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THRESHOLD TEST BAN AND PEACEFUL  
NUCLEAR EXPLOSION TREATIES

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HEARINGS

BEFORE THE

COMMITTEE ON FOREIGN RELATIONS

AND THE

SUBCOMMITTEE ON ARMS CONTROL, OCEANS  
AND INTERNATIONAL ENVIRONMENT

OF THE

COMMITTEE ON FOREIGN RELATIONS

UNITED STATES SENATE

NINETY-FIFTH CONGRESS

FIRST SESSION

ON

Executive N, 94th Cong., 2d sess.

TWO TREATIES BETWEEN THE UNITED STATES OF AMERICA  
AND THE UNION OF SOVIET SOCIALIST REPUBLICS ON (1)  
THE LIMITATION OF UNDERGROUND WEAPONS TESTS AND  
THE PROTOCOL THERETO, SIGNED IN MOSCOW ON JULY 23,  
1974; AND (2) UNDERGROUND NUCLEAR EXPLOSIONS FOR  
PEACEFUL PURPOSES, AND THE PROTOCOL THERETO, SIGNED  
IN WASHINGTON AND MOSCOW ON MAY 28, 1976

JULY 28, AUGUST 3, AND SEPTEMBER 8 AND 15, 1977



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## THRESHOLD TEST BAN AND PEACEFUL NUCLEAR EXPLOSIONS TREATIES

THURSDAY, JULY 28, 1977

UNITED STATES SENATE,  
COMMITTEE ON FOREIGN RELATIONS,  
*Washington, D.C.*

The committee met at 10:55 a.m., pursuant to notice, in room 4221 Dirksen Senate Office Building, Senator Claiborne Pell presiding.

Present: Senators Pell, Church, Glenn, Case, and Percy.

Senator PELL. The Committee on Foreign Relations will come to order in open session.

We apologize to the witnesses and the others for the prolongation of the closed session.

### OPENING STATEMENT

Today the Committee on Foreign Relations is holding the first of four hearings on the proposed Threshold Test Ban and Peaceful Nuclear Explosions Treaties. Witnesses are the Honorable Philip C. Habib, Under Secretary of State for Political Affairs, and the Honorable Paul C. Warnke, Director of the Arms Control and Disarmament Agency.

The Threshold Test Ban Treaty, which would limit underground tests to a level of 150 kt, was agreed to at a summit meeting in Moscow in July 1974. The treaty was not submitted for the Senate's advice and consent, however, since the executive branch wished to reach a further agreement limiting peaceful nuclear explosions. That second treaty was signed in May 1976, and the executive branch submitted the two treaties to the Senate last July. Earlier this year, the new administration requested that the Committee on Foreign Relations hold hearings on the two treaties, and these hearings are the result of that request.

As chairman of the Subcommittee on Arms Control, Oceans and International Environment of the Committee on Foreign Relations, these treaties are of special interest to me, and I intend to make certain that the committee's four hearings on these two treaties are thorough and comprehensive. At the second hearing next Wednesday, the committee is scheduled to receive testimony from the Central Intelligence Agency in executive session, and hear witnesses from the Department of Defense in open session. At final hearings in September, the committee will hear from the Energy Research and Development Administration and nongovernmental witnesses.

These two treaties must be considered within the context of our overall arms control objectives—in particular, a comprehensive test ban. Mr. Warnke has just returned from Geneva, where he represented the United States in the first trilateral discussions on a comprehensive test ban. The participants, Great Britain, the United States, and the Soviet Union are parties to the Limited Test Ban Treaty, which was heralded in 1963 as a major first step toward a complete end to nuclear testing. The world still awaits the fulfillment of that 14-year-old commitment. I hope that Mr. Warnke will give us a progress report in connection with his testimony today.

There are a number of key issues to be considered: Is a complete end to nuclear explosions—a comprehensive test ban treaty—in the national interests of the United States? Would ratification of the Threshold Test Ban and Peaceful Nuclear Explosions Treaties reinforce efforts to achieve a comprehensive test ban? Would the national security interests of the United States—including the preservation of nuclear deterrence—be maintained under the Threshold Test Ban and Peaceful Nuclear Explosions Treaties? Would those two treaties further U.S. nonproliferation objectives?

These are questions that should be asked. They are simple questions, but they are vital.

I look forward to these hearings casting illumination on these subjects.

Mr. Habib will be the first witness.

Would you care to lead off?

**STATEMENT OF HON. PHILIP C. HABIB, UNDER SECRETARY  
FOR POLITICAL AFFAIRS, DEPARTMENT OF STATE**

Mr. HABIB. Mr. Chairman, I am pleased to have an opportunity to discuss with the committee today the treaty between the United States of America and the Union of Soviet Socialist Republics on the limitation of underground nuclear weapon tests with its protocol and the treaty between the United States of America and the Union of Soviet Socialist Republics on underground nuclear explosions for peaceful purposes with its protocol and agreed statement.

The goal of the United States in the area of constraints on nuclear testing has long been an adequately verifiable comprehensive test ban. President Carter strongly supports such a ban. The two treaties we are addressing today are useful steps in that direction and the President and Secretary Vance urge advice and consent to their ratification.

**BACKGROUND OF TREATIES**

Since 1945 the United States has recognized the need to prevent the spread of nuclear weapons and to stop their further development and, indeed, in 1946 proposed the Baruch plan to control atomic materials. Although our proposals did not gain international acceptance, our efforts continued. Since 1958, we have consistently held that an adequately verifiable cessation of nuclear testing would be in our national interest.

In pursuit of this goal, in 1963, President Kennedy presented to the Senate the first treaty to limit nuclear explosions, the "Treaty to Ban Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water." This treaty, called The Limited Test Ban Treaty, reduced the dangers to mankind by placing restrictions on the parties' weapons testing activities, but it did not ban underground explosions. Although the problem of verification precluded the achievement of a comprehensive test ban at that time, the parties pledged themselves to continue negotiations to the end of "seeking to achieve the discontinuance of all test explosions of nuclear weapons for all time." The Limited Test Ban Treaty is now in force for 105 countries.

Another milestone in reaching our goal was achieved in 1968 when President Johnson presented to the Senate the Treaty on the Non-Proliferation of Nuclear Weapons. The purpose of this treaty is to prevent the spread of nuclear explosive capabilities and promote the peaceful uses of atomic energy. It obligates the parties to pursue negotiations of effective measures to cease the nuclear arms race. The Non-Proliferation Treaty is in force for 101 countries and another 11 have signed but not yet ratified.

Thus our efforts to achieve an effective cessation of nuclear testing reflect our desires to end competition in nuclear weapons development, to demonstrate our good faith to the nonnuclear weapons states who have forsworn nuclear weapons, and, thereby, to contribute to our nonproliferation objectives. These nonnuclear weapon states are looking to us, the United Kingdom, and the Soviet Union, to meet the undertaking contained in article VI of the Non-Proliferation Treaty that we shall "Pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date \* \* \*."

#### THRESHOLD TEST BAN TREATY AND PNE TREATY

With this background in mind, let me turn to the Threshold Test Ban and Peaceful Nuclear Explosion (PNE) Treaties. These treaties mark the first additional limitations to be placed on nuclear explosions since the 1963 Limited Test Ban Treaty. They demonstrate the continuing desire of both ourselves and the Soviet Union to achieve a complete cessation of nuclear testing.

While these agreements are complicated, they reflect the complexity of the problems which the United States and Soviet negotiators faced. The fact that these problems were overcome demonstrates once again that with patience and mutual good will, even complex problems touching on national security concerns can be worked out. Each treaty contains useful precedents that may contribute to the solution of analogous problems in a comprehensive test ban.

#### PROVISIONS OF THRESHOLD TEST BAN TREATY

With regard to the specific provisions of the two treaties, I would like to discuss briefly several of the more significant points.

The Threshold Test Ban Treaty requires each party to prohibit, to prevent, and not to carry out any underground nuclear weapon

test having a yield exceeding 150 kt and to keep the number of underground tests to a minimum.

Verification is made the responsibility of each party using its own national technical means of verification. To assist each party in its verification efforts, a protocol to the treaty establishes specific provisions for an extensive exchange of data, an important step which goes beyond the Limited Test Ban Treaty. The protocol requires that data on geographical boundaries and geological and geophysical characteristics of the testing areas be exchanged, and provides that testing is limited to specifically designed test sites.

