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The Comprehensive Test Ban:
Views from the Chinese Nuclear Weapons Laboratories

A Report on Recent Discussions in Beijing

June 1-4, 1993

sponsored by
The Nuclear Program of the Natural Resources Defense Council
and the
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of the Institute of Applied Physics and Computational Mathematics

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EXECUTIVE SUMMARY

From June 1 - 4, 1993, a six person American delegation[1] sponsored by the Nuclear Program of the Natural Resources Defense Council (NRDC) met in Beijing with a group of Chinese nuclear weapons experts to discuss nuclear test ban issues under the auspices of the Program for Science and National Security Studies of the Institute for Applied Physics and Computational Mathematics (IAPCM). The main points expressed by the Chinese participants during two days of meetings held at the IAPCM were as follows:

-- In view of the enormous disparity in nuclear arsenals and numbers of test explosions between the U.S. and Russia and other nuclear weapon states, these countries should take the lead in making further reductions and in stopping their nuclear tests without linking these actions to those of other nuclear powers, such as China. The U.S. should not say that it will stop testing only if other countries do not test.

-- The US has conducted about 1000 tests over 48 years, an average of about 20 per year. China has had 38 tests over 30 years, an average of a little over 1 test per year. The US now says it wants another 15 tests before September 1996 for US weapon safety. But other countries may have their own reasons for testing, and the timetable should not be decided by the US alone.

-- Agreement(s) on No-First-Use (NFU) or Non-Use (NU) of nuclear weapons is very important, more important than the testing question. Chinese nuclear weapons program came directly from the threat of the USG to use nuclear weapons based in Japan against China. China established its nuclear force to prevent it from becoming the target of a nuclear attack. China never planned to be on an equal basis with the US and Russia.

-- The most urgent purpose of nuclear disarmament is eliminating or reducing threats of the use of nuclear weapons. A CTB should be a step toward complete prohibition or complete elimination of nuclear weapons. CTB cannot be used as a strategy to limit other countries while preserving one's own superiority. Even after 2003, nuclear weapons owned by the US and Russia will exceed by an order of magnitude those of the U.K., France, and China. A CTB under these circumstances will only freeze this situation.

-- Because START I and II do not limit non-deployed nuclear warheads, and do not even destroy the missiles, they are equivalent only to the reduction of deployed forces, an increase in reserve forces, and the maintenance of actual capacity. The problem is that the U.S. will preserve so much nuclear fighting capability. US has rejected Russia's proposal for "zero-alert" forces, and persists in policy of First-Use. The problem thus becomes how to persuade countries to give up the nuclear option under these circumstances. Some in the U.S. propose to use coercive measures -- this is not the best plan and it is dangerous.

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[1] Composed of G. Bunn (Stanford), T.B. Cochran (NRDC), R.L. Garwin (IBM Fellow Emeritus), R.E. Kidder (LLNL, Ret.), C.E. Paine (NRDC), and R.S. Norris (NRDC).

-- A vague definition of a CTB will not satisfy non-nuclear states. China's definition is to ban all kinds of nuclear explosion tests, including those for research on effects and maintenance of arsenals, while approaching zero yield. Low -yield explosive tests under a CTB are not compatible with the purpose of a CTB, because a test below 1 kt can have very strong military significance. To convert ICF [inertial confinement fusion] results from the laboratory to weapons, you need nuclear tests. ICF should not be permitted in conjunction with nuclear tests. At a nuclear yield of 10 kg., one can do one point safety tests, but it requires a certain skill -- sometimes one can get several dozen tons when one is wanting to stay below 10 kg.

-- It is disputable whether one could detect clandestine tests below 1 kt, so more research work is needed on the technical and political components of verification is one wants to implement a CTB. Based on present verification technology, what is the verification standard? We [i.e. China and US] need to invite more experts and have more research on these questions.

-- All countries should have a timely detection capability, which requires a network which can process signals in real time. All concerned countries should share the same level of verification technology, to avoid one-sided conclusions from one or two countries. Information processing technology should be open and shared with all countries. Verification techniques not available to all parties should be considered illegal.

-- China would consider halting tests by a date certain -- possibly as early as September 1996 -- if all nuclear powers adopt non-use or at least NFU of nuclear weapons. China is working on insensitive high explosives and needs more tests -- "not very many, only a few." Their weapons scientists are unsure about finishing this program by 1996, "but we have no desire to continue testing indefinitely."

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This report was compiled and edited by Christopher Paine, NRDC Senior Research Associate, based on his own notes and those taken by other members of the delegation, in particular the comprehensive and detailed notes taken by Richard L. Garwin and George Bunn. While considerable effort was expended to make this account of the meeting as accurate as possible, not all members of the delegation were able to review the final draft report prior to its circulation to a wider audience. Any errors are thus the sole responsibility of the Editor. Please do not quote or cite this report in public media without the permission of the Editor.

MEMCON TO: Test Ban Colleagues and Other Interested Parties
FROM: Christopher E. Paine and Robert S. Norris
SUBJECT: Test Ban Discussions in Beijing, June 1-4, 1993.
DATE: June 29, 1993

At the end of March 1993 the Natural Resources Defense Council (NRDC) proposed to Professor Hu Side, Deputy Director of the Ninth Academy, and Professor Wang Deli of the Institute for Science and Applied Physics and Computational Mathematics that a small delegation come to Beijing to discuss the issue of ending nuclear weapons tests with interested Chinese experts (Appendix 2). Professors Hu and Wang responded favorably and a date in early June was scheduled (Appendix 3).

Five of the six members of the NRDC delegation met on Tuesday, 1 June 1993 at the Institute of Applied Physics and Computational Mathematics. The IAPCM is at No. 6 Huayuan Road in the Haidian District in the northwest part of Beijing. The IAPCM is a closely spaced compound of low-rise buildings set in the middle of a dense residential neighborhood. There was no obvious security perimeter or buffer zone between the institute and the surrounding area. Construction was underway on what we were told was a new administrative and office building. Some 1,000 people work at IAPCM. Director Fu Hongyuan told Garwin that 700 of these are "researchers," -- i.e. scientific staff members. Prof. Wang remarked that his own work is on detonation theory.

Our host, Professor Hu, was until last year the Director of IAPCM. He has since become the Deputy Director of the Chinese Academy of Engineering Physics ("Ninth Academy"). The Ninth Academy is comparable to the Los Alamos laboratory plus the Nevada Operations office, overseeing the research, development, and testing of Chinese nuclear weapons. Professor Hu retains a position as head of the Program for Science and National Security Studies (PSNSS) within IAPCM. In that capacity he sponsors conferences with Western arms control experts.

After each of the approximately 25 Chinese experts introduced themselves (Appendix 1), Fu Hongyuan gave a description of the Institute's activities in Nuclear Physics, Plasma Physics, Theoretical Physics, Fluid Dynamics, Computational Mathematics and Applied Mathematics Research, and Applied Computer Science.

FU: In Nuclear Physics and Plasma Physics they study primarily laser-material interaction, transport theory in Plasma Physics, Atomic Theory, Numerical Computation and [unintelligible] of nuclear data, compressible fluid flow, 1-D and 2-D fluid problems; Deformation Theory and Shock Physics; Numerical Simulation Methods of Fluid Dynamics; Numerical Solutions of Partial Differential Equations (PDE); Theory and Research on Linear Algebra; Numerical Simulation Methods for various kinds of physical problems, Numerical Solutions of Non-Linear PDE; Evolution Equations of Mathematical Physical Problems.

> In computer applications they develop many software items. The closest Professor Fu got to saying that IAPCM was involved in nuclear weapons work was that their's was "mainly a theoretical institute with many connections to experimental institutes." IAPCM also conducts a program of graduate study for masters and doctor's degrees. Several years ago the Institute established the Program for Science and National Security Studies (PSNSS). This includes scientists not only from IAPCM but also from other institutes. PSNSS does research on arms control problems, verification, nuclear non-proliferation problems, etc.
>
> Members of PSNSS have a chance to attend international conferences, and exchange research [lost in translation] with foreign scientists. They have organized some international conferences in Beijing. Exchanging ideas can enhance mutual understanding. I hope our talk beginning now will have that effect.

Professor Hu Side made some further introductory remarks, stressing that he hoped for a good discussion and that it be confidential.

> HU: Very glad to have the opportunity to discuss with American colleagues on Nuclear Test Ban. Have exchanged our view several times. Although informal and conducted at the NGO level, still believe this can further mutual understanding and arms control. I hope also that like before these discussions will not be offered for publication-- especially not leaked to newspapers.

To avoid any confusion about the matter of confidentiality, Paine spoke with Prof. Hu during the first break and clarified for him our intention, in line with standard practice, to prepare a report on the meeting for limited distribution to interested parties in the arms control community and the U.S. government. Hu agreed that this would be alright, but asked again that the report not be provided to members of the press. (Note: Chinese participants in previous arms control symposia have had their individual views on sensitive topics appear in the U.S. press, to the consternation of government officials back home. Presumably, Hu was seeking to avoid a repetition of that experience, and perhaps to encourage a freer discussion than that which normally occurs at such meetings.)

Dr. Richard L. Garwin began the briefing. His remarks set the overall context for the ensuing discussion by reviewing the reasons why many individual citizens, organizations and governments are interested in ending nuclear weapons test explosions, emphasizing that the primary object of such a ban had now shifted from countering the superpower arms race to countering proliferation. Not only would a test ban serve to limit the vertical proliferation potential of threshold and undeclared nuclear weapons states, but it would also help to remove political and bureaucratic obstacles to more vigorous and effective nonproliferation efforts by the nuclear weapon states. Nuclear explosions only served to underscore the continuing reliance of some countries on nuclear weapons for defense, thereby undermining attempts to construct a stronger nonproliferation regime.

(Garwin gave Du Xiangwan the Bulletin of Atomic Scientists issues from March 1992-May 1993 (except April 1993).

Dr. Robert S. Norris followed by reading a short paper about the historical patterns of testing (Appendix 4), and passed out two recent issues of "Nuclear Notebook" (Appendix 5) for background data.

DISCUSSION -

HUANG ZUWEI: To Norris, "What is your personal [view]point?"

NORRIS: That we ought to have a CTB, and we will discuss how to get there.

DU XIANGWAN: One question-- Dr. Norris gave us a very good report. On page 5, the current situation in the United States, but do not mention anything about nuclear tests now. My question is that President Bush proposed a position on nuclear tests before 1996. Clinton has not given a position.

NORRIS: We will give you a full report. To Professor Hu -- a question for you about China -- why so few tests? Am I correct or not (in the hypothesis stated in the paper that China has very few types of nuclear warheads and so doesn't need very many tests)?

HU: I have read your speech and believe personally your hypothesis is correct, but my colleagues later will give full details on this.

Christopher Paine had the difficult task of explaining the current state-of-play on the testing issue in Washington as well as the intricacies of the complex legislation (Appendix 6).

PAINE read an abridged version of his paper. The interpreter had a copy to help in interpretation.

DISCUSSION -

TIAN DONG FENG: A question -- you mention that even some people in Congress do not consider verification a technical obstacle."

HUANG ZUWEI: There is need to install such sensors within the country...

PAINE: To take advantage of regional phases, [in-country] seismic stations would need to be spaced several hundred kilometers apart. China has good relations with the USGS and cooperatively operates stations. At NRDC we believe these should be

open networks with full exchange of data and should serve scientific purposes as well as for verification of a CTB.

NORRIS: The number and location would be determined in multilateral negotiations.

TAN HAN: I am not very familiar with technical questions, but did read that both U.S. and Russia had developed a technique of simulation testing and computer modeling. To what degree does this have safety benefits? If such modeling technology replaces actual tests, could we assume the U.S. can guarantee the effectiveness of nuclear weapons without carrying out any more nuclear testing?

PAINE: This is a matter of debate in the U.S. now. I am satisfied that the combination of simulation and reliance on archived test data would be adequate for maintaining existing weapons. The dispute is about how far one can go in designing new weapons with just computer modeling."

HU SIDE: Just now you mention that President Clinton failed to submit his report by March. Why?

PAINE: The new Administration rejected the report Bush had sent to Congress. President Clinton is trying to put together a program for tests and negotiations that will receive broad support. President Clinton wants to please everybody, but in this case there is no position that will do so.

LI HUA: I got the impression that any nuclear testing must go through the legislative channel; but [under a test ban] could a lab go into small scale testing [without consulting higher authority]?

PAINE: You mean hydronuclear testing? Under the U.S. system of government, the labs and DOE could not possibly under present circumstances carry out tests without consulting the President and the relevant committees in Congress.

LI BIN: Dr. Paine has just now mentioned that the U.S. would stop testing in 1996, but only if no other foreign state tests. However I regard this as not so reasonable--since the U.S. has tested almost 1000 times; so the US should take the lead in stopping, and should not require that other countries should stop and then the U.S. stop.

