Near-Term Confidence Building Measures for the CTBT
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Introduction

The 2012 National Research Council (NRC) report, *The Comprehensive Nuclear Test Ban Treaty: Technical Issues for the United States* examines issues related to the Comprehensive Nuclear Test Ban Treaty (CTBT) from the perspective of U.S. national security. It is charged with answering four questions: (1) Can the U.S. maintain its nuclear weapons without nuclear-explosion testing? (2) How well can the U.S. detect, locate, and identify nuclear explosions? (3) What does the U.S. need to do to sustain nuclear weapons and test monitoring systems? And (4) what kinds of nuclear weapons developments are possible under the constraints of a CTBT (vs. a return to nuclear testing)? Since its release in late March 2012, the NRC CTBT report has been praised as a balanced, technical assessment of the CTBT's impact on U.S. national security by those on both sides of the ratification debate in the U.S.

As part of the section on detecting, locating, and identifying nuclear explosions, the NRC CTBT report recommends that "the United States…pursue bilateral and…multilateral programs of scientific cooperation for purposes of confidence building in support of monitoring nuclear explosions" (p.74). This paper builds on this recommendation and proposes additional confidence building measures for the U.S. to undertake with members of the P5 that improve CTBT monitoring capabilities and increase transparency. Complementary confidence building measures, like efforts to cooperatively monitor at and around nuclear test sites and technical data exchange between the members of the P5 would be useful from the perspective of the U.S. ratification debate and facilitate the process of CTBT entry into force.[1]

CTBT Monitoring and Verification

The CTBT International Monitoring System (IMS) established by the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) Preparatory Commission was established to detect violations of the CTBT and serves as a deterrent against attempts to cheat.[2] The capabilities of the IMS have improved steadily and the system is almost 90 percent complete. The NRC CTBT report finds that today, any cheater in the Northern Hemisphere "would need to restrict device yield to levels below 1 kiloton (even if the explosion were fully decoupled) to ensure no more than a 10 percent probability of detection by IMS and open monitoring networks" (p.112). Although the IMS is strong and getting stronger, the NRC CTBT report notes that "any monitoring system intended

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[1] Of the P5, only China and the United States have not ratified the CTBT. There have been strong indications that if and when the United States ratifies, China will ratify, too.

[2] After the U.S. Senate failed to give its advice and consent to the ratification of the CTBT, U.S. General John Shalikashvili noted in his 2001 report that "the value of a verification system extends well past the range where a monitor has high confidence of detecting, identifying, locating, and attributing a violation, and down into the gray area where a potential evader lacks certainty about the likelihood of discovery. See: http://www.fas.org/nuke/control/ctbt/text/shalictbt.htm

to support verification of Treaty compliance—whether the CTBT's IMS, National Technical Means or other systems—has to be considered potentially imperfect. The system will have sensitivity, as well as resolution in space and time, below which events are unreliably detected…" (p.73).

It is up to a state's leadership to determine if activities that can take place without detection under the CTBT have the potential to harm state security. The IMS has exceeded expectations and has already achieved its design goal of being able to detect tests in most places in the world above 1 kiloton but it is often those opposing an arms control treaty who determine the level of verification[3] that is sufficient. Some in the U.S. feel that states (other than the U.S.) would conduct small "hydronuclear" experiments or decoupled nuclear explosions—both violations of the CTBT—at levels that are impossible to detect by the remote technical monitoring means incorporated into the IMS. Theoretically, low-yield nuclear tests can be used to improve nuclear weapons, and it is therefore argued that since the IMS cannot detect tests at very low levels the Treaty would put the U.S. at a strategic disadvantage and should not be ratified.

The NRC CTBT report anticipated this objection, recommending that "although in principle it would be desirable to improve test-site transparency with all States possessing nuclear weapons, the United States should give priority to Russia and China. They are the States whose weapons programs are of the greatest strategic concern [to the U.S]. They are also the States most capable of benefiting from very-low-yield testing" (p. 75). The IMS detection capabilities at known test sites are sensitive enough to detect tests greater than 1 kiloton of explosive yield even after evasion measures such as decoupling.[4] The NRC CTBT report describes the potential benefits that states could gain by clandestinely testing under the 1 kiloton detection threshold (although it states that there is still a significant risk of detection even below this threshold) as well as under the 100 ton and 1 ton thresholds.[5] Additional complementary confidence building measures undertaken in cooperation by members of the P5 are useful ways to address the potential gains states could make by testing at very low levels. This paper proposes three; (1) monitoring at nuclear test sites, (2) transparency visits to nuclear test sites and (3) additional seismic monitoring around nuclear test sites.