In addition, for the first time, each party will provide to the other specific data for two nuclear weapons tests from each geophysically distinct testing area for calibration purposes. This data will include yield, date, time, depth and coordinates. Thereafter, after each future test has taken place, the geographic coordinates of the test location are to be given.

Soviet agreement to the U.S. proposal to exchange these detailed data to assist each side in calibrating and improving its national technical means of verification represents a significant development in cooperation between our two countries.

I should make clear to you that in the event of Soviet tests at or near 150-kt level, we could not be absolutely certain that the yield is at or below 150 kt. However, in this regard, taking into account the uncertainties in our monitoring systems, the weight of the evidence supports the judgment that the Soviet Union has respected the threshold in the last 15 months.

#### PROVISIONS OF PNE TREATY

At the time the Threshold Test Ban Treaty was concluded, the two sides recognized that they would have to assure that neither party could gain, through nuclear explosions for peaceful purposes, benefits which would otherwise be precluded to the parties under the Threshold Test Ban Treaty. This was necessary because there is no distinction between the technology of nuclear explosive device which could be used as a weapon and one which could be used for peaceful purposes.

The PNE Treaty, a companion to the Threshold Test Ban Treaty, was developed to meet this need. This treaty, together with its associated protocol and an agreed statement, covers all underground nuclear explosions outside of nuclear weapons test sites, whether in the territory of the parties or in third countries. In concluding this treaty, the United States pursued three basic objectives: Peaceful nuclear explosions must not provide weapon-related benefits otherwise precluded by the Threshold Test Ban Treaty; The fact that nuclear explosions for peaceful purposes do not contribute such benefits must be adequately verifiable; and The treaty must be consistent with existing international obligations, in particular the Limited Test Ban Treaty of 1963.

In achieving these objectives, it was necessary to go beyond the Threshold Test Ban Treaty. The PNE Treaty provides for more extensive data exchange and, of particular significance, the establishment of procedures for onsite access by observers with technical equipment. Specifically, the treaty requires that extensive amounts of information be provided about the details of any project involv-

ing nuclear explosions for peaceful purposes of whatever yield both before and after the explosion.

The central problem of not allowing weapon-related benefits otherwise precluded by the Threshold Test Ban Treaty was solved by ensuring that no individual explosion would have a yield exceeding 150 kt. In other words, the thresholds in the two treaties are identical.

This requirement entails special procedures when the aggregate yield of a group explosion is larger than 150 kt. The verifying side is granted the right to have observers and instruments at the site of a group explosion to determine the yield of each device in the group. In addition, observers may be permitted on the basis of consultation between the parties for explosions with aggregate yields between 100 and 150 kt.

In sum, this treaty sets a precedent for regulating nuclear explosions for peaceful purposes: The Soviets have agreed that such explosions must not provide weapon benefits otherwise precluded by the Threshold Test Ban Treaty. They have abandoned their original position that nuclear explosion for peaceful purposes should not be regulated at all.

I will leave to officials of the Arms Control and Disarmament Agency, the Energy Research and Development Administration, and the Department of Defense the further discussion of these two treaties and their associated protocols as well as the specifics of the data to be exchanged and the functions of observers.

#### ROLE OF TREATIES IN NATIONAL POLICY

Mr. Chairman, we have asked for the Senate's advice and consent to the ratification of these two treaties because of their usefulness in controlling nuclear weapons development and in inhibiting the spread of nuclear weapons. I believe the political benefits which can accrue to us by the ratification of these treaties are as significant as the contributions which they make to the control of nuclear weapons. The limitations which they impose will not be detrimental to our security and their verification features can be very helpful in other arms control negotiations.

The treaties also provide that large yield nuclear explosions will no longer be carried out by the parties. Thus, this restriction imposes a significant quantitative limit on the nuclear weapons development competition. This is a real and present benefit of these treaties.

If we were not to ratify these two treaties, I believe it would be to our disadvantage. Other countries are looking to us and the Soviet Union to end our testing. While these treaties will not completely end that testing, they do represent genuine progress toward that goal. If we were not to ratify them, it could cause concern as to our willingness to seek a comprehensive test ban. Likewise, were we not to fulfill this undertaking that we have negotiated, it could hinder our efforts to press forward with negotiations on further arms limitations.

Finally, were we not to ratify the treaty, it is possible that higher yield tests could resume, a result which would be directly contrary to the essence of the President's determination to achieve the early and total cessation of nuclear testing.

On the other hand, Mr. Chairman, ratification of the two treaties will build confidence and meet the reasonable expectations of our negotiating partner that arms control negotiations with the United States will result in concrete progress. This, in turn, will provide a positive diplomatic climate for negotiations with the United Kingdom, the Soviet Union, and eventually other nations to achieve an effective comprehensive ban on nuclear testing.

Thank you, Mr. Chairman.

Senator PELL. Thank you very much, Mr. Habib.

Before going to questions by my colleagues—

Mr. HABIB. Mr. Chairman, might I make a suggestion? Considering that we are working in tandem, I would suggest that Mr. Warnke read his opening statement before we have questions.

Senator PELL. That is exactly what I was going to suggest. I suggest you might want to go ahead and read your statement, Mr. Warnke.

**STATEMENT OF HON. PAUL C. WARNKE, DIRECTOR, ARMS CONTROL AND DISARMAMENT AGENCY, ACCOMPANIED BY: ROBERT W. BUCHHEIM, ACTING U.S. COMMISSIONER, STANDING CONSULTATIVE COMMISSION, AND DEPUTY CHIEF, U.S. DELEGATION TO THE PEACEFUL NUCLEAR EXPLOSIONS (PNE) TREATY NEGOTIATIONS.**

Mr. WARNKE. In your opening statement you raised four important questions. I would like to give my answers to those, and then read my statement, and in response to questions, give further documentation as the basis for the answers.

**QUESTIONS RAISED IN OPENING STATEMENT**

You ask first, is a complete end to nuclear explosions—a comprehensive test ban treaty—in the national interests of the United States? My answer to that is an enthusiastic "Yes."

You asked, second, whether ratification of the Threshold Test Ban Treaty and the Treaty on Peaceful Nuclear Explosions would reinforce our efforts to achieve a comprehensive test ban. Again I would give a resounding affirmative answer to that question.

Third, you asked whether the national security interests of the United States, including the preservation of nuclear deterrence, would be maintained under the Threshold Test Ban and PNE Treaties. I believe it would not only be maintained, I believe it would be improved.

Then, finally, you asked whether the two treaties would further our nonproliferation objectives. In my opinion, they definitely would.

I am happy to have an opportunity to appear before you today to discuss these two treaties, the TTB Treaty and PNE Treaty

**ROBERT BUCHHEIM**

Accompanying me to assist in answering any questions that the committee may have is Robert Buchheim who is the Acting U.S. Commissioner of the Standing Consultative Commission which was established in accordance with the Anti-Ballistic Missile Treaty and then assigned similar functions with respect to the interim

agreement on control of defensive arms. Mr. Buchheim participated in the PNE Treaty negotiations in Moscow.

#### WHAT TREATIES DO

The two treaties that we are examining here today impose direct restraints on underground nuclear explosions—weapon tests as well as nuclear explosions for peaceful purposes. Thus, they supplement the Limited Test Ban Treaty of 1963 and constitute a step toward complete elimination of nuclear testing.

Because of the problem of distinguishing between nuclear explosive device technology applied for weapon-related purposes and that applied for peaceful purposes, both treaties have been designed to be part of one comprehensive regime. The TTB Treaty places a limit of 150 kt on all underground nuclear weapon tests, which is the identical limit placed on individual underground nuclear explosions for peaceful purposes in the PNE Treaty. The two treaties contain verification provisions not found in previous arms control agreements which are essential to this treaty regime, and which, we believe, will have important precedential value as well.

In his statement, Under Secretary Habib has described the main features of the treaties and discussed their significance in the context of international efforts to reduce the risk of nuclear war. I would like to confine my remarks to a narrow, but vital topic—how the administration's request for prompt Senate action on these two treaties relates to its goal of achieving a comprehensive ban on nuclear explosions at an early date.

