents of nuclear testing. The supposed effectiveness of stockpile stewardship is simply asserted.

The case against resumed nuclear testing often relies on the traditional Minimum Deterrence argument that the United States drives the arms race. The reality is very different. Post-Cold War restraint in U.S. nuclear weapons development has not been reciprocated. Indeed, U.S. adversaries have gone in the opposite direction.

A study in 2021 authored by Michael Frankel, James Scouras, and George Ullrich is of much higher quality than the other literature opposing U.S. nuclear testing. The authors acknowledge the United States faces a serious nuclear threat, but conclude, nonetheless, that:

We are not persuaded that stockpile maintenance needs nuclear testing at this time, and while it well might at some point in the future, it is difficult to predict when that might be. Similarly, while we support the development of low-yield nuclear weapons, simpler designs (or those previously tested but not weaponized) likely can be developed without testing, and even specialized new designs would have no need to be tested for years. Finally, we believe that the ambiguity in definitions of zero yield do not seem exploitable to achieve military advantage.

Their main reasons for opposing resumed U.S. nuclear testing are:

- Other states would inevitably also resume testing, making the world more dangerous.
- U.S. nonproliferation leadership would be undermined, condemnation by the rest of the world provoked, and U.S. bipartisan support for nuclear policy threatened.

This analysis understates the uncertainty concerning the effectiveness of SBSS, the potential for asymmetric reduction in reliability, and its very high costs. The cost is driving down the number of U.S. nuclear weapons types and increasing the potential impact of an inadvertent dud. Frankel, Scouras and Ullrich also understate the potential asymmetric impact of low-yield Russian and Chinese nuclear testing. This includes the possibility these tests are of a much higher yield than simple hydronuclear tests.

The available evidence suggests that at some point Russia and China will resume high-yield nuclear testing or that they may have North Korea test the weapons for them. If so, the United States would very likely be caught flatfooted.

When Dr. Ullrich was working at the Pentagon (as a very well-respected senior official), he often said that “Stewardship was for Wine not Weapons.” He was correct.

Why the United States Must Test

Nuclear deterrence underpins U.S. national security. Moreover, the U.S. nuclear deterrent is essential to the security of the entire free world. Without it, there is a significant chance that one or more nuclear-armed adversaries will actually use nuclear weapons as they frequently threaten to do.

The legacy Biden Administration program of record will reduce the U.S. nuclear deterrent to only four types of weapons in the 2040s: two missile warheads (W87 for ICBMs and the W93 for SLBMs), a bomb (B61), and a cruise missile warhead (W80). In addition, there will be a warhead for the nuclear SLCM but little is known about it at this time. Thus, the failure of even a single weapons type could eliminate an entire leg of the U.S. nuclear Triad, including the critically important submarine-launched ballistic missile force.

The impact of covert nuclear testing by Russia and China and overt testing by North Korea is creating a serious potential asymmetry in reliability. In addition, U.S. adversaries will have an increasing advantage in advanced nuclear weapons technology simply because the United States is not developing it but they are. The United States has no in-kind deterrent to address many nuclear threats.

In light of the large decline in U.S. military spending since the end of the Cold War and the even greater reduction in U.S. nuclear weapons, the high cost of SBSS is not acceptable. The resumption of nuclear testing would substantially enhance confidence in the much diminished U.S. nuclear deterrent.

In short, nuclear testing is necessary to: 1) ensure the deterrent is effective and responsive to negative changes in the overall strategic environment; 2) respond to unanticipated breakout by adversaries that require new U.S. capabilities; 3) correct technical problems resulting from original design flaws and those that develop due to aging, which could impact reliability in a significant way; and 4) substantially reduce costs.

The time to act is now. The United States still has two-to-three types of nuclear weapons available for each leg of the nuclear Triad. Hence, it is still in the position of being able to respond to a discovered warhead failure. While a warhead failure would be significant, it would not mean the loss of an entire leg of the Triad. Yet current plans call for reducing the number of warhead types, with a commensurate increase in the risk of catastrophic failure.

The United States should promptly stage a nuclear test involving simultaneous low-yield detonation of the primaries of a life-extended warhead of an ICBM, an SLBM and a bomber weapon. Depending upon the outcome, subsequent tests with improved instrumentation could include the remainder of warhead types in the U.S. nuclear stockpile. In the longer run, the United States needs to

develop and test new warheads to deal with the rapidly increasing threat, particularly advanced adversary low-yield and low-collateral damage nuclear weapons.

Conclusion

Maintaining an effective nuclear deterrent is essential. The absence of nuclear testing makes this more difficult, uncertain and expensive. Even if stockpile stewardship is successful, it will certainly be far more costly.

Today, even if U.S. nuclear weapons work, the United States has an inadequate deterrent due to the age of its delivery vehicles and insufficient numbers of nuclear weapons. Absent nuclear testing, the certification process is increasingly political in nature. The dangers are growing exponentially as more weapons are life extended with significant design changes without nuclear testing and the numbers of weapon types are being reduced because of the very high costs of stockpile stewardship.

The combination of no nuclear weapons development and no nuclear testing for decades in the context of a rapidly increasing multipolar nuclear threat environment is dangerous. The flaws of relying on stockpile stewardship mean that the reliability of U.S. nuclear weapons will further decline, undermining the credibility of the overall U.S. nuclear deterrent and increasing the risk of deterrence failure.

Introduction

The United States faces an unprecedented threat environment. A devastating war is raging in Europe and one may soon break out in the Far East. In 2023, the bipartisan Congressional Strategic Posture Commission warned about the nuclear threat and the inadequacy of the U.S. nuclear deterrent to deal with it.² Even the Biden Administration, which came into office dedicated to reducing U.S. reliance on nuclear weapons, finally recognized that the United States must be able “...to deter Russia, the PRC [China], and the DPRK [North Korea] simultaneously in peacetime, crisis, and conflict.”³ In 2024, Pranay Vaddi, then-Special Assistant to President Biden and Senior Director for Arms Control, Disarmament, and Nonproliferation at the National Security Council, observed that, “Russia, the PRC and North Korea are all expanding and diversifying their nuclear arsenals at a breakneck pace – showing little or no interest in arms control.”⁴ Vaddi and then-Acting Assistant Secretary of Defense Dr. Vipin Narang stated there was a possible need to increase the

² Madelyn Creedon and Jon Kyl, et al., *America's Strategic Posture: The Final Report of the Congressional Commission on the Strategic Posture of the United States*, October 2023 (Alexandria, VA: Institute for Defense Analyses, 2023), available at <https://armedservices.house.gov/sites/republicans.armedservices.house.gov/files/Strategic-Posture-Committee-Report-Final.pdf>.

³ Department of Defense, “Report on the Nuclear Employment Strategy of the United States,” November 2024, p. 2, available at <https://media.defense.gov/2024/Nov/15/2003584623/-1/-1/1/REPORT-ON-THE-NUCLEAR-EMPLOYMENT-STRATEGY-OF-THE-UNITED-STATES.PDF>.

⁴ Pranay Vaddi, “Adapting the U.S. Approach to Arms Control and Nonproliferation to a New Era,” Arms Control Association, June 7, 2024, available at <https://www.armscontrol.org/2024AnnualMeeting/Pranay-Vaddi-remarks>.

number of U.S. nuclear weapons.⁵ This was an important change but the Biden Administration took no action to implement this policy; rather, it left the decision on increasing U.S. nuclear weapons to the incoming Trump Administration.⁶

Some of the problems the United States now faces are self-inflicted, particularly with respect to the potential decline in the reliability of U.S. nuclear weapons resulting from more than 30 years without nuclear testing. Yet, the U.S. nuclear arsenal has been certified as “reliable.” What this means, as former Director of the Lawrence Livermore National Laboratory (LLNL) Dr. George Miller wrote in 2022, is that, “The directors of the three National Nuclear Security Administration (NNSA) laboratories and the commander of the United States Strategic Command (USSTRATCOM) have assessed the nuclear stockpile each year since 1996 and assured the U.S. president that the country’s nuclear forces remain safe, secure, and effective.”⁷ This is expert opinion (possibly true) but unproven.

⁵ U.S. Department of Defense, “Remarks by Acting Assistant Secretary of Defense for Space Policy Dr. Vipin Narang at CSIS,” August 1, 2024, available at <https://www.defense.gov/News/Speeches/Speech/Article/3858311/nuclear-threats-and-the-role-of-allies-remarks-by-acting-assistant-secretary-of/>.

⁶ Michael R. Gordon, “U.S. Must Be Prepared to Expand Nuclear-Weapons Force, Biden Officials Say,” *The Wall Street Journal*, November 15, 2024, available at <https://www.wsj.com/politics/national-security/u-s-must-be-prepared-to-expand-nuclear-weapons-force-biden-officials-say-3f317fc9>.

⁷ George Miller, “Stockpile Stewardship: What Were We Thinking? How Did It Work Out?,” in Brad Roberts, ed., *Stockpile Stewardship in an Era of Renewed Competition* (Livermore, CA: Center for Global Security Research, Lawrence Livermore National Laboratory, April 2022), p. 18, available at https://cgsr.llnl.gov/sites/cgsr/files/2024-08/CGSR_Occasional_Stockpile-Stewardship-Era-Renewed-Competition.pdf.

If the president of the United States is ideologically committed to ending nuclear testing, as has generally been the case with one exception since January 1993, these officials and the Secretaries of Energy and Defense who send the formal certifications to the president have little choice in their assessments. If they believe the president will not resume nuclear testing, failure to certify the stockpile could result in a crisis in nuclear deterrence with no benefit from it.

The 1958-1961 Nuclear Testing Moratorium

The 1958-1961 nuclear testing moratorium was the first and only time that nuclear weapons were stockpiled by the United States without nuclear testing of the finished product *and*, after the moratorium ended, nuclear tests of these weapons were conducted. The moratorium was proposed by the Soviet Union, which announced a one-year suspension of nuclear testing just after it had completed a series of nuclear tests and just before the United States was planning to start one.⁸ For the price of engaging in fruitless nuclear testing negotiations, the Soviet Union stopped the U.S. test series. Indeed, it even conducted two nuclear tests just after the start of the testing moratorium, which were ignored in the West.⁹ During the negotiations, the Soviets rejected the U.S. and British proposals concerning a Comprehensive Test Ban Treaty (CTBT) over the issue of verification.

The 1958-1961 testing moratorium was a national security disaster for the United States. The Soviet Union broke the moratorium in 1961 and closed much of the gap

⁸ James H. McBride, *The Test Ban Treaty – Military, Technological, and Political Implications* (Chicago: Henry Regnery Company, 1967), p. 14.

⁹ *Ibid.*, p. 15.

in nuclear weapons technology.¹⁰ It conducted a large, well-planned and well-executed nuclear weapons test series; the Soviets “astonishingly” conducted 45 nuclear tests in 65 days.¹¹ The United States replied with a test series that was “...very limited in scale and required a long time to come up to speed.”¹²

The disparity in the test series was important because these were the last atmospheric and space nuclear tests conducted by the United States, which could provide data unobtainable with underground nuclear tests. Worse yet, during the testing moratorium, the United States deployed important strategic and tactical nuclear weapons that did not work.¹³ Tom Ramos, a physicist and nuclear weapons designer at the LLNL wrote, “It was later found after testing resumed in the 1960s that a good percentage of the warheads placed into the stockpile during the test ban had fatal defects.”¹⁴ The results were so alarming that the details were kept secret until 1986. The testing results ended serious U.S. efforts to negotiate a CTBT until the Carter Administration.

In 1986, Paul S. Brown, a noted weapons designer and Associate Assistant Director for Arms Control at LLNL, wrote that the W52 warhead for the Sargent surface-to-surface missile was a failure and that the W45, which served as the warhead for the Little John battlefield missile, the Atomic Demolition Munition, and the Terrier surface-to-air missile, produced only one-half of its expected yield.¹⁵

¹⁰ Ibid., p. 23.

¹¹ Tom Ramos, *From Berkeley to Berlin - How the Rad Lab Helped Avert Nuclear War* (Annapolis, MD: Naval Institute Press, 2022), p. 13.

¹² Paul S. Brown, “Nuclear Weapons R&D and the Role of Nuclear Testing,” *Energy and Technology Review*, September 1986, p. 13.

¹³ Ibid.

¹⁴ Ramos, *From Berkeley to Berlin*, op. cit., p. 184.

¹⁵ Brown, “Nuclear Weapons R&D and the Role of Nuclear Testing,” op. cit., p. 13.

Worse yet, as President Ronald Reagan stated "...we found that the safety mechanism on the [W47] warhead for Polaris missile wouldn't release. Without testing that helped us fix that, most of our sea-based deterrent would have been ineffective."¹⁶ In 1987 Congressional testimony, then-Deputy Assistant Secretary of Defense Frank Gaffney stated the safety system in the W47 "...could have rendered the vast majority in our sea-based deterrent completely inoperable ..."¹⁷

The W47 had been successfully tested prior to the moratorium but the moratorium prevented further important tests of it.¹⁸ Ramos observed, "Nuclear devices were complex and fickle, several tests were needed to understand them adequately."¹⁹

The nuclear testing moratorium had prevented the development of an inherently safe nuclear warhead ("one-point safe") for the W47. This means that "...in the event a detonation is initiated at any one point in the high explosive system, [it] presents no greater probability than one in a million of producing a nuclear explosive yield of greater than 4 pounds of TNT equivalent."²⁰ In the W47, because of the testing moratorium, a mechanical safety system was used. This caused the problem in combination

¹⁶ U.S. Department of Defense, "Remarks of President Ronald Reagan to supporters of the Administration's defense policies," White House, September 23, 1986, *Defense Issues*, Volume 1, No. 65, p. 2.

¹⁷ Testimony of Frank Gaffney J. Gaffney, Deputy Assistant Secretary of Defense before the House Appropriations Committee, March 24, 1987, mimeograph, p. 3.

¹⁸ Ramos, *From Berkeley to Berlin*, op. cit., p. 184.

¹⁹ Ibid.

²⁰ U.S. Department of Energy, "One-Point Safe Nuclear Explosive," July 27, 2020, available at https://www.directives.doe.gov/terms_definitions/one-point-safe-nuclear-explosive.

with chemical corrosion in the warhead.²¹ An LLNL report indicated "...a large fraction of the W47 warheads would be duds and that the number of dud warheads was increasing with age."²² Had the United States not resumed nuclear testing, it would not have known about this problem, much less promptly corrected it. The nine Polaris submarines that were deployed during the Cuban missile crisis would have been carrying warheads, the large majority of which were duds; the declassified information does not indicate how many actually were duds during the crisis.

Solving the W47 problems required the substitution and nuclear testing of a new primary (fission trigger).²³ In effect, it was a new nuclear weapon with the same warhead number. There were other W47 problems that required post-deployment nuclear testing, including vulnerability to nuclear missile defenses. This was not unusual.

Post-Moratorium Nuclear Testing, Nuclear Testing Limits, and the CTBT

In the aftermath of the testing moratorium failures, efforts to negotiate a CTBT, other than giving it lip service in the context of disarmament, ended. In 1971, Dr. Carl Walske, Assistant to the Secretary of Defense for Atomic Energy, stated in Senate testimony that the Defense Department supported a CTBT but in the context of "real disarmament."²⁴ He said that under a CTBT, the result

²¹ George H. Miller, Paul S. Brown, Carol T. Alonso, *Report to Congress on Stockpile Reliability, Weapons Remanufacture, and Role of Nuclear Testing* (Livermore, CA: Lawrence Livermore National Laboratory, October 1987), p. 20, available at <https://www.osti.gov/servlets/purl/6032983>.

²² *Ibid.*, p. 29.

²³ *Loc. cit.*

²⁴ Senate Foreign Relations Committee, "Prospects for Comprehensive Nuclear Test Ban Treaty" (Washington, D.C.: U.S. Government Printing Office. 1971), p. 102.

would be "...large arsenals of nuclear weapons and decreased reliability, which could be destabilizing."²⁵ He also noted that asymmetric reduction in reliability could result in a situation which was "quite destabilizing."²⁶ In response to Committee questioning, the Defense Department stated that there were five instances since the mid-1950s in which nuclear testing was required to fix reliability and safety problems.²⁷ Dr. Walske said that the detection threshold for nuclear tests would be six kilotons in hard rock and 45 kilotons in alluvium (volcanic or soft rock).²⁸

After the moratorium, the United States negotiated the 1963 Limited Test Ban Treaty (LTBT), which banned all but underground nuclear explosions, and the Threshold Test Ban Treaty (TTBT), which limited testing to 150 kilotons yield.

