The Comprehensive Nuclear-Test-Ban Treaty (CTBT): Current Capabilities of the Verification Regime

Given the considerable progress that has been achieved in the past decade and the experience gained, there is a very high probability today that States would be able to discover any nuclear test using data generated by the CTBT verification regime and other assets available to individual States.

Advanced status of International Monitoring System (IMS) build-up

In the late 1990s, only a small number of monitoring stations of the 337 facilities foreseen in the CTBT were in place. Today (March 2009), the IMS is approaching completion. 246 of the IMS facilities[1] have been certified and are providing near real time data to CTBT member states. More than 30 stations are under construction. The IMS stations are dispersed around the globe and are located in the territory of 89 States.

Science and technology advances

- The past decade has seen considerable advances in the sciences and technologies of relevance to the detection and location of nuclear tests. Since 2004, the volume of IMS data transmitted to the International Data Centre (IDC) in Vienna has tripled and a new global communications infrastructure for relaying that data has been installed. Data analysis has improved significantly through better computers and software.[2]
- The noble gas technology, in particular, which was at an early experimental stage at the time of the conception of the CTBT verification regime, has significantly increased the ability to detect and identify nuclear explosions.
- The IMS seismic network has shown a higher capability to detect signals from some areas (e.g. Eurasian continent) compared to the capabilities in the 1990s. In addition, existing non-CTBT seismic systems provide States with a dense network. Moreover, there is a better understanding today of Earth-models and a better ability to understand seismic observations from close distances.
- The different technologies of the IMS complement each other in increasing the verification capabilities to a degree not foreseen in the 1990s. This goes in particular for the radionuclide/noble gas network with the seismic network.

On-site inspections (OSI)

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[1] As per end of 2008, 40 primary seismic stations, 89 auxiliary seismic stations, 41 infrasound stations, 10 hydroacoustic stations, 55 radionuclide stations (among them 20 noble gas stations) and 10 radionuclide laboratories of the International Monitoring System have been certified.

[2] See "Nuclear Weapons in 21st Century U.S. National Security" p7; Report by a Joint Working Group of AAAS, the American Physical Society, and the Center for Strategic and International Studies; December 2008 (http://cstsp.aaas.org/content.html?contentid=1792); "*A key development in the almost ten years since the 1999 Senate rejection of CTBT ratification has been the global expansion of seismic and other sensors, including the International Monitoring System (IMS), whose sensitivity has been validated by the numerous natural events that are continuously recorded down to magnitudes lower than the design criteria of the IMS. Thus, CTBT cheating will be very difficult to hide and unlikely to result in nuclear weapon advances that would alter the strategic balance between the United States and major powers. It is in U.S. interests to freeze nuclear weapons technology and the CTBT would greatly hinder further nuclear weapon innovation.*"

Given the enhanced detection, location and attribution capabilities of the IMS, on-site inspections have become an even more potent tool to both verify compliance with the CTBT and to deter potential violators. OSIs, the final verification measure under the CTBT, can only be invoked after entry into force.

DPRK nuclear test in 2006

Although only 180 or 60 % of the IMS stations had been installed when North Korea conducted a nuclear test on 9 October 2006, the verification system exceeded the expectations of the Treaty negotiators in 1996 in terms of sensitivity, reliability, precision and characterization. The technical capability of the system was demonstrated through the quality of information and data generated by the IMS and the IDC. The low yield explosion (well under one kiloton) was detected by over 20 of the IMS stations worldwide, which registered the shock waves in the ground. One radionuclide station picked up traces of the noble gas Xenon generated by the explosion through Atmospheric Transport Modelling backtracking analysis. The seismic findings also allowed for the identification of a possible inspection area of well below 1,000 km^2, which is the maximum area allowed for an on-site inspection under the Treaty.

Since 2006, the build-up of the noble gas element of the system in particular has been accelerated, from 10 systems in October 2006, to 20 systems in January 2009 (and 40 systems when the system is completed). All together, more than 80 additional IMS stations have been added to the system since the North Korean test, significantly enhancing the verification capabilities.