#### TREATIES' RELATIONSHIP TO COMPREHENSIVE BAN ON NUCLEAR EXPLOSIONS

President Carter has on several occasions expressed his firm commitment to achieving an adequately verifiable comprehensive nuclear test ban treaty. He believes that such an agreement could promote U.S. and global security in a number of ways. By placing balanced constraints on Soviet and U.S. nuclear weapon programs, a comprehensive test ban would be an important factor in stabilizing the bilateral strategic relationship and would therefore enhance the security of both countries in an equitable manner. An effective comprehensive measure—one that covers all nuclear explosions, whether designated to be for weapon testing or peaceful purposes—would also make a major contribution to our nonproliferation objectives.

Diplomatic efforts on behalf of a comprehensive agreement have already begun. Last month, as a result of a decision taken at the Moscow meetings between Secretary Vance and Foreign Minister Gromyko in March, the United States and the Soviet Union carried out several days of exploratory discussions in Washington. For the past two weeks, beginning on July 13, trilateral talks, involving the United States, the Soviet Union, and the United Kingdom, were held in Geneva.

#### IMPORTANCE OF BRINGING TREATIES INTO FORCE

The question may be asked why we wish to press forward with ratification of the TTB and PNE Treaties while we are moving

vigorously to negotiate a comprehensive agreement that would be beyond their provisions. There are several reasons why we attach importance to bringing these two treaties into force.

While the administration believes that it is in the national interest to seek an adequately verifiable prohibition on all nuclear explosions, not just a limit at 150 kt, it nonetheless recognizes that the treaties now before you, by constraining the development and testing of new high-yield warheads and bombs, would have a significant moderating effect in their own right. We would hope that any obstacles to the conclusion of an effective comprehensive test ban can be eliminated at an early date. However, as a hedge against the possibility that the negotiating process will take longer than we would hope, we believe that it would be desirable and prudent to have a formal regime prohibiting explosions over 150 kt already in place while we proceed with the comprehensive test ban negotiations.

Moreover, I think we should keep in mind that a comprehensive test ban of continuing duration may require agreement to its terms by all nuclear-weapon states. The entry into force of these treaties would thus provide valuable insurance against resumption of higher yield nuclear testing.

Another important reason for proceeding with ratification of the two treaties now is that it would give us a basis for building upon some of the treaties valuable provisions in negotiating a comprehensive test ban. Many of the provisions of the TTB and PNE Treaties will not, of course, be directly applicable to the differing scope and verification problems inherent in a comprehensive ban but other provisions could be carried over intact. And several precedents will be important and relevant. The recognition that each side must furnish data to assist the other's national technical means of verification is significant. Of even more significance, moreover, is the recognition that in some cases even national technical means in combination with the data furnished should be supplemented to ensure adequate verification. Where this occurs, the principle will be established by the PNE Treaty that observers with equipment are authorized to assure compliance with treaty provisions. On-site verification is a valid tool that can be helpful in establishing an adequate verification regime in a comprehensive ban on all nuclear tests including explosions for peaceful purposes.

With respect to the latter, the negotiations failed to disclose any means for carrying out individual nuclear explosions for peaceful purposes above 150 kt without raising the risk of making available military benefits otherwise precluded by the threshold ban on nuclear weapon tests. As a result, the threshold for individual nuclear explosions for peaceful purposes was set at the same level as the threshold for nuclear weapon tests. The logical extension of this provision to a regime where the threshold for nuclear weapon tests would be zero would be a ban on peaceful nuclear explosions as well. It should be added that a number of the features of the TTB and PNE Treaties that we consider most valuable, particularly, provisions relating to verification, involved concessions and departures from previous positions by the Government of the Soviet Union.

Prompt ratification of the two treaties can have the additional favorable effect of creating a more promising climate for the current comprehensive test ban negotiations to which you, Mr. Chairman, and members of this committee have for a long time lent support. The Soviet negotiators now are the same ones who worked out with our delegation the treaties now before you. The Soviet Government has emphasized that it regards the TTB Treaty regime as an important product of Soviet-American cooperation, and that it attaches great significance to its early entry into force. That was emphasized to me by the chairman of the Soviet delegation in Geneva in the past 2 weeks.

We believe that our failure to ratify the treaties could raise doubts in the minds of the Soviets about the reliability of the United States as a negotiating partner, and could thus diminish prospects for an early and successful conclusion of a comprehensive treaty.

#### CONCLUSION

In conclusion, we believe that the TTB and PNE Treaties—while certainly less desirable than a comprehensive ban in promoting the objective of curbing the nuclear arms competition and nuclear proliferation—are nonetheless useful as immediate, even if interim steps. It is our view, moreover, that the timetable for concluding an effective comprehensive agreement would be advanced by prompt favorable Senate action on these treaties.

That completes my statement, Mr. Chairman.

Senator PELL. Thank you very much, Mr. Warnke.

#### HOW VERIFICATION WOULD BE ACHIEVED

First, I am delighted in your statement with the references you have made throughout to the possibility of verification. I wonder if you could enlarge a little bit on your thoughts with regard to verification. Some have said you were not giving enough emphasis. I notice in your statement you give a very strong indication. I wonder if you could give us your thoughts on how verification would be achieved.

Mr. WARNKE. I recall the previous colloquy very well, Mr. Chairman. I am delighted to give a concrete example of my position on verification.

It seems to us that verification is absolutely essential when you are dealing with nuclear explosives, test bans or limits, because otherwise you end up with a treaty which is a source of friction and controversy rather than one which is an improvement in bilateral relations and one which is genuinely effective.

It is our feeling that scientific and technological developments have been such during the past several years that we can have good confidence in the verifiability, both of a Threshold Test Ban Treaty and the companion PNE Treaty and eventually in a comprehensive test ban treaty.

One of the features that I have emphasized in my statement is the precedent that would be set, particularly by the PNE Treaty, for certain measures of verification that can stand us in very good stead when it comes to a comprehensive test ban.

Obviously we can place very heavy reliance on what is referred to as our national technical means of verification. We have extensive teleseismic facilities that enable us to determine not only the existence, but the size of either nuclear explosions or earthquakes. This will be obviously a very important measure in verification in both the Threshold Test Ban Treaty and a comprehensive test ban.

In addition, however, in these treaties there is extensive provision for exchange of data which will significantly improve our ability to utilize the national technical means. Mr. Buchheim, of course, is thoroughly familiar with all of these provisions both in the treaty and in the protocol and can spell them out in extreme detail.

But the fact is that by exchanging data, which enables us to calibrate our own national technical means to detect, we significantly improve and refine our own detection techniques.

Now, in addition to that, in the PNE Treaty there is provision for onsite inspection of a very detailed nature. Now, the mandatory, or the onsite inspection as of right exists, of course, only when you reach a certain magnitude of explosion which creates a verification problem. But these provisions, it seems to us, can be adapted and carried over in a comprehensive test ban treaty and can significantly improve our ability to verify.

#### TREATY'S EXPLOSION THRESHOLD

Senator PELL. My recollection is that Hiroshima was about 22 kt. This is calling the threshold at 150.

Mr. WARNKE. Yes.

Senator PELL. Does that mean that explosions up to seven times the Hiroshima bomb would not fall under this treaty?

Mr. WARNKE. That is correct.

#### SMALLEST EXPLOSION VERIFIABLE WITHOUT ONSITE INSPECTION

Senator PELL. What would be the smallest size explosion that you believe could be verified without onsite inspection?

Mr. WARNKE. Of course, the problem of the smaller explosions do not arise as a verification problem under these treaties because the only thing that is controlled is anything in excess of 150 kt.

The problem of what the minimum explosion is that could be detected is one that would have to be resolved in the negotiation of a comprehensive test ban treaty. It would require additional verification procedures even beyond those contained in the PNE Treaty. We have been considering a number of these proposals. We have tabled some of them in our preliminary consultations with the United Kingdom and the Soviet Union in the past 2 weeks and we will continue when we resume our consultation to explore these other verification procedures.

#### ENVIRONMENTAL IMPACT TREATY AS TWIN TO PNE TREATY SUGGESTED

Senator PELL. Mr. Habib, in connection with the peaceful nuclear explosions, I would think that together with this treaty should go some similar treaty, perhaps as set forth in S. Res. 49, my own suggestion for an international environmental impact statement so

that one would know what the effects of the peaceful uses are as well as being able to monitor and inspect.