President Jimmy Carter attempted to negotiate a CTBT but he "...pulled back, bowing to arguments that continued testing was needed to maintain reliability of existing weapons, to develop new weapons, and for other purposes."²⁹ The National Laboratory Directors were unanimous in opposition to a CTBT.³⁰ A 1978 report by Senator Dewey P. Bartlett, published by the Senate Armed Services Committee, left him little choice but will pull back.

The Bartlett report is one of the best analyses of the issue ever written. It noted that "catastrophic failures" in nuclear

²⁵ Ibid.

²⁶ Ibid., p. 103.

²⁷ Ibid., p. 106.

²⁸ Ibid., p. 119.

²⁹ Jonathan Medalia, *Comprehensive Nuclear-Test-Ban Treaty: Background and Current Developments* (Washington, D.C.: Congressional Research Service, January 28, 2009), p. 1, available at <https://sgp.fas.org/crs/nuke/R40612.pdf>.

³⁰ Brigadier General (Ret.) Albion W. Knight, "The High Security Cost of CTBT," *Air Force Magazine*, June 1978, p. 66.

weapons can result from “engineering errors, faulty design or aging.”³¹ The report indicated that design changes, particular to the small fission triggers of modern U.S. nuclear weapons, “...often produce unexpected results, which may lead to a catastrophic failure.”³² It noted that the reliability problems in U.S. nuclear weapons resulted from efforts to “...reduce weight and/or size and to increase safety.”³³ (Later advocacy of the development of a Reliable Replacement Warhead was an effort to get around these problems.) It noted the possible asymmetric impact of the CTBT on highly optimized U.S. nuclear warheads. Senator Bartlett stated that simpler Soviet weapons “...would likely be less sensitive to changes in design, materials and conditions.”³⁴ The report concluded that “...under a test ban the United States would find it difficult even to refabricate weapons already in the inventory exactly as they were originally produced.”³⁵

The CTBT had fundamental problems with verification and compliance. Regarding verification, the Bartlett report concluded that: 1) “Proof that an illegal nuclear test has taken place will in most cases not be possible even with elaborate onsite inspections”; 2) “Mere detection of the signals from nuclear explosion does not mean that it is a nuclear explosion and it does not mean that we have sufficient justification to demand onsite inspection”; 3) “...reliability testing often requires no more than a single nuclear test, and some new weapons development could be continued with a series of low-yield tests”; and 4) the Soviet

³¹ Senator Dewey P. Bartlett, “The Consequences of a Comprehensive Test Ban Treaty” (Washington, D.C.: Government Printing Office, 1978), p. 3, available at <https://original-ufdc.uflib.ufl.edu/AA00022237/00001>.

³² *Ibid.*, p. 4.

³³ *Loc. cit.*

³⁴ *Ibid.*, p. 6.

³⁵ *Ibid.*, p. 7.

Union "...could test outside its boundaries including in the atmosphere, and in outer space," which made it more difficult to detect.³⁶

In 1978, Hamilton Jordan, then-White House Chief of Staff, wrote to President Carter, "In CTB[T], we will be adhering to an agreement that is very difficult to verify and that the American people will expect the Soviets to violate."³⁷ He noted that, "As it presently stands, we will have the Joint Chiefs and the lab directors officially opposing our position and Jim Schlesinger's [Secretary of Energy] lukewarm support, which will be interpreted in the Congress as private opposition."³⁸

Jordan indicated that Secretary of State Cyrus Vance, National Security Advisor Zbigniew Brzezinski and Secretary of Defense Harold Brown believed that President Carter supported a CTBT because of his belief it "...would be helpful to Jim Callaghan [British Prime Minister and leader of the Labor Party] in the British elections..."³⁹ Jordan wrote that, "I doubt if Jim Callaghan would want us to proceed if he knew that we would be jeopardizing the chance of winning Congressional approval for both CTB[T] and SALT."⁴⁰

Election interference in a friendly nation is not a legitimate policy consideration. Moreover, in this case, it was an effort to prevent the election of perhaps the second most important British Prime Minister of the twentieth century, (later Baroness) Margaret Thatcher.

³⁶ Ibid., pp. 7-8.

³⁷ Hamilton Jordan, "Comprehensive Test Ban Treaty/SALT," April 18, 1978, Jimmy Carter Presidential Library, Container: 34a, available at https://www.jimmycarterlibrary.gov/sites/default/files/pdf_documents/digital_library/cos/142099/34/cos_142099_34a_08-Comprehensive_test_ban_treaty.pdf.

³⁸ Ibid.

³⁹ Loc. cit.

⁴⁰ Loc. cit.

Opposition to the CTBT resulted from the fact that the U.S. nuclear weapons community was seriously influenced by the 1958-1961 nuclear testing moratorium failures.⁴¹ According to Dr. John Foster, "When the Soviets broke the [1958-1961 testing] moratorium and we also went back to testing, we found out how badly we had fooled ourselves. We had made lots of mistakes."⁴² (The same thing happened in the United Kingdom. Its chief atomic scientist, the late Kenneth Johnston, stated that, "Our confidence went up as our competence went down."⁴³) At the time of the moratorium, Dr. Foster was the Director of LLNL and, perhaps, the greatest American nuclear weapons designer in the history of the program. According to Ramos, he was the "...man who led a team of physicists in the 1950s to design what would become the modern atomic device in the American nuclear stockpile."⁴⁴ Foster and his team were also involved in the development of "one-point safe" nuclear weapons and the electronic locks on U.S. nuclear weapons.⁴⁵

In 1978, Dr. Donald Kerr, then-Director of the Los Alamos National Laboratory (LANL), told the House Armed Services Committee that "...nuclear tests are essential for determining the proper functioning of nuclear explosives; calculations do not suffice, and there is no way

⁴¹ Miller, Brown, Alonso, *Report to Congress on Stockpile Reliability, Weapons Remanufacture, and Role of Nuclear Testing*, op. cit., pp. 15-16.

⁴² "Statement of John S. Foster, Jr. Before the Senate Armed Services Committee October 7, 1999," available at <https://studylib.net/doc/10962140/statement-of-john-s.-foster-jr.-october-7--1999>.

⁴³ Stephen M. Younger, *The Bomb – A New History* (New York: Harper Collins, 2009), p.185.

⁴⁴ T. F. Ramos, *Call Me Johnny* (Livermore, CA: Lawrence Livermore National Laboratory, July 26, 2019), LLNL-BOOK-783447, p. vii, available at <https://www.osti.gov/servlets/purl/1576166>.

⁴⁵ *Ibid.*, p. 32; and, Thomas C. Reed and Danny B. Stillman, *The Nuclear Express* (Minneapolis, MN: Zenith Press, 2009), pp. 134, 140.

to experimentally simulate the performance of a nuclear design.”⁴⁶ In 1981, President Ronald Reagan signed a directive which stated that “...even assuming Soviet compliance, there are reasons to believe that a Comprehensive Test Ban could create asymmetries in the Soviet Union’s favor.... Therefore, at this time the United States should neither attempt to conclude a Comprehensive Test Ban Treaty nor resume negotiations with the U.S.S.R. and the United Kingdom on a Comprehensive Test Ban.”⁴⁷ In 1986, President Reagan stated “...nuclear testing is essential to guarantee that our weapons—the key to deterring nuclear aggression—actually work.”⁴⁸

The campaign to end U.S. nuclear testing was revived in the 1980s. There was some focus on a one-kiloton threshold treaty (to replace the existing 150-kiloton Threshold Test Ban Treaty). R.E. Kidder, an LLNL scientist, believed this would be sufficient to maintain the reliability of the stockpile. He argued that in the 1980s only a small number of U.S. nuclear tests were unsuccessful, that a one-kiloton threshold would allow reduced yield tests of primaries (the fission bomb trigger of a thermonuclear weapon), and that it would be decades before we would have to face the issue of the loss of experienced designers.⁴⁹ Kidder also argued

⁴⁶ Dr. Donald Kerr before the House Armed Services Committee, “Effects of a Comprehensive Test Ban on U.S. National Security Interests,” mimeograph, 1978, p. 5.

⁴⁷ Ronald Reagan, “U.S. Nuclear Testing Limitations Policy,” National Security Decision Directive No. 51, August 10, 1982, p. 1, available at <https://www.reaganlibrary.gov/public/archives/reference/scanned-nsdds/nsdd51.pdf>.

⁴⁸ “Remarks of President Ronald Reagan to supporters of the Administration’s defense policies,” White House, September 23, 1986, op. cit., p. 2.

⁴⁹ R.E. Kidder, *Maintaining the U.S. Stockpile of Nuclear Weapons During a Low Threshold or Comprehensive Test Ban* (Livermore, CA: Lawrence Livermore National Laboratory, October 1987), pp. 1, 3, 5, 7, available at <http://www.fas.org/programs/ssp/nukes/testing/kidderucrl53820.pdf>.

that remanufacture of existing designs was possible if appropriate action was taken "...in advance [to assure] the future availability of these components and materials...."⁵⁰ He was correct that one-kiloton tests could significantly reduce the possibility of a nuclear dud, but time has demonstrated that he was wrong about the rest.

In response, the Director of the LLNL sent the Senate Armed Services Committee a report by senior LLNL Directors George H. Miller, Paul S. Brown and Carol T. Alonso which revealed that one-third of U.S. nuclear weapons types deployed after 1958, "required and received post-deployment nuclear tests to resolve problems," that "...our understanding of weapons behavior was incomplete" and fixing problems that did not require nuclear testing was "...possible only because the designers and engineers involved could make informed judgments about the problem—judgments that drew on years of experience in actual nuclear testing."⁵¹ They judged that "...exact replication, especially of older weapons, is impossible" and that testing was important because it provided "...our only data on the performance of the whole nuclear weapons package."⁵²

In response to congressional pressure, President George H.W. Bush limited nuclear testing to reliability and safety concerns. Congress mandated in Public Law 102-377 a temporary nuclear testing moratorium in 1992. (President Bush opposed it but did not veto it.) It directed that the Bush Administration provide Congress with a plan for a series of 15 nuclear tests to be conducted over three years to assure future maintenance of nuclear weapons reliability without

⁵⁰ Ibid., p. 7.

⁵¹ Miller, Brown, and Alonso, *Report to Congress on Stockpile Reliability, Weapons Remanufacture, and Role of Nuclear Testing*, op. cit., pp 12-13.

⁵² Ibid., p. 3.

testing.⁵³ This report was provided but said that the goal of maintaining an effective and safe nuclear stockpile without nuclear testing was impossible.⁵⁴ The Bush report stated:

The administration advocates a series of nuclear tests to develop backup warheads which would provide enhanced reliability and safety, and serve as a hedge against the emergence of a significant flaw in one or more weapons types in the existing stockpile. However, it is not possible to develop warheads with the requisite reliability and safety within the constraints of Public Law 102-377. They cannot and should not be developed in haste. Realistically, the effort will take more than 15 test[s] over three years. In addition, post-production tests would be required to have confidence in the warheads; such tests could be well into the future, and thus would not be allowed under Public Law 102-377.⁵⁵

What was described was the concept of developing a more robust type of nuclear weapon with more potential to be effective for long periods without nuclear testing. Note that these were to be “backup warheads.” There was no intent to reduce the number of warhead types or their capability. President Bush stated that, “We must ensure that our forces are as safe and reliable as possible. To do so, we must continue to conduct a minimal number of underground nuclear tests, regardless of the actions of other countries.”⁵⁶

⁵³ “Statement by Dr. Robert B. Barker Before the Senate Armed Services Committee, Thursday, October 7, 1999,” available at <http://armed-services.senate.gov/statement/1999/991007rb.pdf>.

⁵⁴ Ibid.

⁵⁵ Loc. cit.

⁵⁶ George H. W. Bush, “Statement on Signing the Energy and Water Development Appropriations Act, 1993,” October 2, 1992, available at

President Bill Clinton rejected the Bush report, saying that it did not meet the requirements of the law and that he would provide another report. He never did. Clinton's position on nuclear testing became more extreme with the passage of time. While his 1993 directive on nuclear testing allowed hydronuclear (very low-yield) tests,⁵⁷ none were conducted. An LLNL history indicates that in 1993 the Defense Department position "...favored a low-yield treaty with a 500 ton testing limit."⁵⁸

Contrary to the advice provided by the National Laboratories (and even the subordinate officials he appointed⁵⁹), President Clinton sought and obtained a zero-yield CTBT. The late Dr. Paul Robinson was an unquestioned expert on nuclear testing. He had served as Principal Associate Director of the National Security Program at the Los Alamos National Laboratory, headed the U.S. delegation, with the rank of Ambassador, that negotiated the verification protocol to the Threshold Test Ban Treaty (TTBT), and was the Director of the Sandia National Laboratory. In a 2012 presentation at the Heritage Foundation, he said, "At that time [1995], we in the U.S. labs requested that the permitted test level should be set to a level which is, in fact, [was] lower than a one-kiloton limit, which would have allowed us to carry out some very important experiments, in our view, to determine whether

<https://www.presidency.ucsb.edu/documents/statement-signing-the-energy-and-water-development-appropriations-act-1993>.

⁵⁷ Paul Brown, *The Comprehensive Test Ban Treaty: Lawrence Livermore National Laboratory's Impact on U.S. Nuclear Policy from 1958 to 2000* (Livermore, CA: Lawrence Livermore National Laboratory, April 2019), p. 92, available at <https://cgsr.llnl.gov/sites/cgsr/files/2024-08/Brown-CTBTbook.pdf>.

⁵⁸ *Ibid.*, p. 94.

⁵⁹ *Loc. cit.*

the first stage of multiple-stage devices was indeed operating, successfully.”⁶⁰

A side effect of Clinton’s zero-yield restriction was a foolish prohibition on one-point safety testing. An LLNL report indicated that once the concept of one-point safety was developed, “...one point safety tests were integrated into most of the test series conducted at Nevada.”⁶¹ These tests were so important that President Eisenhower had allowed them even under the testing moratorium.⁶²

The Clinton Administration’s claims about the CTBT were disingenuous and shortsighted. President Clinton stated, “I am assured by the Secretary of Energy and the Directors of our nuclear weapons labs that we can meet the challenge of maintaining our nuclear deterrent under a CTBT through a Science Based Stockpile Stewardship program without nuclear testing.”⁶³ As noted above, the Laboratory Directors told him that they needed to test at a half-kiloton. President Clinton stated, “...I consider the maintenance of a safe and reliable nuclear stockpile to be a supreme national interest of the United States.”⁶⁴ Nevertheless, he ended nuclear modernization and cut the defense budget drastically. Indeed, President Clinton

⁶⁰ Paul Robinson, John Foster, and Thomas Scheber, “The Comprehensive Test Ban Treaty: Questions and Challenges” (Washington, D.C.: Heritage Foundation, November 7, 2012), Lecture No. 1218, available at <https://www.heritage.org/arms-control/report/the-comprehensive-test-ban-treaty-questions-and-challenges>.

⁶¹ Jeremy Scott, “The Giants of the Nuclear Testing Era: The Works of Robert K. Osborne” (Livermore, CA: Lawrence Livermore National Laboratory, April 9, 2018), LA-UR-18-27654, p. 7, available at <https://www.osti.gov/servlets/purl/1467192>.

⁶² *Ibid.*, p. 8.

⁶³ William Clinton, “Letter of Transmittal,” Comprehensive Test Ban Treaty, The White House, September 22, 1997, pp. IV-V, available at <https://www.congress.gov/105/cdoc/tdoc28/CDOC-105tdoc28.pdf>.

⁶⁴ *Ibid.*, p. IV.

pursued nuclear arms control proposals that made the Joint Chiefs of Staff “uncomfortable.”⁶⁵

The Clinton Administration’s disregard of expert technical advice was one of the most important reasons for the Senate rejection of the CTBT by a majority vote.⁶⁶ Other issues included the impossibility of verifying a zero-yield CTBT and the likelihood of violation of the Treaty by other nations. In October 1999, *The Washington Post* reported that, “In a new assessment of its capabilities, the Central Intelligence Agency has concluded that it cannot monitor low-level nuclear tests by Russia precisely enough to ensure compliance with the Comprehensive Test Ban Treaty....”⁶⁷

Statements by Russian Atomic Energy Minister, the late Viktor Mikhaylov, about Russian hydronuclear testing were brought up during the CTBT ratification hearings. There is substantial evidence of covert Russian low-yield nuclear testing in Russian open sources.⁶⁸ (In 2011, Russian Major General (Ret.) Vladimir Belous stated that “...in 1994-1995, a series of hydronuclear tests with a total yield of 10 kilograms of TNT were performed at the Novaya Zemlya

⁶⁵ Philipp C. Bleek, “Joint Chiefs of Staff ‘Uncomfortable’ With Start III Reductions Below 2,000-2,500,” *Arms Control Today*, no date (May 2000), available at <https://www.armscontrol.org/act/2000-06/news/joint-chiefs-staff-uncomfortable-start-iii-reductions-below-2000-2500>.

