AFTER THE 150-KT THRESHOLD TEST BAN

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I have been asked to look beyond the 150-kiloton Threshold Test Ban Treaty (TTBT) to further constraints on the yields and/or frequencies of nuclear weapons tests that might be considered in follow-on test-ban agreements.

As Drs. Richards and Nordyke are specialists on the verifiability of possible future agreements with lower thresholds, I will focus on the other issues that arise. My understanding of these questions is based entirely on information that has been made public by the U.S. nuclear weapons establishment combined with the insights that I have been able to derive from the "back-of-the-envelope" calculations that are a principal tool of theoretical physicists. My conclusions, however, appear to be consistent with those of experts who have had full access to classified information but are unable, because of this access, to speak as freely in public as I can.

More Stringent Limitations and the Purposes of Nuclear Testing

The main body of my testimony is organized as a brief discussion of each of the major purposes of testing and how they would be affected by a lower threshold or testing quotas. These purposes are the following:

1) The development of new nuclear weapons;

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2) The understanding of nuclear weapons effects;

3) Testing of design improvements relating to safety or safeguards against unauthorized use; and

4) Fixing problems in already-developed weapons -- the so-called "reliability tests."

Development of New Nuclear Weapons. Although many technical issues have been raised in the debate over nuclear test bans, the principal underlying disagreement that divides the advocates of and opponents of test bans is political not technical. The issue is whether, on balance, new nuclear weapons will make us safer or not:

- Opponents of continued testing see the principal danger of nuclear war as originating from mutual fears of first strikes which could become self-fulfilling in a crisis. And they see most of the new nuclear weapons under development as feeding such destabilizing fears of first strikes.

- Advocates of continued testing see the principal danger of nuclear war as being Soviet expansionism. They believe that maintaining the credibility of U.S. threats of first use of nuclear weapons is critical to keeping the Soviet Union in check.

Obviously, there is some truth to each of these concerns and one's position on test bans depends upon how you balance them.

My own view is that, once a country obtains for itself even one tenth of the huge levels of survivable destructive power that the United States and Soviet Union each currently possess, it has bought for itself most of the deterrence that nuclear weapons can provide. Beyond this point, trying to give the nuclear threat more credibility is like a man who has filled up his house with dynamite continually inventing new triggering mechanisms to convince potential burglars that the house really will blow up if they break in.

Other people have different views. I think that most agree that you cannot fight of win a nuclear war but many nuclear-weapons-policy makers believe that we can squeeze more deterrence out of acting as if we believe that we can, in fact, fight a nuclear war. Choosing between these positions depends primarily upon our individual perceptions of the lessons of history and of psychology.

Although deciding on the desirability of the development of new nuclear weapons depends primarily on political judgements, a technical discussion of the other three purposes of nuclear weapons testing does provide some quantitative guidance concerning the choice of thresholds and quotas.

Understanding Nuclear Weapons Effects. The first of these nonpolitical reasons that is given for continued nuclear testing is the need to understand the effects of nuclear explosions on nearby weapons or communication links.

Once you are restricted to underground testing, however -- as we are by the 1963 Limited Test Ban Treaty, drastic reductions of yield limits would not significantly impede nuclear effects tests. For example, about the same radiation intensities can be achieved 40 meters from a one-kiloton test as 500 meters from a 150-kiloton test. For this reason, and because tests involving smaller-yield explosions are less expensive, most U.S. nuclear weapons effects tests are in fact already conducted at quite low yields.[1]

Safety and Security. Another technical reason that is given for continued testing is the need for design improvements in the areas of safety and protection against unauthorized use.

In fact, the safety of U.S. nuclear weapons is already quite good. Specifically, they are designed to be virtually immune from accidental nuclear explosion -- even if a segment of the chemical explosives in the nuclear trigger is detonated by the penetration of a bullet or by a fire.

Because the problem of accidental nuclear explosions seems to be under control, current work on safety improvements is focused on the much less serious problem of reducing the dispersal of toxic plutonium if the chemical high explosives should detonate or burn. An important advance in this regard has been the use in new nuclear weapons of "insensitive high explosives" that are much less subject to accidental explosions. Retrofitting the remaining nuclear weapons that still contain sensitive high explosives would require some nuclear tests but the process of substitution is well advanced and could, if desired, be brought to completion relatively quickly.

Virtually all other safety improvements are in the mechanical and electrical design of the triggering systems and can be adequately tested without a significant nuclear explosions. One way in which this is done is by removing the chain-reacting nuclear material from the explosive and replacing it with non-chain-reacting material such as depleted uranium. The progression of the implosion is then followed with imbedded sensors and flash X-rays. Even more sensitive tests are sometimes conducted by partially removing the chain-reacting material, leaving only enough so that a very small nuclear explosion results. The production of neutrons from such a "zero-yield" nuclear test provides an extremely sensitive measure of the degree of compression that has been achieved by the chemical implosion. Such zero-yield nuclear tests would not be barred by the lowering of the test ban threshold to one kiloton or even below.