For example, the Soviets, as you know, are considering changing the course of their rivers from moving to the Arctic Ocean into the Black Sea and Caspian Sea in order to make more fertile that area. If they did that through the use of peaceful nuclear explosions there would be less freshwater in the Arctic, therefore less freezing, a smaller size of the Arctic Ice Cap, and warmer climate throughout the Northern Hemisphere, substantially warmer, which would have an impact on agriculture and the way of life of many countries in the Northern Hemisphere. This is an obvious twin of the Nuclear Peaceful Explosion Treaty, a treaty along the line of S. Res. 49.

What would be the viewpoint of the Department in this regard?

Mr. HABIB. I don't think there is any doubt that the Department would consider the environmental considerations you have raised as a subject of considerable importance. I don't have a departmental position on it and I don't want to express it, but what I will do is see to it that we directly will provide an answer for the record. I would suggest additionally that that question be raised equally with some of the other witnesses who will be coming before the committee from other agencies who are more directly concerned with environmental problems. But we will provide a departmental position for the record.

Senator PELL. I appreciate that very much because this subcommittee has oversight not only arms control but over oceans and international environment. We would hope that there would eventually be some departmental approval of this concept which is certainly a natural twin to the Peaceful Nuclear Explosion Treaty.

Mr. HABIB. In previous testimony, I have been reminded by one of my colleagues, the Department has expressed agreement with the basic purpose of S. Res. 49 which we see as a responsible assessment by nations of environmental effects of their actions on other nations. I will give you a more specific answer to the direct questions you have asked.

[The information referred to follows:]

STATE DEPARTMENT POSITION ON S. RES. 49—SUPPLIED BY DEPARTMENT OF STATE

As stated by Mrs. Mink, the Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs, during her testimony before the Subcommittee on Arms Control, Oceans, and International Environment on March 31, 1977; with certain reservations, Senate Resolution 49 has the support of the Department of State. We are entirely supportive of the concept of international cooperation to assess the environmental effects in other countries of one state's actions, and we are taking a number of steps to encourage the development of agreeable international procedures. Of course, we also support Principle 21 of the Stockholm Declaration concerning a state's responsibility to ensure that activities within its jurisdiction do not cause damage to the environment of another state or of areas beyond the limits of national jurisdiction.

Senator PELL. I am very glad indeed. I must say as the author of that resolution I would be most interested in your thoughts and position and seek to work out changes so that we could move ahead in tandem rather than both of us digging our feet in on any particular issue.

Mr. HABIB. You aren't suggesting necessarily changes in this treaty per se?

Senator PELL. No.

Mr. HABIB. But of the resolution?

Senator PELL. That is right.

Senator Church.

#### DISTINGUISHING PEACEFUL TEST

Senator CHURCH. What is a peaceful test? How is it to be distinguished from a test for other purposes? India when it exploded its first device declared it was a peaceful test.

Mr. WARNKE. If I might try to answer that question, and I will ask my colleague, Mr. Buchheim to supplement it, under the treaty the distinction is in terms of location. In other words, any nuclear explosive device which is exploded on a nuclear weapons test site is counted as a weapons test. Anything that takes place outside that location is a peaceful nuclear explosion.

Now, since the limit is the same for both the importance of distinguishing between the two doesn't exist except where you have group explosions. Group explosions are subject to certain definite constraints and the group explosions can only be for peaceful purposes.

As far as the kinds of purposes that they are used for, I would like to point out, first of all, that our PNE program is basically static. It is a study program at the present time. I think the funding for fiscal year 1977 amounted to a total of \$1 million. The Soviet Union, on the other hand, has a more active PNE program. They exploded, I think, an average of about five PNE's a year. They have exploded something like 40 in the 13 years that they have had a PNE program. The breakdown as to the uses of their PNE's is that approximately half of these events seem to be associated with their oil and gas industry. They have used them for putting out gas fires, used them for exploiting oil reserves. About a third are, I believe, considered for deep seismic sounding research and some five were cratering explosions for water resource development. Then they have had some use in mining operations.

Senator CHURCH. May a peaceful test be conducted in the atmosphere or must it be confined to underground?

Mr. WARNKE. PNE's, Senator Church, are subject to the Limited Test Ban Treaty of 1963. They can only be conducted underground, and the provisions of the treaty require that no radioactive debris go outside the national territory.

Senator CHURCH. How can you determine realistically whether or not the test has military advantages or has no military advantages other than the fact that it may not exceed 150 kt.

Mr. WARNKE. We believe that it is very difficult to determine a difference between a peaceful nuclear explosion and a nuclear weapon. That is why in our negotiations it was concluded that the same limit ought to be set for both.

#### POSSIBILITY OF AGREEING TO PEACEFUL TESTS BEING PRECEDENT

Senator CHURCH. By agreeing that peaceful tests may be permissible, even though they are underground, and even though they may not exceed 150 kt, is that a precedent for other nations who want to develop nuclear weapons to say "We are conducting peace-

ful tests, they are being conducted underground and since the United States and the Soviet Union have reserved this right we are still conforming with your established practice formalized by your treaty”?

Mr. WARNKE. In our opinion, it would be far better to have a comprehensive test ban which precluded any nuclear explosions. We believe, however, that this treaty would be an improvement on the existing situation under which there is no limit on the kilotonnage, or megatonnage for that matter, of PNE's. This does settle it. As a result, I think it interferes significantly with some potential uses of PNE's, and as a consequence I believe it furthers the nonproliferation cause. I would point out that under a regime in which there was no restraint on PNE's the Indian Government went ahead and developed what they termed a peaceful nuclear explosive.

#### EFFECT OF PNE TREATY ON COMPREHENSIVE TEST BAN NEGOTIATIONS

Senator CHURCH. Accepting that as a persuasive answer, then do you have any concern that by agreeing to a separate and permissible treatment of peaceful explosion as between the two countries it will then be more difficult to negotiate a comprehensive test ban treaty that doesn't also exclude peaceful underground explosions?

Mr. WARNKE. I don't think it increases the difficulty. I think we have to recognize that that difficulty exists because of the fact that the Soviet Union has a more active PNE program than we have. I would say that ratification of the PNE Treaty is a step toward eventual elimination of all nuclear explosions.

Mr. HABIB. Also, if I may interject, it seems to me, as my colleagues remind me, it implies quite explicitly that there are weapons benefits from peaceful nuclear explosions. Therefore, the relationship between peaceful explosions and possible weapons application is made quite clear.

#### PROGRESS IN DETERRING NUCLEAR ARMS RACE QUESTIONED

Senator CHURCH. I am going to support these two treaties. I think the arguments for them greatly outweigh any arguments against them. But I must say that I first greeted the Limited Test Ban Treaty as a tremendous breakthrough in the direction of arms control. Now, looking back on it, I have doubts because the exceptions to the limited test ban actually intensified and accelerated testing underground.

Looking back I wonder whether it really was an advance towards arms control. I accept your argument and will support them and will vote on the ratification of the treaties, but 150 kt is a level so far beyond the actual military needs of both countries that each country is not inhibited by the threshold procedure on its military program and testing program. That level is just so high that in the sense of limiting further development of nuclear weapons it does not have very much meaning.

I say this because I think we may be building castles in the sand, devising these nice treaties and thinking we are making progress and then the tide will come in and all of them will be swept away,

and we will find they have not really been a deterrent to the nuclear arms race at all.

I really hope that these steps which I commend and support, limited as they are, will lead to the comprehensive test ban treaty. It has been 16 years now since we made the promise. Until we get that far I really don't think we have made much progress. I say that without in any way underestimating the difficulty I know is involved or the hard work in the negotiations that have made these treaties possible.

Mr. WARNKE. If I may say briefly in response, Senator Church, I don't disagree with a thing you have said. If I thought these treaties were a substitute for a comprehensive test ban, I could not come before you to support them. But they aren't a substitute. In my opinion, they are a step forward, and they will facilitate our progress in negotiating a comprehensive test ban.

Senator CHURCH. It is on that ground that I will support them.

Thank you, Mr. Chairman.

Senator PELL. The gentleman from New Jersey, Mr. Case.

Senator CASE. Thank you, Mr. Chairman.

