

A winning gambit

Nuclear armed States stand to gain more than they lose from CTBT ratification

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Countries tested nuclear weapons for technical, political and military reasons. Even though Siegfried Hecker, former Director of the Los Alamos National Laboratory, mentions the positive aspects of nuclear testing, he also explains why it is critical to erect as many barriers as possible to prevent the resumption of testing, the most important barrier being the CTBT's entry into force.

During the Cold War, nuclear testing played a crucial role in increasing the sophistication of nuclear weapons. As nuclear weapons became smaller, delivery methods moved from planes to ships and eventually to missiles.

I believe that countries tested for technical, military and political reasons.

DEMONSTRATING TECHNICAL CAPABILITIES CAN MAKE THE WORLD A MORE DANGEROUS PLACE

In the United States, the main reason for testing was unquestionably technical – we had to demonstrate that the plutonium bomb worked so we exploded the Trinity bomb in the New Mexico desert before a similar bomb was used at Nagasaki. We continued to test and to improve

technologies for nuclear weapons. While I was Director of Los Alamos National Laboratory, the issues of ratifying the Threshold Test Ban Treaty and signing the Comprehensive Nuclear-Test-Ban Treaty (CTBT) came up. In 1995, President Bill Clinton and Secretary of Defense Bill Perry asked me to give a technical assessment of the need for testing.

The question posed by the Chairman of the Joint Chiefs of Staff, General John Shalikashvili, on behalf of President Clinton and Secretary Perry, was whether we needed to test to be able to certify the US nuclear stockpile. I replied that our weapons were safe, secure and reliable and since US policy was not to field weapons with new capabilities, I could not say that we had to test to keep them that way. But, I could not guarantee that they would remain so over time, so they would have

to ask us (the directors of the nuclear weapons laboratories with the technical responsibility for the US arsenal) as the weapons aged or were replaced.

President Clinton signed the CTBT in 1996 and instituted an annual certification process, which requires the laboratory directors to assess the safety, security and reliability of the nuclear stockpile without nuclear testing. The directors of the Los Alamos and Lawrence Livermore national laboratories have continued to certify the US stockpile as safe, secure and reliable without nuclear testing since 1996.

For nuclear weapons, as for any other sophisticated technology, testing had been an indispensable tool for scientific and technological advancement during the Cold War. Over the years, nuclear testing had



President Bill Clinton signing the Comprehensive Nuclear-Test-Ban Treaty on 24 September 1996.



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conducted nuclear tests to declare their nuclear power status. After an interlude of 24 years since its 'peaceful' nuclear explosion in 1974, India tested three devices on 11 May 1998, followed by another two on 13 May. Pakistan retaliated within two weeks with six tests of its own in two separate testing events.

first 20 years. The military needs to gain confidence in the technical community and testing demonstrates a country's nuclear capability. That was the case for the United States and the Soviet Union. They performed many tests and possessed huge nuclear arsenals. The Chinese have a different philosophy: they believe in minimal nuclear deterrence and, hence, are believed to have a small arsenal. North Korea claims it built nuclear weapons as a deterrent, primarily against the United States. However, during my discussions with North Korean authorities in Pyongyang I found little consideration of how they would actually use their nuclear weapons, nor did they seem well versed on the issues of safety and security of nuclear weapons or military posture.

not only allowed for greater sophistication of weapons, but it had also helped to assure the safety, security and reliability of the nuclear arsenal.

The Soviet Union, France and China also tested for technical reasons. France conducted a significant number of tests for the size of its arsenal – 204 tests by 1992. President Chirac announced in June 1995 that France would carry out eight more tests in the Pacific before pulling out of the area and signing the CTBT. The French justified the tests on the grounds that they wanted to make their arsenal safer and more robust. Technical progress and international pressure limited the number of tests in that campaign to six. The Chinese also continued testing for reasons of safety and the need to modernize their arsenal. They completed a test series and signed the CTBT in 1996.