Monitoring at Nuclear Test Sites

[3] It is helpful to remember U.S. Ambassador Paul Nitze's famous quote regarding "effective" verification for the Intermediate-Range Nuclear Forces Treaty during the Ronald Reagan administration: "If the other side moves beyond the limits of the treaty in any militarily significant way, we would be able to detect such a violation in time to respond effectively and thereby deny the other side the benefit of the violation."
[4] Specifically "a maximum yield for fully decoupled tests using a DF of 20-40 would be between 0.04 and 0.42 kilotons" or about 40-420 tons in Novaya Zemlya (p.145). For Lop Nor, the same confidence level comes from "a yield of 0.02 kilotons (20 tons) fully coupled in hard rock. For decoupling factors of 20 and 40, the corresponding yields are 0.4 and 0.9" kilotons or about 400-900 tons decoupled (p.150).
[5] Table 4-3 in the NRC CTBT report updates Table 3-1 from the 2002 NRC CTBT report *Technical Issues Related to the Comprehensive Nuclear Test Ban Treaty*, and indicates that for tests under 1 kiloton, states with greater nuclear testing experience (Russia and China) could gain insights into boosted-weapon designs, one-point safety, validation of unboosted designs, stockpile and design code issues, low-yield weapons, compact weapons with yield up to 1 kiloton, and the validity of some untested implosion weapons design (p. 116).

Any treaty monitoring system will be limited by the technical capabilities of that system, no matter how sensitive or well designed, no purely technical system will ever be omniscient. The CTBT already has the most advanced verification provisions of any multilateral arms control treaty. It is unlikely that the Treaty will ever be formally amended to include additional stations or capability outside of the four agreed monitoring technologies (seismological, radionuclide, hydroacoustic, and infrasound) within the IMS.[6] However there are ways to augment the capabilities of the IMS for specific locations.

The NRC CTBT report states that "allowing continuous measurement at a test site would also decrease the detection threshold significantly for that location" and cites recent DOE/NNSA experiments at the U.S. test site that "contained on the order of a few kilograms of explosive, and this amount was easily detected by seismometers approximately a kilometer away from ground zero" (p. 74-75). The P5 could work together to jointly design monitoring instruments for installation at their nuclear test sites. There is some precedent for this idea, efforts to improve monitoring and verification of U.S. and Soviet Union underground nuclear explosions led to a pair of on-site cooperative Joint Verification Experiments (JVEs) to monitor nuclear explosions at the U.S. (Nevada) and Soviet (Semipalatinsk) test sites in the late 1980s.[7] Monitoring systems cooperatively designed and placed at known test sites could be used as a confidence building measure to increase the monitoring capability at the sites to levels far below the levels achieved by remote monitoring, create greater confidence in CTBT compliance, and satisfy good faith critics of the treaty's built in technical monitoring capabilities.

The measure could be implemented bilaterally or through a program of cooperative work by members of the P5 to determine how to monitor at very low levels without revealing sensitive information at the test sites. They could then decide how and where to place measuring devices at the sites. Work already undertaken by the P5 to develop technology for CTBT on-site inspection and integrated field exercise efforts could feed into this new cooperative effort to monitor test sites outside of the IMS. Simply agreeing to work together on a test site monitoring program would create further confidence that members of the P5 are honoring their moratorium commitments before CTBT entry into force and after entry into force, in-place monitoring technology would help to ensure that the P5 states are not violating the CTBT treaty by testing below the IMS detection capability at their test sites. Near-term non-binding efforts could be designed to lead to a series of bilateral commitments or a negotiated test-site transparency regime between the P5. The U.S. has already conducted experiments and evaluated technology that could be used as part of a test-site transparency regime.[8] The first step is simply

[6] The Treaty does allow for additional information to be considered were a request made for an on-site inspection of a suspected nuclear-explosion event and includes a confidence building measure on "compliance concerns arising from the possible misinterpretation of the verification data relating to chemical explosions" above 300 tons (IV, E).
[7] The effort led to the entry into force of the Threshold Test Ban Treaty in 1990.
[8] The NRC CTBT report notes that "the U.S. [DOE/NNSA)] recently conducted a series of experiments to test technologies that could be used under a test site transparency regime. Technologies evaluated

agreeing to grant P5 access to the three known test sites maintained by the P5; Lop Nor, Novaya Zemlya, and the U.S. Nevada Test Site—now know as the Nevada Nuclear Security Site (NNSS).