⁶⁶ “U.S. Senate Rejects Nuclear Test Ban Treaty,” *News On 6*, October 13, 1999, available at <https://www.newson6.com/story/5e36864a2f69d76f6209bede/us-senate-rejects-nuclear-test-ban-treaty>.

⁶⁷ Roberto Suro, “CIA Is Unable to Precisely Track Testing,” *The Washington Post*, October 3, 1999, available at <http://www.washingtonpost.com/wp-srv/national/daily/oct99/nuclear3.htm>.

⁶⁸ Mark B. Schneider, “Yes, the Russians Are Testing Nuclear Weapons and It Is Very Important” (Washington, D.C.: Center for Security Policy, August 14, 2019), available at <https://centerforsecuritypolicy.org/yes-the-russians-are-testing-nuclear-weapons-and-it-is-very-important/>.

test site.”⁶⁹) Senate Majority Leader Trent Lott, R-Miss., called the Treaty “fatally flawed.”⁷⁰

Efforts by the Obama and Biden Administrations to obtain Senate approval of the CTBT, using the same discredited arguments, failed. In 2016, former Senator Jon Kyl and former Under Secretary of Defense Douglas J. Feith wrote that, “To circumvent Congress, Mr. Obama wants the United Nations to declare nuclear tests illegal. This is an affront to the Constitution and bad nuclear policy.”⁷¹ In 2022, the Biden Administration unsuccessfully called for the CTBT’s ratification despite its determination that Russia, and possibly China, violated their obligations under the CTBT and the declared testing moratorium and, in the case of Russia, also the TTBT.⁷² Under the TTBT, Russia had to report all nuclear tests. (In 2020, the Trump Administration had reached the same conclusion concerning Russian and Chinese compliance with the CTBT and the TTBT.⁷³)

⁶⁹ “Russia: Prospects Unclear for Comprehensive Test-Ban Treaty,” *World News Connection*, January 4, 2011.

⁷⁰ “U.S. Senate Rejects Nuclear Test Ban Treaty,” *op. cit.*

⁷¹ Jon Kyl and Douglas J. Feith, “Evading the Constitution to Ban Nuclear Tests,” *The Wall Street Journal*, August 16, 2016, available at <https://www.hudson.org/national-security-defense/evading-the-constitution-to-ban-nuclear-tests>.

⁷² U.S. Department of State, *Adherence and Compliance with Arms Control, Nonproliferation, and Disarmament Agreements*, 2022, pp. 29-30, available at <https://www.state.gov/wp-content/uploads/2022/04/2022-Adherence-to-and-Compliance-with-Arms-Control-Nonproliferation-and-Disarmament-Agreements-and-Commitments-1.pdf>; and, U.S. Department of Defense, *2022 Nuclear Posture Review*, 2022, p. 18, available at <https://fas.org/wp-content/uploads/2023/07/2022-Nuclear-Posture-Review.pdf>.

⁷³ U.S. Department of State, *Adherence and Compliance with Arms Control, Nonproliferation, and Disarmament Agreements*, 2020, pp. 46-52, available at <https://www.state.gov/wp-content/uploads/2022/04/2022-Adherence-to-and-Compliance-with-Arms-Control-Nonproliferation-and-Disarmament-Agreements-and-Commitments-1.pdf>.

The CTBT is a classic example of ideologically driven arms control. After the defeat of the CTBT, there was an effort by a number of nuclear weapons scientists to get the United States to resume nuclear testing. Just after the 2000 election, *The New York Times* reported that a number of nuclear weapons experts said "...the concept [of] trying to assess the stockpile in the absence of nuclear tests is intrinsically flawed. Without exploding a sample of the bombs they say, they can never reach clear-cut conclusions about the continued reliability of a given nuclear weapons design."⁷⁴ Nuclear weapons designer Dr. Charles Nakhleh told the *Times* that doubts about the stockpile stewardship approach were widespread among weapons designers. Dr. Harold Agnew, perhaps with the exception of Dr. Foster, the most important of the National Laboratory directors, was quoted by the *Times* as saying, "...to consider putting those things [major redesigns] into the stockpile without testing is nonsense." Dr. Carol T. Alonso, an Assistant Associate Director at LLNL, told the *Times* that, "In a blink, I would prefer to go back to testing." Reid Worlton, a retired weapons designer, said, "There [is] nothing that really can replicate a nuclear test." Thomas Thompson, a weapons designer at LLNL, said the United States is "going to have a decline" in weapons reliability and what was going on was an effort to make the decline "as gradual as possible." (According to *The Los Angeles Times*, Thompson "...helped create 25 successful nuclear weapons...."⁷⁵)

President George W. Bush adopted the nuclear testing policy of the Clinton Administration rather than that of his

⁷⁴ James Glanz, "Testing The Aging Stockpile In A Test Ban Era," *The New York Times*, November 24, 2000, p. 1.

⁷⁵ Robert Lee Hotz, "Column One: Learning to Live Without the Bomb: Once at the heart of history, the last of America's nuclear arms designers ponder their future in a nation that no longer needs them," *The Los Angeles Times*, December 22, 1994, available at <https://www.latimes.com/archives/la-xpm-1994-12-22-mn-11917-story.html>.

father, although he did not support the ratification of the CTBT. The failure to support a resumption of testing was an unpleasant surprise to the National Laboratories and probably accelerated the retirement of experienced weapons designers.

Rather than resume nuclear testing, the George W. Bush Administration proposed the development of a Reliable Replacement Warhead (*without nuclear testing*) with a higher margin between success and failure.⁷⁶ This was the same type of weapon that President George H.W. Bush said would require “more than 15 test[s] over three years.” The George W. Bush Administration also proposed a study of a robust nuclear earth penetrator. Both these programs were rejected by Congress in a period where support for nuclear deterrence was at a low point. Dr. John Foster later observed that these decisions “...denied the laboratories the opportunity to develop and demonstrate nuclear weapons competence from design through to production and flight tests.”⁷⁷

In October 2008, then-Secretary of Defense Robert Gates warned that, “To be blunt, there is absolutely no way we can maintain a credible deterrent *and* reduce the number of weapons in our stockpile *without* either resorting to testing our stockpile or pursuing a modernization program.”⁷⁸ (Emphasis in the original.) His reference to “a modernization program” was clearly to the Reliable

⁷⁶ Jonathan Medalia “The Reliable Replacement Warhead Program: Background and Current Development” (Washington, D.C.: Congressional Research Service, 2007), available at <https://apps.dtic.mil/sti/pdfs/ADA470255.pdf>.

⁷⁷ Robinson, Foster, and Scheber, “The Comprehensive Test Ban Treaty: Questions and Challenges,” *op. cit.*

⁷⁸ Robert M. Gates, “Speech at the Carnegie Endowment for International Peace,” October 28, 2007, available at <http://www.defenselink.mil/speeches/speech.aspx?speechid=1305>; and, “Robust Nuclear Earth Penetrator,” February 6, 2018, available at <http://www.globalsecurity.org/wmd/systems/rnep.htm>.

Replacement Warhead. Neither of these happened. The United States has not tested nuclear weapons since 1992 or developed weapons with higher margins between success and failure. (The W93 may be the first deliberate such design.) The success of the stockpile stewardship program is simply asserted.⁷⁹ The problem is that there is no way to prove this absent the final exam – nuclear testing.

The Obama Administration, in its 2010 *Nuclear Posture Review Report* (NPR), mandated: 1) no nuclear testing; 2) minimal changes in the life-extended warheads; 3) the “reuse of nuclear components from different warheads”; 4) no “new military missions” or providing for “new military capabilities”; and, 5) no “new nuclear warheads.”⁸⁰ It stated inaccurately that “...our nuclear warheads have been maintained and certified as safe and reliable through a Stockpile Stewardship Program that has extended the lives of warheads by refurbishing them to nearly original specifications.”⁸¹ (Emphasis added.) The Obama Administration’s restrictions, if fully implemented, would preclude the introduction of the most important safety development since one-point safety – insensitive high explosive – which nearly eliminates the chance of an accidental detonation, much less any nuclear yield.

Despite the effort to minimize changes and reuse components, there have been changes to correct problems.⁸²

⁷⁹ “Divider, 30 years later - Los Alamos marks three decades since its last nuclear test,” Los Alamos National Laboratory, November 28, 2022, available at <https://www.lanl.gov/media/publications/national-security-science/1122-divider-30-years-later>.

⁸⁰ U.S. Department of Defense, *Nuclear Posture Review Report*, April 2010, pp. vi, xiv, 40, available at https://nuke.fas.org/guide/usa/2010_npr_report.pdf.

⁸¹ *Ibid.*, p. xiv.

⁸² Thomas Scheber and Dr. John Harvey, *Assessment of U.S. Readiness to Design, Develop and Produce Nuclear Warheads: Current Status and Some Remedial Steps* (Fairfax, VA: National Institute Press, 2015), pp. 13, 57,

The life-extension programs have introduced more. Even reused components introduce a change from the original tested versions because of the age of the material. In 2019, Dr John C. Hopkins (the retired leader of the entire nuclear weapons program at LANL) and nuclear weapons designer Dr. David Sharp wrote, "The vast majority of archival nuclear test data pertain to newly manufactured devices. There were no aging or refurbishment effects present. Without nuclear testing, it is not possible to know which, if any, of the devices that were previously tested are representative of devices currently in the stockpile."⁸³

Perhaps the most amazing aspect of the Obama Administration's guidance was that it directed, "In any decision to proceed to engineering development for warhead LEPs [life extension programs], the United States will give strong preference to options for refurbishment or reuse. Replacement of nuclear components would be undertaken only if critical Stockpile Management Program goals could not otherwise be met, and if specifically authorized by the President and approved by Congress."⁸⁴ Thus, some of the most important technical decisions would be made by people who knew little or nothing about nuclear weapons.

Experienced nuclear weapons designers know that there is no such thing as a small change in a nuclear weapon. Ramos writes, "Those who had experienced designing and testing nuclear weapons know a device that performed well in an experimental test could perform differently when tried out in its weapons configuration, like being

available at <https://nipp.org/wp-content/uploads/2021/03/Assessment-of-US-Readiness-for-web.pdf>.

⁸³ John C. Hopkins and David H. Sharp, "The Scientific Foundation for Assessing the Nuclear Performance of Weapons in the US Stockpile Is Eroding," *Issues in Science and Technology*, Vol. 35, No. 2 (Winter 2019), available at <https://issues.org/the-scientific-foundation/>.

⁸⁴ *Nuclear Posture Review Report*, 2010, op. cit., p. xiv.

enshrouded in the warhead compartment of a missile. In a realistic situation material surrounding a device could bounce neutrons back into the pit, the device could be abnormally reshaped after high explosives detonated, or other physics effects could occur that had the potential to affect performance.”⁸⁵

Science-Based Stockpile Stewardship (SBSS)

In 1997, then-Los Alamos National Laboratory Director Siegfried S. Hecker explained, “The premise of SBSS is that we can offset the loss of confidence in the safety and reliability of existing weapons without nuclear testing by demonstrating improved understanding of the underlying science and technology.”⁸⁶ This is a seriously flawed concept. Virtually nothing is put into service without testing the *finished product*. When dealing with very expensive items like dams, bridges or buildings, testing is not to the point of destruction but scale models are often tested to destruction and designs are normally very conservative with regard to strength. The zero-yield testing limitation excludes testing of functional scale models of nuclear weapons and one-point safety tests. Moreover, the one-point safety constraint limits how robust the designs can be.

In most instances, SBSS is equivalent to putting new civilian or military aircraft into service without ever flight testing them. Over 100 years of the development of countless types of aircraft have not resulted in an understanding of the “underlying science and technology” that would eliminate the need to flight test new aircraft.

⁸⁵ Ramos, *From Berkeley to Berlin*, op. cit., p. 184.

⁸⁶ Siegfried S Hecker, “Safety and Reliability of the U.S. Nuclear Deterrent,” Hearing before the Subcommittee on International Security, Proliferation, and Federal Services, Senate Hearing, October 27, 1997, pp. 105-267.

Basic science research is very important but it is not a substitute for testing the *finished product*.

SBSS sought to substitute “advanced computational and diagnostic capabilities” for nuclear testing.⁸⁷ This included understanding: 1) fusion ignition; 2) pre-ignition materials behavior; 3) behavior of plutonium under shock conditions; and 4) advanced simulations.⁸⁸ All of these have relevance to weapons design. However, as Dr. Hopkins and Dr. Sharp wrote, “During the nuclear testing era there were generally significant discrepancies between the output of these simulations and the nuclear test data with which they were compared.”⁸⁹ Moreover, they continued:

...the only unequivocal way to demonstrate that predictions made with simulations meet expected standards of confidence is by establishing a track record of correct and reliable predictions that have been made using that simulation. However, the ability to make such predictions of the nuclear performance of weapons in their current state has not been demonstrated, and cannot be demonstrated, without a nuclear test program.⁹⁰

Most of the techniques of SBSS are not really new. They are mainly more advanced versions of techniques that, in some cases, go back to the 1940s and 1950s. The improved versions are more sophisticated (and often more

⁸⁷ Anna Péczeli and Bruce Goodwin, *Technical Issues in the Comprehensive Nuclear Test Ban Treaty (CTBT)* (Livermore, CA: Center for Global Security Research Lawrence Livermore National Laboratory, September 2020), p. 12, available at <https://cgsl.llnl.gov/sites/cgsl/files/2024-08/CGSRctbtONLINE.pdf>.

⁸⁸ Ibid.

⁸⁹ Hopkins and Sharp, “The Scientific Foundation for Assessing the Nuclear Performance of Weapons in the US Stockpile Is Eroding,” op. cit.

⁹⁰ Ibid.

expensive⁹¹), but inadequate substitutes for nuclear testing.⁹²

Under SBSS, great effort was devoted to recording as much data as possible about the nuclear tests that had been conducted before the original weapons designers had died off.⁹³ However, it is simply impossible to record everything that was learned from almost 50 years of testing. Some has been forgotten and some of what has been recorded is likely inaccurate.

Subjective judgment is very much involved in determining the impact of design changes not verified by a nuclear test, particularly when data from “near neighbor” (i.e., a similar design) nuclear tests are used. The current certification process seems more like the practice of medicine than it does nuclear engineering. One hopes they are good nuclear doctors but what is needed is good, experienced nuclear design scientists and engineers whose work is verified by nuclear testing.

In the more than 30 years without U.S. nuclear tests, the level of risk has been increasing as design changes have been made in the stockpile and experienced designers have retired or died. According to the Federation of American Scientists “...the W76-1 LEP [life-extension program] also involves changes to both the reentry body and the warhead package: replacing detonators; replacing chemical high explosives; refurbishing the secondary; adding a new arming, fuzing and firing (AF&F) system; adding a new gas reservoir and transfer support system; and a new lightning arrestor connector.”⁹⁴ Based upon this and other

⁹¹ Miller, “Stockpile Stewardship: What Were We Thinking? How Did It Work Out?,” op. cit., p. 17.

⁹² Péczeli and Goodwin, *Technical Issues in the Comprehensive Nuclear Test Ban Treaty (CTBT)*, op. cit., p. 13.

⁹³ Hotz, “Column One: Learning to Live Without the Bomb,” op. cit.

⁹⁴ Pat Host, “W76-1 Life Extension Program Reaches Production Phase Halfway Point,” *Defense Daily.com*, October 31, 2024, available at

unclassified reports describing the life-extended Trident W76, the assertion that this is a tested design is questionable. A retired nuclear weapons designer told this author that based on what he had seen in open sources, he estimated that about half the parts in the life-extended W76 were different from the original tested version. This may be the reason that both the United States and the United Kingdom are developing new replacement warheads for the W76. The U.S. W93 reportedly has a higher margin than the W76.⁹⁵ Reportedly, by 2003-2005 a "...consensus emerged in the national laboratories that it would...be increasingly difficult and risky to attempt to replicate existing warheads without nuclear testing and that creating a reliable replacement warhead should be explored."⁹⁶ This judgment was not acted on for 15 years.

The LLNL has revealed that the life-extended W80 cruise missile warhead has not only had its electronics replaced with modern technology but the high explosive that implodes the primary (fission trigger) has been replaced by insensitive high explosive.⁹⁷ To claim that this is a tested design is a stretch.

<https://www.defensedaily.com/w76-1-life-extension-program-reaches-production-phase-halfway-point/navy-usmc/>.

⁹⁵ "W93/Mk 7 Navy Warhead – Developing Modern Capabilities To Address Current and Future Threats," The Los Alamos Study Group, no date, available at <https://www.lasg.org/documents/W93-MK7-WhitePaper.pdf>.