In 1998, the world became a more dangerous place when India and Pakistan

Although the Indian and Pakistani tests demonstrated that their nuclear weapons programmes, both decades in the making, produced functioning nuclear devices, the tests must also have raised many more technical questions. It is common testing practice to stage the timing of tests to allow the results of one to inform the design of the next. This was not the case for India and Pakistan because the five Indian tests in 1998 were conducted almost simultaneously, as were all six Pakistani tests. In nuclear testing, as in most technological ventures, there is always something that doesn't work the way you intended, no matter how good the computers are or how many laboratory tests have been conducted. The Indian and Pakistani test experiences did not allow for learning from one test to guide the design of the next. Hence, there must be strong technical drivers for them to test again.

For deterrence to work, nuclear weapons must be effective. A lot of testing was carried out for military reasons during the Cold War, especially during the

MAKING A 'POLITICAL STATEMENT' WITH NUCLEAR TESTS

The bombs that the United States dropped on Hiroshima and Nagasaki in August 1945 were not only supposed to end the war with Japan but also to send a signal to the Soviet Union. When the Soviets detonated the 'Tsar Bomba' over Novaya Zemlya on 30 October 1961, they were also making a powerful statement. The bomb was designed for 100-plus megatons but the Soviet designer, physicist Andrei Sakharov, persuaded Soviet leader Nikita Khrushchev to test it at half yield. Yuri Trutnev, the co-designer of the 'Tsar Bomba,' explained to me (years later) that the bomb had no military significance but it was exploded to send a message to the rest of the world, i.e. that they were capable of developing a bomb at any level. It is

difficult to imagine the destructive power of a 100-megaton bomb – that's equivalent to 5,000 Nagasaki bombs!

France also tested for political reasons, particularly during the days of President Charles de Gaulle. China had political grounds, to some extent. Political reasons include declaring a country's nuclear status, which was the case for India, and to some extent Pakistan and North Korea. India tested in two phases – first in 1974; what they called a 'peaceful' nuclear explosion. So, it was clearly not strictly driven by national security concerns. Then in 1998, when security was a somewhat greater issue, but I believe the main driving force was domestic politics. Pakistan was obviously concerned about its security because of India: once India tested, Pakistan felt that it had to test as well, making South Asia one of the most dangerous areas in the world. The 1998 tests and the North Korean tests in 2006 and 2009 did significant damage to the international security regime.

North Korea's nuclear programme was principally driven by national security, but the 2006 test changed everything, particularly how North

Korea looked at itself: Pyongyang began to use its self-declared nuclear power status as an international bargaining tool that helped keep the regime in power. In addition, once it tested, the bomb took on domestic importance. It was used to underscore the great danger Pyongyang faces and the need for its people to continue their sacrifices to fend off these dangers. Now for all three reasons – security, making an international statement and domestic reasons – it will be difficult to get North Korea to give up its nuclear weapons. The international community powers must convince Pyongyang that it would be better off without testing and without a nuclear arsenal.

THE PERILS OF THE DISSOLUTION OF THE SOVIET UNION AND THE RISE OF THE 'NUCLEAR WALMART'

I became Director of the Los Alamos National Laboratory shortly after Mikhail Gorbachev came to power in the Soviet Union in 1985. My personal focus changed from technical work in materials science and plutonium metallurgy and being preoccupied with

detering the Soviet Union, to trying to understand how the world's nuclear threats were changing. The immediate danger at that time was the unstable situation in Russia: the country was going through political, economic and societal turmoil while possessing an enormous amount of nuclear materials and a huge nuclear arsenal. Much of my work over the last 20 years has focused on helping the Russian nuclear complex deal with these challenges.

In the late 1990s we were confronted with the additional danger posed by A.Q. Khan and a number of European businessmen who set up the 'Nuclear Walmart', a proliferation network, which involved selling to aspiring nuclear powers the components to make and enrich uranium or to build their own reactor. They also sold nuclear device design data and nuclear test data, making it even more dangerous.

