NATIONAL INSTITUTE FOR PUBLIC POLICY

The Comprehensive Test Ban Treaty: An Update on the Debate

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Executive Summary

During the U.S. Senate's debate of the Comprehensive Test Ban Treaty (CTBT) in October 1999, the treaty's flaws and dangers were examined in detail. Ultimately, the majority of the Senate determined that the CTBT is not in U.S. national security interests. The vote was 51-48 in favor of non-ratification of the treaty, with one senator voting "present."[1]

Since defeat of the CTBT, treaty proponents have renewed their efforts to convince the U.S. Senate and the American public that the best interests of the United States are served by ratification. This paper updates the debate over the CTBT, examining not only proponents' arguments but also the views of individuals who have direct experience with and/or responsibilities for U.S. nuclear weapons. Particular emphasis is placed on publications and data dating from the 1999 Senate debate to the present.

This report finds that since the 1999 Senate vote there have been no significant breakthroughs that would overcome the CTBT's problems. The treaty would not achieve its principal goal, as stated by its proponents, of being an effective nuclear-non-proliferation tool. At the same time, it could have a very negative effect on the U.S. nuclear deterrent. Thus, on balance, the treaty fails the cost-benefit test. The key problems associated with the CTBT are:

- A test ban denies us the surest tool to ascertain nuclear weapons reliability, prevents safety upgrades of the currently deployed arsenal, and impedes our modernization of weapons. Leaders of our weapons laboratories have stated that there already has been a decline of confidence in the reliability of our nuclear arsenal. U.S. weapons are not as safe as they could be. And, we do not know what offensive or defensive technologies will be developed by adversaries and, hence, do not know if we will need more modern weapons.

- The Stockpile Stewardship Program (SSP) is inadequate as an alternative to testing because it depends on unproven, unavailable facilities and technologies. Key components of SSP are behind schedule and over budget, and many experts involved in the effort are concerned that the program will be unable to effectively maintain the U.S. nuclear deterrent. SSP is very risky, and its tools cannot be accurately calibrated without nuclear testing. Without nuclear testing, it is increasingly doubtful that the United States will be able to attract and retain experts with sufficient design capability to maintain a reliable, safe—and, if need be, modernized—arsenal. One of the key components of SSP, remanufacturing, is currently not possible due to lack of facilities, components, and expertise.

- Confidence in the U.S. nuclear stockpile, as judged by the directors of U.S. nuclear weapons laboratories and weapons scientists, has declined since the current moratorium began.

- Safeguard F—intended to allow the United States to withdraw from the CTBT if it needs to test—is virtually meaningless. The United States test site is years away from being ready to use. And the political hurdles set forth in the Safeguard make it highly unlikely that it would ever be used. Without some level of nuclear testing, it is extremely difficult to maintain a test site and requisite testing expertise.

- The CTBT is not verifiable. The CIA reaffirmed in a letter to the U.S. Senate Select Committee on Intelligence (January 9, 2001) that serious monitoring problems persist. Neither the treaty's verification measures nor U.S. national technical means can detect all militarily significant tests. Furthermore, there are no sure technical means to attribute tests conducted over the open ocean. Non-verifiability is of critical importance because Russia, and perhaps others, could secretly test to develop new weapons.

- The benefit of the treaty, according to proponents, is nuclear nonproliferation. Yet, the CTBT will not prevent nations from acquiring workable nuclear weapons without testing; it will not prevent them from conducting unattributable or undetectable tests; and it will not prevent them from testing openly in defiance of a ban.

Each of these problems is discussed in detail in the main paper. Following each discussion are Questions and Answers that address some of the counterpoints made by treaty advocates.

The Comprehensive Test Ban Treaty: An Update on the Debate

Introduction

On October 13, 1999, the U.S. Senate rejected the CTBT. The treaty was then returned to the Senate Foreign Relations Committee, where it will remain along with other unratified treaties, unless and until it is withdrawn by the President.

Since the defeat of the CTBT in the U.S. Senate, some treaty proponents have published papers and letters in support of ratification. The most notable is a report dated January 4, 2001 by General John Shalikashvili (Ret.) to President Clinton entitled, "Findings and Recommendations Concerning the Comprehensive Nuclear Test Ban Treaty." The Shalikashvili report, together with portions of two other publications,[2] provides the basis for treaty proponents' arguments cited herein. This paper examines those arguments and identifies specific reasons why the CTBT is not in U.S. national security interests. Following the discussion of each of the issues, there is a brief Question and Answer section designed to cover related points.

The Effect of the CTBT on the U.S. Nuclear Deterrent

The CTBT ban on nuclear testing would adversely impact the U.S. nuclear deterrent in at least three ways, by:

- Denying use of the one sure tool for ascertaining nuclear weapons reliability,
- Preventing safety upgrades, and
- Impeding U.S. nuclear weapons modernization.

Each of these points will be addressed in detail below.

Reliability

Many things can and have gone wrong with deployed U.S. nuclear weapons. Some defects have been design flaws; some have been introduced during the weapons' manufacture; others developed as a result of aging. Despite the fact that weapons designs in the stockpile have been extensively tested, problems continue to arise. John C. Browne, Director of Los Alamos National Laboratory, testified in 1999 that

> We also continue to find problems that were introduced during the original manufacturing of some specific weapons. We have identified several issues that, if they had occurred when testing was active, most likely would have been resolved by nuclear testing.[3]

In the future, warhead problems associated with manufacturing may be even more prevalent. This is due to the fact that older weapons will need to be remanufactured. Many materials and components used in original manufacture are no longer available and substitutes must be used; older processes and procedures may have to be changed (e.g. they are outdated or unsafe by today's standards). These changes could severely impact weapons reliability. Nuclear testing is the only way to validate, with certainty, that the new materials, components, processes, and procedures used in weapons remanufacture do not affect weapons performance.

Perhaps the greatest uncertainties, however, are associated with the unknown effects of aging. As U.S. warheads age, their reliability can be adversely affected in numerous ways. For example, heat from radiation of the nuclear materials can damage the explosive material and cause physical changes in components. As the 2001 Report to Congress on the Reliability, Safety, and Security of the U.S. Nuclear Stockpile (the so-called Foster Panel Report) states, "Evidence of worrisome deterioration in nuclear components has already been found. Moreover, the history of the stockpile has demonstrated many surprises, and weapons are entering an age regime for which we have no prior experience."[4]

The danger posed by a problem in the stockpile is not so much that a single weapon will not perform as it should. Rather, the risk is that a problem will affect all weapons or components of a given type. There are only nine U.S. weapons types in the stockpile and there is commonality of some components across weapons types. Depending on which weapon type is affected, or which component develops a problem, a very substantial proportion of the U.S. stockpile could become ineffective if a problem were to develop.

The weaponry upon which our national security relies should be tested. Historically, nuclear testing has been essential to discovering defects and/or demonstrating that solutions to fix those defects work. We depend on testing, not calculations and simulation, to assure that complex machinery such as airplanes and automobiles work as intended. We should do no less for nuclear weapons, which are highly complex systems with thousands of components and which are subject to potential damage from radiation and extended shelf-life.

Safety

The weapons in the current U.S. stockpile do not have all of the most modern safety and security features, the so-called surety features, currently available. Table 1 lists which of the 9 warhead types in the U.S. stockpile have the 6 surety features. For example, they do not all have insensitive high explosive, which would minimize the chances of the explosive detonating if it were accidentally struck or dropped. Nor do all of the stockpiled weapons have a feature that would protect against plutonium release in case the weapon is accidentally engulfed in fire. Because introduction of different materials or protective features could affect warhead performance, it would be necessary to conduct a nuclear test to determine the effects of adding any of the safety measures now available.