PAINE: I agree, as a matter of equity, you are right. But it is not good politics. The political reality probably is that we are all going to have to stop together. A continuation of testing by China after the 1996 date would mean not just U.S. testing, but more British, French, and Russian testing. The CTB is a longstanding goal of over 110 countries that have signed the Limited Test Ban Treaty; strong U.S. government support for a CTB is a recent development. Moreover, we are trying to

do something very serious about non-proliferation. If countries believe they can restrain the U.S. by not testing themselves, that is useful.

CHEN XUEYIN: Now U.S. policy [is] to stop testing immediately. There is a question of definition. On the other hand, U.S. intends to keep a stockpile of nuclear weapons for 30 to 50 years. Because nuclear weapons are so complicated, it is very difficult to have confidence in the reliability of these weapons for such a long time.

LIU GONGLIANG: It seems to me difficult to find a direct relation between Iraq seeking nuclear weapons and the U.S. not testing.

PAINE: There are three main links. First, from a technical perspective, a CTB would help to prevent the proliferation of two-stage thermonuclear weapons, and could, for instance, suppress India's nuclear weapons potential, which presumably would be in China's national security interest. Second, the CTB is not mainly a US proposal, but rather is supported by almost all the 110 signatories of the PTBT who seek to convert that treaty to a CTBT. A CTB would help to reduce -- but not eliminate -- discrimination [between nuclear haves and have nots] in the nonproliferation regime. Third, we seek the indefinite extension of the NPT. How can we obtain that if we continue to test?

GARWIN: There is an additional political point. People in the US will be more serious about countering proliferation if we are not testing our own weapons. The same goes for other nuclear weapon states.

(excellent lunch intervenes; meeting resumes with talk by Ray Kidder).

KIDDER: Now let us discuss the question of explosive limits. (draws on blackboard -- see Table 1) For [chemical] high explosive, an infinite limit. For fusion, perhaps 200 kg HE equivalent, in order to accommodate ICF (inertial confinement fusion).

For fission, perhaps 10 kg of HE equivalent [to accommodate "Hydronuclear" or "One-Point Safety" tests].

Or perhaps 10-30 tons to use as a gamma ray or neutron source; or perhaps 300 tons to use as an x-ray source, or perhaps 1 kt for the development of tactical nuclear weapons; for directed energy weapons; or for reduced yield test of primaries.

For instance, Evgenii Avrorin [in discussions with Kidder] proposed a 10 ton limit.

GARWIN: People talk about tactical nuclear weapons of five, 50, and 500 ton yield; therefore, none of these should be freely developed under a CTBT. A 10 kilogram fission yield is preferable.

DU XIANG WAN: You must consider time [duration] of [energy] release as well as yield.

GARWIN: [agreeing] A normal nuclear power plant generating 1 GWe has an energy release per second corresponding to one ton of HE.

HUANG ZUWEI: How about higher levels of testing?

HU SIDE: At 10 kg, one can do one-point safety but [it] needs a certain skill. Sometimes one can get several dozen tons when one is wanting to stay below 10 kg.

KIDDER: (Explains how one replaces fissile material with non-fissile material at first and "creeps up" in order to ensure one does not exceed the threshold or destroy the site).

CHEN XUEYIN: I saw published reports of 100 T yield for one-point safety tests.

KIDDER: Those tests were conducted in the absence of a moratorium, when it was unnecessary to stay below any limit. So this [shooting at 100 tons] was more economical of fissile material than to use several shots in a "creep up" approach.

Table 1 - R.E. Kidder's Blackboard

HIGH EXPLOSIVE	FUSION	FISSION	FISSION PURPOSE
infinite yield	200 kg for ICF	10 kg	hydronuclear/one- point safety tests
		10-30 tons	pulse neutrons and gammas. Confined explosion
		300 tons	pulse X-rays (hot)
		1 kt	tactical weapons directed energy weapons R&D, reduced yield tests of TN primaries

KIDDER: My study, and an even wider survey of predicted versus measured yields that was also conducted at Livermore, show that US thermonuclear weapons are robust. That is, they have been designed to be relatively insensitive to minor variations in tolerances, materials, primary yield, etc. [Norris] Bradbury, [Hans] Bethe, [Herbert] York, [Carson] Mark, [Andrei] Sakharov, and [Dick] Garwin all agree on this point. The Clinton Administration has decided that it will seek to conclude a CTBT by the end of September 1996. So the question is, "what tests are necessary before then, if any?" Even if China has not made a similar decision to stop testing, it would seem important to provide Chinese political leaders with the option of stopping testing by September 1996.

DISCUSSION -

LI BIN: US has had 1000 tests. China has had about 40 tests. The US wants 15 tests before 1996 for US [weapon] safety. Other countries may have other reasons for testing. Timetable should not be decided by US alone.

WANG DELI: Timetable should be decided in discussions with other countries.

KIDDER: Timetable should be agreed to by all NWS's. But 1996 is already 1 year after 95 NPT Conference. Date was not set by the needs of the US stockpile but by objective need to end testing.

PAINE: The table in my paper shows the range of safety tests that might be conducted -- from 0 - 15. There is no agreement yet that any of these tests are necessary. In establishing the 1996 date, Congress was primarily interested in sending a message to the US weapons bureaucracy, not in dictating a deadline to other governments.

QUESTION [unattributed Chinese]: There are three different options open to the U.S. First, go to CTB directly [within three years]. Second, a transition period with a low yield threshold before CTB. Third, CTB negotiations without a time limit and a quota of, say 20 tests, rather than three years. Isn't the third option more reasonable?

SEVERAL US RESPONDENTS: Only option one is open for the US now.

QUESTION [unattributed]: Could a ten ton limit be verified?

PAINE: Not as a TTBT, but it could be verified by expanded transparency and other provisions.

CHEN XUEYIN: U.S. policy is to go to a CTB immediately. But the US has had almost 50 years to build weapons. Some say that no tests are required for

confidence; other say that they are required. I have two questions. 1) Do nuclear weapons become obsolete when not used; 2) How can we acquire confidence in effectiveness without nuclear tests?

KIDDER: I can only comment as to U.S. weapons. I have looked at the U.S. test record, which shows that the weapons are robust. Our predictions of yield have almost always been good. The few exceptions in this record were more radical designs that were suspected in advance of having a higher risk [of variance from predicted performance].

GARWIN: The uncertainty really is how much it costs to maintain a reliable stockpile, not whether a reliable stockpile can be maintained without tests. All of the discovery of flaws in a well-tested stockpile comes from non-nuclear inspection and disassembly, and from non-nuclear tests. If such early corrosion or other problem is discovered, for a large stockpile the solution may well be the substitution of a new-design nuclear weapon. But for a small stockpile, it is really more economical simply to remanufacture the old design, even if it should have a stockpile life of only 10 years instead of perhaps 30 years for a more durable design. Note that both stockpiles are equally reliable; they simply have different maintenance costs.

BUNN: (Made presentation on "Obstacles to Achieving a CTB," see appendices, translator was provided with a copy)

GARWIN: (Made a presentation about maintaining expertise under a complete test ban. After the meeting, RLG provided this sketch of his talk because there was no prior written version).

> "Two kinds of expertise-- sufficient to maintain the stockpile, and sufficient to resume testing.
>
> "For the latter, there is a large component of test technology and capability. For instance, one needs to retain the knowledge of drilling holes and sealing them, instrumentation, experimental design, and design of the explosive itself.
>
> "So the question is how to preserve the knowledge and the capability, which depends very much on how soon one needs to resume testing.
>
> "One needs to stockpile some instrumentation, cables, and maybe stockpile some holes or the drilling equipment. (But it is important to resist the political demand for the early resumption of large-scale testing, without technical need).

"Probably it is preferable to stockpile the drilling equipment rather than holes in assorted depth.

"Regarding expertise, in the design of nuclear weapons, if I were in charge, I would hold a conference to bring in new young people to the weapons design program. There would be technical talks and documentation, video tape of the sessions and for presentation to the sessions. There would be thorough review and analysis of computer programs, and continuing computation of old tests with new tools [Editor's note: RLG is referring to the fact that weapons design expertise could be maintained by asking the "trainee" designers to use modern computer techniques to model the performance of weapon designs for which archived test explosion data exists -- some 90 different weapon types and 1000 tests. This "blind" modeling result could then be compared with the actual test results, allowing the trainees to assess their design skills.] And the documentation would be reviewed and amplified so that it would be understandable to those who had not participated in the work.

"There would need to be thorough documentation of the manufacturing process, which should be done in any case, (and there should be a program of non-nuclear tests-- e.g., fast photography, x-ray photography, pin shots, etc. Furthermore, there should be continued testing of Compton diodes, etc. to maintain and even improve some of the instrumentation."

DISCUSSION -

GARWIN: We can maintain a reliable stockpile for decades -- even centuries. The weapons will endure longer than the society.

HU SIDE: I was told of a debate in 1987 between Kidder and Miller and whether we needed to test or not. How to maintain capable personnel for weapons design was an important question. Now the USG proposes keeping a large number of weapons without tests. How do they propose to solve this problem of expertise for weapons design?

KIDDER: Garwin went a long toward showing how to solve this problem. This is not a harder problem today than in 1987. Then the questions of reliability and of maintenance of skilled personnel were the principal reasons mentioned. But these reasons have more recently been made secondary to safety. "Safety" was seized upon because the arguments of Miller and others were not persuasive.

PAINE: There is another factor to consider. The number of tests was never a function of the absolute number of weapons, but rather the number of distinct weapon types. In 1987 there was a more varied stockpile -- 16-17 different types

of nuclear warheads, whereas in 1996 there will be on the order of six types. Each of the laboratories, and the experts within them, are specialists in particular weapon types. When these types are retired, you need fewer specialists.

DU XIANGWAN: What is the role of conversion in maintaining expertise?

GARWIN: Conversion is likely to result in the departure of weapons designers. But we don't need so many. Nuclear weapons are now regarded as much less useful than 20 years ago. Skills of weapons designers are useful for ICF [inertial confinement fusion] -- but that's a smaller program. [Bill] Perry says successful conversion means that people stay in some line of business. Since, we don't see a need for new types of weapons now, most designers will probably go into a different field.

PAINE: There are really very few bona fide weapon designers-- most of the people who work at the national laboratories are employed in supporting disciplines, such as material sciences and computing, or in basic and applied sciences. In a sense they are already partially converted, in that their skills can be readily applied in other areas. [There are only perhaps a few dozen "weapon designers" in the United States).

KIDDER: James Wilson (a LLNL designer) and [Yakov] Zeldovich both did excellent work outside the nuclear weapons field. The theoretical side is a lot easier to deal with -- these are very flexible people -- than the experimental side.

(SHU ZHAN is an excellent interpreter. His speciality, he says, is Africa. He travelled for three weeks recently with Bill Dunlop of LLNL and Wendy Frieman of SAIC).

DU SHUHUA: Here is a question for our American friends, but perhaps primarily to G. Bunn. The USG apparently has a very short timetable on the CTB, but no timetable on non-use or NFU. But I believe that NFU or NU is more important than the non-testing question. Is there any timetable on this or even for negotiation of NFU or NU?

BUNN: Supporters could not get it through the USG last year. We will probably come out with a policy of non-use against non-nuclear states adhering to the NPT, or something like that.

PAINE: Sometimes ideology remains the same, but the practice changes. All the weapons which were part of US plans for potential "first use" have been removed from our deployed forces, with the exception of a few hundred gravity bombs in Europe. Our declared policy now has more to do with historical positions -- such as our NATO commitment -- than to the persistence of any real intention to use nuclear weapons first.

DU SHUHUA: In my opinion, NFU by the U.S. has a very important impact on non-proliferation. The first generation of Chinese nuclear weapons came directly from the threat of the USG to use nuclear weapons against China. So this is very important.

GARWIN: Most countries are more interested in security guarantees against the use of nuclear weapons by others against them, rather than in a non-use policy by the USG. Ukraine, for example, wants a security guarantee from the US to deter a Russian attack.

DU SHUHUA: I don't agree. The Russian Government has said that they would follow a Soviet NFU pledge. So there is no possibility of Russia using nuclear weapons against Ukraine, for instance.

BUNN: Ukraine would like a NATO positive security guarantee against conventional attack by Russia. Russia has offered to guarantee CIS-prescribed boundaries of Ukraine, but Ukraine wants them to take out the CIS language.

PAINE: This business of providing positive conventional security guarantees is exactly why the USG did not provide a NFU pledge! We were explicitly reserving the first use of nuclear weapons in response to a massive attack by Warsaw Pact forces against NATO.

HU SIDE: We have worked much later today than planned. Today our U.S. friends gave a very useful set of papers. Our Chinese colleagues will respond fully in the same manner on Thursday.