The world changed again with the events of 9/11. Over the last decade or so, the key international nuclear challenges have been those associated with horizontal proliferation and nuclear terrorism.



Siegfried Hecker, third from right, visiting the Yongbyon Scientific Nuclear Research Center, North Korea, August 2007.

"The international community powers must convince Pyongyang that it would be better off without testing and without a nuclear arsenal," urges Hecker in his article.



World view of former and inactive nuclear test sites.

In Hecker's words: "The CTBT constrains nuclear weapons development and the sophistication of nuclear arsenals. It also reduces the risk of a renewed arms race, especially between India and Pakistan."

WHY TEST NOW OR IN THE FUTURE?

From the American perspective, the focus since 1992, when we conducted our last nuclear test, has been on the safety and reliability of the country's nuclear weapons. I was in Washington when President George H.W. Bush announced the nuclear testing moratorium in 1992. When I returned to Los Alamos I told my technical people: "Testing is over. It will be our responsibility to assure the nation that our weapons are safe, secure and reliable without testing. How are we going to do that?" This continues to be the focus today. The weapons must continue to be safe. They must also be more secure since we now face a level of international terrorist threat unimaginable before 9/11.

Some people claim that we do not need to test because of the enormous advances in computing power and the fact we have acquired a better fundamental understanding of how weapons work through what we call the Stockpile Stewardship Program (SSP). I disagree with those who say we lose nothing by not testing. There are benefits to nuclear testing, just like

in any technological enterprise. Testing represents the ground truth; it keeps the technical experts honest. However, nuclear testing also incurs a cost and the real question is whether or not the costs are greater than the benefits.

WHAT CONSTRAINS NUCLEAR TESTING?

To understand the benefits and costs of nuclear testing, we must understand why countries would want to test and what constrains them from doing so. I have already pointed out that there are technical, military and political reasons for testing. For the United States and Russia, with their huge nuclear arsenals, a return to testing would primarily be directed at keeping those arsenals safe, secure and reliable. For China, India, Pakistan, and North Korea there would also be strong drivers to test to enhance the sophistication of their arsenals. France and the UK are similar to the United States and Russia.

What constrains countries from testing are international norms, domestic pressures, and technical or financial factors. For the United States, it is primarily international norms that constrain it from testing. There is a strong desire by some to have the

United States lead the international non-proliferation regime. Unfortunately, that's not what Washington has done by failing to ratify the CTBT. For the United States there is also significant domestic pressure against testing and there are some financial constraints because it has become so expensive to test.

In Russia, the only constraints I see are international norms and pressures – the same applies for China. The UK and France also have technical constraints because they have no nuclear test site. Israel, of course, is a special case, but it is subject to similar constraints as the UK and France. India and Pakistan have kept the testing option open while observing the moratorium. India has international and domestic constraints, whereas I believe that international pressure is the only thing that prevents Pakistan from testing again. And pressure from China has had some, albeit limited, effect on North Korea.

For North Korea the main technical constraint is the lack of bomb fuel. They only have between 24 and 42 kg of plutonium, which is enough to make between four and eight bombs. There's no plutonium in the pipeline because their plutonium production reactor was shut down in 2007 and has not been restarted. We don't know exactly where

they are with regard to highly enriched uranium but that presents significant additional problems in terms of testing. When I was in North Korea in November 2010, Pyongyang revealed its uranium enrichment facility during my visit to the Yongbyon nuclear complex. Prior to this time, I had assumed that the uranium enrichment programme was at a research and development scale, but what they showed me was far greater and much more sophisticated. It is imperative that the North Koreans don't build more bombs or test again to build more sophisticated weapons.