#### DIFFERENCE IN ARMS CONTROL ASSOCIATION AND FEDERATION OF AMERICAN SCIENTISTS VIEWS

Gentlemen, I think you have pretty much answered the questions that not only I, but the Congress, I think as a whole, and the people of the country have about these two treaties. Senator Church emphasized them pretty much. Why do you come down on the side of a group like the Arms Control Association and the Federation of American Scientists comes down on the other side? What is the reason for that?

Mr. WARNKE. I believe, Senator Case, that the reason is essentially the question of where this hangs. I must say that when these were first proposed that I had much the same negative reaction that has been expressed by some who still hold that position. I regarded them as being possibly a substitute for a genuinely effective comprehensive test ban. But they have now been negotiated. They have been signed and they are not a substitute.

We are currently actively working on a comprehensive test ban. As the chairman has pointed out, I have just returned from 2 weeks in Geneva. We have had previous sessions both with the Soviet Union and the United Kingdom. We find a willingness on the part of all three countries to move forward to a negotiation of a comprehensive test ban. As a matter of fact, the Threshold Test Ban Treaty specified that the parties would undertake to continue to work toward a cessation of nuclear weapon tests. So that I do regard them as being a genuine step forward.

I regard it as being something that we are able to accomplish on a bilateral basis with the Soviet Union and trust that they provide good backup and assurance for some possible complexities in working out a genuinely multilateral comprehensive test ban that will include all nuclear weapons tests.

Senator CASE. Thank you.

Have you anything you wish to say to that, Mr. Secretary?

Mr. HABIB. No, sir.

## POSSIBILITY OF ALLOWING SOVIET EXPLOSION FOR RIVER DIVERSION

Senator CASE. In connection with the negotiations of the Comprehensive Test Ban Treaty, the President has stated a definitive position, the possibility that the Soviets might be allowed some explosions for projects such as river diversions and so forth. What is your position on that so far as they enter into negotiations?

Mr. WARNKE. Our objective is a comprehensive test ban than will end all nuclear explosions, whether for peaceful purposes or for weapons test purposes. We recognize that there is a difference of position because of the fact that the Soviet Union has these potential uses for which they think the PNE's may be valuable. We can't go into a negotiation and present them with an ultimatum because I have never found that an effective way to negotiate with an equal partner. We would hope to be able to persuade them that whatever the benefits may be, they are far offset by the risks and by the proliferation consequences of continuing with the nuclear program.

## SOVIET ATTITUDE TOWARD ONSITE INSPECTION

Senator CASE. On the question of explosions above 150 kt, do you think that if these treaties were ratified the Soviets would ever enter in a kind of peaceful program which would lead to onsite inspections? Are they still touchy and sensitive that they will not have onsite inspection? you have urged the value of one of these treaties as a breakthrough on the question of verification. I wonder if that will ever come into effect.

Mr. WARNKE. Our feeling on that is that they have agreed in the PNE Treaty to certain onsite inspection procedures which would certainly be far in excess of anything that the Soviet Union has been willing to contemplate in the past.

Now, as to what they would do in fact, I can't guess at this point, but they would either have to permit these onsite inspection procedures or forego the kinds of PNE uses which would bring these onsite procedures into effect. We would prefer the latter because we would like to see an end to all nuclear explosions.

Senator CASE. I think that is a very good answer.

The chief thing that they have agreed to in respect to verification and notification is information about the terrain and that sort of thing. Those are the chief useful things that they have agreed to and I am not complaining about that.

Mr. WARNKE. Yes.

## LIMITATION AND OBSERVANCE OF 150-KT LIMIT

Senator CASE. On the other side of this thing will the limit of testing to 150 kt let us conduct the tests that we, at least for the foreseeable future, may find necessary for our weapons programs?

Mr. WARNKE. My answer to that, Senator Case, would be that I think we have to recognize that arms control agreements do in fact control arms, and that they would impose restraints on us that would not otherwise exist. We believe, however, that our national security is enhanced as long as we have restraints which will apply equally to the Soviet Union. Any constraints that would exist on our weapons development would apply to them as well.

Senator CASE. Would you answer the question as to whether this informal adherence to the 150 kt limitation specified in the proposed Threshold Test Ban Treaty has been respected by both sides?

Mr. WARNKE. It certainly has been observed by the United States. We are currently reviewing the methodology that we have used for estimating the yield of Soviet underground explosions. This is being studied carefully by the executive branch at the present time. I am happy to report that at the present time there is no indication whatsoever that the Soviet Union has not complied with its obligations with respect to the 150-kt threshold.

Senator CASE. We have a pretty good idea what tests they have conducted during that time including the estimated yields?

Mr. WARNKE. Yes, we do, Senator.

Senator CASE. Thank you, Mr. Chairman.

Senator PELL. The Senator from Ohio, Mr. Glenn.

Senator GLENN. Thank you, Mr. Chairman.

#### WHY 150-KT LEVEL WAS PICKED

From what I know now I will vote in favor of the treaties here, but I do have some reservations about how this will be viewed here and around the world. Why was the 150-kt level picked? That is a big boom.

Mr. WARNKE. That is a very big boom, Senator Glenn. As has been pointed out, it is 10 times in excess of the Hiroshima bomb. It was a negotiated figure. It was the best that could be done at the time.

Senator GLENN. Who insisted on the 150? Did we want that or did they want that?

Mr. WARNKE. I think there were proponents of that level on both sides.

#### DEVELOPMENT OF SMALLER NUCLEAR WEAPONS

Senator GLENN. The reason I ask that is that we are tending in this country, and I guess the Russians are, too, to make smaller and smaller atomic weapons like 8-inch artillery shells that are down to the few kt range. I gather this would not stop any of that development whatsoever unless we maybe use this as a step to get to the comprehensive ban. Is that correct?

Mr. WARNKE. That is correct. A lot of weapons development will escape any impact from this.

Senator GLENN. I want to bring that out because I think it is very, very important that people not misunderstand that the nuclear weapons development is stopped somewhat. These are big weapons that we are stopping. They are weapons of such size that they obviously set up seismic tremors. The treaties, as I understand them, and as you have presented them this morning, have nothing to do with anything under the 150 size?

Mr. WARNKE. That is correct.

#### LEVEL OF EXPLOSION RELIABLY DETECTED

Senator GLENN. What kind of kilotonnage of subkiloton level can we reliably verify or detect as having been exploded? From outside

the borders of the Soviet Union by whatever means can we reliably detect any explosion down to the 1 kt, just to pick a figure?

Mr. WARNKE. I think we would have no assurance that by means outside the Soviet territory we would be able to get below that level.

Senator GLENN. From outside the Soviet territory do we have a confidence level that we could detect with reliability?

Mr. WARNKE. That is something still under study. It, of course, is not relevant to these treaties because it is at a very high level that the threshold is set, but I think opinions up to this point differ on this. It is one subject, of course, that will have to be examined in terms of what other kinds of supplementary verification procedures will have to be developed for a comprehensive test ban.

Senator GLENN. Does anyone else at the table have a figure they can give me on what they feel is truly verifiable?

Mr. WARNKE. There are figures, Senator Glenn, but they are classified.

#### CALLING TEST BY ANOTHER NAME

Senator GLENN. I thought that might be the answer.

Even with onsite inspection at present, would it be possible, say, to test a device for a delta class ballistic missile and call it a PNE and explode it which would be in effect a test by another name?

Mr. WARNKE. I think there is no question, Senator Glenn, that that could be done, but, of course, there would be no point in doing it under these treaties because the limit is the same for both. So it does not matter what they call it. Now, when you have a comprehensive test ban that would be a problem if you had a PNE exception.

#### METHODS OF VERIFICATION

Senator GLENN. Verification really concerns me as it does in the SALT talks and other areas. I think that is the key to the whole thing. Can you elaborate a bit? The verification has been made the responsibility of each party using its own technical means of verification. Does that mean we rely on our seismic information? What methods are available outside of that? We have heat analysis. Do we have different methods so that we have a high confidence level or do we have a low confidence level without onsite, Russian cooperation, which I know we would be dubious of, that we can detect anything covered under this treaty absolutely, finally and without doubt?

Mr. WARNKE. I don't think that 100 percent certainty, Senator Glenn, is attainable. We believe that the measures that we have provided have adequate verification and that there would not be significant possibilities of violation that we could not detect.

Senator GLENN. I would think that would be true with 150 kt. As I said before, that is a big one going off.