(Thursday morning, 3 June 1993)

CHEN XUEYIN: (Chen gave his paper; a copy was requested but not provided before delegation left Beijing. Copy re-requested by fax).

There are questions of purpose, definition, and related issues of CTB:

1) Purpose and effects of a CTB for nuclear arms reduction and control.

2) Definition and options for related issues and uncertainties.

3) Should CTB ban all research on fission and fusion?

Generally speaking, CTB has two purposes:

1) Prevent non-nuclear weapon states from developing nuclear weapons (horizontal proliferation);

2) Prevent nuclear states from developing new types of warhead (vertical proliferation).

[RLG notes: "But this ignores the political impact of a CTB, both domestically and on other states"].

CHEN: (Continuing) These two aspects are inter-related. Is the CTB the best way to stop the nuclear arms race and allow extension of the NPT beyond 1995? In fact, this is the purpose of the NPT itself, which NPT alone cannot achieve. In the past there are several de facto nuclear weapon states (NWS) and threshold NWS not participants in the NPT and not subject to limitations of research on nuclear weapons.

In the field of nuclear disarmament and arms control, the CTB is only one of several measures. Only after we have gained adequate advances in arms reduction, can CTB be implemented and the purpose of NPT be achieved by drawing in states not participating in the NPT.

The most urgent purpose of nuclear disarmament is eliminating or reducing threats of use of nuclear weapons. From this point we see that the CTB is not the most urgent program in nuclear disarmament and arms control.

A CTB should be a step toward complete prohibition or complete elimination of nuclear weapons.

We can't use CTB as a strategy to limit other countries and preserve one's own superiority. Here I want to quote CISAC-- "U.S. can't gain security at the expense of increased insecurity of other nations." That is, one can't consider only one's own security, but must consider the security of other people.

This is one of the essential principles in dealing with international security. Can the CTB prevent emergence of new nuclear states? It is very difficult to implement this purpose with the CTB alone.

There are two aspects: A) incentive, or demand, or need; B) technological capability.

I think (A) is by far the more important-- if the desire is there, then the nation will do everything necessary at any cost or risk. This is related to national security interests, and CTB will not solve this problem.

A better measure for us is to do more things depending on the situation of various countries, to give incentives to reduce demand, incentives to seek nuclear weapons, and to reduce the threats they feel.

On the other hand, more important is to reduce and limit the functions and roles of nuclear weapons and eliminate the possibility of use. This is the responsibility of the nuclear weapon states, and U.S. and Russia should go first.

The current situation is not of this kind. Some U.S. policies turn out to have consequences just opposite to what the U.S. expected.

At present, the U.S.-USSR confrontation is ended, but regional and local conflicts have increased -- even leading to war. U.S. and Russia still have very powerful military forces to interfere. Particularly the U.S. is a worldwide superpower and considers that events all over the world are connected to the U.S. interest. Therefore, U.S. has the possibility [potential] to participate in regional and local conflicts. Russia also has some potential in certain regions -- CIS and Eastern Europe.

The problem is that at the present process of U.S-Russia disarmament, even in 2003, U.S. and Russia will still deploy oversized strategic nuclear weapon and tactical nuclear weapon forces-- 3000 - 3500 SNW; 5000 - 7000 tactical nuclear weapons (!).

Because START I and START II do not limit non-deployed nuclear warheads, and do not even destroy the missiles, they are equivalent only to the reduction of deployed forces and an increase of reserve forces, and maintenance of actual capacity.

Strategic emphasis of the U.S. is converted to prevention of proliferation of nuclear weapons. The problem is that the U.S. will preserve so much nuclear fighting capability. Russia proposed "zero-alert" forces. US did not agree, and persists in policy of First Use. So, how to persuade the countries to give up nuclear option under these circumstances? Someone in the U.S. proposes to use coercive measures-- I don't think this is the best plan and it is dangerous.

There is a Chinese saying, "Magistrates can burn down houses, but the poor cannot even light their lamps." [In other words] the powerful can do what they want, but the weak are not permitted to do anything. This policy [i.e. of military "counter-proliferation"] won't work.

On the other hand, for the acquisition of a small nuclear arsenal of crude fission weapons, it is not necessary to conduct nuclear explosion tests.

In August 1945, the gun type weapon at Hiroshima did not need any nuclear test. South Africa and Israel created small nuclear arsenals without tests. NTM are not adequate to detect such nuclear weapons. Even OSI in Iraq, if Iraq did not cooperate, would have great difficulty in finding them.

Qualified personnel and facilities are very similar for nuclear weapons and other things. Many Western firms and countries sold dual-use technology, which is very difficult to control-- e.g. South Africa and Israel have developed their own nuclear weapons.

However nuclear tests are necessary for development of more advanced warheads, especially thermonuclear warheads. At this stage, a CTB has very important effects.

On the other hand, CTB effects are limited to vertical proliferation in nuclear weapon states. Could CTB promote disarmament of nuclear states? Even after 2003, nuclear weapons owned by the U.S. and Russia exceed by order of magnitude those of the U.K., France, and China. CTB can only freeze situation. So it is unfair and impossible to ask these three countries to participate in nuclear disarmament and arms control.

Leaders of the U.K. and France have said that they will not participate in nuclear disarmament or arms control until the difference between the superpowers and themselves is reduced.

Actual CTB can't promote the progress of nuclear disarmament. If one wants to implement the purpose of a CTB, one must adopt more effective measures, e.g. prohibition of the use of nuclear weapons, as we have prohibited chemical and biological weapons.

Also to cut off simultaneously tests in these different countries will get us nowhere. U.K. and France have said many times that they can't stop nuclear tests. Different countries must decide for themselves whether they can stop nuclear tests.

In a word, my viewpoint is that if one wants to achieve the purpose of a CTB, one must adopt more effective measures to promote the progress of nuclear disarmament and arms control: i.e., prohibit use of nuclear weapons; create a global convention on large-scale nuclear disarmament; then can promote a CTB once these problems have been solved. In this way the world can avoid nuclear catastrophe. If it can't do so, it can limit the effects of nuclear weapon -- e.g. use only to retaliate against nuclear attack. One can even preclude nuclear retaliation against attack by other large-scale weapons.

(GARWIN asked clarification as to whether Chen was endorsing retaliation by nuclear weapons against biological attack or not.)

CHEN: In principle, I mean nuclear weapons could be used against nuclear attack, but some decision makers want to use U.S. nuclear weapons as a kind of deterrent against biological attack. In one sense it is a step back; in one sense it is a step forward. Personally, nuclear weapons against non-nuclear attack should be seen only as a deterrent against BW and CW.

CHEN: Nuclear states should have the responsibility not to use nuclear weapons against non-nuclear regions.

A very important measure is zero alert.

Non-use or NFU can remove the threat of possibly being attacked by nuclear weapons and reduce the incentive to have nuclear weapons, and promote the purpose of CTB. These are essential confidence-building measures.

QUESTION (unattributed) to Chen: How can you verify a NFU pledge? Or zero alert?

CHEN: Since U.S. emphasizes non-proliferation, U.S. should contribute new efforts to the program; and other nuclear states should contribute their own efforts.

CHEN (Part II): The second problem is definition, issues, and uncertainties of the CTB. A vague definition will not satisfy non-nuclear states.

QUESTION (unattributed) to Chen: If a CTB with some ambiguity [uncertainty?] will not satisfy non-nuclear states, is a non-nuclear state more satisfied with continued nuclear testing by the nuclear states?

CHEN: I am more concerned with how to eliminate threats of use or nuclear threats, than with a CTB.

CHEN (continuing): Our definition is to ban all kinds of nuclear explosion tests, including [those for] research on effects and maintenance of arsenals, while approaching zero [yield]. In this way, not only can't you develop or improve nuclear weapons, but as time passes the confidence in nuclear warheads is decreased and we can move toward the complete destruction of nuclear weapons.

QUESTION (unattributed) to Chen: Do you believe confidence is reduced without testing?

CHEN: My opinion is similar to that of former Secretary of Defense and LLNL Directors Harold Brown and John Foster, and here Kidder has the same opinion.[1]

CHEN: (continuing) Yesterday, U.S. colleagues talked about verification progress and say they think verification problems have been solved, but I think we could have many discussions and it is disputable that one could detect clandestine tests below 1 kt. So if one wants to implement CTB, one should do more research work on technical and political components of verification.

Briefly, regarding low-yield explosive tests to take place if there is a CTB. These are not compatible with the purpose of the CTB. A test below 1 kt. can have very strong military significance. If one wants to achieve the purpose of CTB, it doesn't work to depend upon CTB alone, but one must promote nuclear arms control and adopt more essential measures.

CHEN (Part III): Can a CTB ban all R&D work relating to nuclear weapons technology? For example, ICF should be prohibited according to the purpose of CTB, but actually cannot be prohibited. Fission and fusion research is dual use. Should adopt a prudent policy just as with biological and chemical weapons. This is a complex problem. There is a considerable distance between R&D and weaponization. To convert ICF results from laboratory to weapons, you need nuclear tests. ICF should not take place with nuclear tests. R & D activity is difficult to verify unless two sides can mutually participate in a laboratory research program. But this is very intrusive -- not [feasible? available?] now, when both sides want military secrecy over military science and technology. [In this area] other measures than a CTB are more effective.

It is important that verification be established on a mutual basis, with all concerned parties...strengthening confidence-building measures, and creating conditions to solve the problems that will arise in the verification process. In this way a CTB can be achieved in the near future.

I have two questions for my American colleagues. First, what is the purpose of the U.S. Congress and President in recommending negotiations for a CTB, and what is the US definition of a CTB? Second, based on present verification technology, what is the [verification] standard. We need to invite more experts and have more research [on these questions].

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[1] This sequence of questions and answers strongly suggests that the subject of agreement concerns a loss of confidence in weapons performance absent testing. Ray Kidder notes that either Prof. Chen was mistaken, or that the translation may have become confused at this point, because the matter on which Kidder, Brown, Foster and Chen actually do share the same opinion is that "A test below 1 kt can have [very strong, in Chen's view] military significance."

DISCUSSION -

GARWIN: Should nuclear weapons be used only against nuclear attacks, or did you say they could be used against other large scale attacks?

CHEN: Generally, nuclear weapons should be used to [only] to retaliate against nuclear attack. Some decisionmakers in the US are afraid other countries might attack with biological and chemical weapons, and want to use nuclear weapons to deter such attacks. This is a step backward from retaliating only against nuclear attacks.

GARWIN: You would not use nuclear weapons against CW, BW attack -- only against nuclear attack?

CHEN: Use nuclear weapons in retaliation against nuclear attack, but use only as a deterrent to CW and BW attack.

GARWIN: Would NNWS's be more satisfied with continuing nuclear tests in the NWS, or with a CTB?

CHEN: NNWS's are more concerned with elementary threat of nuclear warfare than with CTB?

GARWIN: So the demand of NNWS's for a CTB as a condition for indefinite extension of the NPT is not sincere?

CHEN: There was a different historical background when the linkage was proposed, with the Cold War and arms competition between the Soviet Union and the U.S. But now that's changed. So many NNWS's say the CTB will not solve the final question -- avoiding nuclear war.

PAINE: No country that supports the CTB links the achievement of a treaty to [prior achievement] of any other measure. Dr. Chen has linked the CTB to the resolution of a whole range of issues. No one but the UK and the US (under Reagan and Bush) have supported that approach.

CHEN: What I mean is that, even in the current historical background, weapons have not been reduced enough. the CTB cannot eliminate nuclear weapons.

TIAN DONGFENG: NNWS's proposed linkage with renewal of NPT so the NWS's would make progress on nuclear disarmament. Reagan-Bush used CTB as long-term target. Even three-party negotiations stopped. The US position in the CD was against negotiations -- only [favored] research on verification technology. China has

adopted consistent policy of linking CTB to other measures of disarmament (cites UNSSOD 1978). In the 1990 NPT Review, NNWS's said more progress was needed.

PAINE: Yes, but much progress has been achieved since then in reducing arsenals. And there is a nuclear test moratorium in effect. France, Russia, the US -- virtually the entire world community -- supports negotiation of CTB. We're closer than ever before. Now is not the time to be insisting on conditions.

GARWIN: You asked what will be the effect of a CTB? I agree that small crude weapons do not need testing. But politically, CTB has a very big influence....

GARWIN: We have noted that START I and II do not destroy weapons and in my estimation do not destroy missiles. If one goes to zero alert, it should be supplemented by destruction of all nuclear warheads not permitted by START II. We should urge the destruction of surplus warheads.

COCHRAN: What did Prof. Chen mean by "no tests" under a CTB? Would you prohibit hydrodynamic tests with zero yield?

HU SIDE: Prof. Du Shuhua will address the verification issues. If we talk of verification capabilities, there will be great debate. Some say 5000 tons, some say 1000 tons, some say a few hundred tons. Chen said that the verification question remains to be resolved.