BENEFITS OF THE CTBT

The CTBT constrains nuclear weapons development and the sophistication of nuclear arsenals. It also reduces the risk of a renewed arms race, especially between India and Pakistan. The Treaty supports the nuclear non-proliferation regime and is consistent with Article VI of the Nuclear Non-Proliferation Treaty (NPT) and the eventual elimination of nuclear weapons. And although the health and ecological effects of testing are more limited today than during the days of atmospheric testing, the CTBT limits potential radioactive leakage from underground tests.

THE VERIFICATION ISSUE AND THE DEFINITION OF 'ZERO YIELD'

Great progress has been made in CTBT verification technologies and protocols. Nevertheless, there are critics who contend that low-yield, decoupled explosions cannot be detected. So, the issue is how proper protocols can be implemented and how to determine the military significance of such low-yield explosions, if such tests are conducted.

In the United States there will definitely be considerable focus on the definition of 'zero yield'. What does it really mean to have no nuclear testing? I believe it comes back to the issue of what is militarily significant. There is particularly great concern in the United States about potential asymmetries in how Russia and China define nuclear

testing and zero yield. Nevertheless, I believe that we have adequate verification capabilities today and that we can build in sufficient safeguards and verification measures to make the Treaty adequately verifiable.

IN THE END, THE BENEFITS OF THE CTBT OUTWEIGH THE RISKS

As I pointed out, the CTBT poses challenges for nuclear armed States to keep their arsenals safe, secure, and reliable as long as they possess nuclear weapons. The technical risks of not testing must be mitigated by other means; for example, a robust SSP that leads to a better fundamental understanding of nuclear weapons and an extensive stockpile surveillance programme to assess and understand aging-induced changes in the stockpile. Likewise, a country's nuclear weapons policies influence the risks of a CTBT. In the United States, for example, the policy of not developing nuclear weapons with new capabilities greatly reduces the technical risks incurred by a CTBT. During the Cold War, testing was necessary to meet the government's drive to continually upgrade the arsenal to counter the perceived Soviet threat. It was also used to explore entirely new weapons concepts and potential vulnerabilities.

As already pointed out, not testing greatly constrains the ability of a country to build more sophisticated nuclear arsenals and, consequently, it reduces the risk of an arms race. Therefore, it is critical to erect as many barriers as possible to the resumption of testing. Ratification of the CTBT and its entry into force is the most important such barrier. We should not settle for the current moratorium on nuclear testing. In addition to these global benefits, each of the States possessing nuclear weapons, in my opinion, has much to gain from a comprehensive test ban.

The United States and Russia have conducted 1,054 and 715 nuclear tests, respectively. Along with France and the UK, they benefit greatly by not having China test since it has conducted only 45 tests. China benefits because India, with only six nuclear tests, will not be

able to enhance its arsenal significantly. India benefits by constraining Pakistan, which has also only conducted six tests, and appears to be readying plutonium-based tactical nuclear weapons for its arsenal. Pakistan benefits by India not being able to increase the sophistication of its weapons. The testing moratorium by the major nuclear countries did not stop Pyongyang from testing and it may not be a decisive factor in Tehran's decision as to whether it may test in the future. However, the increased international pressure of a ratified CTBT may increase the effectiveness of international constraints and possibly affect their decision. Regardless, I believe the States possessing nuclear weapons today have more to gain by CTBT ratification and entry into force than they lose by not testing.



In September 2011, while in Vienna to lecture at the CTBT Introductory Course, Siegfried Hecker gave an in-depth interview in which he discussed his views on the benefits, and the challenges, of ending nuclear testing

To watch the interview point your browser to: ctbto.org/faces

BIOGRAPHICAL NOTE

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He is currently engaged as research professor in the Department of Management and Engineering at Stanford University, senior fellow at the Freeman Spogli Institute for International Studies, and co-director of the Stanford University Centre for International Security and Cooperation.

This article is loosely based on a presentation Dr Hecker made at the CTBT Introductory Course in Vienna in September 2011.