⁹⁶ Thomas Scheber, *Reliable Replacement Warheads: Perspectives and Issues* (Fairfax, VA: National Institute Press, 2007), p. 2, available at <https://www.bits.de/NRANEU/docs/RRW07.pdf>. Also see, Thomas D'Agostino, "Presented at the Woodrow Wilson International Center for Scholars – 'The Reliable Replacement Warhead Program,'" June 15, 2007, available at <http://nnsa.energy.gov/news/905.htm>.

⁹⁷ Lawrence Livermore National Laboratory, "Extending the Life of a Workhorse Warhead," *Science & Technology Review*, October/ November 2018, p. 6, available at <https://str.llnl.gov/sites/str/files/2024-04/10.18.1.pdf>.

Thomas Scheber, former Director of the Military Applications Group and Project Leader for Weapon Studies at LANL, and the late Dr. John Harvey, former Principal Deputy Assistant Secretary of Defense for Nuclear, Chemical, and Biological Defense Programs (and many other senior positions related to nuclear weapons), wrote, “Even small defects or changes in a system like a weapon or a rocket can lead to catastrophic results.”⁹⁸

U.S. policy makers have created a situation in which the central element of the scientific method — testing — has been replaced by a process that resembles an odd combination of science and historical research. Indeed, a publication of the LLNL states:

[Robert K.] Osborne’s notebooks are critical as they capture his extensive work and knowledge, and so are also critical for the nuclear weapons work that continues at Los Alamos. His notebooks (and those of the other “nuclear giants”) are primary resources; they contain the original ideas and data from which the U.S. nuclear weapons in today’s stockpile were designed and built. As current weapons designers have never designed, built, and tested a nuclear weapon the knowledge in these notebooks provides key elements necessary to perform stockpile stewardship, and to design new weapons should the Laboratory be ordered to do so.⁹⁹

Very few nuclear physicists and engineers also have training in historical research; it is a poor substitute for nuclear testing. Moreover, the emphasis on historical

⁹⁸ Scheber and Harvey, *Assessment of U.S. Readiness to Design, Develop and Produce Nuclear Warheads: Current Status and Some Remedial Steps*, op. cit.

⁹⁹ Scott, “The Giants of the Nuclear Testing Era: The Works of Robert K. Osborne,” op. cit., p. 10.

research largely eliminates innovations and new designs. The design approaches taken by the great nuclear weapons designers were dictated by the technology and knowledge that existed many decades ago when the current U.S. nuclear weapons were originally designed and tested, which is very different from what exists today.

In 2009, Dr. Stephen Younger, a former Director of the Weapons Program at Los Alamos National Laboratory and former Director of the Sandia National Laboratory, stated:

I no longer believe that the current nuclear arsenal can be maintained indefinitely without nuclear testing.... Small changes—some purposefully introduced to fix known problems and some naturally occurring as a result of age—are accumulating to take the weapons further and further from their original configuration. At some point, so many small changes will have occurred that our test pedigree will fade as the principal argument for confidence. We will then face one of three options: conduct a nuclear test to verify the performance of our much-refurbished weapons, design new weapons that are more robust, or accept decreased confidence in our nuclear deterrent.¹⁰⁰

In 2019, Dr. Hopkins and Dr. Sharp wrote, “In the absence of experimental data that comes uniquely from nuclear tests, the nation can be left not knowing whether there are nuclear performance problems with any of its weapons that have not been revealed by surveillance programs. Likewise, it may not be known which problems

¹⁰⁰ Quoted in Kathleen Bailey and Thomas Scheber, *The Comprehensive Test Ban Treaty: An Assessment of the Benefits, Costs, and Risks* (Fairfax, VA: National Institute Press, 2011), p. 45, available at <https://nipp.org/wp-content/uploads/2021/05/CTBT-3.11.11-electronic-version.pdf>.

that may come to light, by whatever means, could have a serious impact on the nuclear performance of weapons in the stockpile.”¹⁰¹

Computers have become far more capable since nuclear testing ended in 1992. However, two problems still remain: 1) the degree to which the sophisticated programs actually model the physics that goes on during a nuclear explosion; and 2) garbage in, garbage out. The first is more significant. In the era of nuclear testing, data from nuclear tests were used to make changes in the computer programs to better simulate the observed results from nuclear tests. Since the end of nuclear testing, changes have been made in the design codes based upon nonnuclear testing.¹⁰² Hopefully, they have improved their fidelity. However, without resumed nuclear testing there is no way to know for sure if this is the case.¹⁰³ In 2019, Dr. Hopkins and Dr. Sharp pointed out that “...the only unequivocal way to demonstrate that predictions made with simulations meet expected standards of confidence is by establishing a track record of correct and reliable predictions that have been made using that simulation. However, the ability to make such predictions of the nuclear performance of weapons in their current state has not been demonstrated, and cannot be demonstrated, without a nuclear test program.”¹⁰⁴

Three-dimensional simulations of nuclear weapons are relatively new. The first U.S. three-dimensional simulation of a thermonuclear weapon detonation did not happen until

¹⁰¹ Hopkins and Sharp, “The Scientific Foundation for Assessing the Nuclear Performance of Weapons in the US Stockpile Is Eroding,” op. cit.

¹⁰² Ibid.

¹⁰³ Loc. cit.

¹⁰⁴ Loc. cit.

2002.¹⁰⁵ Hence, no nuclear weapon designed on the basis of such simulations has ever been tested.

During the life-extension programs many of the original designers participated mainly as consultants. With the passage of time this will inevitably cease.

In 2020, the Office of the Deputy Assistant to the Secretary of Defense for Nuclear Matters characterized U.S. policy under stockpile stewardship as follows:

Since early 1993 the U.S. Nuclear Weapons Program has been essentially “stuck” in a continuous loop that represented only a small segment of what was previously a full cycle of perpetual production and replacement. During this time, the truncated process consisted primarily of activities associated with the continuous assessment, maintenance/repair, and refurbishment of the weapons.¹⁰⁶

This is not what the hostile nuclear-armed states are doing. They are modernizing and improving their nuclear weapons. In 2025, Thomas Scheber pointed out that, “Regrettably, we have gone another decade without any new nuclear warhead developments. This means we are not creating opportunities for the next generation of weapons designers and producers to challenge them and help them develop skills to assess warheads in the current stockpile and the judgement to develop new designs in the future.”¹⁰⁷

¹⁰⁵ Lawrence Livermore National Laboratory, “Livermore, Los Alamos labs complete first 3-D simulation of full-system nuclear weapon,” March 8, 2002, available at <https://www.llnl.gov/article/28761/livermore-los-alamos-labs-complete-first-3-d-simulation-full-system-nuclear-weapon>.

¹⁰⁶ Office of the Deputy Assistant to the Secretary of Defense (Nuclear Matters), “Nuclear Matters: A Practical Guide,” 2020, available at <https://www.lasg.org/Nuclear-Matters-2008.pdf>.

¹⁰⁷ “An Interview with Thomas Scheber, former Director of Strike Policy and Integration, Office of the Secretary of Defense,” National Institute

The Impact of Covert Nuclear Testing

Concerns about Soviet compliance with nuclear testing prohibitions date to the Eisenhower Administration. It is certain that Soviets conducted nuclear tests that were not detected. In 1996, Russia released a list of "...340 underground nuclear tests (UNTs)... carried out on the Semipalatinsk Test Site (STS) from 1961 to 1989. Only 279 of them had been included in previously published lists of Soviet underground nuclear explosions...."¹⁰⁸ This list did not even count the Soviet hydronuclear tests (very low-yield nuclear tests).

There are serious verification problems with the CTBT. In 1987, the Senate Armed Services Committee stated that the nuclear test detection threshold was between "1 kiloton and 10 kilotons."¹⁰⁹ Even today, tests ranging from sub-kiloton yield to ten kilotons (and possibly more with earthquake masking) are technically possible without detection or at least without conclusive detection using: 1) explosive containment chambers for very low-yield tests; 2) decoupling (creating a near vacuum in a cavity around the device); 3) testing in salt mines particularly when combined with decoupling; and 4) the use of natural earthquakes to mask the seismic signal from a nuclear test. There are great difficulties in detecting and *proving* a nuclear test seismically, particularly if conducted outside known nuclear test sites in a manner designed to minimize the

for Public Policy, 2025, p. 102, available at <https://nipp.org/wp-content/uploads/2025/06/Interviews-5.2.pdf>.

¹⁰⁸ Vitaly I. Khalturin, Tatyana G. Rautian, and Paul G. Richards, "A Study of Small Magnitude Seismic Events During 1961-1989 On and Near the Semipalatinsk Test Site, Kazakhstan," *ldeo.columbia.edu*, 2001, p. 144, available at https://www.ldeo.columbia.edu/~richards/my_papers/Khalturin_et_al_STSevents.pdf.

¹⁰⁹ Miller, Brown, Alonso, *Report to Congress on Stockpile Reliability, Weapons Remanufacture, and Role of Nuclear Testing*, op. cit., p. 57.

seismic signal.¹¹⁰ A 2001 study by Vitaly V. Adushkin and William Leith reported that the Soviet Union conducted 117 nuclear tests outside of its nuclear weapons test sites.¹¹¹

The theoretical one-kiloton detection threshold in the CTBT International Monitoring System can be evaded. It does not assume testing in a manner designed to minimize detection. Moreover, according to the Department of State, China has been "...frequently blocking the flow of data from its International Monitoring System (IMS) stations to the International Data Center...."¹¹² Thus, combining decoupling and testing in salt mines could conceal much higher yield tests.

As noted above, both the Trump and Biden Administrations determined that Russia was conducting yield-producing nuclear tests (supercritical tests) contrary to their obligations under the CTBT, the testing moratorium, and the TTBT. (The TTBT required notifications of nuclear tests, which did not happen.) Both raised concerns that China also was conducting nuclear tests. (China continued to conduct high-yield nuclear tests until 1996.)¹¹³

The claims concerning the adequacy of verification made during treaty ratification hearings rarely match the

¹¹⁰ Bailey and Scheber, *The Comprehensive Test Ban Treaty: An Assessment of the Benefits, Costs, and Risks*, op. cit., pp. 17-23.

¹¹¹ Vitaly V. Adushkin and William Leith, "The Containment of Soviet Underground Nuclear Explosions" (Washington, D.C.: U.S. Department of the Interior, September 2001), p. 14, available at <https://pubs.usgs.gov/of/2001/0312/report.pdf>.

¹¹² *Adherence to and Compliance with Arms Control, Nonproliferation, and Disarmament Agreements and Commitments*, 2020, op. cit., p. 49.

¹¹³ International Atomic Energy Agency, "Communication of 1 August 1996 Received from the Permanent Mission of the People's Republic of China to the International Atomic Energy Agency," INFCIRC/522, September 16, 1996, available at <https://www.iaea.org/sites/default/files/publications/documents/infcircs/1996/inf522.shtml>.

assessments made when real world events happen. The first State Department determination (2020) that Russia was in violation of the CTBT, the testing moratorium, and the TTBT happened over 20 years after reports of it appeared in the Russian press.¹¹⁴ In 2009, the Congressional Strategic Posture Commission reported that, "Apparently Russia and possibly China are conducting low yield tests."¹¹⁵

The late Dr. Robinson, in his CTBT ratification testimony as the Director of the Sandia National Laboratory, stated that, "If the United States scrupulously restricts itself to zero yield while other nations may conduct experiments up to the threshold of international detectability, we will be at an intolerable disadvantage."¹¹⁶ All yield producing nuclear tests provide benefits regarding nuclear weapons safety, sustainment and modernization compared to non-yield-producing (subcritical) experiments.¹¹⁷ In 2016, Dr. Foster said that hydronuclear tests "of less than one ton" yield could provide high confidence in the "performance [of nuclear weapons] at low yield."¹¹⁸ According to Siegfried Hecker, former Director of

¹¹⁴ Schneider, "Yes, the Russians Are Testing Nuclear Weapons and It Is Very Important," op. cit.

¹¹⁵ William J. Perry and James R. Schlesinger, *America's Strategic Posture - The Final Report of the Congressional Commission on the Strategic Posture of the United States* (Washington, D.C.: U.S. Institute of Peace, 2009), p. 83, available at http://media.usip.org/reports/strat_posture_report.pdf.

¹¹⁶ "Statement of C. Paul Robinson, Director Sandia National Laboratories, United States Senate Committee on Armed Services October 7, 1999," p. 9, available at <https://nuke.fas.org/control/ctbt/conghearings/robinson.pdf>.

¹¹⁷ Central Intelligence Agency. "Russia Developing New Nuclear Weapons at Novaya Zemlya," July 2, 1999, p. 7, available at <https://nsarchive2.gwu.edu/NSAEBB/NSAEBB200/19990702.pdf>.

¹¹⁸ Dr. John S. Foster, "Future Possible Paths for the Nuclear Weapons Complex," January 22, 2016, mimeograph, p. 9.

the LANL, “[M]ost [new] designs could be adequately tested at yields between one and ten kilotons.”¹¹⁹

Russia may even assess hydronuclear tests as being more important. According to a declassified CIA report, First Deputy Minister for Atomic Energy has said, “Russia is looking at a range of techniques—including hydronuclear experiments—that they say would allow them to continue warhead design and maintenance research within the limits of the Comprehensive Test Ban Treaty.”¹²⁰ If it is unnecessary to hide these tests, they could be conducted more easily and cheaply. In 1999, Dr. Mikhaylov said that “...developed traditional nuclear powers can use hydronuclear experiments to perform tasks of *improving reliability* of their nuclear arsenal and effectively steward its operation.”¹²¹ (Emphasis added.)

In 1999, the Russian Atomic Ministry issued a report stating that the Soviets conducted hydronuclear tests on the earth’s surface, in the air and underground.¹²² The late Dr. Boris Litvinov, who was the chief of weapons development at the Chelyabinsk-70 nuclear weapons laboratory, reportedly told Siegfried Hecker, “We didn’t bury it [the hydronuclear device] the way you guys did. We did [tests] out on the surface. We dug a little trench. We put our

¹¹⁹ Baker Spring and Michaela Dodge, “Keeping Nuclear Testing on the Table: A National Security Imperative” (Washington, D.C.: Heritage Foundation, February 27, 2013), available at <https://www.heritage.org/node/11938/print-display>.

¹²⁰ “Russia: Mikhaylov Pressing for Hydronuclear Experiments,” Senior Intelligence Brief, May 4, 1999, available at <https://nsarchive2.gwu.edu/NSAEBB/NSAEBB200/19990504.pdf>.

¹²¹ Mark Schneider, “The Future of the U.S. Nuclear Deterrent,” *Comparative Strategy*, Volume 27 - Issue 4, July 1, 2008, p. 349, available at <https://www.tandfonline.com/doi/abs/10.1080/01495930802358539>.

¹²² N. Mikhailov, N.P. Voloshin, and A.M. Matushchenko, “Nuclear Tests of USSR, Hydronuclear Experiments. Plutonium Consumption Stock-Taking” (Moscow: Russian Federation Ministry for Atomic Energy, 1999), available at <https://inis.iaea.org/records/1r5tf-6dn15>.

experiments in there. And we just blew it up. Then we took bulldozers and bulldozed that over, and we took care of it. We thought, who is ever going to go out there?"¹²³ This was a clear violation of the 1963 Nuclear Test Ban Treaty, which prohibited all atmospheric nuclear tests. There is no indication that any of these tests were detected. In addition to weapons reliability and development, this has implications for weapons effects testing.

In November 2010, writing in Russian state media, Dr. Alexei Fenenko of the Russian National Academy of Scientists said, "Over the past 15 years, significant progress has been made in subcritical and hydronuclear testing."¹²⁴

Obviously, testing at full yield, or a significant fraction of it, provides much more information and confidence in weapons performance. Limiting testing to ten-kilotons or less generates uncertainty about the maximum yield of high-yield thermonuclear weapons but should prevent duds. The United States operated under the 150-kiloton limit of the TTBT from 1976 despite having weapons with substantially higher yield.¹²⁵ The Reagan Administration determined that the Soviet Union was "...likely to have violated the nuclear testing yield limit of the Threshold Test Ban Treaty."¹²⁶ President Reagan assessed this as allowing

¹²³ Tatyana G. Rautian, Paul G. Richards, and William S. Leith, "A Review of Nuclear Testing by the Soviet Union at Novaya Zemlya, 1955-1990," *Science and Global Security*, Vol. 13, 2005, p. 28, available at <http://www.princeton.edu/~globsec/publications/pdf/131-2khalturin%20NZ%201-42%20.pdf>.

