Union of Concerned Scientists

FACT SHEET

The Comprehensive Nuclear Test Ban Treaty: Technical Issues for the United States

MAY 2012

A SUMMARY OF THE NATIONAL ACADEMY OF SCIENCES 2012 REPORT

The National Academy of Sciences (NAS) released in March 2012 an update of its 2002 report on technical issues associated with the Comprehensive Test Ban Treaty (CTBT), the international treaty to ban all nuclear-explosion testing. In brief, the new report finds that the United States "has the technical capabilities to maintain a safe, secure, and reliable stockpile of nuclear weapons into the foreseeable future without nuclear-explosion testing" and "is now better able to maintain a safe and effective nuclear stockpile and to monitor clandestine nuclear-explosion testing than at any time in the past."

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The CTBT was negotiated in the 1990s and signed by the United States in 1996. The U.S. Senate debated the treaty in 1999, but declined to ratify it. The Obama administration has said that it will pursue ratification of the CTBT and in 2009 directed the NAS to produce an updated report. The NAS assessment focuses solely on technical issues, not political ones. It looks at the risks to national security that might arise as a result of ratifying the treaty. It finds that those risks are limited because the Stockpile Stewardship Program (SSP), which was established to maintain the reliability, safety and security of U.S. arsenal without nuclear-explosion testing, has been very effective.

The new report, *The Comprehensive Nuclear Test Ban Treaty—Technical Issues for the United States*,[1] strengthens the 2002 report's conclusion that the United States does not need to resume nuclear testing to maintain its security or the reliability of its nuclear weapons. It describes the technical improvements since 2002 in U.S. capabilities to maintain its nuclear stockpile, monitor compliance with a test ban, and detect cheating. It finds that the Stockpile Stewardship Program established to maintain the U.S. nuclear weapons arsenal without nuclear testing "has been more successful than was anticipated in 1999." According to Marvin Adams, a member of the panel that authored the report, "we understand these weapons today even better than we did while testing." The panel also concludes that "the status of U.S. national monitoring and the International Monitoring System has improved to levels better than predicted in 1999." Panel chair Ellen Williams said that the system "has created a capability so that any potential tester would have to be concerned about being detected."

Overall, the report concludes, the United States has no technical reason to resume nuclear testing. Advances in technology and understanding during the past ten years have significantly strengthened the U.S. ability to maintain its existing nuclear stockpile and verify compliance with a test ban, leaving no technical reason not to participate in the treaty. As the panel concludes, "although there are legitimate concerns about maintaining the capabilities needed to sustain U.S. national security into the future…these concerns are *not* the result of intrinsic technical limitations and are not limited by a possible future under the CTBT." [emphasis in original]

The report focuses on four areas: maintaining the U.S. nuclear stockpile; monitoring and verification; sustaining U.S. technical capabilities under the CTBT; and potential technical advances from nuclear-explosion testing. Each is summarized below.

Maintaining the U.S. Nuclear Stockpile

While noting that sustaining the U.S. arsenal will require a continuing commitment of resources and skilled personnel, the report finds that, in terms of technical capabilities, the United States has a greater ability to maintain the safety, security, reliability, and effectiveness of its nuclear stockpile than was anticipated in 2002.

The report identifies a number of significant developments since the 2002 report that support this conclusion, including:

- Recent studies finding that plutonium "pits" (the core of all U.S. nuclear weapons) have a lifetime of at least 85-100 years, reducing the need to produce new pits to maintain stockpile weapons.
- Increases in computing power by a factor of 1,000 (from terascale, or one trillion floating point operations per second (flop/s), to petascale, or one quadrillion flop/