Evasion

The 2002 non-partisan, peer-reviewed report by the US National Academy of Sciences concluded that it would be highly unlikely that any nuclear test of military significance would go undetected[3]. Such a likelihood has further decreased significantly in light of the above-cited advances in the verification sciences and technologies (i.e. noble gas and data analysis) and the state of the build-up and proven capabilities of the IMS (i.e. North Korea). Moreover, the seismic detection capability of the IMS today is significantly better in many parts of the world than the level discussed during the Treaty negotiations in the mid 1990s. In addition, the ability to detect radionuclide noble gases is less dependent on the yield of the explosion than on the geological and other conditions at the source, and underwater explosions in the oceans can be detected down to very low yields (tons or hundred of kilograms). Additional national technical means of verification and the possibility of an on-site inspection further decrease the chances for a potential violator to evade detection and, thus, provide for a powerful deterrent.

[3] National Academy of Sciences (NAS), *Technical Issues Related to the Comprehensive Nuclear-Test-Ban Treaty*, Washington, D.C., National Academy Press, 2002, pp. 10. The NAS report concludes that: “Very little of the benefit of a scrupulously observed CTBT regime would be lost in the case of clandestine testing within the considerable constraints imposed by the available monitoring capabilities. Those countries that are best able to successfully conduct such clandestine testing already possess advanced nuclear weapons of a number of types and could add little, with additional testing, to the threats they already pose or can pose to the United States. Countries of lesser nuclear test experience and design sophistication would be unable to conceal tests in the numbers and yields required to master nuclear weapons more advanced than the ones they could develop and deploy without any testing at all. The worst-case scenario under a no-CTBT regime poses far bigger threats to U.S. security—sophisticated nuclear weapons in the hands of many more adversaries—than the worst-case scenario of clandestine testing in a CTBT regime, within the constraints posed by the monitoring system.”

The Comprehensive Nuclear-Test-Ban Treaty (CTBT):

Non-Proliferation Value

Today's non-proliferation context is significantly different from the late 1990s. There are new and complex non-proliferation challenges, made even more challenging by an emerging global nuclear renaissance. In addition, nuclear terrorism is widely seen as one of the main threats facing the international community. Viewed against this radically altered backdrop, the relevance of the CTBT has only increased further. The CTBT is not only a measure in its own right (test ban), but also a catalyst for progress in the wider nuclear non-proliferation and disarmament context.

Progress towards the CTBT's entry into force, in particular the ratification by the U.S., will provide new momentum to multilateral arms control efforts. It will likely facilitate agreement in several arms control fora that have been blocked in recent years, notably the Conference on Disarmament. It will also increase the chances of achieving a successful (and badly needed) outcome of the 2010 Review Conference for the Non-Proliferation Treaty (NPT) to strengthen the non-proliferation and disarmament regime. In addition, CTBT ratification by the U.S. will be beneficial for the U.S.-Russia strategic relationship.

The CTBT is a strong instrument for non-proliferation. It limits the ability of countries that do not have nuclear weapons to develop these weapons. A country that does not have the capability beforehand and builds a nuclear device will face many uncertainties with regards to the performance of the device. Uncertainty will increase when trying to make it deliverable by cruise or ballistic missile when weight is a major factor. This in turn greatly reduces the possibility of integrating nuclear weapons in military planning or strategic doctrines. The CTBT is therefore the last hurdle to a significant nuclear weapons capability. This is of particular significance in light of current non-proliferation challenges, such as Iran and North Korea.[4]

In addition, the issue of nuclear testing is clearly separate from the inalienable right of nuclear energy for peaceful purposes under Article IV of the NPT, as testing is not necessary to pursue a peaceful nuclear program. If Iran wishes to restore confidence in the exclusively peaceful nature of its nuclear programme, CTBT ratification would be a logical step. This is a requirement around which international consensus could be easily built. In the case of North Korea, the importance of a legally binding ban on nuclear testing is evident, and should be considered as a next logical step in the Six Party talks.

The CTBT is also a catalyst for nuclear disarmament. It provides a firm legal barrier against nuclear testing, thereby curbing the development of new types and new designs of nuclear weapons. This will be essential when moving towards deeper arms reductions between Russia and the United States. It will also be essential in a future multilateral disarmament process that involves all the nuclear armed states. In this context, it will be particularly important that the CTBT is a non-discriminatory instrument: the ban on testing is the same for everyone, nuclear weapon States and non-nuclear weapon States alike.