DU SHUHUA: (presents paper on Verification of a CTBT; main points were as follows):

Verification plays the role of a deterrent. CTB is a component of "thorough nuclear disarmament," -- i.e. stopping production and deployment, a ban on use, and destruction of nuclear weapons. CTB has importance in preventing proliferation and reducing reliance on nuclear weapons. Definition of a CTB -- should cover all explosions with yield greater than zero.[2] For verification to satisfy that definition, it should meet the following criteria:

> (1) promptness -- timely evidence of violating action, to draw the attention of the international community while depriving the violating party of time to cover up its action. Should be capable of detecting violating actions during preparatory period.

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[2] On this point, Ray Kidder notes that a ban on all explosions with yield greater than zero is often incorrectly equated with a requirement for zero yield nuclear tests, which would "unintentionally rule out all fast-burst neutron facilities that do not explode. There is a decisive difference between tests and explosions that needs to be stated.

(2) accuracy and reliability -- verification information should be highly believable. Even if information [by itself] cannot be used to confirm violating action, it can be used as a basis for further verification action. The verification system (VS) should reliably identify nuclear explosions from other events.
(3) openness -- the VS should be acceptable to the international community; methods should be commonly recognized by all parties to the treaty and accepted by them. All parties should have an obligation to accept the VS and a right to share its capabilities and information resources.

Promptness, accuracy, reliability, openness -- these constitute effective verification. The scope of verification should include all parties to the treaty, and needs their cooperation. All countries should actively research how to meet the needs of the VS. Technically advanced countries have to make a major contribution.

Problems of Verification -- In order to ensure promptness of verification, detection should be timely, especially timely detection and analysis of regional signals. All countries should have timely detection capability. But differences in the intensity of signals, and different degrees of seismic attenuation, means that some [countries? stations?] cannot get the signal. Thus it is necessary to establish a network which can process the signals in real time.

In order to insure accuracy of verification, all concerned countries should share the same level of verification technology. In this way the results can be compared and cross-referenced. To insure reliability of verification, authoritative expert group of all concerned parties should be formed to give a coordinated evaluation [of the VS]. The aim is to assure all concerned countries that they have the same verification capabilities. Need to avoid one-sided conclusions from one or two countries. Information processing technology should be open and shared with all countries. Verification techniques not available to all parties should be considered illegal.

The foregoing is a discussion of principles. Must point out that verification of any treaty can never be complete, without any shortcomings.

Nuclear powers should undertake unconditional obligation on no first use. On the basis of NFU, NWS's can achieve a convention eliminating nuclear weapons. NFU is more important than CTB.

DISCUSSION -

PAINE: Can you clarify this? I understood you to imply that detection and identification capability should be uniformly high for all events. Can we accept less confidence for less probable or less militarily significant events?

DU SHUHUA: CTB should ban all nuclear tests [explosions?] with yield greater than zero,[3] including peaceful and non-peaceful. This will need better verification technology than we now have; so [we] must make an effort to supply it.

PAINE: Must this verification be uniform?

DU SHUHUA: What I mean is that verification technology should be uniformly available.

GARWIN: Do you mean that you need the same probability of detection of 1 kg as 1 kt of fission yield?

DU SHUHUA: This question I would leave to the experts.

COCHRAN: Do you believe (as I do) that it is more important to have agreement to stop testing than to agree on all the details of verification?

DU SHUHUA: We should have a CTB that can be verified. We want to be sure of the effectiveness of a CTB. "Maybe I misunderstand your question."

COCHRAN: For instance, the biological warfare treaty is not verifiable, but it is more important to have the treaty than to have perfect verification.

BUNN: The NPT is a CTB for all non-nuclear weapon states that have signed it! If we insist on such a high standard of verification for a CTB, what is the reason? Are we suspicious of one another?

DU SHUHUA: India has not participated in the NPT, and it has done one nuclear test.

COCHRAN: Would China be ready to announce that it would stop tests by date certain if others did also (without a treaty)?

DU SHUHUA: That should be decided by the Chinese Government.

COCHRAN: Your own opinion?

DU SHUHUA: In my own opinion, it can be considered by the Chinese side. The precondition is that all nuclear powers adopt non-use or at least NFU of nuclear weapons. Or the international community should state that it will enforce such rules. I believe China should have such a position.

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[3] See note on page 18.

CHEN XUEYIN: I think Professor Cochran gave a very good case in the biological warfare convention, because it prohibits use so there is no need of a treaty on testing. So if we can solve the problem of non-use, then we can proceed to the CTB.

KIDDER: Suppose NFU were agreed very soon. Would you be in a position to stop testing by September 1996?

CHEN XUEYIN: If all nuclear powers agree to non-use, then other problems can be solved very quickly -- yes.

NORRIS: Re Du Shuhua's level of verification, this is a very strict level, banning and verifying even those things without military significance.

DU SHUHUA: When I say zero yield, it is only one aspect -- "no military significance." Two days ago we had not come to an agreed definition of a CTB. We need consensus on definition.

HU SIDE: We are running out of time. Now for LIU GONGLIANG.

LIU GONGLIANG: (presents his paper) Regarding the congressional legislation of 1992 re nuclear testing. In 09/92-- great change in U.S. nuclear testing policy since Reagan (which attracted a lot of concern from the international community). We should welcome such a positive attitude.

Because U.S. and SU have done the most nuclear testing and have large nuclear arsenals, and because USG for 40 years always opposed ending nuclear tests, it is up to the U.S. to take the lead.

Understandable that U.S. needs to carry out limited number of tests to solve the problem of safety and reliability of nuclear weapons.

I can say a lot about necessity of ensuring safety of nuclear warheads -- e.g., Three-Mile Islands and Chernobyl.

Of course, the better way is to put all these nuclear weapons off alert, stop their deployment -- and move to thorough destruction of all nuclear weapons.

However, it seems to me the USG is not ready to give up its nuclear arsenal now. Could stop all tests by 1996. However some experts from U.S. national laboratory have different opinion, so there is this contradiction.

Because in 1992 the legislation stopped testing for only nine months, why do this if there is a need to complete a number of tests? DoD Undersecretary John Deutch

[LIU continued] said to the House -- "We need continued testing after the moratorium -- for safe, stable, reliable and effective nuclear deterrence."

From the news from France, Russian, and the U.K., they are also preparing for further testing. So a moratorium is not significant and it can't lead to a CTB.

(More about the general uselessness of a moratorium). Some people suggest that some countries declare a moratorium to impose pressure on those countries that have not declared a moratorium. e.g. China could have declared a one or two year moratorium in 1991, etc. China has had moratoria of longer than 9 months -- as has the UK. The U.S. should not pressure China to stop tests.

One should link testing ban with large scale disarmament to achieve real conditions for a CTB.

There should be no preconditions to a CTB. The U.S. should lead in a test ban. It should not say that it will stop testing only if other countries do not test.

I think this is really unnecessary...

There are still differences within the U.S., and that is why the Congress left itself a way out. Because the U.S. and Russian have tested so much... So UK, France, and China have only wanted to develop a nuclear deterrent, not an offensive capability.

All need to carry out testing to solve the problems of safety. Others need this too. More fair and reasonable than to ask other countries to take the same step. Unfair and not practical.

Final point. Early achievement of CTB. We hope not to leave the impression that CTB can't be achieved or that we need to carry out our own testing without time limit. We have worked hard for a global CTB, but we should be realistic.

Since 1960, only...or political treaties -- e.g. TTBT bilateral. This is too slow.

U.S. and Russia often change their positions in this area. We need 3-5 years of experience to see whether they mean a given position or not. We have low confidence in their sincerity.

Both extremes are unrealistic and not recommended:
1) Immediately achieve a CTBT (in a nuclear weapon free world). 2) Now do nothing toward a CTBT. (Would be opposed by people worldwide)

[LIU continued] Therefore, there should be active measures to achieve a more practical and more realistic CTBT, in less time than another 16 years.

Go to a CTB step-by-step. Quite a number of people in the international community...number of suggestions should be analyzed:

-- limited numbers of tests from each nuclear power, e.g. 1 or 2 times per year;
-- limits on yields or thresholds; 1 kt to 10-20; maybe certain [tests at?] 150 kt;
-- limits on total numbers of tests from all nuclear powers;
-- limits on time -- ban after a certain time;
-- limits on yields and numbers for each year (quota);
-- limits on total time -- e.g. 1992.

Each has its own merits and shortcomings. We need to carry out a serious study of each of these options (!). Limiting number of tests each year would limit the development of new weapons and would focus attention on safety and reliability.

For instance two per year might get support from many countries and serve as a useful step.

Limits on yield-- low-threshold ban also a transitional step, but if too high, no agreements; if the threshold is 1 kt, it creates problems for verification, so maybe 10 or 20 kt.

Limiting total period of time involves condition and [agreement] of various nuclear powers. If one can achieve this, not impose a certain date, but allow a delay without time limit.

Combine all these suggestions and find a middle way-- making it easier to find a consensus.

In a transitional period: 1) promote further progress in verification technology; 2) further effort in confidence building; 3) persuade U.S. and Russia to take part in a program of large scale nuclear disarmament.

All this could lead to a CTB and a nuclear weapon free world.

LIU GONGLIANG: I should add all the above mentioned can be discussed, but they should be discussed on an equal footing.

COCHRAN: There is information that I need to obtain. It is very clear that the U.S. will stop testing by 09/96. Only two things can change that --

[Cochran continued] for Russia to continue testing, or possibly for China to continue testing and to show no interest in the CTB. The debate within the USG this week is whether to recommend to Mr. Clinton 0, 10, or 15 nuclear tests before 1996.

It would be very useful for us to be able to go back and relay to the people in this debate what your recommendations would be to your government.

What would your advice be if the U.S. decided to stop testing now -- zero tests -- or if the U.S. planned to conduct 15 tests?

You can tell me privately if you wish.

HU SIDE: My suggestion is that we don't have much time and all have something to say. During the lunch hour the four Chinese speakers will have lunch together with you.

HU SIDE: (Gives his paper). "Chinese Nuclear Policy." Why China developed nuclear weapons, and policy toward nuclear disarmament. All of you have already read the book by John Lewis-- "China builds the atomic bomb." We were compelled by mistaken, unwise policy of USG, i.e. nuclear blackmail from U.S. nuclear weapons in Japan (quotes). The end of 1950s, importance of Sino-Soviet relations lead to the independent nuclear weapons development. After the first Chinese bomb explosion, Chinese Government declared that China had developed nuclear weapons only for breaking the nuclear weapons monopoly. At no time would China be the first to use nuclear weapons. China established its nuclear force to prevent it from becoming a target of nuclear attack.

For more than 30 years China has abided by these principles and exercised restraint. China never planned to be on an equal basis with US and Russia. SIPRI Yearbook says China's warheads are only a few percent of US and Russia's.
China has had only 40 tests since 1964, about one per year on average while the U.S. has had about 20 tests per year on average. China tests about once per year to maintain the effectiveness of the strategic force at the lowest level.

If USG had a wise policy and allowed U.S.-China relations to develop, would Chinese leaders have chosen another option [than?] developing a nuclear force? Basic stand of China on disarmament questions has been the same for many years. 1) Final goal should be a ban and elimination of all nuclear weapons; 2) U.S. and Soviet Union should take the lead in the "three stops and one reduction" to create conditions for an international conference on nuclear disarmament to include all nuclear powers and non-nuclear powers... 3) All nuclear powers should undertake obligations under no circumstance to use nuclear weapons first and also not to use or threaten to use nuclear weapons against non-nuclear states.

Leaders of the Chinese Government have promised that China has no intentions to avoid the obligations and responsibilities it has. China has always advocated comprehensive nuclear disarmament and a CTB...

If all nuclear powers undertake NFU and NU against non-nuclear states and nuclear free zones, that can effectively increase confidence and security and create a favorable atmosphere for reaching a CTB.

China asks the two nuclear superpowers to take the lead toward three stops and one reduction and more substantial arms reduction. Only in that way can it reduce the need for nuclear testing and reduce the obstacles toward a CTB.

China has done a lot toward nuclear arms control, maintaining a force at low levels and testing only once a year. Not a member of LTBT, but undertakes also not to conduct atmospheric or underwater tests. Although believes NPT is incomplete, has signed the NPT. Before that, the Chinese Government undertook the obligation of non-proliferation.

Chinese participates actively in the work of the Ad Hoc Committee of the CD. Also abides by NFU without conditions. I emphasize that China does this without asking the other nuclear powers to undertake the same as a prerequisite.

I believe China will undertake more and more obligations toward nuclear arms control, but, however, this will depend on its own ... of our national security and on the development of international nuclear arms control and on improvement of relations between China and other nuclear powers.