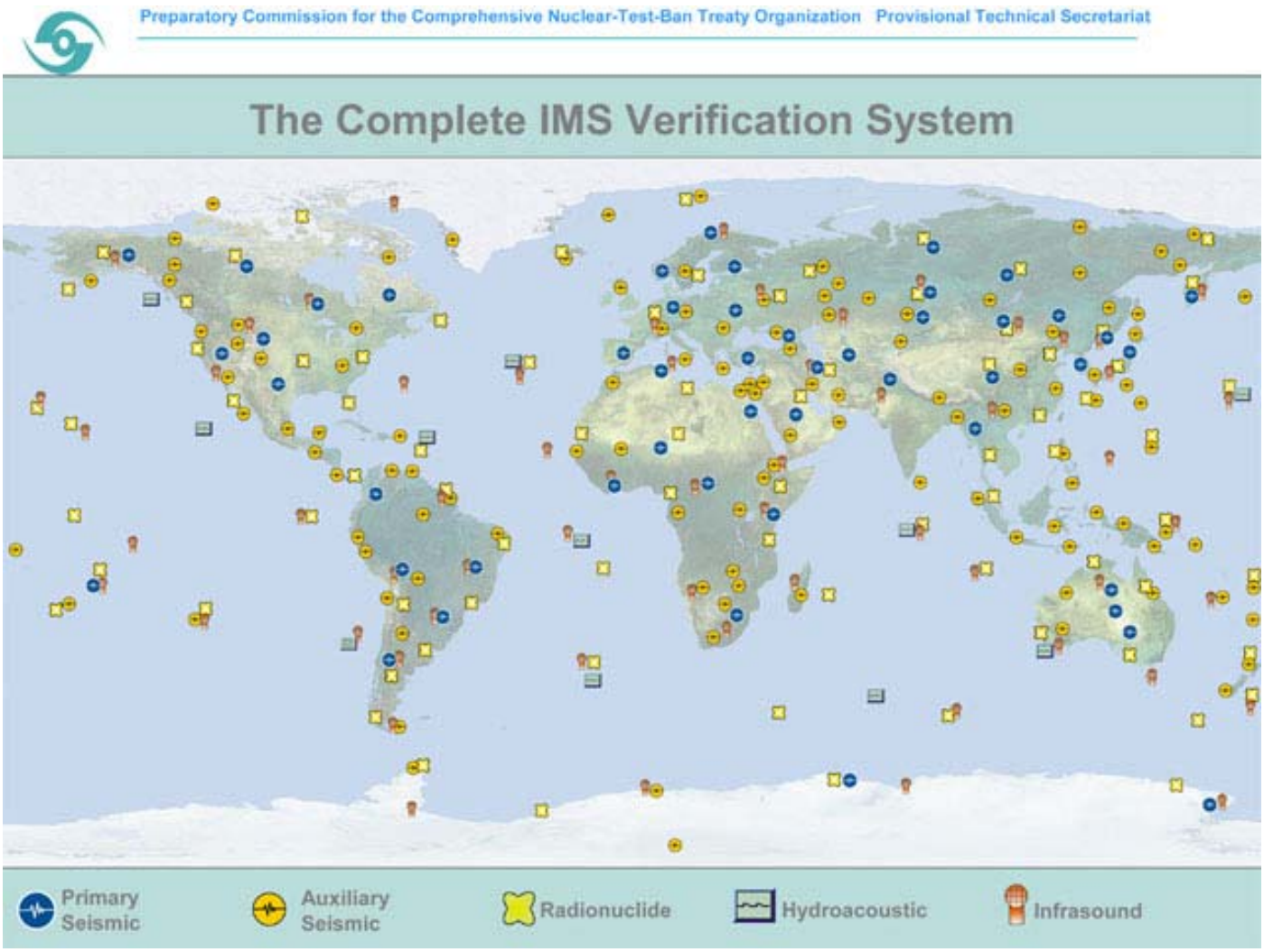
s), which allows better modeling and assessment for weapons programs.
- The completion of several major SSP-related research facilities, including the National Ignition Facility (NIF) at Lawrence Livermore National Laboratory, the Dual-Axis Radiographic Hydrodynamic Test Facility (DAHRT) at Los Alamos National Laboratory, and the Microsystems and Engineering Sciences Application Facility (MESA) at Sandia National Laboratory. All of these facilities help improve understanding of how nuclear weapons work and contribute to the ability to continue to maintain them without additional nuclear-explosion testing.
- Production of certified W88 pits at Los Alamos. These are the first pits manufactured in the U.S. since 1989 and demonstrate that the nuclear weapons complex retains the ability to manufacture pits if needed to maintain stockpile weapons.
- Successful completion of the W87 life-extension program (LEP), including modification of the nuclear explosive package to improve reliability.
- The beginning of a LEP for the W76, including certification of the first production unit. The W76 refurbishment is more extensive than the W87 LEP and requires new manufacture of parts using original design specifications.
- The initiation of two new stockpile surveillance programs for the U.S. arsenal: the Enhanced Surveillance Program (ESP), to improve non-destructive diagnostic tools; and the Surveillance Transformation Project (STP), to collect data more relevant to stockpile stewardship needs, such as data on trends in weapons aging.