	Detonator Safing	Fire Resistant Pit	Insensitive High Explosive	Enhanced Nuclear Detonator Safety	Command Disable System	Permissive Action Link
B61						
W62						
W76						
W78						
W80						
B83						
W84						
W87						
W88						

Table 1: Surety Design Features of U.S. Stockpile Weapons
Source: Lawrence Livermore National Laboratory

The decision not to incorporate such safety features into the U.S. stockpile was made by President George Bush in January 1993, who said of currently deployed weapons,

> Given the weapons' safety and the high cost of introducing new warheads incorporating additional safety improvements throughout the deployed force, we do not believe it would currently be cost-effective to incorporate them in the existing stockpile.[5]

President Bush's decision is often cited by test ban advocates as evidence that the current stockpile has been judged to be safe enough and that enhancing U.S. weapons' safety is not sufficient reason to resume nuclear testing. This conclusion is inaccurate; President Bush never said that the stockpile is safe enough. Conversely, he advocated continued nuclear testing specifically for the purpose of testing newly designed warheads to improve safety and to maintain reliability of U.S. nuclear forces. He said,

> [W]e should have available weapons designs with enhanced safety features, that are thoroughly designed and tested, should they be needed. This aspect of planning for the future becomes more compelling recognizing that the weapons in the enduring stockpile may be retained well into the mid-21st century.[6]

This statement was contained in a report to Congress responding to legislation passed in 1992, the so-called Hatfield-Exon-Mitchell amendment, which was the first step in establishing the current nuclear testing moratorium. This legislation, Public Law 102-377, would have limited U.S. nuclear tests to a total of 15, had the moratorium not ensued. President Bush argued that the Congress should urgently overturn the nuclear testing limitation, saying

> 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 tests over three years. In addition, post-production tests would be required to have confidence in the warheads; such tests could be well in the future, and thus would not be allowed under Public Law 102-377.

Without nuclear testing, there is no question that existing safety technologies cannot be incorporated into today's weapons and, more importantly, new safety measures will be precluded. In the future, there may be discoveries that would improve weapons surety, such as the invention of materials that might make accidental detonation even less likely or mechanisms to prevent terrorist use and access. As the Director of Sandia National Laboratories, Dr. Paul Robinson noted,

> While improvements to safety and security systems for nuclear weapons can be developed and implemented without nuclear explosive testing, several attractive technical concepts for enhancement of these features will be foreclosed by the inability to test.[7]

The inability to test has another adverse impact on the development of new safety measures: it reduces the motivation of technologists. As former Assistant to the Secretary of Defense for Atomic Energy, Dr. Robert Barker, stated,

> The absence of nuclear testing also removes any incentive for designers to invent further enhancements to inherent nuclear weapon safety. Even if such features are invented they will sit unused as long as we deny ourselves the ability to conduct nuclear tests.[8]

In conclusion, as President George H.W. Bush said, "…safety improvements can only be developed if nuclear testing can continue."[9]

Modernization

Modernization here refers to significant advances in technology being incorporated into U.S. nuclear weapons, as well as adapting existing technology to new weapons systems. Modernization may be to enhance weapons performance, survivability, or surety. It is U.S. policy to "maintain capability to design, fabricate, and certify new warheads."[10]

There are many reasons why the United States may need modernized nuclear weapons. Just as safety technologies are likely to evolve, so will technologies for weapons delivery. For example, if adversaries develop effective countermeasures to current U.S. delivery systems, the United States may be compelled to develop new systems. Or we may need nuclear-tipped missile interceptors to counter enemy missiles armed with weapons of mass destruction. Or, there may be developments in adversaries' defenses that necessitate a new type of warhead. Already there is discussion of the need to have new warheads capable of striking deeply buried enemy targets and mobile missiles. New delivery systems and/or warhead types would probably make it necessary to revise warhead shape, size, or performance. Because we cannot predict the future of technology, we cannot be sure today what features we might want to include in our weapons tomorrow.

A test ban severely restricts the U.S. ability to develop nuclear weapons in response to technological advances. As the former director of Lawrence Livermore National Laboratory, Michael May, said on July 19, 2000,

> The [CTBT] is a real impediment to weapons development, one that increases with time. It was designed to be such an impediment, and it should be treated as such.[11]

Currently, the United States is not modernizing its nuclear warheads; no new designs are on the drawing board. However, because the future is so unpredictable—both in terms of political changes and technological evolution—the United States' policy has been to preserve the ability to design and build new nuclear warheads. Indeed, the Foster Panel has recommended to the U.S. Congress that replacement warheads for some of the weapons in the current inventory be designed as a hedge against future uncertainties.[12] If the decision were made to build a new warhead, it would almost certainly have to be tested. To modernize U.S. nuclear weapons without nuclear testing would be extremely foolhardy and very unlikely. As Director Bruce Tarter of Lawrence Livermore National Laboratory opined,

> I believe it unlikely that an entirely new warhead, developed without the benefit of nuclear testing, would be certifiable by today's standards.[13]

Questions and Answers

Q1: Did the national laboratory directors assure the president before he signed the CTBT that confidence in the reliability of our stockpile could be maintained in absence of nuclear testing.

A1: No, they did not. The laboratory directors have repeatedly stated that nuclear testing is the surest method of assuring reliability and safety of the stockpile, and that they cannot guarantee the success of stockpile stewardship technologies. In 1995, the directors were asked by staff of the National Security Council whether they could certify the reliability of the stockpile under a CTBT. They responded that "…the Stockpile Stewardship Program offered the best chance to maintain the nuclear stockpile under a CTBT assuming sustained support from both the Congress and the Administration."[14] In addition to their requirement that there be full funding and support for SSP, the laboratory directors firmly tied their support of the CTBT to the fulfillment of all of the proposed safeguards transmitted along with the treaty by President Clinton to the Senate.[15]

Q2: The Jasons Report of 1995 stated that sub-kiloton tests would be of very limited utility in assuring the reliability of nuclear weapons. If this is true, why would a nation want to test at such low yields?

A2: The Jasons is a group chaired by a passionate supporter of the CTBT, Dr. Sidney Drell, who has never designed a nuclear weapon. Their report arbitrarily defined sub-kiloton tests to be those of less than 500 tons of nuclear yield, a level at which testing, for the United States, would indeed have more limited value. If one were to define sub-kiloton tests to include those at or above 500 tons their utility to the United States in determining weapons reliability could be substantial.[16] Not only could such tests be sufficient to test reliability of existing nuclear weapons, they may be sufficient to test some new designs.

We should not mirror-image and assume that testing with yields even below 500 tons is not useful to other countries. Testing at levels below 500 tons may be sufficient to allow China and/or Russia not only to assure weapons reliability, but also to develop new types of weapons.

Q3: The Jasons Report also said that past problems with weapons in our current stockpile were primarily the result of the design process and that these problems have been corrected. So isn't it true that we don't need to test these warheads anymore?

A3: The nuclear weapons laboratories have continued to find problems with each of the warheads in the stockpile every year since the current moratorium began.[17] Some of the problems are associated with the manufacturing process and some are due to aging. As the Director of Los Alamos Laboratory has said, if there were no test ban, we would use nuclear testing to address the problems we are finding and to be sure that the fixes do not themselves cause additional problems.

Q4: Over 150 of the more than 1000 nuclear tests we have done have been on our modern arsenal, so why would we need further testing of those same weapon types?

A4: There are two parts to the answer. First, warheads change with age and thus may no longer perform as intended. (For example, heat from radioactive materials might cause deterioration in materials and components.) Testing can reveal such problems and assist in fixing them. Second, past testing was done with the technologies and understanding of the time. The very fact that we have discovered problems with the weapons since the current moratorium began demonstrates that past testing did not reveal and/or fix all problems.

Q5: But, isn't it the case that only a very few of our tests in the past 20 years have been stockpile confidence tests?

A5: There were some tests in which stockpile confidence was the principal motivation, but there were many tests in which confidence in the stockpile was one of several objectives.

Q6: A ban on nuclear testing does not stop testing of components or high explosives. Why do we need to conduct tests that produce nuclear yield?