Improvement of U.S.-China relations will play an important role in this request. Our U.S. friends would like to see the U.S.-China relations develop in a good direction. For many years you have done a lot of work in increasing mutual understanding. Sincerely hope you will continue your efforts.

PAINE: You said only more substantial nuclear reductions would eliminate the need for testing. I don't understand the relationship. Will you explain at what level of armaments would the need for testing be eliminated?

HU SIDE: I think there are differences among different countries in level of nuclear weapons and need for nuclear tests. If no nuclear weapons, then no need for nuclear tests.

GARWIN: But operationally, how will you link the need for Chinese tests to the level of armaments?

HU SIDE: It is very complicated, but one can have a comparison. Previously when U.S. had a very oversized armament it had a lot of need for nuclear tests; China with its much smaller force had less need for tests. Must link the need for Chinese nuclear test to many aspects (of the international situation).

PAINE: The number of tests is related to the number of different types of weapons, not the absolute number of weapons. In recent years the US has gone from 18 different types to 6 or 7 types. How much more reduction needs to take place before [Paine continued] China will feel comfortable [enough] with the level of nuclear weapons [to undertake a test ban]?

HU SIDE: I would say you make some important points. If we reduce the number of types of weapons, the need for tests is reduced. But your conclusion that when you reduce to 7 types there is no need for further tests -- the lab experts don't agree.

KIDDER: But the lab experts have not persuaded the Congress, because they are not correct.

HU SIDE: We can continue this over lunch. We are glad this conference took place. Thanks for coming to Beijing. We hope there will be more chances for this kind of exchange in the future.

Lunch Thursday, 06/3/93: (Dick Garwin adds the following postcript to the exchanges at the meeting)

"I sat to the right of Hu Side. Chen Xueyin sat on his left in order to be able to interpret, and Tom Cochran was at his left. Please note, these are fragments from a conversation that occurred when it was noisy, and Chen's English, although good, is very hard to understand because of his specific pronunciation. Also, I have no idea how Chen interpreted my questions in detail. I asked Hu Side (remember, Chen was interpreting)" --

GARWIN: It would help to know why China tests nuclear weapons.

HU: Safety.

GARWIN: Are you putting IHE and fire-resistant pits (FRP) into the stockpile?

HU: Yes; it would be very bad to have a nuclear accident anywhere.

GARWIN: How many tests? How long will it take to do the necessary safety tests?

HU: We are accelerating somewhat.

GARWIN: Can you be finished by 1996?

HU/CHEN: I don't know, but we have no desire to continue testing indefinitely.

(Tom Cochran adds the following)

"At the lunch, I told HU that I wanted to summarize what I understood to be China's policy and would he tell me if my understanding was correct."

COCHRAN: It is my understanding that China's testing schedule will not depend on the test schedule of the United States--whether we tested zero times of fifteen times--but is driven by China's national security needs. Is this correct?

CHEN (interpreting for HU): Yes, that is correct.

In a question directly to CHEN (not to HU):

COCHRAN: Do you use insensitive high explosives in your weapons?

CHEN: We are working on insensitive high explosives. We need a few tests. Not very many. Only a few.

(end)

APPENDIX I
List of Participants
Beijing Test Ban Meeting: June 1-4, 1993.

Hu Side - Professor Hu used to be the Director of the Institute of Applied Physics and Computational Mathematics (IAPCM). Sometime in 1992 he was made Deputy Director of the Chinese Academy of Engineering Physics (CAEP or Ninth Academy). The Ninth Academy would be somewhat similar to our three National Laboratories (Los Alamos, Livermore and Sandia) plus the Nevada Operations Office. IAPCM's role seems to be to provide some of the theoretical research and computational calculations for the Chinese bomb program, supporting other experimental research institutes of the Ninth Academy. While Director of IAPCM, Hu started the Program for Science and National Security Studies (PSNSS) in an effort to conduct research and discussions about arms control, and to meet Western experts. He continues to wear that hat.

Fu Hongyuan - current director of IAPCM

Du Xiangwan - a physicist and deputy director of IAPCM. He is also a vice-president of the Chinese Nuclear Physics Society.

Du Shuhua - identified himself as technical director of IAPCM.

Liu Gongliang - IAPCM and PSNSS

Tian Dongfeng - IAPCM and PSNSS

Li Hua - IAPCM and PSNSS

Wang Deli - IAPCM and PSNSS

Sun Xiangli - woman graduate student at IAPCM, specializing in nuclear warhead verification, fissile material monitoring.

Cheng Huaifan - woman graduate student at IAPCM

Chen Xueyin - Senior weapons scientist, Ninth Academy, exact title not given, has visited the U.S. several times.

Bi Aili - a woman from Committee of Science, Technology and Industry of National Defense (COSTIND). COSTIND works with numerous ministries, institutes and the military to ensure effective coordination in researching and prodcing new weapon systems.

Liu Huaqiu - from the China Defense Science and Technology Information Center (CDSTIC), which is the publishing house for COSTIND

Pan Jusheng - also from CDSTIC

Niu Qiang - Chinese People's Association for Peace and Disarmament (CPAPD). A mass organization used for propaganda purposes, and to host foreign delegations.

An Yuejun - CPAPD

Cheng Huaifan - CPAPD

Shu Zhan - CPAPD, the ablest translator

Du Genqi - CPAPD - also a translator

Huang Zuwei - a senior research fellow at the Space Systems Engineering Research Center (SSERC) of the Ministry of Aerospace Industry, and Professor at the Beijing University of Aeronautics and Astronautics. Work on arms control in outer space problems.

Cheng Chiping - works with Huang at SSERC, also a tranlator.

Wang Ling - a woman working on arms control issues at the China Institute of Contemporary International Relations.

Tan Han - research fellow at the China Institute for International Studies, had been at the Conference on Disarmament in Geneva.

Lu Min - a research fellow at the Beijing Institute of System Engineering (BISE). Under the authority of COSTIND, BISE may perform technical evaluations of weapon systems.

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Date: March 29, 1993

Dear Prof. Hu and Prof. Wang:

As you know, in September 1992 the United States Congress:

-- initiated a nuclear test moratorium lasting through July 1, 1993, and possibly longer;

-- directed the President to renew negotiations on a Comprehensive Test Ban Treaty (CTB);

-- prohibited any U.S. nuclear test explosions after September 30, 1996, unless another country conducts a test after this date;

-- directed the President to examine the costs and benefits of installing three specific safety improvements (insensitive high explosive, fire-resistant pits, and enhanced electrical system safety) in weapons to be retained in the U.S. nuclear stockpile that currently lack these features.

-- in the event such safety improvements can be justified on a cost-benefit basis, directed the President to report to Congress on the number of nuclear test explosions (not to exceed 9 safety improvement tests, 3 "reliability" tests of weapons without enhanced safety features, and 3 U.K. tests in the period July 1, 1992 - September 30, 1996) that should be conducted prior to a CTB.

As you know, some of us have been intimately involved in the nuclear testing debate for many years. The new Administration is now involved in a major review of U.S. nuclear testing policy in

preparation for making its required report to Congress on CTB negotiations and the future of the U.S. nuclear testing program.

We think that now is an especially important time for us to discuss this matter, on an informal and unofficial basis, with you and your colleagues and with other senior officials involved in the Chinese nuclear weapons program. We are interested in your views regarding what kinds of "experiments" (or tests) involving fissile and fusion reactions should be permitted under a CTB, and your analysis of what kinds of monitoring and inspection measures are needed to verify such a treaty.

We are also interested in hearing the views of Chinese experts on the approach taken by the United States Congress to bringing about a halt to all nuclear weapons test explosions. What, if any, impact would a limited resumption of U.S.. Russian, and British testing for safety and reliability purposes have on the course of the Chinese nuclear weapons program? Or, to put the question another way, what would be the effect, if any, on the future course of the Chinese test program if the current U.S.- Russian - French test moratoria were extended indefinitely and converted at the earliest possible date into a Comprehensive Test Ban Treaty? What are your views on the likely impact of a resumption of testing on the future of the Russian nuclear weapons program?

We would welcome an invitation to visit China <u>at the earliest possible date</u> so that we might discuss these important matters in some detail. In addition to ourselves, the following persons should be included in a request for visa support, as they have indicated their desire to participate if their schedules permit: Richard L. Garwin, IBM Research Division; Ray Kidder, LLNL; George Bunn, Stanford Center for International Security and Arms Control; Phil Schrag, Georgetown University Law Center, Greg Van der Vink, Incorporated Research Institutions in Seismology; and Frank von Hippel, Princeton.

Sincerely,

Thomas B. Cochran
Senior Scientist

Christopher E. Paine
Senior Research Associate

Dear Dr. Cochran and Dr. Paine: April 12, 1993

Thank your for your Fax of March 29, 1993. Due to our planned schedule, We suggest that the date of your visit might be arranged in early June. It will be appropriate for us .

We will send you a formal invitation to get vissa on the basis of visitors' information (full name, date of birth, full address, present nationality, passport number, present professional activities and work address). And I would be pleased if you could give us the resume of Ray Kidder, George Bunn, Phil Schrag, Greg Van der Vink (if those new friends will come to China)

Please let me know what kind of hotel is available for you and what other help do you need.

Sincerely,

Hu Side

Hu Side

Wang Deli

Wang Deli

Remarks on Testing
Robert S. Norris, NRDC
Beijing, June 1-4, 1993

Let us look at the testing records of each of the five declared nuclear powers. Comparing the different experiences reveals a number of interesting insights.

One obvious fact is that there is a large discrepancy between the number of tests that the U.S. and the former Soviet Union have conducted, and the smaller number conducted by Britain and China. France is somewhere in the middle. Why is this the case? Let me offer a hypothesis and I ask you to give me your views on the matter.

The U.S. has conducted nearly one-half of the known tests, 48 percent to be exact. In the early period, when there was atmospheric testing in both the South Pacific and Nevada, tests were conducted from towers, on barges, suspended from balloons, dropped by aircraft, lifted by rockets, underwater and then exclusively underground. Two large laboratories (Los Alamos and Lawrence Livermore) competed with one another to provide new and improved nuclear warheads for receptive customers - namely the Air Force, Navy, Army, and Marine Corps. Throughout the 1950s and early 1960s there was a great enthusiasm for nuclear weapons in the U.S. military. Each of the four services wanted them, and almost every military mission was nuclearized, from anti-submarine warfare torpedoes, to air-to-air missiles, to artillery, land mines, missiles of every range, and bombs of great variety. With few restraints, the laboratories tested almost every conceivable device they could think of. The political context was one of few limits

and almost everything was permitted. The two highest years were 1958 with 77 tests and 1962 with 96 tests. An average of almost 40 tests per year prevailed through the rest of the 1960s.

In the United States, I think it is true to say, that it was the professional military itself that began to lose their enthusiasm for nuclear weapons. Professional soldiers began to realize that nuclear weapons could not be used, that they were costly to maintain and to guard, and that conventional weapons were preferred. One by one the nuclear weapons for particular military missions were abandoned. Nuclear air defense was phased out, the Navy got rid of all of their anti-submarine weapons, the Air Force stopped the nuclear air-to-air mission, today the U.S.Army, for the first time in forty years has no nuclear weapons at all.

Over fifty years in the U.S. has researched and developed approximately 100 different warhead types. Many of these have been cancelled before proceeding to production. About 70 of the designs have advanced to become finished warheads and bombs that have been deployed on weapons systems. Various modifications of a design for multiple application also have been a feature of American practice. In the early years it probably took approximately 20 tests to develop a new design. As computer capability increased and other advances were made, the number of tests decreased. Recent practice suggests that the number is probably about five or six tests are needed to develop a new warhead.

The Soviets have gone through a similar experience but lagged behind the U.S. by a period of five to seven years. They have tested, according to Victor Mikhailov, of the Ministry of Atomic

Energy, a total of 715 times (37 percent of the world total), starting in 1949 and achieving by the end of 1955 the major milestones of lighter weight fission bombs, boosted weapons, and modern multi-stage thermonuclear weapons. Their military too seemed to have a great enthusiasm for nuclear weapons, and like the U.S. they built great numbers of them for almost every military mission. The love affair seemed to last longer with the Soviets as their stockpile peaked in the mid-1980s, almost twenty years after the U.S. In characteristic fashion the Soviets seem to have kept more of the weapons they have built, recycling far fewer than the U.S. did.

The third nation to become a nuclear power was Great Britain. After very close collaboration during World War II the British and the Americans broke their cooperative relationship from 1946 to 1958. During this period the British developed their own bombs, conducting 21 tests in Australia and the South Pacific and going through the key milestones, a fission bomb in October of 1952, miniaturization and boosting in 1953 and 1956, and finally thermonuclear weapons in 1957 and 1958. After the end of the test moratorium in 1961, and atmospheric testing in 1963, the British have used the Nevada test site to conduct 23 underground tests in a thirty year period. This is a small number, even for a nation with a small arsenal. I think part of the explanation is that the U.S. shares information with their British counterparts and thus the British draw upon the huge reservoir of knowledge that has come from almost 1,000 U.S. tests.

