The United States was the first nation to sign the Comprehensive Nuclear-Test-Ban Treaty (CTBT) when it was negotiated in 1996, but the U.S. Senate, after a far too limited debate, failed to recommend its ratification in 1999. This negative decision was based largely on two technical concerns:

1) Can the U.S. retain high confidence in the effectiveness of its nuclear arsenal under the Treaty’s ban on underground explosive testing?

2) Can compliance by other nations with a test ban be adequately verified?

During the past ten years since that Senate decision, significant technical progress has been made toward removing these concerns. Based on this progress, the Obama administration should initiate a timely bipartisan review of the value of the CTBT to the nation’s security, leading to its ratification. The International Monitoring System (IMS) for identifying and locating Treaty violations has been almost entirely deployed and activated since 1999. It impressively displayed its sensitivity and effectiveness by rapidly locating, identifying and determining the very low yield of the 2006 test explosion by North Korea.

In this article I will address the important technical progress made by the United States over the past decade in maintaining high confidence in the nation’s nuclear arsenal under a test ban. Taken together, these achievements give confidence that ratifying the CTBT is not tantamount to the U.S. endangering its nuclear deterrent or otherwise jeopardizing its security.

Remarkable success of the Stockpile Stewardship Program

Following the moratorium on underground tests initiated in 1992 by the first President Bush, the United States established a broad science-based Stockpile Stewardship Program (SSP). This programme is now in its 17th year, or 10 more than at the time of the ratification debate in 1999. There is general agreement that the SSP, to date, has achieved remarkable successes that have enabled the directors of the nuclear weapons laboratories to assure the nation that there is no need to conduct nuclear test explosions for them to certify that the deterrent meets the requirements of safety, security and reliability to function as intended. Two fundamental measures of the programme’s success have been the ability a) to discover causes for concerns in the stockpile, the so-called Significant Findings, whether they are due to design flaws, production errors, or aging; and b) to fix them successfully and promptly.

Here is a representative list of important technical achievements during the past decade that are responsible for the “remarkable success” that the labs have attested to:

- Successful Life Extensions Programs (LEPs) have refurbished materials and components of the weapons in the stockpile to ensure their continued viability with high confidence.

- For the first time since 1989, when the Rocky Flats plant (a nuclear weapons production facility near Denver, Colorado, USA) was closed down because of environmental concerns, the United States can now build new plutonium pits which are the core components of the primaries of thermonuclear warheads that have been certified for deployment, if replacements are needed.

A thorough study by the Los Alamos and Lawrence Livermore National Laboratories has removed a critical concern about the stability of the plutonium metal in the pits as it ages due to radioactive decay while sitting in the stockpile. We can confirm that pit lifetimes are longer than 85 to 100 years.

Where appropriate, the margins by which the yields of the primaries of weapons exceed the minimum values required to ignite the secondaries in thermonuclear weapons have been increased. This has been accomplished by developing more robust boost gas transfer systems.

**Reliable nuclear arsenal maintained since 1992 without testing**

The achievements enabling the United States to maintain a safe, secure, and reliable nuclear arsenal, without explosive testing since 1992, have been made possible by important advances in scientific understanding of nuclear explosions. Critical to this success of the SSP is its ability to maintain a strong cadre of expert scientists and engineers embedded in a programme with both the facilities and vision that allows them to retain and hone their expertise.

Understanding and assessments rely on theory, experiments (including the more than 1000 past nuclear test explosions), and computation. The development of scientific understanding of physical phenomena requires theoretical and experimental investigations. Experiments inform theorists and test their theories. Theories are incorporated into mathematical models that can be solved (approximately) with powerful computers. Powerful new instruments enabled the key experiments that served as stand-in for explosive tests to supply the crucial data.

The importance of strong peer review in this process cannot be overemphasized. In the absence of confirmatory data from a nuclear test explosion, it is necessary to take great pains to carefully assess any modification to or replacement of an existing tested design. It is equally important to subject the assessment to careful scrutiny by an independent team of scientists using an independent set of analysis tools (such as different simulation codes), both to discover any weaknesses in the assessment and to build high confidence in its validity and rigour.

**“I conclude that technically, in terms of maintaining confidence in our nuclear stockpile, there is no barrier to ratifying the CTBT.”**

I believe that it is now clearly in the national security interest of the United States to ratify the CTBT and lead a global effort to bring it into force. It would strengthen the non-proliferation regime by constraining further development and deployment of the world’s most devastatingly destructive weapons. It would enhance diplomatic efforts to reduce nuclear dangers for all nations, en route toward realizing the vision of a world free of nuclear weapons.

**Biographical note**

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