¹²⁴ Quoted in Schneider, "Yes, the Russians Are Testing Nuclear Weapons and It Is Very Important," *op. cit.*

¹²⁵ "Complete List of All U.S. Nuclear Weapons," *Nuclear Weapon Archive*, March 30, 2023, available at <https://nuclearweaponarchive.org/Usa/Weapons/Allbombs.html>.

¹²⁶ Ronald Reagan, "Message to the Congress Transmitting a Report on Soviet Noncompliance With Arms Control Agreements," February 1, 1985, available at <https://www.reaganlibrary.gov/archives/speech/message-congress-transmitting-report-soviet-noncompliance-arms-control-agreements>.

the "...development of advanced nuclear weapons with proportionately higher yields of weapons than the U.S. could develop under the Treaty."¹²⁷

Despite 50 years of Soviet/Russian nuclear test violations (which also included the 1963 Limited Test Ban Treaty¹²⁸), little was done in response. The maximum yields of Russian and Chinese post-CTBT nuclear tests have not been made public other than a description of the Russian tests as "low-yield."¹²⁹ The United States knows a great deal about Russian hydronuclear tests; in the 1990s, Russian Atomic Energy Minister Dr. Viktor Mikhaylov was very open about them, apparently in an effort to legitimize them under the CTBT.¹³⁰ He even co-authored a Russian Atomic Energy Ministry report on Soviet-era hydronuclear tests which said there were 89 of them and, "The nuclear energy released during *most* of these experiments was less than 100 kg of chemical explosive equivalent."¹³¹ (Emphasis added.) The maximum yields were not disclosed. The report also said that Soviet hydronuclear tests were conducted on the earth's surface, in the air and underground. Testing in the atmosphere violates the 1963 Limited Test Ban Treaty. This Russian admission never made its way into the State Department arms control compliance reports. The Russian definition of a nuclear test apparently means the release of one metric ton of TNT in nuclear yield.¹³² However, it is

¹²⁷ Ibid.

¹²⁸ Loc. cit.

¹²⁹ Schneider, "Yes, the Russians Are Testing Nuclear Weapons and It Is Very Important," op. cit., p. 347.

¹³⁰ Ibid.

¹³¹ Mikhailov, Voloshin, and Matushchenko, "Nuclear Tests of USSR. Hydronuclear Experiments. Plutonium Consumption Stock-Taking," op. cit.

¹³² Vitaly I. Khalturin, Tatyana G. Rautian, Paul G. Richards, and William S. Leith, "A Review of Nuclear Testing by the Soviet Union at Novaya Zemlya, 1955-1990," *Science and Global Security*, Vol. 13, 2005, p. 28, available at

possible that some of the tests Mikhaylov was describing were more than hydronuclear tests since it is unlikely that they would have been conducted as an air burst because of the difficulty of instrumenting such tests.

If the Russians and/or the Chinese have been covertly testing at even a half-kiloton yield, they have obtained a large advantage in the reliability of their nuclear weapons, not to mention the development of new weapons types. China also benefited from very successful nuclear espionage against the United States.¹³³ The combination of espionage and continued nuclear low-yield testing is consistent with the scope of Chinese nuclear modernization. Reportedly, "...testing under a 500 ton yield limit would allow studies of boost gas ignition and initial burn, which is a critical step in achieving full primary design yield."¹³⁴ As discussed above, even at such a low testing yield level, the probability of a dud decreases dramatically compared to the stockpile stewardship approach.

New Russian and Chinese Nuclear Warheads

Russia has been developing new types of nuclear weapons since supposedly ending nuclear testing and is improving their technical performance (e.g., higher yield-to-weight ratio). Such advances require nuclear testing. Much of

<http://www.princeton.edu/~globsec/publications/pdf/131-2khalturin%20NZ%201-42%20.pdf>.

¹³³ Select Committee, House of Representatives, *Report of the Select Committee on U.S. National Security and Military/Commercial Concerns with the People's Republic of China*, Volume I (unclassified), May 1999, pp. 68–69, available at <https://www.congress.gov/105/crpt/hrpt851/CRPT-105hrpt851.pdf>.

¹³⁴ Sidney Drell, Chairman, "Nuclear Testing Summary and Conclusions," JSR-95-320, August 3, 1995, available at <https://rlg.fas.org/jsr-95-320.htm>.

Russia's nuclear escalation strategy (escalate to de-escalate) is based upon its monopoly on almost all types of tactical nuclear weapons, particularly low-yield battlefield weapons.

A now declassified CIA report from 2000 states, "Moscow's military doctrine on the use of nuclear weapons has been evolving and probably has served as the justification for the development of very low-yield, high-precision nuclear weapons."¹³⁵ In 2009, Colonel General Vladimir Verkhovtsev, then-Chief of the Defense Ministry's 12th Main Directorate, Russia's nuclear weapons organization, said the newly developed and manufactured nuclear munitions will have "...improved tactical and technical specifications."¹³⁶ (This is precisely what President Barack Obama prohibited for the United States a year later.) According to General Paul Selva, then-Vice Chairman of the Joint Chiefs of Staff, Russia was "...developing new nonstrategic nuclear weapons...."¹³⁷ According to Dr. Foster, "Russia has said it has developed low-yield, clean, penetrating, and electromagnetic-pulse (EMP) nuclear weapons.... Other than a low-yield warhead, the U.S. has no deployed nuclear weapons with such capabilities."¹³⁸ Thomas Scheber has observed, "Russia and China already

¹³⁵ Central Intelligence Agency, "Evidence of Russian Development of New Subkiloton Nuclear Warheads [Redacted]," Intelligence Memorandum, August 30, 2000, approved for release October 2005, p. 6, available at <https://nsarchive2.gwu.edu/NSAEBB/NSAEBB200/20000830.pdf>.

¹³⁶ "Nuclear Munitions to be Improved and Revitalized – Russian Federation Ministry of Defense," *Ria Novosti*, September 4, 2009 (Translated by World News Connection.)

¹³⁷ Michael Gordon, "Russia Has Deployed Missile Barred by Treaty, U.S. General Tells Congress," *The New York Times*, March 8, 2017, available at <https://www.nytimes.com/2017/03/08/us/politics/russia-inf-missile-treaty.html>.

¹³⁸ Robinson, Foster, and Scheber, "The Comprehensive Test Ban Treaty: Questions and Challenges," *op. cit.*

have a variety of weapons in their inventory that they deploy, on which they have nuclear test data, and we don't have any of these kinds of nuclear weapons in the U.S. inventory. Examples of these kinds of nuclear weapons are a 300-ton x-ray warhead, enhanced neutron warheads, clean, and low-yield nuclear warheads."¹³⁹

In 2017, the late Vice Admiral (Ret.) Robert Monroe, former Director of the Defense Nuclear Agency, stated that Russia was now 20 years ahead of the United States in these [low-yield fusion] weapons.¹⁴⁰ Indeed, in 1961, the Joint Chiefs of Staff urged Secretary of Defense Robert McNamara to brief President Kennedy in opposition to extending the nuclear testing moratorium. Their memorandum stated, "The Joint Chiefs of Staff remain of the belief that the continuation of a voluntary moratorium on tests which cannot be detected by any inspection system would be unwise at this time and could be seriously inimical to the continued security of the United States."¹⁴¹ They were concerned that extending the testing moratorium would prevent the U.S. development of pure fusion weapons, the neutron bomb and testing of nuclear weapons in space.¹⁴²

The development of fission-free or pure fusion weapons would constitute a revolutionary development. They generate nuclear yield without fission-generated fallout (minimum residual radiation). Russia has long been

¹³⁹ Ibid.

¹⁴⁰ Vice Admiral (Ret.) Robert Monroe, "Facing the grave nuclear risk," *The Washington Times*, January 27, 2017, available at <https://www.washingtontimes.com/news/2017/jan/26/america-must-resume-underground-nuclear-testing/>.

¹⁴¹ "Memorandum From the Joint Chiefs of Staff to Secretary of Defense McNamara," JCSM-221-61, April 8, 1961, available at <https://history.state.gov/historicaldocuments/frus1961-63v07/d14>.

¹⁴² Ibid.

working on them.¹⁴³ They represent the ultimate in clean, low-collateral damage nuclear weapons—a very low-yield neutron bomb. Major Lorin D. Veigas (U.S. Army) and Major C. D. Gunter (U.S. Army Reserve), note that, “This new class of weapons could be designed with a highly-tailorable range of yields and would produce significantly less residual radiation and collateral damage, making them well-suited for close integration with maneuver forces in regional conflicts.”¹⁴⁴ If these weapons are developed by U.S. adversaries, it will give them a nuclear advantage. The United States is likely to be taken by surprise because these weapons can even be tested in explosive containment containers which generate no seismic signal.

In 1999, Russian Major General (Ret.) Vladimir Belous wrote about Russian development of pure fusion weapons in which “a chemical explosion or magnetic field compression is used to implode a thermonuclear mixture,” and he stated that work was underway at Sarov (Arzamas-16) on such weapons.¹⁴⁵ This was a year after the Clinton Administration’s Department of Energy (DOE) announced that, “...the U.S. does not have and is not developing a pure fusion weapon and no credible design for a pure fusion weapon resulted from the DOE investment.”¹⁴⁶

¹⁴³ Robert R. Monroe, “Change U.S. Nuclear Weapons Policies!,” Nuclear Deterrence Summit (Arlington, VA: February 16-19, 2016), p. 3, mimeograph.

¹⁴⁴ Major (U.S. Army) Lorin D. Veigas and Major C. D. Gunter (U.S. Army Reserve), “Fourth Generation Nuclear Weapons,” *Fletcher Security Review*, Vol 7, No. 1, 2020, p. 26, available at https://sites.tufts.edu/fletcherrussia/files/2020/12/RE_SR-Nuclear.pdf.

¹⁴⁵ Quoted in Mark B. Schneider, *The Nuclear Forces and Doctrine of the Russian Federation* (Fairfax, VA: National Institute Press, 2006), p. 15, available at <https://nipp.org/wp-content/uploads/2021/05/Russian-nuclear-doctrine-NSF-for-print.pdf>.

¹⁴⁶ “Assessment of Inertial Confinement Fusion Targets (2013), Chapter: 3 Proliferation Risks Associated with Inertial Fusion Energy and with

It is clear from Russian sources that Russia has introduced new nuclear warheads that have reported yields that do not equate to any of the reported yields for Soviet-era warheads (which in part have been declassified by Russia).¹⁴⁷ Then-Defense Minister Sergei Ivanov stated that the Bulava-30 SLBMs and the SS-27 Mod-2/RS-24 Yars carry the same “new” warhead.¹⁴⁸ The large, heavy and powerful SS-17, SS-18, SS-19 and SS-25 warheads could not possibly be deployed as MIRVed warheads on the new smaller Russian missiles. Several Russian publications have said that Russia developed 100 kt warheads with a weight of 100 kg.¹⁴⁹ This closely corresponds with the declared six warhead Bulava-30 with a throw-weight of 1,150 kg.¹⁵⁰ These are apparently deployed on the Bulava-30 SLBMs and some SS-27 Mod 2/RS-24 Yars ICBMs, although the yield is sometimes reported in Russia to be in the 100-150-kt range.¹⁵¹ Reportedly, the best comparable Soviet-era designs were “...in the 110-130 kg range (this includes

Specific Target Designs,” National Academies Press, 2013, available at <https://nap.nationalacademies.org/read/18288/chapter/5>.

¹⁴⁷ “The Strategic Missile Forces,” Ministry of Defense of the Russian Federation, no date, available at https://eng.mil.ru/en/structure/forces/strategic_rocket/mission.htm.

¹⁴⁸ Schneider, “The Future of the U.S. Nuclear Deterrent,” op. cit., p. 347.

¹⁴⁹ National Institute for Public Policy, “Section II: Minimum Deterrence Fragile Hope of a Constant and Benign Security Environment,” September 2014, available at

https://www.esd.whs.mil/Portals/54/Documents/FOID/Reading%20Room/Litigation_Release/Litigation%20Release%20-%20Section%20II%20Minimum%20Deterrence%20Fragile%20Hope.pdf.

¹⁵⁰ James Howe, “China/Russia Strategic Nuclear Weapons: 2044 Forces and Potential U.S. Responses,” National Institute for Deterrence Studies, May 2025, available at https://www.youtube.com/watch?v=sF_88-6i8K8.

¹⁵¹ Mark B. Schneider, *How Many Nuclear Weapons Does Russia Have? The Size and Characteristics of the Russian Nuclear Stockpile* (Fairfax, VA: National Institute Press, 2023), pp. 59-60, 63, 144, available at <https://nipp.org/wp-content/uploads/2023/09/Vol.-3-No.-8.pdf>.

reentry vehicle body and electronics) and yields of 50 and 75 kt respectively.”¹⁵²

Two Russian generals described the warhead for the SS-27 Mod 1/Topol M Variant 2 ICBM as having a higher yield (presumably compared to the Soviet SS-25), which implies a new design.¹⁵³ Concerning the Soviet-era weapons, in 2000, Russian Lieutenant General (Ret.) Mikhail Vinogradov spoke about Russian nuclear modernization. He stated, “Basically the mechanical and electronic assemblies of the design and the chemical explosive [of Soviet-era nuclear weapons] will undergo modernization.”¹⁵⁴ The reference to modernizing the chemical explosive may be to the use of insensitive high explosive.

In 1997, then-Atomic Energy Minister Dr. Viktor Mikhaylov said Russia was developing earth-penetrating nuclear weapons.¹⁵⁵ In 2002, Dr. Mikhaylov, then-Director of the Russian nuclear weapons laboratory at Sarov, revealed that, “The scientists are developing a nuclear ‘scalpel’ capable of ‘surgically removing’ and destroying very localized targets. The low-yield warhead will be surrounded with a superhardened casing which makes it possible to penetrate 30–40 meters into rock and destroy a buried target—for example, a troop command and control point or a nuclear munitions storage facility.”¹⁵⁶ In 2003, Dr. Mikhaylov said that, “Efforts to improve thermonuclear weapons continue even now in several countries, among them the United States and Russia. The range of such weapons that exist is quite broad. There are weapons in the

¹⁵² Pavel Podvig, “Jane’s cover story,” *Russian Forces.org*, July 9, 2007, available at https://russianforces.org/blog/2007/07/janes_cover_story.shtml.

¹⁵³ Schneider, “The Future of the U.S. Nuclear Deterrent,” op. cit., p. 348.

¹⁵⁴ Ibid., pp. 348–349.

¹⁵⁵ Loc. cit.

¹⁵⁶ Loc. cit.

megaton class, and weapons *yielding hundreds of tons.*"¹⁵⁷ (Emphasis added.) Dr. Mikhaylov said that the low-yield weapons were variable yield.¹⁵⁸ (The United States has not improved thermonuclear warheads since the end of testing. Russia frequently attributes to the United States things that it is doing.)

China conducted atmospheric nuclear tests until 1980,¹⁵⁹ 18 years after the United States, the United Kingdom and the Soviet Union ended atmospheric nuclear testing. China was the only P-5 nation that conducted high-yield nuclear tests after 1992. These tests were important because they were linked to China's modernization objectives and continued until 1996.¹⁶⁰ China has probably used covert nuclear testing since then to develop a new generation of nuclear weapons; it also has used nuclear weapons information obtained through espionage against the United States to augment its nuclear tests.¹⁶¹ The warhead for the Chinese DF-31 ICBM is reportedly based upon the advanced U.S. W88.¹⁶²

¹⁵⁷ Loc. cit.

¹⁵⁸ Howe, "China/Russia Strategic Nuclear Weapons: 2044 Forces and Potential U.S. Responses," op. cit.

¹⁵⁹ Peter Suci, "China's Nuclear Tests Might Have Killed Hundreds of Thousands," *The National Interest*, May 1, 2021, available at <https://nationalinterest.org/blog/reboot/chinas-nuclear-tests-might-have-killed-hundreds-thousands-184134>.

¹⁶⁰ Schneider, "The Future of the U.S. Nuclear Deterrent," op. cit., p. 351.

¹⁶¹ Select Committee, House of Representatives, *Report of the Select Committee on U.S. National Security and Military/Commercial Concerns with the People's Republic of China*, Volume I (unclassified), May 1999, pp. 68–69, available at <https://www.congress.gov/105/crpt/hrpt851/CRPT-105hrpt851.pdf>.

¹⁶² James Rissen and Jeff Gerth, "China Is Installing a Warhead Said to Be Based on U.S. Secrets," *The New York Times International*, May 14, 1999, available at <https://archive.nytimes.com/www.nytimes.com/library/world/asia/051499china-nuke.html>.