The fourth nation to become a nuclear power was France, in February 1960. The large number of tests, 210, suggests several things. France had no help in achieving the key milestones of a modern nuclear power. Because of policies originally established by Charles de Gaulle the French have committed a great deal of their resources to nuclear weaponry. The percentage of the defense budget allocated to nuclear weapons, throughout the 1970s and 1980s, has been in the 25 to 30 percent range, higher than that for the other four powers.

The fifth nation to become a nuclear power was China in October 1964. The full story of everything that was involved in this accomplishment has yet to be told. Very early on there was some help from the Soviet Union, who initially were even going to give China a prototype device. After the serious split, which occurred in 1959 and 1960, China was on its own. Exactly how much China learned from the Russians before the split, about rector designs, uranium enrichment technology, bomb designs, etc., and how much the Chinese discovered on their own, remains to be described in an objective historical account.

From the initial success in 1964 to 1993, China has tested only 38 times. There is no doubt that China could have tested many more times, had they chosen to do so. Why didn't they? There seems to have been a conscious policy decision to have a very modest sized arsenal, and to test the minimum amount necessary to develop the arsenal. This has probably led to a design practice and philosophy that relies on a few generic warhead types that are adaptable to different kinds of weapon systems. The basic design

serves as a missile warhead and with slight variations is also a bomb. The primary is a small yield fission weapon.

Let me conclude by a quick review of the current situation in each of the five nuclear powers. In the U.S. there are no new nuclear weapons being produced, there are no new requirements for new weapons from the Pentagon and thus there are no new nuclear weapons in research and development plans. The plant in Texas which used to make the new U.S. nuclear weapons is mainly occupied with cleaning up the pollution that was created over the years, a very costly and lengthy process that will take decades and cost several billion dollars. There are plans to consolidate the different parts of the complex. While no firm decisions have yet been made the future complex will be very small compared with the one of today.

In Russia there are similar things going on. Almost all of the activity at the plants is taking apart retired warheads. Almost all of the reactors have ceased producing new plutonium for weapons. Those still operating also generate electricity. There are many problems and concerns about keeping track of over 30,000 nuclear weapons, the missile material, the components, and the scientists and engineers. Every nation in the world has a deep interest in ensuring that these potential problems do not contribute to future proliferation problems.

France has postponed or cancelled most of its future nuclear weapon programs and has joined the U.S., Britain, and Russia in the current testing moratorium. There are forces within the French military and the nuclear weapons establishment that are pushing to

resume testing and to develop new weapons. I don't think the French will test first but it wouldn't take them long to test second if someone else resumed testing.

The British are bound by what the U.S. decides since they test in Nevada. The issues are somewhat complex but the British should not pose a barrier to continuing the moratorium and the accomplishment of a comprehensive test ban.

This leaves China, who has a very important role to play in what happens. There are people in the U.S. military and in the design laboratories, along with their counterparts in Russia, Britain, and France who want China to test. This would then give them en excuse to resume testing as well. The issue of course is not China's alone and needs full discussion. Let me stop here and let my colleagues present to you some of the other important facts surrounding this issue.

KNOWN NUCLEAR TESTS WORLDWIDE, 1945 TO DECEMBER 31, 1992

Year	U.S.	S.U.	U.K.	FR	CH	Total
1945	3	0	0	0	0	3
1946	2	0	0	0	0	2
1947	0	0	0	0	0	0
1948	3	0	0	0	0	3
1949	0	1	0	0	0	1
1950	0	0	0	0	0	0
1951	16	2	0	0	0	18
1952	10	0	1	0	0	11
1953	11	4	2	0	0	17
1954	6	7	0	0	0	13
1955	18	5	0	0	0	23
1956	18	9	6	0	0	33
1957	32	15	7	0	0	54
1958	77	29	5	0	0	111
1959	0	0	0	0	0	0
1960	0	0	0	3	0	3
1961	10	50	0	2	0	62
1962	96	44	2	1	0	143
1963	44	0	0	3	0	47
1964	38	6	1	3	1	49
1965	36	10	1	4	1	52
1966	43	15	0	7	3	68
1967	34	17	0	3	2	56
1968	45	15	0	5	1	66
1969	38	16	0	0	2	56
1970	35	17	0	8	1	61
1971	17	19	0	6	1	43
1972	18	22	0	3	2	45
1973	16	14	0	5	1	36
1974	14	18	1	8	1	42
1975	20	15	0	2	1	38
1976	18	17	1	4	4	44
1977	19	18	0	6	1	44
1978	17	27	2	8	3	57
1979	15	29	1	9	1	55
1980	14	21	3	13	1	52
1981	16	22	1	12	0	51
1982	18	32	1	9	1	61
1983	17	27	1	9	2	56
1984	17	29	2	8	2	58
1985	17	9	1	8	0	35
1986	14	0	1	8	0	23
1987	14	23	1	8	1	47
1988	14	17	0	8	1	40
1989	11	7	1	8	0	27
1990	8	1	1	6	2	18
1991	7	0	1	6	0	14
1992	6	0	0	0	2	8
	942	**715***	**44**	**210***	**38**	**1,950***

*Totals include 86 Soviet and 17 French tests not identified by date, and one 1974 underground explosion by India.

Eight tests were conducted in 1992, six by the United States and two by China. None of the other three declared nuclear weapons states tested. It is possible that there will be no tests in 1993. The United States has no new warhead programs under development. Russian and French challenge moratoria in 1992 led the U.S. Congress to call for a testing halt until July 1993.

Since 1945, at least 1,950 known nuclear test explosions have been conducted, about 85 percent of them by the United States and the Soviet Union. About 27 percent of all tests were atmospheric. The United States conducted 217 atmospheric tests, the Soviet Union 214, Britain 21, France 50, and China 23, for a total of 525. The United States conducted its last atmospheric test on November 4, 1962; the Soviet Union, December 25, 1962; the United Kingdom, September 23, 1958; France, September 15, 1974; and China, October 16, 1980.

For the entire period the average has been one nuclear test every nine days. Dating from each country's first explosion, the rate for the United States is one test every 18 days; the Soviet Union, one test every 22 days; France, one test every 57 days; China, one test every 279 days; and the United Kingdom, one test every 340 days.

The United States does not announce all of its tests. The U.S. total includes 116 unannounced tests, the most recent of which was conducted on April 6, 1990. It is likely that several dozen more remain to be discovered and the true U.S. total is close to 1,000. Twenty-seven peaceful nuclear explosions (PNEs), conducted between 1961–1973, are included in the U.S. total. In recent years, the annual Energy Department testing budget has been approximately $500 million. Vertical shaft tests cost around $30 million each, and the more complicated horizontal-tunnel weapons-effects tests, paid for by the Defense Department's Defense Nuclear Agency, $50–60 million each.

Russia was unable to test during 1992 and may not test again anytime soon. President Mikhail Gorbachev announced on October 5, 1991, that a unilateral one-year moratorium would take effect. On October 19, 1992, Russian President Boris Yeltsin extended the moratorium to July 1, 1993—reaffirming his October 26, 1991, decree "On Halting Nuclear Weapon Tests on the Novaya Zemlya Proving Ground."

Beginning in 1962, the United Kingdom conducted 23 of its 44 tests jointly with the United States at the Nevada Test Site.

According to a reliable source, the total number of French nuclear tests is 210. We are not able to identify 17 of these by date, but we calculate that two were atmospheric, probably safety tests between 1972–74; two between 1975–77; 11 between November 1981 and October 1986; and two from October 1986 to the end of 1991. Precise dating is difficult because a test may not produce an explosive yield with a seismic signature, either because it is a dud or because it is not intended to.

The precise dates of all 38 Chinese tests are now known. The overall total includes one Indian underground test on May 18, 1974.

Negotiations for a comprehensive test ban may include a requirement that the five declared nuclear powers divulge a complete list of their tests.

APPENDIX 5

NUCLEAR NOTEBOOK

Nuclear

	United States	Soviet Union	Britain	France	China
Warheads					
Warheads in stockpile	10,500 active, 6,000 awaiting disassembly	15,000 active, 18,000 awaiting disassembly	200	540	450
Peak number of warheads/year	32,500/1967	45,000/1986	410/1969	540/1993	450/1993
Total number of warheads built/year	70,000 1945–1992	55,000 1949–1992	915 1952–1992	1,150 1960–1992	600 1964–1992
Number of known test explosions (end of 1992)	942	715	44	210	38
Weapon development milestones					
Atomic bomb developers	J. Robert Oppenheimer, Gen. Leslie Groves	Igor V. Kurchatov	William G. Penney	Gen. Charles Ailleret, Pierre Guillaumat	Nie Rongzhen, Liu Jie, Deng Jiaxian
Hydrogen bomb developers	Stanislaw Ulam, Edward Teller	Andrei Sakharov, Yuli B. Khariton, Yakov B. Zeldovich	William Cook Keith Roberts Brian Taylor	Robert Dautray	Deng Jiaxian, Yu Min, Peng Huanwu
First operational ICBM	Oct. 31, 1959 Atlas D	1960 SS-6	none	Aug. 2, 1971 S-2 IRBM	Aug. 1981 Dong Feng-5
First nuclear-powered naval SSN enters service/vessel	Jan. 1955 *Nautilus*	Aug. 1958 *November*	1963 *Dreadnought*	Jan. 1971 *Le Redoutable*	1974 *Han*
First SSBN patrol with Polaris-type SLBM/ vessel/missile	Nov. 15, 1960 *Washington* Polaris A1	1968 *Yankee* SS-N-6	June 1968 *Resolution* Polaris A3	Jan. 28, 1972 *Le Redoutable* M1	1986 *Xia* Julang-1
First MIRVed missile deployed	Aug. 19, 1970 Minuteman III	1974 SS-18 or -19 ?	1994–1995 Trident II	April 1985 M-4A SLBM	none
Testing milestones					
First fission test, type/yield	July 16, 1945 Plutonium/23 kt.	Aug. 29, 1949 Plutonium/20 kt.	Oct. 3, 1952 Plutonium/25 kt.	Feb. 13, 1960 Plutonium/60–70 kt.	Oct. 16, 1964 U-235/20 kt.
First test of boosted fission weapon/yield	May 8, 1951 Item/46 kt.	Aug. 12, 1953 Joe 4/400 kt.	May 15, 1957 ? Short Granite/ 150 kt. ?	Sept. 24, 1966 Rigel/150 kt.	May 9, 1966 ~ 200 kt.
First multistage thermonuclear (hydrogen bomb) test/yield	Oct. 31, 1952 10.4 mt.	Nov. 22, 1955 1.6 mt.	April 28, 1958 2 mt. ?	Aug. 24, 1968 2.6 mt.	June 17, 1967 3 mt.
Number of months, first fission bomb to first multi-stage thermonuclear	87	75	66	102	32

Pursuits

	United States	Soviet Union	Britain	France	China
First airdrop explosion of nuclear weapon/aircraft used	Aug. 6, 1945 B-29	Nov. 6, 1955 Bear ?	Oct. 11, 1956 Valiant	July 19, 1966 Mirage IV-A	May 14, 1965 Hong 6
Known atmospheric tests (includes underwater)	217	214	21	50	23
Largest atmospheric test	Feb. 28, 1954 15 mt.	Oct. 30, 1961 50 mt.	Sept. 1958 2.5–3 mt.	Aug. 24, 1968 2.6 mt.	Nov. 17, 1976 4 mt.
Last atmospheric test	Nov. 4, 1962	Dec. 25, 1962	Sept. 23, 1958	Sept. 15, 1974	Oct. 16, 1980
First underground test	July 26, 1957	Oct. 11, 1961	March 1, 1962	Nov. 7, 1961	Sept. 23, 1969
Largest underground test	Nov. 6, 1971 5 mt.	Oct. 27, 1973 2.8–4 mt.	Dec. 5, 1985 <150 kt.	July 25, 1979 120 kt.	May 21,1992 660 kt.
Current test sites	Nevada	Semipalatinsk*, Novaya Zemlya	Nevada	Moruroa atoll, Fangataufa	Lop Nur (Malan)
The nuclear infrastructure					
Assembly and disassembly plants	Pantex near Amarillo, Texas	Nizhnyaya Tura (Sverdlovsk-45), Yuryuzan (Zlatoust-36), Penza (Penza-19)	Burghfield Royal Ordnance near Reading	Centre d' Etudes de Valduc (Côte-d'Or)	Subei (Gansu), Guangyuan (Sichuan)
Plutonium production/ number of reactors	Hanford*/9 Savannah River*/5	Chelyabinsk-65*/6 Tomsk-7/5 Krasnoyarsk-26/3	Calder Hall/4 Chapelcross/4 Windscale*/2	Marcoule*/3 Chinon-2*,-3*/2 Bugey-1/1 Phénix /1 Celestin-1,-2/2	Jiuquan (Gansu)/1 Guangyuan (Sichuan)/1
Uranium enrichment plants	Oak Ridge,* Portsmouth, Paducah	Verkni-Neyvinsky, Krasnoyarsk, Angarsk, Tomsk	Capenhurst	Pierrelatte	Lanzhou, Heping (Sichuan)
Chief design labs	Los Alamos, New Mexico; Lawrence Livermore, California	Arzamas-16, Chelyabinsk-70	Aldermaston near Reading	Limeil-Valenton in Val-de-Marne	Ninth Academy Mianyang (Sichuan)
Current directors and administrators	Hazel O'Leary, Energy Secretary; Siegfried Hecker, dir., Los Alamos; John Nuckolls, dir., Livermore	Viktor Mikhailov, Minister of Atomic Energy and, dir., Arzamas-16; Evgeni Avrorin, Scientific dir., Chelyabinsk-70	Donald Spiers, Controller of Establishments, Research and Nuclear; Brian Richards, dir., Aldermaston	Roger Baléras, dir., Direction des Applications Militaires	Hu Renyu, dir., Ninth Academy; Hu Side, Deputy dir.