Virtually all significant improvements in the permissive action links and self-disabling features protecting U.S. nuclear weapons from unauthorized use also involve changes in their electrical and mechanical design that can be adequately checked out with nonnuclear or zero-yield nuclear tests. At the moment, however, the most serious obstacle to making

the U.S. nuclear weapons more terrorist resistant appears to be institutional rather than technical: the U.S. Navy's refusal to have permissive-action links installed in the nuclear weapons under its control.

Reliability Tests. The final purpose for nuclear weapons tests -- and the one that apparently played a key role in derailing President Carter's efforts to achieve a comprehensive test ban -- are tests of fixes of problems that are detected in already deployed nuclear weapons.

The first point that should be made here is that random tests of weapons already in the stockpile make a negligible contribution to the detection of problems. Prohibitive numbers of tests would be required to maintain confidence in the stockpile in this way. The principal way in which problems are detected and rectified is by disassembly and inspection and by nonnuclear tests.

The latest and most specific official statement concerning the need for nuclear reliability tests is the following:

> "one third [14 out of 41] of all weapons designs introduced into the stockpile since 1958 have encountered reliability problems...[of which] 75 percent were discovered and/or corrected as a result of nuclear testing."[2]

Thus far, information on eight of these fourteen cases has been made available for review by Dr. Ray Kidder, an experienced weapons designer at the Livermore Laboratory who has in the past demonstrated a willingness to take an independent position on such questions.

Dr. Kidder has concluded that none of the eight cases can be used to support the argument that nuclear testing is required to deal with reliability problems in fully tested and deployed designs. For example, he finds that one half of the cases that have been cited by the Department of Energy and have been made available for his review involved weapons that were placed in the stockpile before undergoing a full program of certification tests because of the 1958-61 testing moratorium.[3]

Based on Dr. Kidder's review, it appears that the weapons laboratories have overstated the need for reliability testing. This conclusion is supported by other senior former weapons designers and arms control experts who have had access to the relevant classified information.[4] However, it is impossible for an outside observer like myself who has not had access to classified information to judge whether the laboratories' claims are completely without foundation. The Congress might therefore consider commissioning an independent outside review of the issue -- perhaps under the auspices of the the Office of Technology Assessment or the National Academy of Sciences.

Significant further limitations on nuclear weapons tests could be agreed to, however, even while we await the final clarification of this issue. This is because:

i) Only a few percent of all nuclear tests are reliability tests, and

ii) These reliability tests could be conducted below a threshold set at about 10 kilotons.

With regard to the frequency of relibility tests, the Department of Defense has informed this Commitee that, during the period 1970-85, only eight tests -- an average of one every two years -- were justified by the need to test the remedy of a defect in an already-deployed nuclear weapon.[5] This should be compared with the average of approximately 20 nuclear tests per year for all other purposes during this same period. It would therefore appear that a quota of less than one test per year could deal with the concerns that have been raised about the need for nuclear tests to fix problems found in the stockpile.

With regard to the yields required, concerns about reliability appear to focus almost exclusively on the finely-tuned "boosted" fission explosives that are used to ignite the thermonuclear reactions in the second more powerful stage of modern strategic warheads.[6] The yields of most US primaries fall in the range 5-15 kilotons and the consensus of weapons experts seems to be that reliability testing can be done at less than full yield. A lowering of the testing threshold to about 10 kilotons would therefore not significantly impair our ability to test fixes to problems with the primaries.

A Potential Consensus Position

Based on the above discussion, it appears to me that there are are two steps required to achieve a consensus position on further limits on nuclear testing.

- First, it is necessary to achieve political agreement that the world would be a safer place if we didn't have the U.S. and Soviet nuclear weapons laboratories continually promoting what they claim are more useable nuclear weapons. I think that, after more than a decade of discussions of the controllability and consequences of so-called "limited" nuclear wars, we may be within sight of such an agreement.

- Secondly, we must achieve a broader understanding that testing for purposes of determining nuclear weapons effects and for testing safety and security can be done below a very low threshold, such as one kiloton, and that any required reliability testing can be carried out within a quota of one test a year at a yield of less than 10 kilotons.

A More Comprehensive Test Ban?

Many arms controllers would advocate still more stringent limitations on nuclear weapons testing. Richard Garwin, for example, would allow "explosive releases of nuclear energy taking place only in permanently occupied above-ground buildings, within 30 meters of personnel."[7] This limit would correspond to a limit of about 10 tons nuclear yield.