A6: Consider the analogy used by former Secretary of Energy (under President Carter), James Schlesinger, in his testimony in 1999 against the CTBT. He said that non-nuclear testing is akin to determining whether an automobile works by looking under the hood, but never turning on the ignition. Only by actually testing the nuclear device can you know for sure that it works as intended.

Q7: Won't stockpile stewardship provide adequate assurance that the stockpile is reliable?

A7: The word *adequate* is subjective. However, as John Nuckolls, former Director of Lawrence Livermore National Laboratory, stated in a letter, "Without nuclear testing, confidence in the stockpile will decline.'' In fact, stockpile stewardship may give us knowledge that creates new doubts about weapons reliability. Mr. Nuckolls also wrote, "It cannot be assured that powerful computational and experimental capabilities of the stockpile stewardship program will increase confidence in reliability. Improved understanding may reduce confidence and estimates of performance margins and of reliability if fixes and validation are precluded by a CTBT.''[18]

Q8: Aren't U.S. weapons scientists confident that the stockpile is reliable without testing?

A8: No. Most weapons designers at the national laboratories agree that the absence of nuclear testing lowers confidence in U.S. nuclear weapons reliability. A New York Times article on November 28, 2000, quoted several weapons designers. That article said, in part:

> A stewardship program with no testing is a 'religious exercise, not science,' said Dr. Merri Wood, a senior designer of nuclear weaponry at Los Alamos National Laboratory. Dr. Wood said that as the weapons aged, it was becoming impossible to say with certainty that the stockpile was entirely functional. 'I can't give anybody a safe period,' she said of the possibility that some weapons could become unreliable. 'It could happen at any time.'
>
> Dr. Charles Nakhleh, another weapons designer at Los Alamos, said doubts about the stewardship program were widespread among weapons designers. 'The vast, vast majority would say there are questions you can answer relatively definitively with nuclear testing that would be very difficult to answer without nuclear testing,' he said.[19]

Q9: Do all of U.S. nuclear weapons incorporate the most advanced safety and security technologies? If not, why not?

A9: No, only one of the nine weapons designs in the stockpile has all of the currently available safety and security features. The decision not to incorporate safety features into all weapons types was made on the basis of cost by the Bush Administration. Instead of adding the newer safety features to older warheads, President Bush recommended development of new, safer warheads as backups for those in the current stockpile. President Clinton chose not to pursue newer, safer warheads.

Q10: Did President George Bush decide in 1992 that there would be no new nuclear warheads designed by the United States?

A10: No. President Bush signed Congressional legislation in October 1992 that contained an amendment limiting the number and purpose of nuclear tests. However, he specifically objected to that part of the legislation and, in January 1993, he recommended to the Senate and House, in writing, that nuclear testing be resumed for, among other reasons, the purpose of developing backup warheads in event that there might be safety or reliability problems with existing stockpiled weapons. The decision not to resume nuclear testing or order designing of backup warheads was made by President Clinton.

Q11: Did President Bush advocate a comprehensive nuclear test ban treaty?

A11: No. In his 1993 letter to Congress, President Bush said, "…as long as nuclear weapons and nuclear deterrence continue to be a critical element of U.S. national security strategy, we must be able to conduct a modest number of nuclear weapons tests to ensure the safety and reliability of our forces. Therefore, the President does not view the negotiation of a multilateral comprehensive test ban as envisioned in P.L. 102-377 as consistent with the national security interests of the United States."

Q12: Won't the Stockpile Stewardship Program enable our scientists to develop modern weapons without testing?

A12: As former Director of Lawrence Livermore National Laboratory, Dr. Michael May, stated on July 19, 2000, "The stewardship program is just what the words imply, a program to maintain what exists, not a program to replace nuclear tests for the purpose of further weapons development. It could not do the latter now and it will be even less able to do it in the future."[20]

Q13: Doesn't the CTBT freeze the current U.S. nuclear advantage by stopping the development of new nuclear weapons in China and Russia?

A13: No. Both countries could continue to test clandestinely with little or no risk of detection. Secret testing could be done at a yield level sufficient to develop new nuclear weapons.

Q14: Wouldn't Russia and China also face problems in assuring weapons reliability under a test ban?

A14: No, the assumption that Russian and Chinese designs are like our own is dangerous mirror-imaging. Russian and Chinese nuclear weapons could have been designed so that reliability can be ascertained with very low-yield testing. Furthermore, Russia's weapons were designed in such a manner that they could be routinely remanufactured to prevent the Russian weapons from suffering the effects of aging.

Russia and China might not need to conduct "illegal" tests to ascertain nuclear weapons reliability. The CTBT contains no definition of what constitutes a nuclear test and there is disagreement on whether low-yield tests are prohibited. Thus, current Russian testing could be at a yield sufficient to test reliability and be, as Russia states, totally consistent with the CTBT.

Q15: Can't the United States maintain the reliability of its arsenal by remanufacturing old weapons to their original designs?

A15: No, unlike Russia, the United States does not have an intact manufacturing capability. Furthermore, the types of materials, processes, and components used in the original manufacture are not all available today. Even if new manufacturing facilities were constructed, the United States would need to conduct nuclear tests to assure that components, processes, and materials used in remanufacture have not introduced changes that would affect the weapons' performance.

The Stockpile Stewardship Program (SSP)

> There is general agreement among those having direct stockpile responsibilities that existing assessment tools and the current level of scientific understanding are inadequate to provide sufficient confidence in either a future aged stockpile or a newly manufactured replacement, without nuclear testing.[21]

To try to increase scientific understanding and to develop better assessment tools, the Clinton Administration undertook the Stockpile Stewardship Program (SSP). SSP is intended to provide technologies, personnel, and procedures that will expand understanding of how nuclear explosions work, thus enabling scientists to help assure the reliability of the U.S. stockpile in absence of nuclear testing. The program consists of calculations, experiments, and manufacturing. To enable scientists to enhance their understanding of nuclear weapons and to develop the tools to do experiments, several capital projects are underway, including the development of supercomputers and building of experimental facilities at the national laboratories.

SSP is not intended as, nor is it, a substitute for nuclear testing. There is no way that SSP can ever provide the high level of confidence in reliability of the stockpile that can be achieved by nuclear testing.

Despite the fact that SSP was designed to make it possible for the United States to retain adequate confidence in its nuclear arsenal in absence of testing, there are indications that it may not achieve that objective. There are some very serious problems associated with SSP, including:

- SSP will not enable the United States to retain the capability to design and produce reliable modern nuclear weapons, if needed.
- SSP technologies are not proven and may not work.
- SSP tools cannot be calibrated without nuclear testing.
- The principal tools of stockpile stewardship, including supercomputers, advanced computer simulations, advanced hydrodynamic testing, lasers, and other facilities, will not be fully operational until the middle of this decade, at the earliest. Currently, the program is behind schedule
- Funding is not assured.
- SSP unclassified work could result in nuclear weapons proliferation.

No new nuclear weapons designs

As noted previously in this paper, we cannot foresee what weapons technologies will be developed by adversaries in the future and thus cannot know what, if any, modernization of the U.S. nuclear force will be required. We can be certain, however, that if the testing moratorium continues, the United States will not have a skilled cadre of designers with test experience available to undertake the job.

SSP is attempting to nurture a new generation of scientists to replace the aging population of designers with test experience. Without having conducted nuclear tests themselves, these new experts will be seriously handicapped; they will not have been humbled by mistakes discovered only through testing, nor will they have insight that can only be gained by such experience. One would not want to be operated upon by a doctor who had not first practiced the procedure under the watchful eye of an experienced surgeon. Similarly, one should not want to entrust the design of nuclear weapons upon which our national security depends to experts who have no test experience.