China is not only expanding but diversifying its nuclear arsenal.¹⁶³ One 1996 Chinese nuclear test was described as “a great spanning leap” because it solved the problem of “nuclear weapons miniaturization.”¹⁶⁴ A 2017 briefing by the People’s Liberation Army Rocket Forces (PLARF) described an extensive MIRV capability for the new Chinese ballistic missiles.¹⁶⁵ The listed weight and yield of these weapons suggested these were developed after the supposed end of nuclear testing in 1996. Despite concern often stated in Washington about the need for more Chinese transparency, the PLARF briefing has been virtually ignored.

The 2023 Pentagon annual Chinese military power report states that, “The PLA seeks a diverse nuclear force, comprised of systems ranging from low-yield precision strike missiles to ICBMs with multi-megaton yields.”¹⁶⁶

¹⁶³ “Statement by Ms. Andrea Yaffe, Acting Principal Deputy Assistant Secretary of Defense for Space Policy,” House Armed Services Committee, May 7, 2025, p. 2, available at <https://www.congress.gov/119/meeting/house/118208/witnesses/HHRG-119-AS29-Wstate-YaffeA-20250507.pdf>.

¹⁶⁴ Schneider, “The Future of the U.S. Nuclear Deterrent,” op. cit., p. 350.

¹⁶⁵ Mark B. Schneider, *Current and Projected Growth of China’s Nuclear Arsenal*, Occasional Paper, Vol. 4, No. 10 (Fairfax, VA: National Institute Press, October 2024), p.14, available at <https://nipp.org/papers/current-and-projected-growth-of-chinas-nuclear-arsenal/>.

¹⁶⁶ Department of Defense, *Military and Security Developments Involving the People’s Republic of China 2023* (Washington, D.C.: Department of Defense, October 2023), p. 109, available at <https://media.defense.gov/2023/Oct/19/2003323409/-1/-1/1/2023-MILITARY-ANDSECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OFCHINA.PDF>.

The CTBT and Nuclear Nonproliferation

According to then-President Clinton, “The Comprehensive Nuclear Test-Ban Treaty is of singular significance to the continuing efforts to stem nuclear proliferation and strengthen regional and global stability.”¹⁶⁷ Yet, the CTBT could not prevent and has not prevented nuclear proliferation. India, Pakistan and North Korea have overtly tested high-yield nuclear weapons. Since the CTBT, Pakistani nuclear weapons scientist A.Q. Khan proliferated detailed design information about a nuclear bomb.¹⁶⁸ The weapon was the Chic-4, the first Chinese missile delivered nuclear weapon.¹⁶⁹ China’s involvement in the proliferation of nuclear weapons is well documented in a book by former Secretary of the Air Force Thomas C. Reed and former head of intelligence at LANL Danny B. Stillman.¹⁷⁰

Since 2006, North Korea has tested nuclear weapons and has developed a dangerous relationship with Russia, China and Iran. In the future, it could be testing nuclear weapons for any of these regimes. Indeed, there are reports that this has happened with regard to Iran.¹⁷¹ In 2012, the journal *Nature* reported, “North Korea may have conducted two covert nuclear weapons tests in 2010 [with yields of 50-200 tons of TNT], according to a fresh analysis of radioisotope

¹⁶⁷ Clinton, “Letter of Transmittal,” op. cit., p. IV.

¹⁶⁸ “A. Q. Khan Physicist/Pakistan” *Nuclear Museum.org*, no date, available at <https://ahf.nuclearmuseum.org/ahf/profile/q-khan/>.

¹⁶⁹ David E. Sanger and William J. Broad, “Officials Fear Bomb Design Went to Others,” *The New York Times*, June 16, 2008, available at http://www.nytimes.com/2008/06/16/world/asia/16nuke.html?page_wanted=all.

¹⁷⁰ Thomas C. Reed and Danny B. Stillman, *The Nuclear Express – A Political History of the Bomb and Its Proliferation* (Minneapolis, MN: Zenith Press. 2009).

¹⁷¹ Mark B. Schneider, “Has Iran Covertly Acquired Nuclear Weapons?,” *Comparative Strategy*, Vol. 32, No. 4, September 2013, pp. 308-312, available at <http://www.tandfonline.com/loi/ucst20>.

data.”¹⁷² Hans Rühle, who from 1982–1988 headed the German Defense Ministry’s planning staff, has stated that, “Several intelligence services believe that at least one of them was commissioned by Iran.”¹⁷³ *The Wall Street Journal* reported that Obama Administration officials believed that a September 2012 agreement between North Korea and Iran could involve cooperation in both ballistic missiles and nuclear programs. The agreement was reportedly similar to the agreement between North Korea and Syria that was related to the development of nuclear weapons.¹⁷⁴

Neither the CTBT nor the Nonproliferation Treaty (NPT) will prevent nuclear proliferation. Nations have developed nuclear weapons without testing them. Israel is believed to have covertly developed and built nuclear weapons.¹⁷⁵ The Republic of South Africa developed and stockpiled nuclear weapons (gun-type bombs) while thought to be in compliance with the NPT.¹⁷⁶ The Central Intelligence Agency assessed that North Korea had built

¹⁷² Geoff Brumfiel, “Isotopes Hint at North Korean Nuclear Test,” *Nature*, February 3, 2012, available at <http://www.nature.com/news/isotopes-hint-at-north-korean-nuclear-test-1.9972>.

¹⁷³ “German Expert Suggests Iran Tested Nuclear Bomb in North Korea in 2010,” *BBC Monitoring International Reports*, March 7, 2012, available at <http://www.accessmylibrary.com/article-1G1-282411462/german-expert-suggests-iran.html>.

¹⁷⁴ Hay Solomon, “Iran-North Korea Pact Draws Concern,” *The Wall Street Journal*, March 8, 2013, available at <http://online.wsj.com/article/SB10001424127887323628804578348640295282274.html>.

¹⁷⁵ “Israel’s Nuclear Inventory,” Center for Arms Control and Proliferation, no date, available at <https://armscontrolcenter.org/wp-content/uploads/2020/03/Israel.pdf>.

¹⁷⁶ David Albright, “South Africa’s Secret Nuclear Weapons,” *ISIS Report*, May 1994, available at <https://isis-online.org/publications/southafrica/ir0594.html>.

two nuclear weapons by January 2003,¹⁷⁷ years before its first test in 2006. Pakistan staged a nuclear test only slightly more than two weeks after India resumed nuclear testing.¹⁷⁸ Hence, it had them well prior to the test.

The ideologically driven dictatorships will not operate under U.S. safety restrictions. This makes it much easier for them to develop nuclear weapons without testing them, or with minimal testing.

Nuclear weapons developed without nuclear testing and without U.S.-style safety constraints, will not be nearly as sophisticated, as small, as light and as safe as American nuclear weapons but they will still likely be robust, lethal and deliverable by a variety of existing ballistic missiles.

Absent stringent U.S. safety requirements, it is much easier to develop nuclear weapons without testing them. Without U.S.-mandated one-point safety, robustness can always be increased by adding more fissile material and/or high explosives to a fission bomb or a thermonuclear primary. For example, in 1954, before the development of the concept of one-point safe nuclear weapons, Dr. Foster and his team had concerns about whether a new device would work. Ramos writes, the usual procedure was to "...add a small amount of plutonium."¹⁷⁹ Under the one-point safe restriction, this generally cannot be done.¹⁸⁰ One-

¹⁷⁷ "North said to have 2 nuclear weapons," *Korea JoongAng Daily*, January 5, 2003, available at <https://koreajoongangdaily.joins.com/2003/01/05/socialAffairs/North-said-to-have-2-nuclear-weapons/1901441.html>.

¹⁷⁸ Jonathan Medalia and Dianne Rennack, "India-Pakistan Nuclear Tests and U.S. Response." Congressional Research Service, November 24, 1998, available at https://www.everycrsreport.com/files/19981124_98-570_6ba82961282f5bb2b429282bbb444eeda17df798.pdf.

¹⁷⁹ Ramos, *Call me Johnny*, op. cit., p. 34.

¹⁸⁰ Dan Stillman, "Inside China's Nuclear Weapons Program" (Boston: Massachusetts Institute of Technology, October 10, 2001), available at https://web.mit.edu/SSP/seminars/wed_archives01fall/stillman.htm.

point safety limits the amount of fissile material and high explosive that is possible in the primary, which in turn limits robustness. (Absent a significant nuclear pit production capability, which the United States lacks, this is not even theoretically possible.) Hence, a nuclear testing prohibition favors the world's most irresponsible and dangerous nuclear-armed states. In the 1990s, Chinese nuclear weapons scientists admitted in a conversation with Danny B. Stillman, the retired Chief of Intelligence at LANL, that Chinese weapons were not one-point safe.¹⁸¹

U.S. non-proliferation policy is significantly flawed. It does not distinguish between friendly, hostile or even rogue states. Indeed, former President Clinton recognized the contribution of his non-proliferation policy to the current Russian war against Ukraine. He stated, "I feel a personal stake because I got them [Ukraine] to agree to give up their nuclear weapons. And none of them believe that Russia would have pulled this stunt if Ukraine still had their weapons."¹⁸²

Self-Denial of a Nuclear Golden Dome

As part of President Ronald Reagan's Strategic Defense Initiative, the United States developed a nuclear bomb-pumped X-ray laser in a project called Excalibur.¹⁸³ Writing in *The New York Times*, Michael Gordon said, "Code-named Greenwater, the test had been in the works for years and had been preceded by other tests of the X-ray laser concept.

¹⁸¹ Ibid.

¹⁸² Anastasiya Gordiychuk, "Clinton regrets persuading Ukraine to denuclearize in 1994," *Kyiv Independent.com*, April 5, 2023, available at <https://kyivindependent.com/clinton-regrets-persuading-ukraine-to-denuclearize-in-1994/>.

¹⁸³ Ramos, *From Berkeley to Berlin*, op. cit., p. 255.

Tens of millions of dollars have been spent on the test, which was to have been carried out in September [1992].”¹⁸⁴

Since the cancelled test was never conducted and there were no follow-on tests to improve the device, it is impossible to know how effective it would have been. However, the nuclear bomb-pumped X-ray laser is potentially the most effective ballistic missile defense system ever conceived. An article published by the *BBC* observed, “Project Excalibur was, in theory, capable of protecting against a large-scale nuclear attack from the Soviet Union.”¹⁸⁵

There is no reason that U.S. adversaries cannot develop this type of weapon if they engage in high-yield nuclear testing. In March 2023, Putin hinted Russia might resume nuclear testing.¹⁸⁶ Russia’s envoy to the United Nations in Vienna stated that, “*Never say never. Tests may resume under certain circumstances.*” (Emphasis in the original.)¹⁸⁷ In April 2025, Russian Security Council Secretary Sergey Shoigu repeated the Russian position on resumed nuclear testing.¹⁸⁸

¹⁸⁴ Michael R. Gordon, “‘Star Wars’ X-Ray Laser Weapon Dies as Its Final Test Is Canceled,” *The New York Times*, July 21, 1992, available at <https://www.nytimes.com/1992/07/21/us/star-wars-x-ray-laser-weapon-dies-as-its-final-test-is-canceled.html>.

¹⁸⁵ Sharon Weinberger, “The most outlandish ideas for missile defence systems,” *BBC*, August 5, 2013, available at <https://www.bbc.com/future/article/20130805-rise-and-fall-of-missile-defences>.

¹⁸⁶ William Courtney, “Putin Could Escalate with Nuclear Testing,” *RAND*, March 6, 2023, available at <https://www.rand.org/pubs/commentary/2023/03/putin-could-escalate-with-nuclear-testing.html>.

¹⁸⁷ “US conducts underground explosion at nuclear test site,” *RT*, October 20, 2023, available at <https://www.rt.com/news/585390-us-underground-explosion-nevada/>.

¹⁸⁸ Ileana Ferrer Fonte, “Russia to resume nuclear tests in response to US actions,” *Prensa Latina*, April 24, 2025, available at <https://dialog.proquest.com/professional/professionalnewsstand/docview/3194107910/fulltext..19696FC6D14/2.?>

At some point, China may do the same because preparation for testing has been reported.¹⁸⁹

The Asymmetric Impact of Resumed Russian and Chinese High-Yield Nuclear Testing

If Russia or China resumes overt high-yield nuclear testing, the United States will be caught flatfooted. Russia and China have experienced nuclear weapons designers; the United States does not. The situation will be much worse than it was in 1961. In 1961, Dr. Foster was able to resume nuclear testing in two weeks.¹⁹⁰ Today, the United States probably could not do it in two years.¹⁹¹ Moreover, arms control enthusiasts will work to block any U.S. nuclear tests in response to Russian or Chinese restarting of high-yield testing.

The Costs of Nuclear Weapons Under Stockpile Stewardship – Mandated Inefficiency

Stockpile stewardship is inherently costly and less effective than even minimal nuclear testing. It involves protracted and costly efforts to squeeze more certainty from inadequate substitutes for nuclear testing. Life-extension

¹⁸⁹ William J. Broad, Chris Buckley and Jonathan Corum, “China Quietly Rebuilds Secretive Base for Nuclear Tests,” *The New York Times*, December 20, 2023, available at <https://www.nytimes.com/interactive/2023/12/20/science/chinanuclear-tests-lop-nur.html>.

¹⁹⁰ Ramos, *Call Me Johnny*, op. cit., p. 30.

¹⁹¹ Scheber and Harvey, *Assessment of U.S. Readiness to Design, Develop and Produce Nuclear Warheads: Current Status and Some Remedial Steps*, op. cit.

programs should be relatively simple, prompt and inexpensive. Instead, due to stockpile stewardship, they are of long duration and are expensive. For example, Scheber has pointed out that the W76 life extension program “...took 11 years to complete and was fraught with difficulties.”¹⁹² It was also expensive.

The increased cost of SBSS is very important. As illustrated in the following chart, U.S. defense expenditures in the post-Cold War era dramatically declined.¹⁹³

Defense Spending as a % of Gross Domestic Product (GDP)



Source: National Defense Budget Estimates for FY 2019 (Table 6-13); historical and projected GDP from both the FY 2019 and FY 2020 Budget of the United States Government.

DOD funding is near a record low as a percentage of our economy

¹⁹² “An Interview with Thomas Scheber, former Director of Strike Policy and Integration, Office of the Secretary of Defense,” *op. cit.*, p. 102.

¹⁹³ U.S. Department of Defense, “Defense Spending as a % of GDP,” 2023, available at <https://www.defense.gov/Multimedia/Photos/igphoto/2002099941/>.

Even with the proposed Trump Administration defense spending increases, U.S. defense spending represents a substantially lower percentage of the U.S. gross national product than at any time since the start of the Korean War. Moreover, since 9/11, the United States has been engaged in continuous military operations that have eaten up a great deal of the defense budget. The United States faces a large deficit resulting from increased non-defense spending. At this time, the United States cannot afford ideologically driven inefficiency.

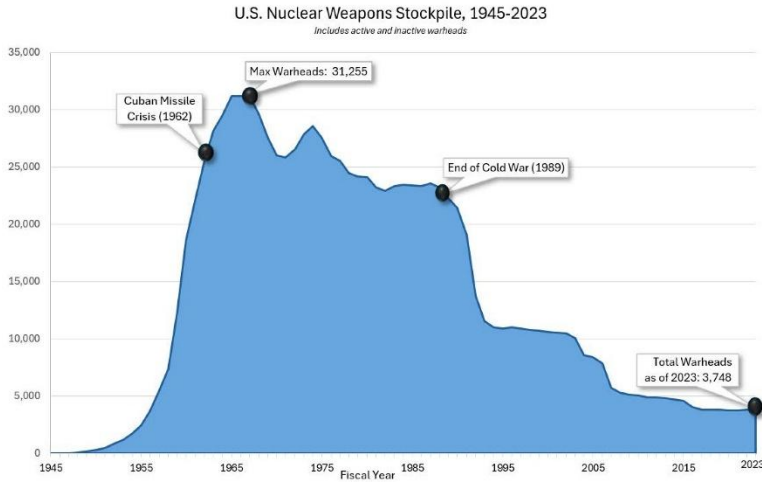
Compared to nuclear testing, SBSS is a far more costly and a much less effective way to maintain a viable nuclear deterrent. In 1999, the late Dr. Robert Barker, a former Assistant to the Secretary of Defense (Atomic Energy), stated in the CTBT hearings that “....the Stockpile Stewardship Plan is not now, and never will be—even ten years from now when its major components might be operational—a ‘substitute’ for nuclear testing in the sense of giving us equal confidence in the safety and reliability of our nuclear weapons.”¹⁹⁴ The enormous cost of stockpile stewardship is driving downward the types of nuclear weapons in the U.S. stockpile, which is increasing the risk of a catastrophic impact from an inadvertently stockpiled dud.