Mr. WARNKE. Yes, it is.

Senator GLENN. I would think that we could pretty reliably discover that. I am concerned that we expand this treaty by other means into lower levels of development. Then we would be getting somewhere. Big weapons have been developed in the past. They are

available for use, if we are crazy enough to use them, on both sides. Whether we are limiting those or not this is a step forward. I hope it is a step toward the comprehensive ban.

#### POSSIBILITY OF LOWERING THRESHOLD BELOW 150

My question is, is there anything going on right now that would lower this threshold down to below 150 as an addendum to this or follow-on treaty, or would that only come about on a comprehensive ban?

Mr. WARNKE. We believe that there would be no purpose in trying to negotiate a lower threshold at this point. We think that our efforts instead ought to be directed toward a comprehensive ban. As I say, the developments thus far in our consultations are sufficiently promising so that we believe we ought to exert our efforts toward achieving basic desirable goals.

#### TREATY'S EFFECT ON U.S. TESTING

Senator GLENN. Will we be able to conduct any tests we have planned when this goes into effect? Will this cut out the testing?

Mr. WARNKE. I am sure it would cut out some tests that otherwise would be conducted. As I said in answer to a previous question, it would have the same impact on the Soviets.

#### ATTITUDES OF OTHER NATIONS

Senator GLENN. Our main concern is the spread of nuclear weapons to third world nations as we spread the benefits of nuclear power around the world for power generation. We have talked about that a lot. We have things in the mill right now both in administration proposals and our proposals here that we are in the process of working out. Have you had any feedback on what the attitude of other nations has been on this? Other nations, some of them, even openly state they want to develop nuclear weapons. Do they oppose any such limitations as we are proposing in this treaty or do you think they would all be willing to accept this if we could expand it beyond just United States-Russian relationship?

Mr. WARNKE. The contracts I have had, Senator Glenn, with representatives of other countries, including some of those that we regard as having nuclear potential, have been very positive with respect to these treaties. As I mentioned, I recently returned from Geneva. The Conference Committee on Disarmament is in session there at the present time. I appeared before the Conference Committee on Disarmament to explain our objectives with respect to a comprehensive test ban. I had the opportunity to have bilateral discussions with a number of representatives and they all believe that these treaties will be a step forward toward controlling both the nuclear arms competition and siminishing the risk of proliferation.

Senator GLENN. Have any of these other nations indicated a willingness to establish such treaties on their own with you or other nations?

Mr. WARNKE. The United Kingdom, of course, has volunteered its adherence to the principle of these treaties. We have not heard as yet from France and China. As far as the nonnuclear weapon

states are concerned, we wouldn't want them, of course, to be parties to these treaties because it would appear to give them permission to go ahead both with nuclear weapons up to 150 kt and with PNE's.

#### VERIFICATION TECHNIQUES BESIDES SEISMIC

Senator GLENN. What other techniques are there for verification besides seismic?

Mr. WARNKE. I believe that this subject will be addressed by the CIA witnesses when they appear.

Senator GLENN. That is all I have right now, Mr. Chairman. Thank you.

Senator PELL. The gentleman from Illinois, Mr. Percy.

Senator PERCY. Mr. Warnke, you and I have had discussion about verification in the past. I have indicated that that is the litmus test. I still have a lot of problems. In the two agreements you cite a useful precedent for verification procedures and have indicated that each side in this case must furnish data, and permit on-site inspection by the other nations' representatives.

#### SIGNIFICANCE OF VERIFICATION TECHNIQUES

Could you expand on the significance of the verification techniques? You may have done it while I was out of the room. Is it change in the Soviet Union's attitude from the past and, if so, would they now feel it essential that there be on-site verification?

Mr. WARNKE. With regard to the provisions of the treaty, there are two precedents at least which strike us as being very valuable for the future.

One is the exchange of data in which there are detailed provisions for the exchange of information with respect to geophysical conditions, for furnishing test results from two previous tests which enable us then to calibrate and refine our own national technical means of verification. This enables us to calibrate our equipment and put ourselves in a position where we can have a high level of confidence about the use of our teleseismic capability. There is also, with respect to group explosions in the PNE Treaty, very detailed provision for on-site inspection and even for the use of certain seismic devices which can be utilized by the United States on Soviet territory. Mr. Buchheim can go into more detail if you want that, Senator Percy, as to the exact nature of this. These are the two basic elements that we think constitute very valuable examples for the future.

#### STATE DEPARTMENT AND ACDA REACTION TO RESOLUTION 124

Senator PERCY. Have you, Secretary Habib, asked for the State Department reaction to Senator Kennedy's resolution 124 introduced by him and six other Members? The resolution calls for mutual cessation of all nuclear explosions and Presidential efforts to seek a treaty ending all nuclear explosions. Has the Department taken a position on that?

Mr. HABIB. We welcome the support shown by this resolution for our efforts in the direction of a comprehensive test ban treaty. As far as the proposal in the resolution for an immediate cessation

testing our discussions with the United Kingdom and Soviet Union are still in this exploratory phase or preliminary phase that Mr. Warnke spoke of and no proposal to suspend testing during the discussions has been made.

I will let Paul supplement that to whatever extent he wishes but that has been our position at this stage.

Mr. WARNKE. As Secretary Habib has said, Senator Percy, we do welcome this as a support for our basic objective. It would be very good if we were able to agree with the Soviet Union on an immediate cessation. But the problem, of course, is that of the peaceful nuclear explosive program of the Soviet Union. We have, first of all, to resolve that question because otherwise we would be in a position where we would both perhaps suspend nuclear weapons tests, but they then would be continuing with PNE's, and we would not have assurance that they weren't getting weapon benefits out of that.

So, the PNE problem has to be resolved before we can have a moratorium. As far as the second part of the resolution is concerned, the business of setting forth a new proposal for a comprehensive test ban treaty, our feeling is that one of the major objectives is to get maximum adherence from other states. I think we can get maximum adherence if we try to develop the key elements of a treaty in these trilateral consultations, but then turn the matter of elaborating that in a full treaty in the conference of the Committee on Disarmament because then it will not appear to be just a superpower deal but rather something which is a genuinely and internationally devised treaty.

#### ADMINISTRATION'S OBJECTIVE CONCERNING COMPREHENSIVE BAN

Senator PERCY. For clarification as to the administration's position, the President has indicated that he wanted to move toward a more comprehensive test ban but has always mentioned that there will be some allowances for explosives such as the Soviet projects on river diversion. Is the administration seeking a total comprehensive test ban of all kinds or will it seek one with certain exceptions such as river diversion as was mentioned?

Mr. WARNKE. Our objective, Senator Percy, is to have a genuinely comprehensive ban which would prohibit all nuclear explosions, whether for peaceful purposes or for weapons testing purposes. The President's statement recognizes that the Soviet Union at the present time does have a PNE program. We have to take that into account. We would hope to be able to persuade them that that is not worth doing in terms of its interference with a genuine comprehensive test ban and the fact that it would not be as effective in discouraging proliferation.

Senator PERCY. Is it not true that if you did allow exceptions under a comprehensive test ban there would be the possibility of weapon benefits from the peaceful explosions?

Mr. WARNKE. That is our view. We have not been able to think of any means by which you could preclude the acquisition of weapons benefits from peaceful nuclear explosions.

Senator PERCY. It is almost a case of go for broke, all or none, and try to achieve that. I would hope that the Soviet Union, who knows as well as any nation on Earth the potential dangers, would

cooperate on this problem. Really it is one area where we can cooperate with them because I think they are as concerned as we are about it.

#### EFFECT OF NOT RATIFYING TTB TREATY

Finally, in your testimony you say, "The Soviet Government has emphasized that it regards the TTB Treaty regime as an important product of Soviet-American cooperation and that it attaches great significance to its early entry into force."

You have testified this would have a negative effect upon the comprehensive test ban treaty if we refuse to ratify this. It will also have a negative effect on our whole relationship or our ability to do anything. Certainly we are trying to move toward getting down to brass tacks on SALT II which is the big payoff for the whole world. Wouldn't this be a step back, with everything involved, in our relationship with the Soviet Union which is somewhat perilous right now? All of us would want to see some repair work done without sacrificing principles. In those areas where we do have a mutuality of interest we ought to keep moving ahead.