In justifying such a low threshold, it is argued that:

- Means other than nuclear tests are sufficient to maintain stockpile reliability;
- Nuclear weapons effects tests can be adequately carried out a these very low yields;
- Intelligence derived from non-seismic means could identify any significant program of sub-kiloton tests; and
- There would be a very significant nonproliferation benefit to a Comprehensive Test Ban that would not be realized with, for example, a 1-kt Threshold Test Ban.

Verification of the 150-kt Threshold Test Ban

Finally, I would like to return to the question of immediate concern to the Senate: the ratification of the 150-kiloton Threshold Test Ban, and the Administration's reservation relating to additional verification requirements -- specifically the on-site CORRTEX method.

Two weeks ago, I participated in an International Workshop on the Verification of Threshold Test Bans which was held in Moscow. U.S. experts were originally supposed to present the Administration's position on CORRTEX there but, at the last minute, the Administration decided not to send them. The Workshop is therefore of interest principally because it provided a first opportunity to hear a Soviet critique of the CORRTEX technique.

Basically, the position presented by the Soviet experts was that, while CORRTEX can be a relatively reliable means for a country to monitor its own tests, it would not be reliable in an adversarial situation. They described various uncertainties and potential evasion methods which they felt could result in uncertainty factors for the yield estimates from CORRTEX as large as 2-3 -- far larger than the uncertainty range of 1.3-1.5 that is estimated for seismic yield estimates by independent U.S. seismologists.

The Soviet CORRTEX experts acknowledged that the various uncertainties and evasion possibilities could be dealt with by detailed inspections of the geology and testing arrangements. But they felt that these inspections would have to include the inspection of the interior of the large cannisters that contain the nuclear explosive and diagnostic equipment. They felt that such inspections would be unacceptably intrusive for the weapons labs.

Pending the translation of the Soviet paper, I can say little about its quantitative conclusions. Qualitatively, however, its conclusions are consistent with those that were arrived at by Professor Frederick Lamb in a review of the CORRTEX technique done for the Senate Foreign Relations Committee.[8] Similar concerns about the potential intrusiveness of the inspections required to ensure the accuracy of CORRTEX measurements have also been expressed by the U.S. weapons labs.[9]

REFERENCES

1. See, e.g., the listing of the yields and purposes of U.S. underground tests in R.S. Norris, T.B. Cochran and W.M. Arkin in Known U.S. Nuclear Tests: July 1945 to 16 October 1986 (Washington, DC: Natural Resources Defense Council Report # NWD 86-2 (Rev. 1), October 1986.

2. Paul Brown, Assistant Associate Director for Arms Control, Lawrence Livermore National Laboratory, "Nuclear Weapons R&D and the Role of Nuclear Testing," invited talk at a meeting of the American Physical Society, San Francisco, 28 January 1987. Virtually the same statement was submitted by Richard Perle as part of an answer to a question for the record in a hearing before this Committee held on 29 April 1986 (see below).

3. The cases of the W45, W47, W52, W56, W58 and W68 are reviewed by Dr. Ray Kidder in an unclassified report, Evaluation of the 1983 Rosengren Report from the Standpoint of a Comprehensive Test Ban (Lawrence Livermore National Laboratory report #UCID-20804, June 17, 1986). Kidder gives but does not explain his conclusions concerning the W80 and W84 in an unclassified letter to Professor Frederick Reines, Chairman of the University of California Scientific Advisory Commmittee, 8 January 1987. The associated classified report by Kidder is entitled Evaluation of Recent Problems with the U.S. Stockpile of Nuclear Weapons from the Standpoint of a Comprehensive Test Ban (CTB).

4. See, e.g., the letter to the Honorable Dante Fascell, Chairman of the House Committee on Foreign Affairs, from Hans Bethe, Norris Bradbury, Richard Garwin, Spurgeon Keeny Jr., Wolfgang Panofsky, George Rathjens, Herbert Scoville Jr. and Paul Warnke, 14 May 1985.

5. Richard Perle, Assistant Secretary of Defense for International Security Affairs, answer to a question from Senator Carl Levin for the record in Nuclear Testing Issues, hearing before the Senate Armed Services Committee, 29 April 1986, p. 46.

6. Donald R. Westervelt, "Nuclear Weapons: The Role of Laboratory Tests," paper presented at the SIPRI/CIIPS symposium on A Comprehensive Test Ban: Problems and Prospects, Ottawa, Canada, 23-25 October 1986.

7. Richard Garwin, "The Administration's Case Against a Comprehensive Test Ban is Wrong," Federation of American Scientists Public Interest Report, December 1986, p. 13.

8. Frederick K. Lamb, Monitoring Yields of Underground Nuclear Tests (University of Illinois, Department of Physics, 31 January 1987).

9. See e.g. Roger Batzel, Director of the Lawrence Livermore National Laboratory in testimony before the U.S. Senate Foreign Relations Committee. [Exact reference to be provided for the record.]