*No longer operational. **"Boosted":** small quantities of tritium and deuterium incorporated in fission weapon to increase efficiency of yield; **kt.:** kilotons; **mt.:** megatons; **ICBM:** intercontinental ballistic missile; **IRBM:** intermediate-range ballistic missile; **SSN:** nuclear-powered submarine; **SSBN:** nuclear-powered ballistic missile submarine; **SLBM:** submarine-launched ballistic missile.

THE DEBATE OVER A COMPREHENSIVE TEST BAN: THE VIEW FROM WASHINGTON, D.C.

by Christopher E. Paine
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I. The New Test Ban Debate 1985-1992.

The implications of a Comprehensive Test Ban (CTB) can be examined and debated at several levels. U.S. supporters of a complete test ban have long believed that:

-- any military technology benefits (including improved safety) that might come from continued testing underground are outweighed by the risks of advanced thermonuclear weapons proliferation and radioactive contamination entailed by further nuclear weapons tests;

-- a Comprehensive Test Ban is an important means of minimizing discrimination between nuclear weapon- and non-weapon-states when the Nuclear Nonproliferation Treaty (NPT) comes up for extension in 1995;

-- a CTB could help to stabilize the so-called "existential" nuclear deterrent balance that now exists in South Asia between India and Pakistan, without either state feeling compelled to develop and deploy a sophisticated nuclear arsenal;

-- above all, a test ban is an important symbolic and political component of a broader nonproliferation strategy which seeks to stigmatize acquisition of nuclear weapons and thereby diminish the potential for their threatened or actual use.

During the period 1989-1991, as the Cold War ended and the Soviet Union disintegrated, the primary U.S.justification for continuing nuclear weapons testing abruptly shifted from staying ahead in the arms competition ("modernization") and demonstrating predicted explosive yields ("reliability") to "enhancing nuclear weapons safety." Under this rubric, proponents of nuclear testing proposed to spend billions of dollars over the next decades developing a new generation of nuclear warheads which could endure severe collisions and plane crashes without scattering toxic plutonium into the environment.

However, members of Congress and the general public did not believe that a new generation of safer warheads was necessary. Current U.S. weapons are already designed to be safe against an accidental nuclear explosion under a wide, if not completely exhaustive set of possible accident scenarios. In the 45 year history of the nuclear arms race, despite numerous accidents involving nuclear weapons less "safe" than today's designs, no such accidental U.S. nuclear explosion has ever occurred.

Opponents of continued nuclear weapons tests argue that there are far more cost-effective ways to reduce the public's exposure risk to cancer-causing agents than spending billions of dollars building so-called "safer" nuclear weapons. If public health is really the

new measure of merit by which the need for nuclear explosions will be judged, then the scatter of warhead plutonium by fire or chemical explosion constitutes one of the least likely public cancer exposure risks, and the most obvious way to further reduce this risk is not to transport nuclear weapons by air in peacetime. Testing opponents argued that further reducing the public's environmental and occupational exposure to lead, benzene, and cadmium, for example, would be a far more effective use of a billion taxpayer dollars than further refinements in nuclear weapons technology.

Beginning in 1985 with the ascendancy of President Gorbachev, the former Soviet Union went out of its way to demonstrate a willingness to stop all nuclear weapons testing if the United Sates would agree to do the same. In August 1985, the USSR began a 19-month unilateral testing moratorium, and in June 1986 President Gorbachev agreed to a joint proposal by the Natural Resources Defense Council (NRDC) and the Soviet Academy of Sciences to install seismic stations around the main Soviet test site in Kazakhstan.

The first step in a long-standing campaign in Congress to end nuclear testing was a surprise victory in an August 1986 House vote that was influenced by NRDC's success only weeks before in setting up the first "in-country" seismic stations for monitoring a test ban. The House of Representatives approved an amendment that barred all U.S. nuclear tests with a nuclear energy release exceeding one kiloton (1000 tons) of chemical explosive equivalent provided the USSR showed similar restraint. NRDC's stations boosted confidence in Congress that the USSR would observe a reciprocal test moratorium, and the same restriction passed the House again in 1987 and 1988. But it twice failed passage in the Senate, where similar Hatfield-Kennedy amendments were held to a maximum of 40 votes.

The Reagan Administration declined to join the moratorium or begin CTB negotiations, and the Soviet Union resumed testing in February 1987. Despite the moratorium, the Soviet Union still managed to conduct 61 underground nuclear explosions in the four year period from 1984 through 1987. Over the same period, the United States conducted 62 underground explosions.

As the Reagan era gave way to the Bush Administration, Senators Ted Kennedy and Tom Harkin and Representatives Ed Markey and Martin Sabo arranged for government funding and expansion of NRDC's seismic monitoring network in the former Soviet Union under the auspices of a large university consortium, the Incorporated Research Institutions for Seismology (IRIS). Technical support for the IRIS stations came from the same geophysics research group at Scripps Institute at U.C. San Diego that had earlier collaborated with NRDC. The NRDC-IRIS broadband seismic networks demonstrated for the first time that high frequency signals from small mining explosions (equivalent to a 1 kiloton "fully decoupled" test) could be clearly detected above background at distances of several hundred kilometers from the Soviet Semipalatinsk site, thereby establishing the practicality of an in-country seismic network to help detect and deter the kind of evasion scenarios that had long been presented as the primary obstacle to a CTB.

From 1987-91, congressional supporters of a test ban also vigorously pursued the other ostensible technical barriers to a test ban, by mandating a DOE study of the test requirements, including any needed safety upgrades, that would permit reliable remanufacture of weapons under a future test ban, and by commissioning an independent evaluation of the weapon reliability and safety issue by Livermore physicist Ray Kidder. Both these studies eventually turned out to play an important role in the deliberations leading to the successful compromise and historic Senate vote on Aug. 3, 1992 to end nuclear testing. The estimated number of tests needed for certifying various safety upgrades to warheads that are candidates for retention in the future stockpile is given in **Table 1.**

Two years after the Soviet Union resumed testing, two of its underground tests leaked radioactive material into the atmosphere. The accident initiated a grassroots environmental movement calling for the closure of the Soviet test site in Kazakhstan. At the beginning of 1990, Moscow announced that testing at Kazakhstan would be phased out over three years and moved to an existing test site on the Arctic Island of Novaya Zemlya. Testing in the Arctic, however, also faced opposition, notably from the newly elected President of the Russian Republic, Boris Yeltsin, whose election platform included opposition to testing on Novaya Zemlya. The last test in Kazakhstan occurred on October 19, 1989, and the last test conducted by the former Soviet Union was on Novaya Zemlya on October 24, 1990.

While the debate over the technical requirements for a comprehensive ban continued in Congress, the Bush Administration never delivered on President Reagan's pledge to Congress to resume test ban negotiations "immediately" following ratification of the Threshold Test Ban Treaty, an agreement dating back to the Nixon Administration that had become a convenient obstacle to progress on a CTB. After years were wasted negotiating cumbersome on-site technical measures -- to more exactly determine the size of large nuclear explosions permitted by the Threshold Treaty -- this agreement finally received Executive and Senate approval in September 1990.[1]

In August 1991, the Semipalatinsk test site was permanently closed at the direction of the newly independent Kazakh Republic. Following the disintegration of the Soviet Union in December 1991, Russian President Boris Yeltsin continued to seek negotiations on a CTB and pledged that Russia would adhere to the one-year unilateral moratorium on testing initiated by then Soviet President Gorbachev on October 5, 1991. French Prime Minister Pierre Beregovoy announced on April 8, 1992 that France, long considered one of the staunchest opponents of a test ban, would suspend testing for the remainder of the year, and he urged the United States and other nuclear weapon states to follow suit.

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[1] For a detailed discussion of the technical issues and political lessons of the TTBT verification debate, see G. van der Vink and C.E. Paine, "The Politics of Verification: Limiting the Testing of Nuclear Weapons," Science and Global Security, Vol. III, No. 3/4, Gordon and Breach Science Publishers, New York, 1992.

On February 27, 1992, President Yeltsin quietly ordered the Russian Ministry of Atomic Energy and the Russian Navy to resume preparations for conducting 2-4 tests at Russia's Arctic site "in case of termination of the existing moratorium."[2] On October 13, 1992, responding to the enactment of a 9-month U.S. test moratorium imposed by the U.S. Congress, Russian Defense Minister Pavel Grachev announced, "If the tests resume, it will not be before mid-1993."

On May 21, 1992 China conducted a nuclear test with an estimated yield of 660 kilotons. The next day the U.S. State Department called on China to restrain its program of underground nuclear testing. However, the Bush Administration continued to adhere to the essentials of the Reagan doctrine on testing, namely, "as long as we rely on nuclear weapons as a deterrent, we must continue testing." In the minds of at least some senior Bush Administration officials, this imperative applied to foreign nuclear testing programs as well. Despite the ongoing Russian and French test moratoria, Richard Claytor, the DOE's Assistant Secretary for Defense Programs, told the Senate Armed Services Committee in August 1992:

> With respect to the French, I know in their technical community there is strong support from a safety and reliability standpoint that this is very important, that any nation that has nuclear weapons feels the necessity to test to assure the safety and reliability of the stockpile. Sometimes the political considerations have overridden that, but I believe that those nations with whom we deal would want to resume testing....
>
> I do not think it would make any difference if we have a moratorium. I am sure the Chinese would not be affected one way or the other. That is my view....
>
> Our laboratory directors from our weapons laboratories have been in touch with their [Russian] counterparts and have actually visited the former Soviet Union. I am suggesting to you, sir, that the technical community in Russia, from the information fed to me, feel it is very important to continue testing for safety and reliability of their stockpile. That is the only view I have.

The possible implications for nonproliferation and regional security of his "any nation that feels the need to test should test" position seems to have escaped Mr. Claytor, and other senior officials as well. Douglas Graham, the Deputy Assistant Secretary of Defense for Strategic Defense, Space, and Verification Policy, agreed with Claytor's testimony:

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[2] The English text of Yeltsin's decree is reproduced in "Report of the Fourth International Workshop on Nuclear Warhead Elimination and Nonproliferation, FAS/NRDC Washington, D.C., Feb.26-27, 1992, Appendix G-20).

> In our view, the reasons we test have nothing to do with the fact that the Russians are testing or the French are testing, and in our view the Russians and the French have very compelling reasons to be doing testing of their own.... As long as those two countries rely on nuclear weapons, it seems to us that the United States has an interest in their having as safe and secure a stockpile as possible.

Dr. John Birely of Los Alamos National Laboratory, the Acting Assistant to the Secretary of Defense for Atomic Energy, testified that in a recent discussion with "a top-level official of the Russian defense establishment," he and Mr. Graham had asked him why the Russians had formally notified the U.S. in accordance with the TTBT of their intent to resume testing:

> And he said, "well, just read your own President's policy." So the top-level policymakers in Russia, in addition to the technical people, are also actively debating the resumption of testing, for the exact technical reasons that we have incorporated in our policy....for the foreseeable future...both sides will have a substantial stockpile. As long as we have that stockpile, improving and assuring its safety and reliability is the responsibility of both sides, and one could make an argument based on those concerns that it would be to our advantage to have them testing.[3]

[3] (emphasis added) "Military Implications of START I and START II," SASC Hearings, 102nd Cong., 2nd Session, USGPO:1992, p. 213-215.

TABLE 1: ESTIMATED NUMBERS OF NUCLEAR EXPLOSIVE TESTS REQUIRED TO INSTALL SAFETY UPGRADES (AND OTHER PERMITTED TESTS) UNDER THE "HATFIELD-EXON-MITCHELL AMENDMENT" (HEMA) OF 1992.