SSP will not provide nuclear weapons experts with the skills and experience that they would need to be able to design new, modern weapons. As Dr. Michael May, former Director of Lawrence Livermore National Laboratory, has said,

> The stewardship program is just what the words imply, a program to maintain what exists, not a program to replace nuclear tests for the purpose of further weapons development. It could not do the latter now and it will be even less able to do it in the future.[22]

Unproven Technologies

SSP was a program proposed by the Department of Energy to maximize the chances of maintaining the current aging stockpile, given a decision by President Clinton to stop nuclear testing. Technically, SSP is designed to have two effects that would enable scientists to assure reliability of our weapons. First, SSP technologies should help account for empirical factors and explain hitherto unexplained anomalies in nuclear test results. Second, the technologies should help attract and retain competent scientists and engineers.

From the outset, the directors of the three national laboratories gave their view that, from the technical perspective, actual testing is the preferred means of making sure that high-technology devices work. The Director of Los Alamos National Laboratory, John Browne, explained why SSP cannot assure the same level of confidence as can be obtained from nuclear testing,

> It is important to note that even with a complete set of tools [SSP] we will not be able to confirm all aspects of weapons safety and performance. Nuclear explosions produce pressures and temperatures that cannot be duplicated in any current or anticipated laboratory facility. Some processes simply cannot be experimentally studied on a small scale because they depend on the specific configuration of materials at the time of explosion.[23]

The laboratory directors have repeatedly warned that SSP technologies are unproven and that success is not guaranteed. Indeed, they have characterized SSP as high risk:

> This undertaking [SSP] is an enormous challenge which no one should underestimate, and will carry a higher level of risk than at any time in the past. —Paul Robinson, Director of Sandia National Laboratories

> Maintaining the safety and reliability of our nuclear weapons without nuclear testing is an unprecedented challenge. —John Browne, Director of Los Alamos National Laboratory

One or more of the technologies of SSP may fail. For example, the supercomputers may not be able to solved the simultaneous equations as hoped and expected, or the National Ignition Facility may fail to ignite thermonuclear fuel as intended. Yet, even if these unproven technologies do achieve success, there is no certainty that they will accomplish the intended objectives. Indeed, as Dr. Michael May has warned, the knowledge gained from SSP could backfire:

> It could give designers of the future misplaced confidence in making changes, since empirical factors and anomalies are typically due to a number of unknowns so that any explanation would need to be checked with reality, especially if the changes contemplated take the design outside the range of tested parameters. Our group [a group of specialists who conducted a study of SSP] particularly feared basing changes on theories derived from apparently consistent non-nuclear experimental results and calculations, especially in the hands of people with no test experience.[24]

There is growing concern among some nuclear weapons designers participating in SSP that the project will not achieve its objectives. Carol Alonso, a nuclear weapons designer at Lawrence Livermore National Laboratory, wrote on December 17, 2000,

> At the rate SSP is progressing, we will never get to a point where we can confidently predict from simulations alone how a nuclear weapon is going to perform. Our designers know that. If you ask them, young and old, whether they would rather have regular testing or largescale ASCI [computer] simulations, their voice would be strongly in favor of testing—with, of course, continued emphasis on trying to understand this complex science. …[M]y integrated assessment is that the slope of true SSP progress is almost zero on the day-to-day design level. The science of nuclear weapon design is becoming dormant. The only way to revitalize it is to shock people out of it with unexpected results from nuclear tests. This [the need for testing] has been true for every feld of science in which humans ever engaged, and to expect it will be different for nuclear weapon design is folly.[25]

Paul Robinson summed up the dangers that SSP will fail, "The difficulty that we face is that we cannot today guarantee that Science-Based Stockpile Stewardship will be ultimately successful; nor can we guarantee that it will be possible to prove that it is successful." There is danger that SSP will fail and we won't know that it has. There is no event and there are no metrics that will signal the success or failure of the program.

Calibration Requires Nuclear Testing

SSP will use new technologies and facilities to conduct experiments to better understand the reactions that result in a nuclear explosion. These experiments cannot duplicate what happens in a nuclear explosion. Calculations must extrapolate the results of the laboratory experiments to predict nuclear weapons performance. The only way to validate the accuracy of computer extrapolations is to use results of nuclear testing. Data from past nuclear testing is, in general, too coarse to test the validity of the high resolution, complex models that SSP seeks to develop.

The initial plan for SSP called for quick execution. The reason for speed was to allow the program's calculations and results to be checked by design experts who have nuclear testing experience. At the current pace of SSP, those experts will be gone when the facilities and projects are completed. There are no trustworthy alternatives to calibrating SSP, other than a limited number of nuclear tests. Low-yield nuclear tests would enable technologists at our laboratories to calibrate the SSP technologies, once they are available, and to ascertain whether SSP will truly be able to assure the reliability and safety of the stockpile.

Timing and Funding Problems

SSP, according to Director of Los Alamos John Browne, is at least 10 to 20 years away from being up and running. We don't know, and have no way of knowing, if the construction of facilities will fall further behind schedule than they already have. We already know, for example, that the essential National

Ignition Facility (NIF) is more than a billion dollars over budget and will certainly be completed 5-7 years late. Complicating the technical and schedule hurdles is the fact that SSP has already come under attack from CTBT supporters in Congress. For example, Senators Harkin and Reid co-sponsored an amendment in September, 2000 that would have capped funding for NIF for FY 2001 at the level first requested by Clinton Administration**.** This was less than half what was needed to keep the program on schedule.

Support for SSP has wavered, in part, due to its tremendous financial costs. At the outset, SSP was budgeted at $4.0 billion per year for ten years. It then grew to $4.5 billion per year for a minimum of a decade. In fiscal year 2001, it is $5.1 billion and is expected to continue to increase.

Funding and management problems have resulted in SSP not yet meeting its goals and milestones. The Foster Panel also noted that SSP has not yet met most of its key objectives in developing SSP tools. The February 2001 Report stated,

> We are nevertheless concerned that most of the accomplishments of the first five years of SSP have been made on an ad hoc basis, in the sense that we have not seen programmatic implementation of plans to develop needed stockpile tools.

With schedules slipping and budgets rising, future support for SSP may continue to wane. If SSP is slimmed down, there will be no way that it can achieve its initial objectives of assuring stockpile reliability. Additionally, some in Congress support SSP as a means to achieve the CTBT. If the treaty were ratified, it could be expected that their support for SSP would decline.

Proliferation Dangers

As noted, one of the two objectives of SSP is to attract, train, and retain highly competent scientists and technicians. In fulfilling this objective, SSP is involving the U.S. academic community in the weapons program to an unprecedented degree. This has the unavoidable result of channeling knowledge from the weapons laboratories to the world at large. Foreign researchers now have more access to U.S. nuclear weapons-relevant technology than ever before. As Carol Alonso, a weapons designer at Lawrence Livermore National Laboratory, has written,

> SSP and ASCI [computer simulation] are recognized by many of the workers on the floor to be much more proliferative (sic) than testing, and this bothers them. In order to make ASCI work, its managers say, the American universities must be highly involved. Well, the American university these days has a majority of foreign physics graduate students—52% in 1998 and steadily growing. Fully 37% of the faculty in American engineering schools are non-U.S. citizens. Who are we training to design nuclear weapons and missiles, the whole world? Why?[26]

Questions and Answers

Q16: Did the national laboratory directors say that the Stockpile Stewardship Program could maintain reliability of the U.S. stockpile without nuclear testing?

A16: No. White House staff instructed the directors to consider only the case of no testing. With this restriction, the directors then said that SSP "*offers the best chance* of assuring reliability in absence of testing." (emphasis added)[27] No guarantee was given.

Q17: Treaty proponents have said, "The Stockpile Stewardship Program is working today." Is this accurate?

A17: The Stockpile Stewardship Program (SSP) facilities are still under construction and the experiments intended to give the knowledge to "replace" testing have not yet been successfully conducted. The people who manage and work in the SSP say that it will be at least 10 years before scientists will be able to say whether SSP can meet its goals.