Transparency at Nuclear Test Sites

Working to design a scheme to place instruments at P5 nuclear tests sites in order to further limit the ability to confidently detonate a nuclear small explosion or test evasively at test sites is a useful way to augment the CTBT, but the activity is also a kind of confidence building measure itself. The NRC CTBT report states that "The [P5] Nuclear Weapon States have been able to maintain their nuclear weapons programs under a nuclear-explosion-test moratorium and are likely to be able to make nuclear weapons modifications that fall within the design range of their test experience without resorting to nuclear-explosion testing" at all (p. 100). Test site access through controlled visits between the P5 would also provide valuable insight into how the other members are maintaining and improving their weapons in the absence of nuclear explosive testing and lead to greater stability between the nuclear weapons states, especially between China and the U.S. as Russia and the U.S. reduce their nuclear forces. Controlled visits would create greater transparency and further help assuage concerns about cheating. The U.S. could take the first step and make it clear to the other members of the P5 that they are willing to open up the NNSS. The U.S. could host visits by science and policy experts from other P5 countries. Other countries could do the same, although visit invitations and visits should include no expectation of reciprocation. Bilateral or joint P5 visits to the NNSS would allow members of the P5's policy and technical community to tour U.S. experimental facilities located on-site[9], facilities that function as important parts of the U.S. Stockpile Stewardship Program. Although visiting the NNSS should not be tied to visiting sites in other P5 countries, other states could offer visits to their test sites and in the case of the UK and France, the facilities that they use to maintain their weapons without nuclear testing. These visits could kick off joint cooperation on test site monitoring technology or other cooperative confidence building efforts.

Seismic Monitoring Around Nuclear Test Sites

The CTBT includes a confidence building measure to ensure that large chemical explosions are not nuclear. The measure allows for data exchange and visits to address the possible misinterpretation of verification data from chemical explosions above 300 tons. In 1996, after the treaty was signed, the U.S. considered pursuing additional complementary confidence building measures. The Defense Threat Reduction Agency suggested "data exchange provided by States Parties, on a voluntary basis, of national monitoring station information which provides equal transparency at the existing nuclear test sites" as an additional confidence building measure to support the CTBT.[10]

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included geophysical, ground-based visual, remote monitoring, over flight, and radiological technologies" (p. 74).

[9] A visit might include controlled access to facilities such as the Source Physics Test bed, the Big Explosives Experimental Faculty (BEEF), the U1a Underground research complex, and the Joint Actinide Shock Physics Experimental Research (JASPER) compound.

[10] However at the time "further investigation of these new CBMs was halted as it was quickly decided…that pursuing any new CBMs was a 'dead-end' path and only those CBMs specifically

The P5 could work together to improve seismic detection around test sites. During the CTBT negotiations the U.S. offered to let the regional network stations that are in close proximity to the Nevada Test Site (now NNSS) be included as part of the IMS. Today the IMS primary seismic station at Mina, Nevada (at 38.4°N and 118.2°W) is located around 300 kilometers from the NTS. The closest primary IMS stations to China and Russia's test sites are located more than 900 kilometers away. The IMS station at Makanchi in Kazakhstan is the closest IMS primary seismic station to the Chinese test site. Additional seismic stations exist in Mongolia, however these are almost as far away as the station in Kazakhstan and they are not part of the IMS. China and the U.S. might consider sharing data from their own regional networks on a regular basis. China could share seismic data with the U.S. from Chinese Earthquake Administration stations, or establish additional open seismic stations closer to its test site; and the U.S. could share data from its regional stations around the NNSS. This could be done on a bilateral basis at first, and later in cooperation with other members of the P5.

Conclusion

When considering additional confidence building measures to augment existing arms control agreements it is wise to remember Voltaire's tenet, *le mieux est l'ennemi du bien,* or the best is the enemy of the good. If poorly designed and implemented the complementary confidence building measures detailed above have the potential to undermine the credibility of the IMS system, but sometimes additional work—like the JVEs in the 1980s—can overcome difficult verification challenges and help bring a treaty into force. Because the verifiability of the CTBT, like other international arms control agreements, is ultimately a political judgment by an individual state, it is in the best interest of the P5 to work together to improve verification capabilities so the remaining treaty hold-outs can address their concerns and ratify the CTBT. The nature of the enormous challenge to detect nuclear testing anywhere in the world combined with the political realities associated with CTBT ratification makes cooperation in the form of confidence building measures outside of the official IMS framework worthwhile and potentially necessary to achieve CTBT entry into force.

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mentioned in the treaty protocol would remain viable." See: http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ada389105