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[4] See Mark Fitzpatrick in Arms Control Today Jan/Feb 2009; Forestalling Nuclear Proliferation in the Middle East; "(…) *The legal barrier between latent capability and weaponization could be strengthened if Iran were to ratify the Comprehensive Test Ban Treaty (CTBT), which will require the United States to exercise leadership in following through with its own ratification. It may be argued that the CTBT has little significance for Iran if it acquired a weapons design from the Abdul Qadeer Khan network that it would not need to test anyway, but CTBT ratification would add to the overall legal framework constraining Iran's options*."

The CTBT is a strong confidence- and security building measure. In the U.S.-Russia strategic relationship, additional confidence would be gained if the United States were to ratify the Treaty as Russia has done; a point that is frequently underscored by Russian officials. This would assist arms control measures such as de-alerting, strategic and non-strategic arms reductions, and changes of strategic doctrines. The extension of the provisions of the START treaty, the completion of the SORT treaty and reductions beyond SORT would be facilitated with a CTBT in force.

The CTBT could also serve as a regional confidence and security building measure. Ratification of the CTBT by states in the Middle East, in particular the Annex 2 States Egypt, Iran and Israel, would be a positive catalyst for other security related issues affecting the region. Similarly, there is a need to engage India and Pakistan on a range of security and arms related issues. The CTBT would naturally be one of them, providing a cap on the further development of nuclear weapons and thus on the further production of weapons materials to that end. The importance of a legally-binding commitment on nuclear testing in this regional context should not be downplayed. In a wider regional context, much would be gained for confidence- and security building in Asia if the continent as a whole moved towards ratification.

A consensus agreement on the CTBT and its entry into force will be essential if the Non-Proliferation Treaty and its current review process is to be successful. Looking back in history to the negotiations of the NPT in the 1960s with the inclusion of the permanent nuclear test ban in the preamble of the Treaty, and to the successful review conferences of 1995 and 2000 as well as the unsuccessful ones over the years, the critical role of the CTBT in ensuring success within the NPT review process becomes clear. Progress on the CTBT prior to the 2010 NPT Review Conference will be a catalyst for progress on other measures necessary for the strengthening of the non-proliferation regime (e.g. agreement on an FMCT, strengthening of the IAEA Safeguards system (including the Additional Protocol), a multilateral system of guaranteed supply with nuclear fuel and tighter expert controls).

The CTBT is of crucial relevance given the prospect of a nuclear energy renaissance. More and more States are mastering the nuclear fuel cycle. The decision between using nuclear energy for peaceful or for weapons purposes will become more of a political and legal issue than one of technology and knowhow. Legal instruments “upstream” of the nuclear fuel cycle are facing increasing difficulties when it comes to the delineation between prohibited and permitted activities (e.g. IAEA Safeguards regime in the case of the Iranian nuclear programme). A nuclear test provides unquestionable “downstream” proof of the intentions of a State. The CTBT thus provides the last and clearly visible barrier between the two. This legal line needs to be drawn clear and irrevocably. A CTBT in force would also be an incentive for ending the production of fissile material for weapons use, pending the entry into force of a Fissile Material Cut-Off Treaty, as well as reducing the stocks of such materials.

The nuclear security and non-proliferation system is not yet ready to deal with a nuclear renaissance as it is forecasted. Such a renaissance must go hand in hand with a strengthening of the relevant legal regimes. With more fissile material in circulation, and more actors handling that material, a comprehensive system of barriers against misuse is required. This means a Fissile Material Cut-Off Treaty in force, IAEA safeguards and the Additional Protocol as the accepted norm, tighter export controls, multilateral fuel assurances, and downstream of the nuclear fuel cycle – the CTBT. A new international consensus needs to be forged around these measures.

Of these urgent issues, progress on the CTBT is the one measure that is most urgently awaited by the international community. It is also the one measure where progress can be achieved in a relatively short time, since the Treaty is already in place - it has been signed by 180 and ratified by almost 150 states - and the verification regime is close to completion. While the CTBT is not the answer to all of the challenges facing the non-proliferation regime, it is part and parcel of a comprehensive nuclear non-proliferation regime that is needed to address current and future challenges. The CTBT’s entry into force may pave the way for solving the most important of them.