Mr. HABIB. I think that is perfectly true. There is no question but that it would have such a consequence. There is no reason why it should not be ratified in terms of its precedential elements in respect to the comprehensive test ban.

#### REPORTING OUT TREATIES QUICKLY RECOMMENDED

Senator PERCY. Mr. Chairman, this testimony which we have heard today I consider extremely good. I know all of fully appreciate the tremendous amount of work which has gone into something like this. We have a couple pieces of paper which represent tens of thousands of man-hours of thought on both sides. I think now, having done your end of it, it is up to us to move with dispatch and report these out. I hope we will move very quickly and put them on the floor of the Senate. I will enthusiastically and wholeheartedly be working toward ratification.

Mr. WARNKE. Thank you very much, particularly on behalf of my colleague, Mr. Buchheim.

Senator PELL. Thank you, Senator Percy.

I have a series of questions here that maybe you would care to answer to put in the hearing record for the parliamentary debate on the floor in regard to the ratification of these treaties.

The first one is directed to Mr. Warnke.

#### ANSWER TO THOSE WHO HAVE RESERVATIONS

One, as you know, the two treaties now under consideration have not generated a great deal of enthusiasm. Some groups, such as the Arms Control Association, and the Federation of American Scientists, have opposed them. This lack of enthusiasm has been evident across the political spectrum.

How would you answer those who have these reservations. How strongly does the administration support these treaties and desire their ratification?

Mr. WARNKE. I endeavored to answer that basic question before in terms of whether this is a substitute for a comprehensive test

ban or a step toward it. I think our present conduct of discussions with the Soviet Union and the United Kingdom indicates this is a step forward to the comprehensive test ban. As a consequence I support these treaties unqualifiedly.

Mr. HABIB. And the administration does.

Senator PELL. To be specific, why would the Arms Control Association be opposed? Because they feel it postpones the comprehensive test ban treaty?

Mr. WARNKE. That is the only reason I could imagine. If this were to defer a comprehensive test ban negotiation then it might be regarded as being a negative sort of thing. Since in our opinion it will advance negotiations which are already scheduled it should be regarded as being a positive step.

Senator PELL. As a politician I say a half loaf is better than no loaf. They would rather wait for a whole loaf.

Mr. HABIB. I might put it the other way. You put the dough in the oven and you wait for the bread.

#### ONSITE INSPECTION: PERSONNEL, EQUIPMENT, AND COST

Senator PELL. If circumstances required onsite inspection of a Soviet peaceful explosion, how many people and how much equipment would be required and how much would a single onsite inspection cost?

Mr. WARNKE. I believe, Mr. Buchheim would be in a position to furnish more information on that.

Mr. BUCHHEIM. Senator Pell, the treaty provides for the number of personnel onsite depending on the scope of the activity. There is a schedule of such numbers of personnel provided for in the treaty. Rather than go through that schedule, I can just give you a range of typical numbers. It would be somewhere in the range of 6, 10, 15 people, numbers of that sort, with their equipment.

Senator PELL. What would be the cost? About \$100,000?

Mr. BUCHHEIM. Several hundred thousand dollars I think would be the broad way to characterize it. More or less depending on the scope of the activity.

Senator PELL. Less than \$500,000, but more than \$100,000?

Mr. BUCHHEIM. That is right. I think ERDA would be better prepared to give you an estimate on that.

Senator PELL. Is any test now being conducted or scheduled to be conducted on any weapons system which would hold up the Comprehensive Test Ban Treaty?

Mr. WARNKE. I am not sure I understand the question, Senator Pell.

#### WEAPONS TESTS WHICH WOULD BE HELD UP

Senator PELL. Is any testing of weapons now going on that would be held up by a Comprehensive Test Ban Treaty?

Mr. WARNKE. If we are able to get a comprehensive test ban, of course, it would be just a question of when the testing would be suspended totally. We would, I suppose, at any time that it went into effect have an ongoing program which would have to be suspended.

Senator PELL. Is any weapon presently being tested that would be held up by the passage of the Threshold Test Ban Treaty?

Mr. WARNKE. I believe as of March 1976, after the PNE Treaty was signed, that both parties have since that time abided by the limit of 150 kt. So there are no tests being conducted at the present time that would be interfered with by these treaties.

#### OTHER NATIONS CONDUCTING NUCLEAR TESTING

Senator PELL. What about any other nations? I know that China is, but do we know if any other nation has conducted nuclear testing?

Mr. WARNKE. The French, of course, have an ongoing testing program.

Senator PELL. Any others?

Mr. WARNKE. We have a cooperative agreement with the British with regard to weapon tests. They don't have any sort of PNE program, to the best of my knowledge.

Senator PELL. You have no evidence that any other nation has exploded a nuclear weapon?

Mr. WARNKE. Not since the Indian explosion 2 years ago.

Senator PELL. That is the only other nation, to the best of your knowledge, that has exploded a nuclear weapon?

Mr. WARNKE. That is correct.

Senator PELL. Do any other nations have weapons?

Mr. WARNKE. I have no such information.

#### UNITED STATES AND SOVIET UNANNOUNCED NUCLEAR TESTS SINCE LTB

Senator PELL. How many unannounced nuclear tests has the United States conducted since the Limited Test Ban Treaty, and how does this number compare with the Soviet Union?

Mr. WARNKE. I would have to furnish that information for the record, Senator Pell. I am not sure of the degree of classification.

Senator PELL. Is it classified?

Mr. HABIB. Yes, it is. I think it was provided to the committee in a letter. If it has not been, it could be on a classified basis. That is classified information. It has been provided to the committee on a classified basis.

Senator PELL. I am aware of that. Could you submit for the record what information could be published in the open record in this regard?

Mr. HABIB. We will take a look at that, yes, sir.

Senator PELL. I think it would be helpful in the course of the debate if we had, if not a figure, at least an estimate.

Mr. HABIB. We will take a look at it and respond, Mr. Chairman. [The information referred to follows:]

#### UNITED STATES AND SOVIET UNANNOUNCED NUCLEAR TESTS SINCE LTB—SUPPLIED BY ACDA

As of August 1, 1977 the U.S. had announced a total of 297 nuclear tests since the Limited Test Ban Treaty was signed on August 5, 1963. The total number of U.S. tests is presently classified. The need for the classification of the number of U.S. tests is under review in light of the Protocol to the TTBT.

Although the Soviet Union rarely announces tests, the U.S. has publicly identified 124 seismic signals as presumed nuclear tests during the same period. This number should not be considered definitive for two reasons: (1) current U.S. national technical means of detection cannot provide assurance that all tests conducted by the Soviet Union are detected and, (2) information about the exact number and yields of Soviet tests is classified to protect our intelligence sources, capabilities, and methods.

#### RESULT OF 1963 COMPREHENSIVE TEST BAN

Senator PELL. Would the strategic balance be fundamentally different today if we had negotiated a comprehensive test ban treaty in 1963 and both sides had complied with it? Under the same circumstances what would have been the result if we had complied and the Soviet Union had conducted some undetected tests?

Mr. WARNKE. That was in 1963?

Senator PELL. Yes.

Mr. WARNKE. I think the answer to the first question is that the strategic balance would be more stable today than it is because the technology would not have developed to the point at which there would have been some danger to the retaliatory capability of each side. As it is, we would have a stable strategic balance, in my opinion, had we had a comprehensive test ban back 14 years ago.

It would be less precarious and less subject to change by further technological development. Obviously, if the Soviet Union were to continue testing while we unilaterally gave up that opportunity, there would be a risk that they could achieve something in the way of meaningful advantage. Any restraint ought to be equal on both sides.

#### EQUIPPING SYSTEMS WITH WARHEADS WITHOUT FURTHER TESTING

Senator PELL. Is there any known system now in any stage of development which you could not equip with a satisfactory warhead without further nuclear testing?

Mr. WARNKE. Again, I think that any such information would be classified. I think I can give a general answer, which is that at the present time both sides have a superabundance of both strategic and tactical nuclear weapons and that therefore any interference with the further accumulation could only be in the interest of the national security of both and in the interest of mankind.

Senator PELL. Would it be in the classified area to specify a particular system?

Mr. WARNKE. I believe that it would be.