Warhead/Bomb	Safety Upgrade(s)	# of Explosions Min #	Max #	Source
W76 Trident I/II	Add IHE/FRP[4]		3	DOE, Dec. 1990
W88 Trident II	Add IHE/FRP		2-4	DOE, Dec. 1990
[W76/88 Trident I/II	*No change needed*	*0*		*DoD, March 1992]*[5]
[W76/88 Trident I/II	*Test W89 replacement*	*4*		*R. Kidder, 1992]*
W78 MM III	Add IHE/FRP		2	DOE, Dec. 1990
	No change needed	*0*		*DoD, March 1992*
[DeMIRV W78 MMIII	*Replace with MX/W87*	*0*		*R. Kidder, 1992*
W80 ALCM/ACM	Add FRP		2	DOE, Dec. 1990
B61 bomb	Add FRP		1	DOE, Dec. 1990
[W80/B61	*Do not add FRP's*	*0*		*DoD/Air Force,*[6] 1991-92
Subtotal - safety upgrade tests		0-4	10-12	
"Reliability" tests (incl. DNA) @ 1 per year		0	3	President must certify
British tests @ 1 per year		0-3	3	President makes determination
Est. Hatfield-Exon-Mitchell tests[7]:		**0-7**	**16-18**	

[4] IHE = "Insensitive High Explosive;" FRP = "Fire Resistant Pit."

[5] As recently as March 31, 1992, the Asst. to the Secretary of Defense for Atomic Energy testified "that there is not now sufficient evidence to warrant changing either warheads or propellants" in the Trident SLBM force."

[6] The Air Force response to the Drell Panel in August 1991 stated that it would not be cost effective to remanufacture the W80 and B61 weapons with fire resistant pits: "Qualitative Assessment indicates that safety risk associated with incorporating FRP into bombs and cruise missile warheads which already have ENDS and IHE would exceed the safety gain." Air Force Response to the Drell Panel, NWCWSC 1 August 1991, Lt. Col John R. Curry SAF/AQQS.

[7] The number of tests ultimately arrived at in the "Hatfield-Exon Mitchell" legislation was 15, between the upper end of the minimum and the low end of the maximum credible estimates. As the final vote neared, DOE officials testified that 25 tests would be needed to accomplish these tasks, apparently on the basis that additional tests should be included as a buffer, to insure against the failure to accomplish the safety upgrade objectives within the forecast number of tests.

The Bush Administration had scheduled 6 nuclear tests during FY 1993. Facing the likelihood of a one-year nuclear test moratorium imposed by Congress if it failed to act on its own, on July 10, 1992 the Bush Administration "modified" U.S. nuclear testing policy by imposing new unilateral restraints on the conduct of U.S. tests. "The purpose of all U.S. nuclear tests of our weapons will henceforth be for safety and reliability of our deterrent forces. ... We do not anticipate, under current foreseen circumstances, more than six tests per year over the next five years, or more than three tests per year in excess of 35 kilotons."[8] This policy resulted in the cancellation of one test for FY 1992 -- "Greenwater" -- the final test planned prior to the congressionally mandated phase-out of the controversial x-ray laser program.

In June 1992 the House of Representatives approved by a vote of 237 to 167 an amendment imposing a one year ban on all nuclear tests unless the President certified that Russia or another nation that was part of the former Soviet Union conducted a nuclear test during that period. On August 3, 1992 the Senate voted 68 to 26 in favor of a more extensive and complex provision, the "Hatfield-Exon-Mitchell" nuclear testing amendment to the Energy and Water Appropriations Bill. With the seemingly mundane pronouncement by President Bush on October 2, 1992, that he had "signed into law H.R. 5373, the Energy and Water Development Appropriations Act, 1993," a long-sought milestone was achieved on the road to a CTB. The President's signature immediately triggered the *Hatfield-Exon Mitchell* provision mandating a nine-month moratorium on underground nuclear test explosions, renewed negotiations for a global CTB treaty, and complete phase-out of U.S. nuclear weapons testing by December 31, 1996 if other nations refrain from testing after that date.

While he signed the bill into law on October 2, President Bush nonetheless characterized the test ban provision as "highly objectionable," and he pledged to "work for new legislation to permit the conduct of a modest number of necessary underground nuclear tests." In transmitting a classified report on nuclear testing to Congress on January 19, President Bush noted in an accompanying unclassified letter to the departing Chairman of the House Armed Services Committee, defense-secretary designate Les Aspin, that "the framework of the law is far too restrictive

> to provide a basis for a proper test program that ensures the safety and reliability of U.S. deterrent forces. The enclosed report, therefore, does not propose a specific test plan to the Congress."[9]

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[8] (Letter from National Security Advisor Brent Scowcroft, Secretary of Defense Richard B. Cheney and Secretary of Energy James D. Watkins to Senator J. Bennett Johnson, July 10, 1992).

[9] Letter from George Bush to Les Aspin, (HASC Control No. 93-14) January 19, 1993.

In fact, late in 1992 the departing Bush Administration had formally notified the Russian government of a scheduled resumption of U.S. underground testing. According to Russian sources, on March 4, a Russian Defense Ministry spokesman announced that the U.S. Department of Energy, in accordance with the verification protocol of the Threshold Test Ban Treaty requiring four months notice about preparations for a test, had officially informed the Russian government that "on July 7, 1993, the DOE will be lowering a nuclear device into a shaft at the Nevada Test Site." According to Victor Ivanov of the Russian Ministry of Atomic Energy, the notification specified that the test, codenamed "Icecap," was scheduled for July 28 and that a delegation of U.S. testing experts would arrive in Moscow on March 15 to discuss a schedule of tests.[10]

The incoming Clinton administration promptly notified Congress that the Bush testing report was null and void, and notified the Russian government that the U.S. test planned for July, 1993 had been, not "cancelled," but rather "postponed."

II. Phasing-Out Nuclear Tests - 1993-95.

The Clinton-Gore Administration is likely to build on the bipartisan Congressional compromise established by the "Hatfield-Exon-Mitchell" amendment attached to the FY 93 Energy and Water Appropriations Bill. In a "Roundtable Discussion" with employees of Sandia National Laboratory on September 18, 1992, Governor Bill Clinton was asked whether he favored a CTB:

> Yes, I'm in favor of the one that I think Congress is developing that I believe this [Bush] administration will finally sign off on, which would permit some testing for a few years, working toward and absolute ban, providing testing for safety in the near term. I know there is a big dispute about this. But let me say that France has stopped testing; Russia has stopped testing. And I perceive the biggest threat in the future to be...the proliferation of nuclear technology, as well as other weapons of mass destruction, to other countries. And I think to contain that, we ought to get out there and join the parade on working toward a comprehensive test ban, and then focus our energies on this proliferation issue."[11]

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[10] Physicians for Social Responsibility, Washington D.C., Faxmemo to R. Degrasse, DOE from D. Kimball, Associate Director for Policy, re: "communication from Russia concerning U.S. preparations for resuming nuclear weapons tests," March 10, 1993.

[11] Clinton-Gore Campaign media release, "Remarks by Governor Bill Clinton: A Roundtable Discussion with Employees of Sandia National Laboratories, Albuquerque, N.M., September 18, 1982, p. 9.

While setting a near-term deadline for ending testing worldwide, this approach seeks to defuse conservative domestic opposition to a test ban by allowing the President the option of a carefully circumscribed resumption of testing for the purpose of incorporating into current stockpile weapons additional safety features that are deemed cost-effective after review by the President and relevant Congressional committees. The key provisions of the legislation are as follows:

- Minimum 9-month moratorium expiring 90 "legislative days" after Congress has received the first of three Presidential annual reports on testing.

- First annual report, due March 1 (but likely to be delivered in June 1993), must outline a plan for resuming negotiations and achieving a multilateral CTB by September 30, 1996, and describe the specific safety or other objectives of each test proposed to be conducted under the annual quota established by the amendment.

- If the President submits a plan to test -- and the Congress does not disapprove this plan within 90 days -- up to five tests may be conducted in each of three "report periods" (4th quarter FY93-94, FY95, FY96) for the primary purpose of adding one or more specified safety features -- "insensitive high-explosive (IHE)," "fire-resistant pits (FRP's)," and "enhanced nuclear detonation safety (ENDS)"-- to existing weapon designs that will be retained in the stockpile.

- *Exceptions*: Of the 15 tests conditionally permitted by the amendment before September 30, 1996, 3 tests need not involve installation of added safety features, but may be conducted to confirm the "reliability" of unmodified weapons, if the President certifies that each such test is "vital to the security interest of the United States." Up to three of the 15 allowed tests may be conducted by the UK if "the President determines that it is in the national interest of the United States to do so."

- Regardless of the timing of CTB negotiations or an eventual treaty, no tests may be conducted after September 30, 1996, "unless a foreign state conducts a nuclear test after this date."

Opponents of relying on "improved safety" as a justification for resuming U.S. testing note that:

(1) all weapons planned for retention in the stockpile already have ENDS, and all air-delivered weapons (i.e. those with the highest accident risk) already have IHE and will not be deployed on aircraft in peacetime;

(2) the Department of Defense, the Air Force, and the Navy have all maintained that the weapons they plan to retain in the stockpile are adequately safe, and that additional safety features for air-delivered weapons (FRPs) or sub-launched weapons (IHE/FRPs) are not required; and

(3) replacement of the current stockpile with entirely new warhead designs that ensure an even higher level of safety, by physically separating the plutonium from the high explosive, cannot be accomplished within the 15 test quota, would cost many billions of dollars, and could delay a test ban by a decade or more.

III. Can Further U.S. Tests for Safety be Justified?

The report to Congress called for under Section 507 of the Energy and Water Development Appropriations Act, 1993 (P.L. 102-377) [henceforth "Hatfield-Exon-Mitchell"] must include:

> "(F) A plan for installing one or more modern safety features in each warhead identified in the assessment referred to in subparagraph (C) [i.e warheads that will be in the stockpile on September 30, 1996], as determined **after** an analysis of the costs and benefits of installing such feature or features in the warhead...."

The legislation further requires that the report to Congress include:

> "An assessment of the number and type of nuclear weapons tests...that are necessary to ensure the safety of each nuclear warhead in which one or more modern safety features are installed pursuant to the plan referred to in subparagraph (F).

Finally, the Congress directed that, with the exception of up to three U.K. tests, and three tests of the "reliability" of a nuclear weapon which the President must separately certify to Congress as "vital to the national security interest of the United States,"

> "(e)(1)(A) Only those nuclear explosive devices in which modern safety features have been installed pursuant to the plan referred to in subsection (d)(1)(F) may be tested."

The act defines specifically "modern safety features" as "any of the following features:

> (1) An insensitive high explosive (IHE).
> (2) Fire resistant pits (FRP).
> (3) An enhanced detonation safety system (ENDS)."

If the Clinton Administration complies with these legal requirements in good faith, it will not likely be able to resume testing for safety purposes, because the ratio of benefits to costs is so poor for the naval warheads at issue -- the W-76 and W-88 Trident SLBM warheads. Computer simulations have suggested that these warheads may be vulnerable -- when mounted around the top stage of the Trident missile -- to an accidental multipoint detonation of their high explosive systems, with a resulting nuclear yield, should the missile itself explode by accident during a loading or maintenance operation.

However, replacing the current warhead high-explosive with IHE in these warheads does little to preclude this particular scenario, as the force of the missile explosion would be such as to cause the IHE to detonate as well. "Fixing" this particular "safety problem" would require rebuilding not only the warheads with IHE, but also the missiles with a less volatile propellant - a multi-billion dollar fix that both Congress and the Defense Department have so far declined to pay for. For its part, the U.S. Navy has said that loading the missiles into the submarines separately from the warheads has eliminated the most likely scenario for such an accident -- a missile dropped from a crane when fully loaded with warheads.

If safety is discarded as a justification for resuming tests, under the Hatfield-Exon-Mitchell Amendment, the Clinton Administration is left with six possible testing opportunities -- three joint tests with the UK and three so-called "reliability" tests. However, the President must make the increasingly difficult case that testing for such purposes is more vital to the U.S. national security interest than seeking an immediate worldwide halt to testing by continuing the current moratorium and moving directly to a CTB. After conducting approximately 1000 nuclear tests, the President should have difficulty explaining why another three tests of weapons with already proven "reliability" are vital to the national security interest. And if this case is impossible to make, and no further U.S. tests are justified, how can the President in good conscience determine that a British test is somehow more vital to the U.S. national security. In short, the future of nuclear weapons testing in the United States hangs by a very slender thread. An initiative by China -- that it will refrain from testing as long as the U.S. and the other nuclear powers do not resume testing -- could be a decisive factor in the achievement of a CTB before the opening of the 1995 Conference to consider extension of the NPT.