During and just after the 1958-1961 testing moratorium, the United States had many new types of nuclear weapons that had been fully tested, along with highly experienced nuclear weapons designers and a large and fully functional nuclear weapons production complex. Indeed, as illustrated by the following chart released by the Department of Energy,¹⁹⁵ during the testing moratorium, and in the years

¹⁹⁴ “Statement by Dr. Robert B. Barker Before the Senate Armed Services Committee, Thursday, October 7, 1999,” *op. cit.*

¹⁹⁵ U.S. Department of Energy, “Transparency in the U.S. Nuclear Weapons Stockpile” (Washington, D.C.: Department of Energy, no

immediately after it, the United States produced thousands of nuclear weapons every year.



Thus, the problems exposed by resumed nuclear testing post-moratorium could be and were rapidly fixed. Indeed, in the early 1960s, the United States had more than the necessary capability to replicate the *entire current* U.S. nuclear arsenal in less than a year.¹⁹⁶ Russia still does. In 2019, then-Director of the Defense Intelligence Agency Lieutenant General Robert P. Ashley, Jr., said that, “In contrast to the United States, during the past decade, Russia has improved and expanded its production complex, which has the capacity to process thousands of [nuclear] warheads

date), available at <https://www.energy.gov/nnsa/transparency-us-nuclear-weapons-stockpile>.

¹⁹⁶ National U.S. Security Administration, “Transparency in the U.S. Nuclear Weapons Stockpile,” 2023, available at https://www.energy.gov/sites/default/files/2024-08/U.S.%20Nuclear%20Weapons%20Stockpile%20Transparency%207_22_24.pdf.

annually.”¹⁹⁷ Today, the United States has no such capability.

In 2017, according to Dr. Hopkins and Dr. Sharp, the United States could “...remanufacture weapons in only very small numbers.”¹⁹⁸ In 2022, Dr. George Miller, who served as Director of LLNL from 2006-2011, wrote, “Even today the U.S. production capability is woefully lacking and that which exists has limited capability. The U.S. has managed to execute a few modest life extension programs (LEPs), albeit over very long timescales.”¹⁹⁹ The U.S. nuclear weapons production complex “...lacks the flexibility or capacity to handle multiple problems at once.”²⁰⁰

In 2023, the United States reportedly produced only 200 nuclear weapons, the most in decades.²⁰¹ At 200 weapons a year, it would take over 18 years to replace the current U.S. nuclear stockpile, even assuming the United States could produce a sufficient number of new nuclear pits to accomplish this objective. Hence, the U.S. ability to fix detected problems promptly has been drastically reduced at a time when the nuclear threat is rapidly increasing.

Because of the scope of nuclear production capabilities in the early 1960s, the United States was able to fix problems

¹⁹⁷ Lieutenant General Robert P. Ashley, Jr., “Russian and Chinese Nuclear Modernization Trends, Remarks at the Hudson Institute,” Defense Intelligence Agency, May 29, 2019, available at <https://www.dia.mil/Articles/Speeches-and-Testimonies/Article/1859890/russian-and-chinese-nuclear-modernization-trends/>.

¹⁹⁸ Hopkins and Sharp, “The Scientific Foundation for Assessing the Nuclear Performance of Weapons in the US Stockpile Is Eroding,” op. cit.

¹⁹⁹ Miller, “Stockpile Stewardship: What Were We Thinking? How Did It Work Out?,” op. cit., p. 12.

²⁰⁰ Ibid., p. 15.

²⁰¹ David A. Hoagland, “Why the Nuclear Gravity Bomb Has Gotten a Reboot,” *War on the Rocks*, May 20, 2025, available at <https://warontherocks.com/2025/05/why-the-nuclear-gravity-bomb-has-gotten-a-reboot/>.

in a short period of time once nuclear weapons testing resumed. Today, this would be clearly impossible under the SBSS approach without nuclear testing and without fixing the problems with the U.S. nuclear weapons production complex.

From its inception, SBSS was linked to an equally dangerous concept—no improvements in U.S. nuclear capability. U.S. adversaries are not limited in this way and they are improving and testing nuclear weapons. The “no improvements” mentality will, in the long run, result in Russia and China, and possibly others, having superior nuclear weapons technology. The Russians have already demonstrated this with some of their novel systems.²⁰²

Under stockpile stewardship, the development time for the W93, the first new U.S. nuclear weapon in several decades, is taking 20 years. It was begun by the first Trump Administration in 2020 and will not be operational until 2040.²⁰³ This is a ridiculously long time to develop a nuclear weapon that is not even pushing technology forward. According to the National Nuclear Security Administration, “Key nuclear components [of the W93] will be based on currently deployed and previously tested nuclear designs and extensive stockpile component and materials experience.”²⁰⁴ This sounds like a weapon that could have been developed and deployed 40 years ago. By the time the

²⁰² Schneider, “The Future of the U.S. Nuclear Deterrent,” op. cit., pp. 345-360.

²⁰³ Aaron Mehta, “Inside America’s newly revealed nuclear ballistic missile warhead of the future,” *Defense News.com*, February 24, 2020, available at <https://www.defensenews.com/smr/nuclear-arsenal/2020/02/24/inside-americas-newly-revealed-nuclear-ballistic-missile-warhead-of-the-future/>.

²⁰⁴ National Nuclear Security Administration, “Management Plan—Biennial Plan Summary-Report to Congress, September 2024,” 2025, pp. 1-7, available at <https://www.energy.gov/sites/default/files/2024-10/FY2025%20Stockpile%20Stewardship%20and%20Management%20Plan.pdf>.

W93 is deployed, the warheads it will replace will have been in service for half a century.²⁰⁵ They were never designed for such a long service life.

The Livermore National Laboratory published a tribute to Dan Patterson, one of “The Giants of the Nuclear Testing Era,” which reviewed his career.²⁰⁶ In the 20-year period from 1965 to 1985, the same amount of time that W93 development will take, Patterson contributed to the design of the first two MIRV warheads, the W62 (Minuteman III) and the W68 (Poseidon), both major improvements over previous designs. In the early 1970s, he developed the warhead for the Spartan ABM which enhanced X-ray output while suppressing effects that could degrade the performance of ABM radars. He moved on to develop the Mark 500, an evader multiple warhead designed to penetrate advanced missile defense systems. Peterson also developed the W87 warhead (for the Peacekeeper and later the Minuteman III), which enhanced safety by using insensitive high explosive.

Robert Clough, another of “The Giants of the Nuclear Testing Era,” worked on development of the W62, W68, and B77 (later the B83) and, as Deputy Associate Director for the Weaponization Program had responsibility for the W79 (the Short-Range Attack Missile), W84 (the Ground-Launched Cruise Missile), and the W87 warhead.²⁰⁷ Development of

²⁰⁵ Linton F. Brooks, Franklin C. Miller, and John R. Harvey, “The W93 SLBM Warhead Will Deter America And Britain’s Enemies,” *The National Interest*, May 17, 2020, available at <https://nationalinterest.org/blog/reboot/w93-slbm-warhead-will-deter-america-and-britains-enemies-154726>.

²⁰⁶ Lawrence Livermore National Laboratory, “The Giants of the Nuclear Testing Era – A Series of Notebooks from the Pioneers – The Works of Dan Patterson,” no date, pp. 5-9, available at https://sd.llnl.gov/sites/sd/files/2022-10/giants-notebook_vol2_dan-patterson_spread-mobile.pdf.

²⁰⁷ Lawrence Livermore National Laboratory, “The Giants of the Nuclear Testing Era – A Series of Notebooks from the Pioneers – The

these systems was relatively prompt and efficient. Thus, under SBSS, the time it takes to develop new nuclear systems has increased tremendously, which also increases costs.

Dr. Foster described his approach to nuclear weapons development as follows: "Take a big enough step so that things get a little radical. Don't look so far ahead you really don't know what you are talking about. But don't look so close in the future that you are putting existing pieces together."²⁰⁸ The W93 sounds like a warhead that involves "putting existing pieces together." This is the only thing the United States can do under its very stringent safety requirements and a prohibition on nuclear testing.

By comparison, when the United States was testing, by 1956, only 11 years after the first test of the World War II 10,000-pound Fat Man nuclear bomb, Dr. Foster and his team had developed a 60-pound nuclear device with a higher yield than the Fat Man.²⁰⁹ Nothing like this could possibly happen under the current stockpile stewardship approach.

Dr. John Foster and his team developed the W47 Polaris missile warhead, a revolutionary improvement in nuclear weapons performance, in four years; the Polaris missile system was deployed within five years.²¹⁰ At the same time, the LLNL developed the advanced W59 warhead for the Minuteman ICBM.²¹¹ It had no reported post-moratorium problems.

The weight of the entire Polaris reentry vehicle, including its warhead, was only 850 pounds, less than a

Works of Robert Clough, no date, pp. 5-9, available at https://sd.llnl.gov/sites/sd/files/2024-02/giants-notebook_vol3_robert-clough_spread-mobile.pdf.

²⁰⁸ Ramos, *Call Me Johnny*, op. cit., p. 32.

²⁰⁹ Ramos, *From Berkeley to Berlin*, op. cit., p. 174.

²¹⁰ Ibid., op. cit., p. 200.

²¹¹ Ramos, *Call Me Johnny*, op. cit., p. 32.

third of the Atlas missile warhead (which became operational in 1959), the first U.S. ICBM.²¹² The Atlas warhead itself was a major improvement over nuclear weapons developed only two years earlier.

The size and weight reduction in nuclear weapons saved countless billions of dollars in the cost of delivery vehicles. In current dollars, the savings would probably be an order of magnitude higher.

Increasing development time from a few years (almost always fewer than 10) to 20 years *must result in a comparable increase in costs* not even considering inflation over such an extended timeframe. The main reason for this is the prohibition on nuclear testing. When the National Laboratories could test, they were always developing several often revolutionary nuclear weapons at any given time. At the end of the Cold War, the United States had 26 types of nuclear weapons.²¹³ Stockpile stewardship is reducing this to four types. Hence, the impact of inadvertently stockpiling a dud would be far greater today than it was from 1958 to 1961.

The nearly endless and costly efforts to certify nuclear pits (the fissile material component of a nuclear weapon) without nuclear testing is a self-inflicted wound. Just over 20 years ago this author asked the late Dr. Robinson how long it took to certify a pit when we were testing nuclear weapons? He replied, "A few weeks after the first test."

Under stockpile stewardship, the certification process has become a quasi-political exercise. In my last years before retirement, this author frequently represented the Office of the Secretary of Defense for Policy on the Nuclear Weapons Council Standing and Safety Committee and was struck by the difference between the detailed technical reports about

²¹² Ramos, *From Berkeley to Berlin*, op. cit., p. 182.

²¹³ "U.S. Nuclear Weapon Enduring Stockpile," Nuclear Weapon Archive.org, August 31, 2007, available at <https://nuclearweaponarchive.org/Usa/Weapons/Wpngall.htm.l>.

the weapons and the sugarcoated version that eventually went to the President. Whether U.S. nuclear weapons work depends upon physics, not whether the Secretary of Energy and the Secretary of Defense sign a piece of paper saying that they do.

The impact of stockpile stewardship at the National Laboratories has been deleterious. At the beginning, essentially all of the designers recognized the risks involved. Most still do. After three decades of stockpile stewardship, some seem to believe that the current process is normal. Vested interests have developed at the labs. For example, the National Ignition Facility, a very expensive laser fusion testing device with a three-billion dollar annual budget, is being presented as a substitute for nuclear testing.²¹⁴ It is not.

According to Dr. Miller, "NIF [National Ignition Facility] was controversial within the community due to competing capabilities at other institutions, the cost of the facility, and differing judgments on the importance of the physics that could be investigated at NIF."²¹⁵ He also noted that the project cost significantly more than originally planned.²¹⁶ Eventually, all the laboratory directors approved the project probably because the politics of the time allowed nothing better.

Certainly, increased understanding of fusion ignition is important but it is related more to the development of fusion power than nuclear weapons. The termination in 1998 of all U.S. efforts to achieve fusion ignition through the use of high-explosive compression in a pure fusion weapon

²¹⁴ Liz Landers, "How a lab in California is ensuring the effectiveness of US nuclear Weapons," *Kpax.com*, April 11, 2025, available at <https://www.kpax.com/science-and-tech/how-a-lab-in-california-is-ensuring-the-effectiveness-of-us-nuclear-weapons>.

²¹⁵ Miller, "Stockpile Stewardship: What Were We Thinking? How Did It Work Out?," *op. cit.*, p. 9.

²¹⁶ *Ibid.*

is foolish indeed. This program could have been continued at minimal expense compared to the cost of the NIF. No one can say if this effort would have been successful, but it took 24 years after the termination of this program for the laser fusion effort to achieve ignition. Without a doubt, the design of a pure fusion device would be much more similar to a standard thermonuclear weapon primary than is the NIF.

The laser fusion effort has provided more evidence that simulations often do not work. In 2017, Dr. Sharp and Dr. Merri M. Wood-Schultz (a nuclear physicist at LANL) wrote that the laser fusion effort, "For most of its duration...utilized simulations and partial-system experiments at several facilities...."²¹⁷ The simulations were proven wrong when full scale laser fusion testing was initiated because of the "...failure to achieve fusion capsule ignition [which] was repeatedly and conclusively demonstrated in full-system experiments."²¹⁸ If these tests had not been conducted, there would have been no indication that the simulations were faulty. A successful laser fusion test (more energy out than in) was not achieved until 2022. When the Department of Energy announced this achievement it did not even mention nuclear weapons applications.²¹⁹

The laser fusion simulations were based upon the same understanding of the underlying science that was used in

²¹⁷ David H. Sharp, and Merri M. Wood-Schultz, "Stockpile stewardship in the light of national ignition campaign experience," *Comparative Strategy*, Volume 36, Issue 3, April 2017, available at <https://www.tandfonline.com/doi/abs/10.1080/01495933.2017.1338479?tab=permissions&scroll=top&role=tab&aria-labelledby=reprints-perm>.

²¹⁸ Ibid.

²¹⁹ U.S. Department of Energy, "Laboratory Makes History by Achieving Fusion Ignition," December 13, 2022, available at <https://www.energy.gov/articles/doe-national-laboratory-makes-history-achieving-fusion-ignition>.

the contemporary simulations of the life-extended U.S. nuclear weapons with their significant changes from the tested versions. While the failed laser fusion tests were conducted, there was no comparable testing of the nuclear weapons that were modified based upon the same understanding of the basic science of fusion.

In 2025, the National Nuclear Security Administration announced that the National Ignition Facility had achieved a power output of 8.6+ megajoules.²²⁰ While an important accomplishment, this is about two kilograms of TNT, which is less than the one-point safety requirement that the United States applies to its nuclear weapons.

A better understanding of nuclear fusion initiation is certainly helpful, but it is not a substitute for nuclear weapons testing. A laser fusion capsule in no way simulates a standard thermonuclear weapon. There is little similarity between the small pellet of tritium and the design of a nuclear weapon. The processes that occur in the primary of a thermonuclear weapon are much more complex and difficult to model. Even Dr. Richard Garwin, who for decades opposed nuclear testing, admitted that it would be "...a mistake to assume that NIF experiments are going to be directly relevant to weapons testing. The temperatures in the NIF chamber are much lower than they are in actual nuclear weapons, and the amounts of material being tested are much smaller."²²¹

The argument that laser fusion is comparable to testing a nuclear weapon is roughly comparable to arguing that

²²⁰ "Testimony Statement of Teresa Robbins," House Armed Services Committee Subcommittee on Strategic Forces, May 7, 2025, p. 2, available at https://armedservices.house.gov/uploadedfiles/nnsa_hasc-sf_2026_budget_testimony.pdf.

²²¹ Bill Sweet, "National Ignition Facility: Mother of All Boondoggles?," *IEEE Spectrum*, October 5, 2012, available at <https://spectrum.ieee.org/national-ignition-facility-mother-of-all-boondoggles>.

anti-tank weapons could be developed by exclusively testing firecrackers. Even taking into account the startup costs of resumed nuclear testing, one year's cost of operating the laser fusion facility would assure the safety and effectiveness of the U.S. nuclear stockpile and even allow for the development of new and improved nuclear weapons in a fraction of the time and at much less expense than currently planned.

The Opposition to Resumed Nuclear Testing

The strongest opposition to resumed nuclear testing comes mainly from the Minimum Deterrence advocacy community and pacifist groups who seek to reduce substantially the U.S. nuclear deterrent because they do not believe that there is a serious nuclear threat and that deterrence is "existential" and reliable. Minimum deterrence is often linked to the unrealistic and dangerous goal of "global zero." Hence, they often appear to be relatively unconcerned about declining weapons reliability.