In fact, there is a very real possibility that SSP will not work. As Dr. Michael Anastasio, associate director of defense and nuclear technologies at Lawrence Livermore National Laboratory, said, "But we've always said there's no guarantee that it [SSP] will work."[28]

Q18: General Shalikashvili has said, "Few nuclear weapons experts view sudden catastrophic failure of the nuclear deterrent as anything more than a remote theoretical possibility." True or false?

A18: On the contrary, many nuclear weapons experts say that a problem could develop at any time that would cause catastrophic failure of a U.S. weapon type. [Catastrophic failure refers to the event in which all weapons of a given type have a problem that results in their not working as intended.] Annual certification does not mean that U.S. weapons are guaranteed to be fully functional for the year; it merely means that they are believed to be fully functional at the moment of certification. A problem in a weapon type could develop, or a problem that had previously gone unnoticed could be discovered, immediately following certification. At present, the only sure way to determine if the current stockpile is reliable is to conduct nuclear tests to examine the significance of the problems already identified.

Stockpile Certification

As noted above, one of the central concerns of those responsible for maintaining an effective U.S. nuclear deterrent is that the CTBT would undermine confidence in the reliability and safety of the U.S. stockpile. In an effort to address their concerns, the Clinton Administration undertook two major initiatives. The first was the Stockpile Stewardship Program. The second was to formalize the process by which the Directors of the national laboratories and the Departments of Energy and Defense certify U.S. nuclear weapons.

Stockpile certification entails traditional stockpile surveillance (taking weapons apart and testing non-nuclear components), assessment of results by experienced nuclear weapons designers at all three national laboratories, and review by the U.S. Strategic Command (STRATCOM). Although the process is now more formalized than before the current test moratorium, certification uses the same tools that have been used for decades minus one element—nuclear testing. Certification is a "snapshot in time" that says the U.S. nuclear arsenal is believed to be functional at a given time; it is not a certification that they will be functional for a longer period such as a month or a year hence.

The Clinton Administration formalized the certification process by making the end product a memorandum to the President from the Secretaries of Energy and Defense and requiring that the certification be done annually.

Can the certification process assure, with very high confidence, that the U.S. stockpile is reliable? This question is difficult to address because there are no clearly defined metrics by which one would assess whether the certification process has effectively assessed the status of the stockpile. One can, however, determine that the certification process has uncovered an increasing number of questions about and difficulties with the stockpile. These are called "findings." Although they have not been explained in unclassified form, there are references to the growing number. In discussing the certification process, John Browne, Director of Los Alamos National Laboratory, said that every year each weapon system has had one or problems needing resolution. Some of these problems resulted from the original manufacturing process; others are due to aging. He said,

> … I am concerned about several trends that are reducing my confidence level each year. These include annual shortfalls in the planned budgets*, increased numbers of findings in the stockpile that need resolution*, an augmented workload beyond our original plans, and unfunded mandates that cut into the program.[29] (emphasis added)

He also said in the same testimony,

> We have identified several issues that, if they had occurred when testing was active, most likely would have been resolved by nuclear testing.[30]

At present, the most important aspect of stockpile stewardship is the cadre of weapons designers with nuclear testing experience who evaluate the health of the stockpiled weapons. Only about 80 U.S. nuclear weapons designers remain, of which only 30 ever served as a lead designer on a nuclear test. Their collective knowledge makes it possible to analyze SSP data and to undertake fixes to problems. As their numbers dwindle in the future, it will be increasingly difficult to certify the stockpile with confidence.

In summary, there are two principal problems with the certification process. First, it is a formalization of the historical process of examining weapons for reliability, but without the rigor and certainty provided in the past by nuclear testing. Second, it is highly dependent on a diminishing resource—the small cadre of nuclear-test-experienced designers. Certification is also a process that can be politicized; there will almost certainly be tremendous pressures against any recommendation that a problem should be resolved through use of nuclear testing.

Withdrawing from the CTBT as a "Safeguard"

When the Clinton Administration decided to support the CTBT, it needed to obtain support from the directors of the national nuclear weapons laboratories and key military decision-makers. These experts were highly reluctant, however, and were fearful that a problem could develop in a nuclear weapons warhead or system that could only be detected or resolved with nuclear testing. To answer their concerns, the Clinton Administration devised a set of safeguards, including Safeguard F, which states that

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

Safeguard F is a critical issue in the CTBT debate, in part, because the nuclear weapons laboratory directors predicated their support for the CTBT upon it. Repeatedly, each of the directors has said that Safeguard F is of the highest importance as a backup should SSP fail or should a significant problem develop with the stockpile.

However, there are two difficulties that render Safeguard F virtually meaningless. The first is technical; the second, political.

Technically, the United States is not prepared to resume nuclear testing underground. The Nevada Test Site (NTS), despite ongoing non-nuclear experiments there, has been allowed to atrophy. Key personnel who knew how to prepare for and conduct a test—engineers, electricians, drillers, and a host of specialized skills—have died, retired, or changed jobs. Highly complex equipment is no longer available and, in many cases, is not off-the-shelf, so it could not readily be replaced. In 1999, the Department of Energy reported that it would require 24 to 36 months to prepare to conduct an underground nuclear test.[31]

The lack of readiness constitutes a serious problem. Any nuclear weapon that develops a significant flaw that requires testing to correct would be rendered ineffective. Thus, depending on the weapon or component involved, more than half the U.S. arsenal could be unworkable, pending a nuclear test. Compounding this difficulty, test site preparations, which would necessarily be lengthy, would signal to others that the U.S. arsenal had an extremely serious problem.

Politically, the hurdles set up by Safeguard F make it highly unlikely that the United States would resume testing, even if a catastrophic problem occurred with a stockpiled weapon. The safeguard states that withdrawal would be possible if there were a high level of confidence that the safety or reliability of a nuclear weapon type which the two Secretaries consider to be critical to our nuclear deterrent could no longer be certified. There is no definition of what constitutes a "high level" of confidence, nor is there a measure for what makes a weapon "critical" to our national deterrent. The lack of clear guidance is compounded by the number of people that must agree on the nature and severity of the problem in the stockpile, and by the fact that the recommendation to invoke the Safeguard is to be made by political appointees. Additionally, given the lack of test readiness, military leaders will be loath to signal our weakness to others by leaving the treaty in order to test. Thus, the likely scenario is that Safeguard F would never be used. Instead, the troubled weapon would probably be removed from the stockpile, thus unilaterally and arbitrarily weakening the U.S. nuclear deterrent.

A Ten-Year Review "Safeguard"

General Shalikashvili's report proposed, in addition to Safeguard F, that the Administration and Senate should undertake 10-year reviews of the CTBT's net value for national security after ratification. Supposedly, this could pave the way for ratification because it would set the stage for American withdrawal from the CTBT if it were later found to be of negative net value.

The short rebuttal to this proposal is: the case for the CTBT's being of benefit to U.S. national security has not been made, so the treaty should not be ratified in the first place. Ten-year reviews do nothing to alter the fact that the treaty would have a negative impact on U.S. security.

A longer rebuttal to the proposal must note that the United States already would have the option to withdraw from any treaty, including a CTBT, without a "ten-year review" as proposed by General Shalikashvili. Any treaty may be abrogated or withdrawn from by any state party that perceives that treaty to be contrary to its national security interests.

What is different about the Shalikashvili proposal, however, is that it actually would make it much more difficult to withdraw from the CTBT if it were ratified. General Shalikashvili suggests a review process that would be lengthy and unavoidably politicized. He says the CTBT review should examining SSP priorities, accomplishments and challenges; current and planned verification capabilities; and the Treaty's adherence, implementation, compliance, and enforcement record. He further suggests that recommendations must be formulated to address concerns. Such a process would be even more highly contentious than have been the inconclusive U.S. Government "compliance reviews" of other arms control treaties. Also, the suggestion that any withdrawal from the treaty be done in consultation with Congress is not only of questionable constitutionality, it invites a process that has so many participants that it would be unlikely to ever reach consensus.