In addition, the report states, over the past ten years the nuclear weapons complex has encountered a number of technical issues during its surveillance and design work and has demonstrated its ability to resolve them. During discussions with the committee, directors of each of the three nuclear weapons labs also indicated that "there is no evidence of any technical issues that cannot be resolved with the present competency."

Monitoring and Verification

To ensure that signatory states are in compliance with a test ban treaty, and to detect any tests by a non-signatory state, the United States and other parties to a CTBT need to maintain the ability to monitor nuclear testing worldwide. There are a number of systems that can be used for this, including an International Monitoring System (IMS) run by the CTBT Organization (CTBTO), national technical means (NTM) of member states, and independent networks of sensors deployed for purposes unrelated to nuclear explosion detection (such as seismic networks designed to monitor earthquake activity). The treaty also provides for on-site inspections at the request of signatory states; these must be based on information collected by the IMS or NTM and approved by the CTBTO Executive Council.

Concerns about the ability of monitoring systems to detect low-yield tests or tests that a state attempted to conceal played a role in the U.S. decision not to ratify the CTBT in 1999. Since that time, significant improvements in monitoring capabilities have addressed some of these concerns, including:
- ***Near completion of the IMS.*** This system, which was in an embryonic state at the time of the 2002 NAS report with only three monitoring stations active, is now more than 80% complete. It includes seismic, radionuclide, hydroacoustic, and infrasound monitoring capabilities.
- ***Improved seismic monitoring.*** There have been substantial improvements in technical capabilities for seismic monitoring (to measure underground motion) over the past decade, allowing greater sensitivity in detection, identification, and location of nuclear tests. These improvements affect both the international and U.S. networks.
- ***Improved radionuclide detection.*** Radionuclides (radioactive particles) are produced in high quantities during a nuclear explosion, and can be detected in the air or when deposited on the ground near a detonation site. Over the past decade there have been significant improvements in the U.S. ability to detect radionuclides associated with nuclear testing. Moreover, there is increased coverage by radionuclide monitoring stations in the IMS, leaving little chance that even a small atmospheric nuclear detonation would not be detected.
- ***Enhanced hydroacoustic monitoring.*** The IMS hydroacoustic network (which measures sound underwater) is near completion. This improves U.S. and global capabilities to monitor underwater nuclear testing, and enhances monitoring of underground testing in areas in and around ocean basins. Moreover, there have been improvements in the ability to fuse hydroacoustic and seismic monitoring data, enhancing the ability to detect smaller explosions in some regions of the world.
- ***Establishment of an infrasound network.*** The IMS



When completed, the IMS Verification System will be comprised of 337 monitoring stations, which use 4 monitoring methods, monitor seismic, hydroacoustic and infrasound vibrations and radionuclide respectively, and can detect every nuclear test explosion over the magnitude of 1 kiloton on the globe. In 1999, there were no certified IMS monitoring stations operational; today 271 of the planned 337 stations are certified and operating. For an interactive version of the map above showing the growth of the system over time see http://www.ctbto.org/map/

infrasound network (which measures low frequency sound waves) is now over 70% complete and new methods have been developed for detection and location of explosions. When the full IMS infrasound system is operational, it should be capable of detecting one-kiloton explosions across 90-95 percent of the globe.