Opponents of resumed U.S. nuclear testing universally ignore: 1) that Russia and possibly China are assessed by the Department of State to have been conducting low-yield nuclear tests (reportedly for decades); 2) that the military advantages from these covert nuclear tests are considerable; 3) the fact that zero-yield prohibits one-point safety tests of U.S. nuclear weapons; 4) the serious potential for an asymmetric decline in nuclear weapons reliability; and 5) that the high costs of stockpile stewardship, and the resulting decline in the types of U.S. nuclear weapons, increases the impact of an inadvertently stockpiled nuclear dud, which could be catastrophic – possibly resulting in the loss of an entire leg of the U.S. nuclear Triad in the 2040s. They assert the success of the stockpile stewardship program, which is uncertain.

The idea that U.S. restraint will impact what adversaries do is common among opponents of U.S. nuclear testing. For example, a religious pacifist group asserts that the “moratorium on nuclear testing...has prevented an arms race and strengthened global security.”²²² This belief was central to the Obama Administration’s 2010 NPR. In 2019, Vice Admiral Dave Kriete stated, “One of the assumptions made in the 2010 NPR was that Russia is our friend, and if the United States leads the world in reducing the roles or numbers of nuclear weapons, and their prominence in our national security policies, then the rest of the world would follow.”²²³

Ignoring the poor record of Russian compliance with nuclear testing treaties is common among opponents of resumed U.S. nuclear testing. Indeed, one nuclear testing opponent even asserted that the 1963 Limited Nuclear Test Ban Treaty (LTBT) “has never been violated.”²²⁴ As noted above, the Reagan Administration determined that Russia was violating the LTBT; since then, a great deal of additional evidence has been made public in Russia. The scope of Russian violations of the LTBT is greater than what was believed in the 1980s. The Russian Atomic Energy Ministry stated that the Soviet Union conducted hydronuclear tests on the earth’s surface. France continued atmospheric nuclear testing into the early 1970s. The Chinese did so until 1980. The significance of Russian post-CTBT nuclear testing was largely ignored by CTBT advocates.

²²² Shawn Adams, “The Case Against Nuclear Testing,” Friends Committee on National Legislation, April 28, 2025, available at <https://www.fcnl.org/updates/2025-04/case-against-nuclear-testing>.

²²³ Maria Gallucci, “US Nuclear Weapons Expert on Low-Yield Warheads, Stockpile Stewardship, and Plutonium Pit Production,” *IEEE Spectrum*, May 29, 2019, available at <https://spectrum.ieee.org/a-qa-with-us-nuclear-weapons-expert>.

²²⁴ Christie Brinkley, “Don’t let the US resume nuclear weapon tests that ended decades ago,” *The Kansas City Star*, March 3, 2025, available at <https://www.miamiherald.com/article301178769.html>.

A small number of opponents of nuclear testing recognize the existence of a substantial nuclear threat to the United States. According to a Stimson Center publication authored by David Kenneth Smith:

The United States faces escalating global nuclear threats, with multiple nuclear-armed states modernizing arsenals, testing cutting-edged delivery systems, including ballistic and hypersonic missiles, and signaling readiness to cross historic red lines relative to the use of nuclear weapons. Amidst this volatility, proposals for the incoming Trump administration to resume US underground nuclear testing risk undermining decades of international restraint that rendered such tests a global anathema. Resuming nuclear testing by the United States is unnecessary and destabilizing. A return to nuclear testing will weaken established international norms, to include a test ban, and set an uncertain course that brings the world closer to the catastrophic use of these weapons. Proliferators will take their cues from any decision by the United States. Further testing would only incrementally provide new information not already available from comprehensive laboratory studies and simulations. The current moratorium on nuclear testing by the United States is a critical pillar of global nuclear restraint.²²⁵

This recognition of the existence of a serious nuclear threat to the United States is unusual among opponents of nuclear testing. Smith provides the standard assertions

²²⁵ David Kenneth Smith, "The Chapter on US Nuclear Testing Must be Closed," The Stimson Center, January 15, 2025, [ps://www.stimson.org/2025/the-chapter-on-us-nuclear-testing-must-be-closed/](https://www.stimson.org/2025/the-chapter-on-us-nuclear-testing-must-be-closed/).

concerning the effectiveness of stockpile stewardship: "A combination of studies of materials used in nuclear weapons at extreme conditions, subcritical experiments that study the effects of special nuclear materials in the presence of high explosives, high fidelity three-dimensional computer simulations of weapons performance using new data as well as data archived from the earlier atmospheric and underground tests provides necessary confidence in the effectiveness of the US nuclear deterrent."²²⁶ As Dr. Hopkins and Dr. Sharp have pointed out, none of these can prove that U.S. life extended nuclear weapons actually work. No nuclear weapon designed or modified on the basis of three-dimensional simulations has ever been explosively tested. As former Director of LLNL Michael May once observed, the risk is that inexperienced designers develop misplaced confidence in their calculations and themselves.²²⁷ To some extent this may already have happened.

Smith's assessment represents a substantial disconnect between a reasonable assessment of the growing nuclear threat and the proposed solution to the problem—"established international norms." This is actually common in the Minimum Deterrence advocacy community. The problem is that "international norms" do not protect against the threat posed by nuclear-armed dictators and rogue states.

The suggestion that proliferators will take their cues from any decision by the United States is not credible. This conclusion stems from the traditional Minimum Deterrence argument that the United States drives the arms race. The reality is very different. Restraint by the United States is not matched by adversaries. Former Secretary of Defense Dr. Harold Brown once observed, "Soviet spending has shown

²²⁶ Ibid.

²²⁷ Miller, "Stockpile Stewardship: What Were We Thinking? How Did It Work Out?," *op. cit.*, p. 17.

no response to U.S. restraint — when we build, they build; when we cut, they build.”²²⁸ Vice Admiral Kriete observed that after the 2010 *Nuclear Posture Review*, the nations that potentially threaten the United States did not match U.S. restraint but rather “did exactly the opposite.”²²⁹ Even the Biden Administration finally recognized that the United States faces a rapidly expanding nuclear threat and that the United States may need to increase its nuclear weapons to deal with it.²³⁰

Some of the arguments presented by opponents of nuclear testing are emotional and invalid. For example, one opponent of resumed nuclear testing declared, “We can’t endanger our children again.”²³¹ The implicit equating of underground nuclear tests — particularly in the way the United States would conduct them — with high-yield atmospheric nuclear tests is fallacious. Well-conducted underground nuclear tests do not represent a health threat.

A study in 2021 authored by Michael Frankel, James Scouras, and George Ullrich is of much higher quality than the other literature opposing U.S. nuclear testing. The

²²⁸ Michaela Dodge, “History Shows U.S. Nuclear Restraint is a One-Way Street,” *War on the Rocks*, November 18, 2020, available at <https://warontherocks.com/2020/11/history-shows-u-s-nuclear-restraint-is-a-one-way-street/>.

²²⁹ Gallucci, “US Nuclear Weapons Expert on Low-Yield Warheads, Stockpile Stewardship, and Plutonium Pit Production,” op. cit.

²³⁰ Department of Defense, “Report on the Nuclear Employment Strategy of the United States,” Department of Defense, November 2024, p. 1, available at

<https://media.defense.gov/2024/Nov/15/2003584623/-1/-1/1/REPORT-ON-THE-NUCLEAR-EMPLOYMENT-STRATEGY-OF-THE-UNITED-STATES.PDF>; Vaddi, “Adapting the U.S. Approach to Arms Control and Nonproliferation to a New Era,” op. cit.; and, “Remarks by Acting Assistant Secretary of Defense for Space Policy Dr. Vipin Narang at CSIS,” op. cit.

²³¹ Brinkley, “Don’t let the US resume nuclear weapon tests that ended decades ago,” op. cit.

authors acknowledge the United States faces a serious nuclear threat, but, nonetheless, conclude that:

We are not persuaded that stockpile maintenance needs nuclear testing at this time, and while it well might at some point in the future, it is difficult to predict when that might be. Similarly, while we support the development of low-yield nuclear weapons, simpler designs (or those previously tested but not weaponized) likely can be developed without testing, and even specialized new designs would have no need to be tested for years. Finally, we believe that the ambiguity in definitions of zero yield do not seem exploitable to achieve military advantage.²³²

Their reasons for opposing resumed U.S. nuclear testing are:

- Other states would inevitably also resume testing, making the world more dangerous.
- U.S. nonproliferation leadership would be undermined, condemnation by the rest of the world provoked, and U.S. bipartisan support for nuclear policy threatened.²³³

This author believes that their analysis understates the uncertainty concerning the effectiveness of SBSS, the potential for asymmetric reduction in reliability and the very high costs associated with this approach. High cost is driving down the number of U.S. nuclear weapons types and increasing the potential impact of an inadvertent dud.

²³² Michael Frankel, James Scouras and George Ullrich, *Tickling the Sleeping Dragon's Tail Should We Resume Nuclear Testing?* (Baltimore, MD: Johns Hopkins, 2021), p. viii, available at <https://www.jhuapl.edu/sites/default/files/2022-12/DragonsTail.pdf>.

²³³ Ibid.

Frankel, Scouras and Ullrich also understate the potential asymmetric impact of low-yield Russian and Chinese nuclear testing. This includes the possibility that these tests are of a much higher yield than simple hydronuclear tests.

The available evidence suggests that at some point Russia and China will resume high-yield nuclear testing or that they may have North Korea test the weapons for them. If so, the United States would very likely be caught flatfooted. When he was working at the Pentagon, Dr. Ullrich, who was a very well-respected senior official, said that "Stewardship was for Wine not Weapons." He was correct.

Why the United States Must Test

Nuclear deterrence underpins U.S. national security. Moreover, the U.S. nuclear deterrent is essential to the security of the entire free world. The United States provides the lion's share of the extended nuclear deterrent that protects its friends and allies in Europe and Asia. Without it, there is a significant chance that one or more nuclear-armed adversaries will actually use nuclear weapons, as they frequently threaten to do. There is also the risk that these regimes will use chemical or biological weapons, for which the United States has no in-kind deterrent.

The legacy Biden Administration program of record will reduce the U.S. nuclear deterrent to only four weapons types in the 2040s. Thus, the failure of even a single weapons type could eliminate an entire leg of the U.S. nuclear Triad, including the critically important submarine-launched ballistic missile force. The limited U.S. nuclear weapons production complex could not *quickly* fix such a problem even with resumed nuclear testing. It will be dwarfed by the nuclear production capabilities of Russia and China, and the much smaller but growing capabilities of North Korea.

The impact of covert nuclear testing by Russia and China and overt nuclear testing by North Korea is creating a serious potential asymmetry in reliability. In addition, U.S. adversaries will have an increasing advantage in advanced nuclear weapons technology simply because the United States is not developing such weapons while U.S. adversaries are. More than 30 years of improvement in Russian, Chinese and North Korean nuclear weapons supported by covert and overt nuclear testing has created a situation in which there is no in-kind deterrent to many nuclear threats. The situation will become worse with the passage of time unless the United States changes its policy with regard to nuclear deterrence, improvement of nuclear weapons and nuclear testing.

In light of the large decline in U.S. military spending since the end of the Cold War, and the even greater reduction in U.S. nuclear weapons, the high cost of stockpile stewardship is not acceptable.

The resumption of nuclear testing would substantially enhance confidence in the much diminished U.S. nuclear deterrent. It could significantly reduce the asymmetries that have developed as a result of covert adversary nuclear testing, which apparently has been going on since the 1990s, and the large asymmetries in modernization programs.

In short, nuclear testing is necessary to: 1) ensure the deterrent is effective and responsive to negative changes in the overall strategic environment; 2) respond to unanticipated breakout by adversaries that require new U.S. capabilities; 3) correct technical problems resulting from original design flaws and those that develop due to aging, which could impact reliability in a significant way; and 4) substantially reduce costs.

The time to act is now. The United States still has two-to-three types of nuclear weapons available for each leg of the nuclear Triad. In addition, there are several older versions of the B61 that can still be delivered. Hence, the

United States is still able to respond to a discovered warhead failure. If a serious defect in a modified or life-extended warhead is discovered it will be bad but it will not mean the loss of an entire leg of the Triad.

If the United States does not resume nuclear testing soon, this situation will rapidly get worse. The availability of the older version of the B61 will decline. The Biden Administration's program would get rid of the B83, which appears to be the most reliable weapon in the U.S. inventory. There is a striking lack of reported reliability problems with the B83, although like all nuclear weapons it will have to be life extended.

The United States should promptly stage a nuclear test involving simultaneous low-yield detonation of the primaries of three of the life-extended warheads—one each of an ICBM, an SLBM and a bomber warhead. Depending upon the outcome, subsequent tests with improved instrumentation could include the remainder of warhead types in the U.S. nuclear stockpile. In the longer run, the United States needs to develop and test new warheads to deal with the rapidly increasing threat of advanced adversary low-yield and low-collateral damage nuclear weapons.

Conclusion

Maintaining an effective nuclear deterrent is essential. The absence of nuclear testing makes this more difficult, uncertain and costly. In 2022, Dr. Miller noted that, "There were plenty of risks even with nuclear testing."²³⁴ He also said that, "The biggest risk in my judgement is overconfidence of the current stockpile stewards who lack the experience of actually designing a warhead for the

²³⁴ Miller, "Stockpile Stewardship: What Were We Thinking? How Did It Work Out?," *op. cit.*, p. 17.

stockpile and the successes and failures of actual nuclear tests.”²³⁵ Beyond that, Dr. Miller observed that, “Numerous risks remain with respect to an assessment of whether the Stockpile Stewardship Program meets the country’s current needs, particularly as our peer adversaries continue to enhance their nuclear capabilities.”²³⁶

The combination of no nuclear weapons development and no nuclear testing for decades in the context of a rapidly increasing multipolar nuclear threat environment is dangerous.

If the United States or its allies were ever attacked with nuclear weapons, U.S. nuclear weapons need to be reliable, which is not assured by stockpile stewardship. The arrogant assertion that U.S. weapons designers know so much about the basic science that they do not need to test our weapons is an exercise in self-deception. This criterion is applied only to nuclear weapons. Congress demands every other weapons system be extensively tested.

Stockpile stewardship is a costly self-inflicted wound. In reality, it is an ideological rejection of the scientific method, which is ultimately based upon continuous testing. Despite the usual claims, there is no certainty about the reliability of the U.S. nuclear stockpile. The SBSS approach will at some point likely fail; the only question is how badly and when. Even if stockpile stewardship is successful, it will certainly be far more costly. It will result in U.S. adversaries obtaining a major nuclear advantage, not to mention the possibility they will exploit it.

Today, even if U.S. nuclear weapons work, the United States has an inadequate deterrent resulting from the age of its delivery vehicles, the lack of modernization of its nuclear forces and insufficient nuclear weapons numbers. Absent nuclear testing, the certification process is increasingly

²³⁵ Ibid.

²³⁶ Ibid., p. 18.

political in nature. The dangers are growing exponentially as more weapons are life extended with significant design changes without nuclear testing, and the numbers of weapons types are being reduced because of the high costs of stockpile stewardship. Under the current program, there will eventually be only one type of nuclear weapon on each of the legs of the Triad except for the bombers, which will have two. It would be difficult to maintain a nuclear deterrent Triad with the greater risks this situation portends. The current U.S. program will ultimately give Vladimir Putin and Xi Jinping large nuclear superiority and do so at an unnecessarily high cost to the United States.

About the Author

Dr. Mark B. Schneider is a Senior Analyst with the National Institute for Public Policy. He joined National Institute in September 2004 and specializes in missile defense policy, nuclear weapons, deterrence, strategic forces, and arms control issues.

Before his retirement from the Department of Defense, Dr. Schneider served in senior positions in the Office of the Secretary of Defense for Policy including, Principal Director for Forces Policy, Principal Director for Strategic Defense, Space and Verification Policy, Director for Strategic Arms Control Policy and Representative of the Secretary of Defense to the Nuclear Arms Control Implementation Commissions. He also served as a member of the State Department Policy Planning Staff, the Professional Staff of the Senate Select Committee on Intelligence, the Department of Energy, the Energy Research and Development Administration and the Atomic Energy Commission. Prior to his government career, Dr. Schneider served as a policy analyst with the Stanford Research Institute and taught at the University of Southern California.

Dr. Schneider served as a member of the DoD Compliance Review Group. He chaired several working groups of the START and INF Treaty Implementation Commissions (JCIC and SVC) in Geneva, negotiating many implementation agreements with the successor states of the former Soviet Union. He most recently served as Acting Chairman of the U.S.-Russia Working Group on Missile Defense.

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Dr. Schneider earned his Ph.D. in history at the University of Southern California and Juris Doctorate from George Washington University. He was admitted to the Bar of Washington, D.C. in 1977 and Maryland in 1978. He is the author of many articles on arms control, nuclear deterrence, strategic forces and intelligence issues.

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