The Problem of Verification

The International Monitoring System (IMS) of the CTBT is expected to provide the ability to detect, locate, and identify *non-evasive* nuclear testing of 1,000 tons (1 kiloton) or greater. It will <u>not</u> be able to detect, with any significant degree of confidence:

- Nuclear tests designed to change or hide the signal of a nuclear explosion (evasive tests).
- Nuclear testing below 1,000 tons yield.

Very low-yield or evasively conducted nuclear tests could be used to assure reliability and perhaps to confirm new, modern weapons designs. Furthermore, the monitoring system would not be able to attribute a nuclear test conducted, for example, on or over the ocean.

A likely evasion scenario is to de-couple, or conduct a nuclear test in a mined or natural cavity. The effects of de-coupling are well-documented. For example, the United States conducted two nuclear tests in the Tatum salt dome located at Chilton, Mississippi. *Sterling*, the test conducted on December 3, 1966, had a yield of 380 tons. The apparent seismic yield was only 5.3 tons, a reduction by a factor of 71.7. Using decoupling, a 1,000-ton explosion could be made to look seismically like a 14-ton explosion; a 5,000 ton explosion could look like a 70-ton explosion. Neither would be detectable by either the IMS or by U.S. national technical means in most parts of the world. Experts' opinions vary on the size of the largest explosion that could be easily de-coupled. Most agree that several kilotons could be evasively tested without detection; 10,000 tons is probably the upper limit.

Treaty proponents have attempted to argue that decoupled tests will be detectable by other than seismic means. For example, General Shalikashvili's report states "…cavity-decoupled explosions can reduce seismic signals but increase the probability of radioactive venting."

This statement is misleading; venting would be unlikely if the nation were to take appropriate steps to prevent it. The CIA responded to a question relevant to this issue in a letter dated January 9, 2001 (from the CIA to Senator Richard Shelby of the Senate Select Committee on Intelligence).[32] The question is :

> Some analysts have asserted that decoupled tests in large cavities in hard rock would leak or vent. Given what we know of the construction of Yamantau Mountain and possible other deep mining, how feasible is it to expect testing will not be detected in Russia, China or elsewhere?

The CIA answered:

> There is ample evidence that the engineering technology required to excavate underground cavities in hard rock that are large enough to decouple tests of several kilotons yield is commercially available world-wide. There is also ample evidence that US technical publications on radioactive debris containment, as well as the openly published methods used by US experts to test cavities for containment before a test is conducted, have been closely studied by foreign experts. Therefore, we estimate that an evader could successfully contain a decoupled test in hard rock, using a cautious experimental approach, and thereby avoid detection by sensors external to its country. As documented by the US Geologic Survey, using data from past nuclear tests conducted by several countries in hard rock geologies, prompt venting of gases does not occur when cautious containment measures are used. It is possible that localized

> seepage of small quantities of gases may occur, but it would only be detected and identified by locally placed sensors.

In addition to the very serious difficulties associated with detecting secret nuclear testing, there is also the problem of identifying explosions as nuclear tests. At lower yields, the number of non-nuclear events of similar size increases (e.g., mining explosions and earthquakes on land, explosions for geophysical exploration, volcanoes at sea, meteorite impacts in the atmosphere). These non-nuclear events increase the total number of events to be processed by a verification system, and a small percentage of them generate signals similar to those expected from nuclear explosions. This, too, increases the difficulty of identification.

In addition to its technical limitations, the IMS has other problems. The fact that stations monitoring some nations will be within their own borders offers the possibility that IMS data could be manipulated, or that the stations could be shut down during a test—just as Pakistan turned off a key seismic station within its own borders when it conducted a nuclear test in May, 1998. Some of the stations monitoring China will be within China; some monitoring Russia are within Russia. Hypothetically, either could assure that the station(s) would not be working during the time of a test, thus depriving the IMS of key data. Shutdowns would not necessarily appear unusual because it is inevitable that there will be times when the stations are not functioning properly.

General Shalikashvili and some other treaty proponents have argued that on-site inspections is a means to "provide definitive evidence of a treaty violation." The Shalikashvili report also states "With on-site inspections and other sources of information, though, it is more likely that very low-yield testing would be detected or deterred with the Test Ban Treaty than without it."

These arguments that on-site inspection will fill the verification gap are very misleading. On-site inspections (OSI) will be very difficult to initiate in a timely fashion and are unlikely to produce definitive evidence of cheating. There are several problems involved, as pointed out by the letter from the CIA, cited above. That letter responded to a question as follows,

> If the occurrence of such a test were suspected, how useful would on-site inspection be in verifying that there had or had not been a test? Would one need to know the precise location of the test site in order to detect any escaping gases or to drill? How important is timing of an inspection?
>
> The CIA answer to this question states:

- It would probably take more than the suspicion of the occurrence of a test to "trigger" an OSI. The Treaty requires that 30 out of the 51 States which sit on the CTBT's Executive Council vote positively to undertake an OSI upon request of a treaty member.. The treaty member requesting the OSI will have to convince at least 30 other states that it is highly likely that a nuclear test has occurred, and possibly accomplish this under the circumstances that very little data for this event was recorded by the IMS (i.e., an evasively conducted test). The practical result of this requirement is that an OSI will be a rare event, and not a regular occurrence which can be used as a "confidence building measure" to examine questionable events.

- Once an OSI has been approved by the Executive Council, it is very important that the inspection team reach the search area as rapidly as possible. (We estimate that the minimum time allowed for the Executive Council's deliberations, plus the time needed to assemble and transport the inspection team on-site, will be no less than 11 to 12 days.) Approximately two weeks after the event occurs, we estimate that those observables which would help in precisely locating the event—small "aftershocks" around the explosion cavity and the persistence of any escaping radioactive gas—would have significantly dissipated, making the task of locating and positively identifying the event more difficult, with the difficulty increasing as the days pass.

- From U.S. experience at the Nevada Test Site, seeping gas—if the gas does seep—is most likely to appear within a distance of about a few kilometers of the shot point. Unless some form of NTM provides a good estimate of the precise location, the initial search area for the OSI will, at a minimum, cover several hundred square kilometers.

- If some suspicious evidence is found, an extension to the original duration of 25 days for the OSI can be granted. At this point, the inspection team can request the use of a drill to precisely locate the explosion cavity. However, the success of drill-back in locating the cavity is problematical; U.S. success in drilling back to its own shot cavities, when the location is "accurately" known, has not been entirely successful on the initial attempts.[33]

Another argument articulated by General Shalikashvili is that "Attempts to camouflage tests or test preparations generate their own suspicious signals." This, and similar statements, convey the view that it is likely that cheaters will be caught, despite our technical limitations on detecting and identifying low-yield or evasive nuclear testing. However, it is untrue that nuclear test preparations necessarily generate suspicious signals. For example, the U.S. Intelligence Community focused on India's nuclear test site as well as Indian activities and statements prior to that country's 1998 nuclear tests. Nevertheless, the United States was taken by surprise. The fact is that nations can successfully conceal nuclear test preparations.

When treaty proponents are faced with overwhelming evidence that low-yield nuclear testing can be impossible to detect and identify, they often fall back to the argument that other nations could not obtain significant nuclear advantage through such tests. For example, General Shalikashvili said, "Nuclear weapons states could not make a major qualitative breakthrough without testing above several kilotons."

On the contrary, there are two tremendous military advantages that could be obtained through clandestine nuclear testing by Russia or China—advantages which could undermine the effectiveness of the U.S. nuclear deterrent. The first is that Russian and Chinese nuclear designs may be such that low-yield tests will ascertain warhead reliability. Thus, while U.S. confidence is eroded by the test ban, those two nations may be able to assure high reliability through secret testing.