- ***Improvements in U.S. satellite capabilities for monitoring nuclear explosions.*** Improved optical detection provides greater sensitivity and coverage, electromagnetic pulse detectors provide confirmation of atmospheric nuclear explosions, and the incorporation of updated data processing and communications technologies allows transmission of critical information to decision makers in near real time.
- ***The detection of two North Korean nuclear tests.*** North Korea conducted tests in 2006 (less than a kiloton) and 2009 (a few kilotons), which provided practical tests of the network's capabilities. Both tests were detected by seismic sensors and were clearly identifiable as explosions rather than earthquakes; the 2006 test provided a real world test of seismic detection for a sub-kiloton explosion in a new region. The 2006 test was also detected by radionuclide sensors.

The report concludes that although U.S. NTM provides greater monitoring capabilities than the IMS, the latter still provides valuable data, both to supplement U.S. information and to allow discussion of events when the United States does not want to share its own sensitive or classified data.

Thus, whether the CTBT is in effect or not, it is in the U.S. national interest to support the international monitoring network.

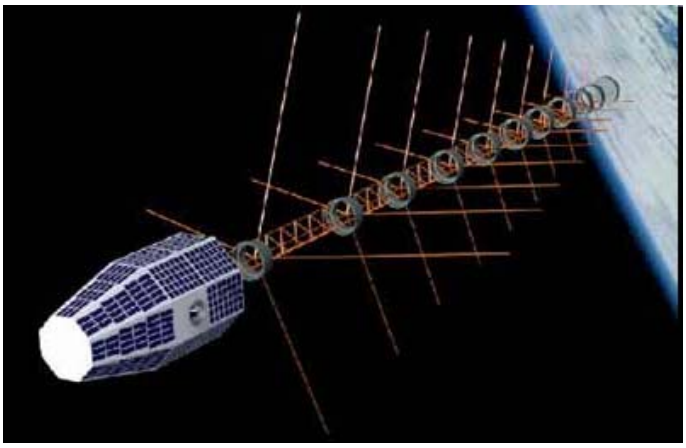
Sustaining U.S. Technical Capabilities under the CTBT

The 2012 panel was explicitly directed to address the issue of sustaining U.S. technical capabilities under a CTBT. Recommendations in specific areas are highlighted below. Most important, however, the panel repeatedly stresses that, "[t]he most serious requirement for sustaining the U.S. stockpile and monitoring capabilities is a clear statement of policy regarding the capabilities that must be maintained, combined with management and support focused on achieving well-defined technical goals underpinning those capabilities." The panel adds that, "The need for such action arises whether or not the United States ratifies the CTBT."

The 2002 report included several observations about the need to maintain a high-quality workforce and the difficulty that the nuclear weapons complex was having in attracting and retaining top-tier scientific talent due to competition with the private sector, budget constraints, and uncertainty about the future of the nuclear weapons program.

The current report concludes that workforce and budgetary issues are still of concern for both stockpile stewardship and monitoring/verification programs, and that several other factors will also be key to sustaining U.S. technical capabilities. These include:

- ***Improved management of the facilities in the nuclear weapons complex.*** Despite the establishment of the National Nuclear Security Administration (NNSA) and changes in the contracting system for nuclear weapons complex facilities, the current system remains inefficient and overly bureaucratic; it lacks sufficient focus on technical missions and does not encourage innovation.
- ***Full support for the CTBTO's monitoring and on-site inspection work.*** Implementation of the full IMS network is in the U.S. national interest and although the CTBTO's on-site inspection capability is less developed, it is moving forward. The United States should support these programs financially and fully participate in their activities, including training and field exercises for on-site inspections.
- ***Continued investment in U.S. monitoring capabilities, including satellites.*** The past decade has seen significant advances in monitoring technologies, but continued improvements will be needed to ensure that the United States stays ahead of possible evasion attempts. This will require investment in personnel and training, access to research facilities, and coordination of sustained investment in the monitoring program among multiple relevant agencies.
- ***The need for "safeguards" to mitigate potential risk the U.S. would assume by ratifying the treaty and constraining its future options.***[2] In addition to those previously proposed by the Clinton administration in 1995,[3] the report recommends that maintenance of adequate nuclear weapons production and non-nuclear explosion testing facilities should be added to the list of safeguards, and that there should be an annual evaluation of the ongoing effectiveness of safeguards.