The second significant advantage that could be obtained Russian and/or Chinese clandestine testing is the development of new types of nuclear weapons, particularly low-yield weapons. To posit that new weapons could not be developed without testing at the several kiloton level is to make unwarranted assumptions not only about what types of weapons Russia or China might be interested in, but also mirror-images the United States' rigorous weapons-certification requirements are the same as other nations'.

Questions and Answers

Q19: The CTBT verification would not be perfect, but wouldn't it be better to have some than none?

A19: No, because the "some verification" that is possible is totally inadequate. It is possible for Russia and others to conduct clandestine nuclear tests, with little or no risk of detection, that would enable them to ascertain weapons reliability and to develop new weapons. If the United States were to adhere to the treaty while others continued to test clandestinely, we would be severely disadvantaged.

Q20: Aren't low-yield tests—those below the threshold of the CTBT verification system—militarily insignificant?

A20: A nuclear test with a yield of one-half kiloton would be sufficient to assure the reliability of U.S. nuclear weapons.[34] However, other nations' nuclear weapons designs could be such that reliability could be ascertained from a level of testing well below that. We should not mirror-image. Other nations determine what yield of test is sufficient for their own objectives.

Q21: Can we address the verification deficiency by increased monitoring at the Russian and Chinese nuclear test sites?

A21: Intensive monitoring at a known test site will simply assure that any cheating will take place somewhere else. If nuclear testing is conducted at low yields, the whole world becomes a potential test site. For example, tests in the tons can be done in old mines or underground cavities, and tests in the pounds[35] can be done almost anywhere. Russia is so large that we will never know if it is conducting such low-level tests, even if the verification regime entails full transparency of known or declared test sites. Thus, additional monitoring at known test sites is of marginal, if any, utility.

Q22: Is on-site inspection sufficient to address some of the verification deficiencies of the CTBT?

A22: There are political, logistical, and technical limitations that make on-site inspections of very limited utility in assuring that there have been no clandestine nuclear tests. Politically, on-site inspections would be difficult to initiate. Such inspections can go forward only if 30 of the 51 members of the Executive Council decide that the request for an inspection is valid. Given the likely composition of the Executive Council, the United States may find it very difficult to muster support for an inspection. Furthermore, a nation can declare areas of up to 50 km^2 to be off-limits to inspection, enabling them to hide any illicit activities. (The treaty requirement that they then provide alternative means to show compliance is impractical.)

Logistically, it would take 11 to 12 days, minimum, for inspectors to reach a suspect location. By this time, most of the aftershocks around the site and any possible leaks of radioactive gases would be gone. This would greatly reduce the likelihood of finding the exact site or clear-cut evidence of a test.

Technically, it would be required that inspectors know the exact location of the suspected test site if drilling were to be used to look for evidence of testing. For the above-cited reasons, the precise location is unlikely to be found.

Q23: Would less developed nations like Iran, Iraq, or North Korea be able to dig cavities deep and large enough to hide a nuclear test by decoupling?

A23: The engineering technology required to excavate underground cavities in hard rock—cavities large enough to decouple tests of several kilotons yield—is commercially available worldwide. That other nations can build large underground facilities is well known. Iraq has built deeply buried bunkers for its military as well as an underground oil refinery. North Korea has a vast network of underground facilities and tunnels. Libya built a massive in-mountain chemical-weapons-production facility at Tarhunah.

Q24: Because we watch the Chinese and Russian test sites so carefully, wouldn't we know if they cheated on the test ban?

A24: No. The buildup activities to a nuclear test can be obscured, as India did before its test. (Despite close observation of the Indian nuclear test site by the United States, the Indian test in 1998 caught the United States by surprise.) We currently have no technologies that would detect low-yield or decoupled tests.

Q25: Why can't we address the verification deficiencies of the CTBT by having additional bilateral agreements with Russia and China?

A25: If the agreement were to allow observers whenever there is to be activity at the test sites, they could simply not notify us. If the agreement were to have us be present all the time, they could just conduct the test somewhere else. There is no bilateral agreement that would be effective in assuring that there is no clandestine nuclear testing.

Q26: General Shalikashvili's report states that "…the IMS primary seismic system will provide three-station 90% detection thresholds below 500 tons on all continents and below 200 tons for all historic test sites in the northern hemisphere—with one and two station detection thresholds going even lower." Isn't this sufficient for CTBT verification?

A26: Setting aside the point that the nation conducting a test could simply turn off the seismic stations on its own territory, there remains a tremendous deficiency in the ability of the IMS to detect and identify nuclear explosions, particularly if the nation attempts to conceal its activities. In response to a question from the Senate Select Committee on Intelligence, the CIA stated in a letter on January 9, 2001 that,

> The IMS is aimed at providing approximately equal global monitoring coverage for nuclear tests where there has been no attempt to conceal such tests from the IMS. For the most part, the network can identify an event as a nuclear explosion at the yield level of approximately one kiloton*, assuming there has been no effort to conceal the explosion*. Below this yield level, or if evasion or concealment occurs, the capability of IMS sensors to provide enough data to identify an event as a nuclear explosion dramatically decreases. Note that evasion techniques can easily reduce the signature of a nuclear explosion by factors of 50 to 100. (emphasis added)[36]

Q27: General Shalikashvili's report said that "Focusing only on classified national capabilities to monitor foreign nuclear testing or on unclassified capabilities of the International Monitoring System (IMS) underestimates our overall verification capabilities." What additional verification capabilities are there?

A27: There are no other verification capabilities. It is possible that a "human source" will leak information about clandestine testing, but such intelligence is serendipitous.

The Non-proliferation Argument

Treaty proponents continue to argue that combating proliferation is the principal reason that the United States should ratify the CTBT. Yet, there is no evidence or sound argument that the CTBT will help prevent proliferation. We know that nations do not need to test to develop a "simple" fission nuclear weapon; South Africa built and deployed such weapons without testing. We also know that most nations are already bound by a treaty—the Nuclear Non-Proliferation Treaty (NPT)—not to develop nuclear weapons. An additional treaty that obligates nations not to test a weapon that they are already obligated not to develop is redundant. This leaves one argument: that the CTBT would help prevent proliferation of advanced thermonuclear weapons by nations that have nuclear weapons and are not party to the NPT. There are only 3 nations in this category—Israel, India, and Pakistan. It is unclear that these nations want or need thermonuclear devices, but if they do perceive such weapons as vital to their national security, a test ban will not stop them. They could refuse to join the treaty, could violate it clandestinely, or could abrogate it to test. In any case, the argument that the CTBT is an important tool for nuclear nonproliferation is weak, at best.

Questions and Answers

Q28: Does the CTBT make it more costly politically for a proliferator to test?

A28: Some nations acquiring nuclear weapons want the world to know it. For example, both India and Pakistan wanted their tests to be detected. By publicly proving their nuclear capabilities, they send a potent signal to their adversaries. This might mean that, in the future, nations wishing to test will not care about hiding their actions irregardless of whether they are party to a test ban.

Assuming that a nation did want to hide its cheating under the CTBT, would it be costly politically if it were caught cheating? Historically, there have been a host of examples when nations have violated arms control treaties with little or no political cost. For example, North Korea remains in noncompliance with the NPT and one could argue credibly that this cheating actually has been politically and economically lucrative.

Q29: Doesn't the CTBT make it more costly financially and difficult technically for a nation to cheat?

A29: The cost of a nuclear test is small compared to the cost of a nuclear weapons program. The cost and ease of testing over the ocean would be almost the same, whether one were doing it openly or clandestinely. If the testing were underground, the cheater would probably excavate a cavity in rock or salt. The costs for digging in rock would be the drilling and removing the spoil out of sight; for salt, it would involve pumping water in and out. Neither would be of significant cost. The level of technical difficulty is not such that it would be a barrier to secret testing by most nations.

Appendix A: The Process Used to Consider the Treaty

CTBT proponents often make issue of the Senate's vote not to give advice and consent to ratification the treaty, saying that there was inadequate debate and that the vote was politically driven. While not worthy of much discussion, these points should be addressed briefly because, in fact, the proponents err.

The first point that should be made is that the Senate undertook debate and vote on the CTBT by unanimous consent. This means that senators of both parties agreed to do so.

The second point is that the CTBT was addressed in several Senate hearings in the three years preceding the October 1999 vote. The Senate Governmental Affairs Committee held 3 hearings specifically on the CTBT in 1997 and 1998. The Senate Armed Services Committee held 9 hearings on the Stockpile Stewardship Program, which the Clinton Administration hoped would enable us to assure weapons reliability under the CTBT. The Senate Foreign Relations Committee held 14 hearings that touched on the CTBT between 1997 and 1999. Additionally, Senate staffs received extensive information through briefings and papers on the CTBT, including intensive lobbying by treaty proponents.

In the two weeks prior to the Senate vote in October 1999, the treaty received intensive examination. Three Senate committees held five hearings and heard from over 30 witnesses:

Armed Services Committee

10/5/99	Closed hearing on Military Implications of the CTBT of Energy and Intelligence Community
10/6/99	Open hearing on National Security Implications of the CTBT Secretary of Defense, Chairman of Joint Chiefs of Staff, Former Secretary of Energy and of Defense, Former Chairman of Joint Chiefs of Staff
10/6/99	Closed session on National Security Implications of the CTBT Secretary of Defense, Chairman of Joint Chiefs of Staff, Former Secretary of Energy and of Defense, Former Chairman of Joint Chiefs of Staff
10/7/99	Open hearing on Ability of SSP to Assure Safety and Reliability of the U.S. Nuclear Arsenal under a CTBT Panel 1: Secretary of Energy, Director of Sandia National Laboratories, Director of Los Alamos National Laboratory, Director of Lawrence Livermore National Laboratory Panel 2: Former Assistant to the Secretary of Defense for Atomic Energy, Former Assistant Director for Nuclear and Weapons Control in the Arms Control and Disarmament Agency, Former Commander-in-Chief of U.S. Strategic Command, and Professor Emeritus of Stanford Linear Accelerator Center

Foreign Relations Committee

10/7/99	Final Review of the CTBT (Morning Session) Former Secretary of Defense, Senior Fellow of American Enterprise Institute, Former Chief Negotiator of the CTBT
10/7/99	Final Review of the CTBT (Afternoon Session) Panel 1: Chairman of Senate Armed Services Committee, Chairman of Select Committee on Intelligence, Ranking Minority Member of Committee on Armed Services, Vice Chairman of Senate Select Committee on Intelligence Panel 2: Secretary of State Panel 3: Former Director of Arms Control and Disarmament Agency, Chairman of Nevada Alliance for Defense, Senior Fellow for S&T at Council on Foreign Relations

The CTBT was then formally debated by the full Senate for two and one-half days, with 64 Senators speaking on the treaty over a period of 18 hours. The Senate spent more hours debating the CTBT on the floor than similar treaties like the Chemical Weapons Convention. As Senator Kyl has said, "In fact, the Senate spent more time debating the CTBT than the START-I, START-II and CFE Treaties combined."[37]

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1. The 51 votes in opposition were 17 more than required to defeat the treaty, as a 2/3 majority vote is required for treaty ratification.

2. The two other publications are: "The Comprehensive Test Ban Treaty: Next Steps" a roundtable discussion at Stanford University on July 19, 2000, and "White Paper on the Comprehensive Nuclear Test Ban Treaty" by the Lawyers Alliance for World Security, Fall, 2000. The Web page maintained by the Coalition to Reduce Nuclear Dangers—<www.clw.org/pub/clw/coalition/ctbindex.htm>—is an excellent source listing proponents' arguments.

3. Testimony of Dr. John C. Browne before the Committee on Armed Services, U.S. Senate, October 7, 1999.

4. *FY2000 Report to Congress of the Panel to Assess the Reliability, Safety, and Security of the United States Nuclear Stockpile*, February 2001, p. 6. Hereafter cited as the *Foster Panel Report*.

5. Testimony of Dr. Robert B. Barker before the Subcommittee on International Security, Proliferation, and Federal Services of the Committee on Governmental Affairs, U.S. Senate, October 27, 1997, p. 40.

6. Ibid.

7. Testimony of Dr. Paul C. Robinson before the Committee on Armed Services, U.S. Senate, October 7, 1999.

8. See Testimony of Robert Barker, October 27, 1997.

9. Ibid.

10. *Nuclear Posture Review*, briefing format report, 1994, p. 27. This policy was reiterated in United States Senate, "Resolution of Ratification," January 26, 1996, *Congressional Record*, S461-S463.

11. Comments by Michael M. May at *a Roundtable Discussion on The Comprehensive Test Ban Treaty, Next Steps*, July 19, 2000, Stanford University. Hereafter cites as *CTBT Roundtable*.

12. *Foster Panel Report*, p. 12.

13. Letter from Bruce Tarter, Director of Lawrence Livermore National Laboratory, to Senator Jon Kyl, recorded in the Hearing on the Safety and Reliability of the US Nuclear Deterrent before the Subcommittee on International Security, Proliferation, and Federal Services of the Committee on Governmental Affairs, S. Hrg. 105-267, October 27, 1997, pp. 72-79.

14. Questions and Responses from Mr. Vic Reis Submitted for the Record, Report of the Hearing Before the Subcommittee on International Security, Proliferation, and Federal Services of the Committee on Governmental Affairs, S. Hrg. 105-267,October 27, 1997, p. 69.

15. See Letters from Directors of Los Alamos and Livermore National Laboratories.

16. Director Bruce Tarter of Lawrence Livermore National Laboratory stated in a letter to Senator Jon Kyl that the lowest useful level of nuclear testing to determine the reliability of US weapons is 500 tons. See October 27, 1997 hearing.

17. The fact that the number of "aging findings" is increasing has been acknowledged by Los Alamos National Laboratory. See James Glanz, "Testing the Aging Stockpile in a Test Ban Era," *The New York Times*, November 28, 2000, p. 1.

18. Testimony of Secretary James Schlesinger before the Senate Armed Services Committee hearing on National Security Implications of the Comprehensive Test Ban Treaty, October 6, 1999.

19. Quoted in Glanz, "Testing the Aging Stockpile."

20. See Comments by Michael M. May in *CTBT Roundtable*.

21. *Foster Panel Report*, p. 17.

22. See *CTBT Roundtable*.

23. See Browne Testimony, October 7, 1999, p. 7.

24. See *CTBT Roundtable*, p. 48.

25. Letter from Carol Alonso to the author, December 17, 2000.

26. Ibid.

27. See Testimony of Paul Robinson before the Senate Armed Services Committee hearing on National Security Implications of the Comprehensive Test Ban Treaty, October 7, 1999, p. 6.

28. See James Glanz, "Testing the Aging Stockpile."

29. See Browne Testimony, October 7, 1999.

30. Ibid.

31. US Department of Energy, *Stockpile Stewardship Program, 30-Day Review*, November 23, 1999, p. 2-8, 6-4.

32. Letter from John. H. Moseman, Director of Congressional Affairs, Central Intelligence Agency, to Senator Richard C. Shelby, Vice Chairman of the Senate Select Committee on Intelligence, January 9, 2001

33. Ibid.

34. See Tarter Letter to Senator Kyl.

35. Testing with a few pounds of yield is useful for ascertaining nuclear weapons safety. Testing the reliability testing of complex U.S. nuclear designs can be done at sub-kiloton levels. However, other nations, such as Russia, may utilize different types of designs whose reliability could be tested at very low nuclear yield—perhaps even at the level equivalent to a few pounds of explosive.

36. Letter from John H. Moseman, Director of Congressional Affairs, CIA to Senator Richard Shelby, January 9, 2001.

37. Speech by Senator Jon Kyl at the Carnegie Endowment for International Peace, June 5, 2000.