FORTE (Fast On-orbit Recording of Transient Events), a satellite program to monitor violations of the nuclear test ban. Developed by Los Alamos and Sandia National Laboratories, the FORTE program is sponsored by the Department of Energy as a testbed for technologies applicable to U.S. nuclear detonation detection systems.

The report includes straightforward recommendations on sustaining monitoring and verification capabilities, and the panel notes that the United States has an interest in maintaining these capabilities independent of any decision about the CTBT.

According to the report, the tougher challenge will be maintaining U.S. technical capabilities relevant to its own nuclear weapons program. Repeating their call for a clear policy statement on what capabilities must be maintained and a focus on achieving well-defined technical goals, the panel notes explicitly,"[t]he need for such action arises whether or not the United States ratifies the CTBT."

Potential Technical Advances from Nuclear-Explosion Testing

Like the 2002 report, the current report considers the potential threat to the United States from a state carrying out an undetected nuclear explosion test.

The main change since 2002 is that improved monitoring capabilities make it increasingly less likely that states could evade detection of tests, even if they attempted to conceal their activities.[4] While it might be possible for states to develop lower capability weapons without detection, this would be the case with or without the CTBT. A fully functioning IMS and on-site inspection capability, however, would reduce the risk that clandestine testing could escape detection. And, the report concludes, "such developments would not require the United States to return to testing in order to respond because it already has—or could produce—weapons of equal or greater capability based on its own nuclear-explosion test history."

The threat that could most plausibly lead to a technical need for the U.S. to resume nuclear explosion testing, the panel finds, would be that of an adversary developing a capability that would require the U.S. to develop a new type of nuclear weapon, not previously tested. Development of such a new adversarial capability would be unlikely without significant testing, at the multi-kiloton level, to build confidence in the new design. Such testing would be detectable by NTM or the IMS, allowing the United States to decide whether it could respond with its current capabilities or would need to invoke the supreme national interest clause and withdraw from the treaty.

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[1]Committee on Reviewing and Updating Technical Issues Related to the Comprehensive Nuclear Test Ban Treaty; Policy and Global Affairs; National Research Council of the National Academies, *The Comprehensive Nuclear Test Ban Treaty—Technical Issues for the United States*, 2012, available at: http://www.nap.edu/catalog.php?record_id=12849

[2]Safeguards are unilateral provisions, usually proposed by the administration and adopted by the Senate, that are included with the Senate resolution giving advice and consent to ratification of a treaty and that make ratification contingent on their implementation.

[3]The safeguards proposed in 1995 are: the conduct of a Science-Based Stockpile Stewardship program; the maintenance of modern nuclear laboratory facilities and programs in theoretical and exploratory nuclear technology; the maintenance of the basic capability to resume nuclear test activities; the continuation of a comprehensive research and development program to improve treaty monitoring capabilities and operations; the continuing development of a broad range of intelligence gathering and analytical capabilities and operations relevant to worldwide nuclear programs; and the understanding that the United States would be prepared to exercise the standard "supreme national interests" clause to withdraw from the treaty if the president were informed that a high level of confidence in the safety and reliability of a nuclear weapon type considered critical to the U.S. deterrent could no longer be certified.

[4]The report finds that even an advanced nuclear weapons state such as Russia or China would not have high confidence of avoiding detection of a test at the 1 kiloton level or higher, while testing below the 0.001 kiloton level would likely be undetected.

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