#### DEVELOPMENT AND DEPLOYMENT OF GREATER THAN 150-KT WARHEADS

Senator PELL. Under Threshold Test Ban Treaty restraints, would the United States develop and deploy warheads with yields substantially greater than 150 kt? If so, how would reliability be assured in the instances of substantially greater yields than 150 kt?

Mr. WARNKE. You would have to break that down into the existing weapons and future weapons. As far as existing weapons are concerned they would not be affected except perhaps over a period of time by some erosion of confidence and reliability which, of course, would be an erosion which would apply on both sides. For

the future I think that would be a question which would depend upon military judgment. You could obviously develop a warhead which had greater yield. You would not have the degree of confidence in it that you might have if you were free to test them.

#### REPLACEMENT AND PROCEDURES FOR MAINTAINING CONFIDENCE IN STOCKPILED WEAPONS UNDER CTB

Senator PELL. Under a comprehensive test ban, what procedures would be implemented for retaining confidence in stockpiled nuclear warheads over time? Would there be development and deployment of new warheads under a comprehensive test ban? By "new" I mean different, replacement for them.

Mr. WARNKE. You could in fact replace warheads without further tests. There is no question of the fact that there would be some deterioration of confidence in the stockpile, but again that deterioration would apply to both sides. Since the basic objective of our nuclear weapons is to deter the use by the other side, any erosion of confidence that occurred would make the prospective of a first-strike attempt less likely, and therefore deterrence would be improved.

Senator PELL. Are there any new technologies which would help the United States and the Soviet Union assure reliability under a comprehensive test ban regime?

Mr. WARNKE. I believe that technological developments do exist that would increase confidence in the reliability, yes.

Senator PELL. Could you mention what they are?

Mr. WARNKE. They would be principally, I suppose, extrapolations from previous tests. I think I would prefer to have an answer to that come from our ERDA representatives.

#### EFFECT OF CTB ON UNITED STATES AND SOVIET STRATEGIC ARSENALS

Senator PELL. What would be the relative effects of a comprehensive test ban treaty upon the United States and Soviet strategic arsenals? Would there be a gradual diminution of those arsenals?

Mr. WARNKE. The comprehensive test ban, of course, would not require any reductions in the existing arsenals on both sides. So it would not affect numbers except prospectively.

Senator PELL. Is there any rule of thumb as to the time when the effectiveness of a nuclear weapon—5 years, 50 years, 500 years?

Mr. WARNKE. I have no rule of thumb, Senator Pell. I think it would be strictly speculative.

Senator PELL. As you pointed out earlier, without testing, and without replacement, there is an increasing sense of lack of reliability in that weapon, and they would have a greater reluctance to use it?

Mr. WARNKE. That is correct.

Senator PELL. The same thing, of course, is true with conventional weapons?

Mr. WARNKE. That would be true, too.

Senator PELL. I know in World War II we were equipped with 3-inch ammunition from World War I and the fuses fell apart. A similar situation could obtain with nuclear weapons, too?

Mr. WARNKE. I think the phenomenon would be comparable.

PRIORITIES OF U.S. TESTING PROGRAM ASSURING FUTURE CTB

Senator PELL. Assume that a comprehensive ban on testing were to go into effect 1, 2, 3 and 5 years from now. What would be the priorities in our testing program under such circumstances: What would be the effect upon the reliability of weapons? Do you want to submit that for the record?

Mr. WARNKE. I prefer to submit that for the record, yes.  
[The information referred to follows:]

U.S. TESTING PRIORITIES AND WEAPONS RELIABILITY IF CTB WENT INTO EFFECT 2, 3, AND 5 YEARS FROM NOW—SUPPLIED BY ACDA

If a comprehensive ban on testing were to go into effect one to two years from now, the priorities in our test program would be to complete the testing needed to develop nuclear warheads for currently identified defense needs. This would put priority on weaponizing designs using current technology at the expense of curtailing development of more advanced concepts. If the CTB were implemented three to five years from now, more advanced concepts could be developed and tested for the currently identified and other defense needs.

*CTB in one year.*—If a CTB is implemented in about one year, priority would be given to tests to provide an acceptable nuclear design for a number of systems. Tests could be completed, but some design compromises might be necessary.

*CTB in two years.*—If the CTB were implemented in two years, the essential testing to provide warheads for the systems referred to in the preceding paragraph could probably be completed without design compromises. In addition, it might be possible to conduct sufficient tests to provide warhead options for several more systems with some design compromises.

*CTB in three to five years.*—If a CTB were to be implemented three to five years from now, warheads could be tested for the systems referred to in the preceding two paragraphs plus other specific defense needs not yet identified. Also more advanced safety and security concepts could be integrated into the nuclear components and the life of certain components could be extended for new designs.

In regard to reliability, new weapons tested prior to implementation of a CTB will not have reduced reliability. Unreliable weapons would not be stockpiled, although yield uncertainty greater than normal might be acceptable, and unavoidable, particularly if the required and planned testing is not completed.

EFFECT OF STRATEGIC WEAPONS PROGRAM NOW IN PROGRESS

Senator PELL. When you do submit that for the record, maybe you can remark on the effect of the strategic tactical weapons program now in progress and under construction if they are of an unclassified nature. I would prefer not to receive anything of a classified nature because I want the hearings to be for the public record. We will examine the data we have and endeavor to come up with some sort of declassified version.

I thank you both very much.

Are there any further statements?

Mr. HABIB. I thank you, Mr. Chairman, for your courtesy as usual.

Mr. WARNKE. Thank you, Mr. Chairman.

Senator PELL. The committee is adjourned.

[Whereupon, at 12:20 p.m., the committee adjourned, subject to the call of the Chair.]

**THRESHOLD TEST BAN AND PEACEFUL  
NUCLEAR EXPLOSION TREATIES**  
**Executive Session—CIA Briefing<sup>1</sup>**

WEDNESDAY, AUGUST 3, 1977

UNITED STATES SENATE,  
SUBCOMMITTEE ON ARMS CONTROL,  
OCEANS AND THE INTERNATIONAL ENVIRONMENT,  
COMMITTEE ON FOREIGN RELATIONS,  
*Washington, D.C.*

The subcommittee met, pursuant to notice, at 10:30 a.m., in room 4221, Dirksen Senate Office Building, the Honorable Claiborne Pell (chairman of the subcommittee) presiding.

Present: Senators Pell, Glenn, Stone, Case, and Javits.  
Senator PELL. Would you please proceed, Dr. Stevens.

**STATEMENT OF DR. SAYRE STEVENS, DEPUTY DIRECTOR FOR INTELLIGENCE, CENTRAL INTELLIGENCE AGENCY; ACCOMPANIED BY DR. KARL WEBER, DIRECTOR, OFFICE OF SCIENTIFIC INTELLIGENCE, DR. JOHN S. INGLEY, OFFICE OF SCIENTIFIC INTELLIGENCE, NUCLEAR ENERGY DIVISION; AND CHRISTOPHER MAY, OFFICE OF THE LEGISLATIVE COUNSEL**

Dr. STEVENS. It is a pleasure, Mr. Chairman, to have the opportunity to testify before your committee on the Treaty on the Limitation of Underground Nuclear Weapons Tests, as well as on the Treaty on Underground Nuclear Explosions for Peaceful Purposes.

I have with me today Dr. Karl Weber, who is the Director of Scientific Intelligence at the CIA; Dr. Jack Ingley, who is the chief of the Nuclear Energy Division; and Chris May, who is from the Legislative Counsel's office.

Today I will talk about the United States capability to monitor Soviet compliance with these treaties and the differences that we face in monitoring a threshold-type treaty as opposed to a comprehensive treaty banning all nuclear testing.

**DIFFERENCE BETWEEN MONITORING AND VERIFYING COMPLIANCE**

It is important to understand that we in the intelligence community differentiate between monitoring a compliance with a treaty, which is essentially an intelligence function, and verifying compliance with the provisions of the treaty itself, which essentially requires inputs from nonintelligence agencies and ultimately policy decisions to determine whether or not we could judge that noncompliance has actually occurred.

<sup>1</sup> Staff note: Portions of this hearing day have been deleted in the interest of national security. Deleted portions are indicated by the word [Deleted].

## SEISMIC MONITORING OF TTb

With respect to the Threshold Test Ban Treaty, the primary means available to the United States for monitoring an agreement limiting the maximum yields of underground nuclear explosions are seismic measurements [deleted].

Dr. STEVENS. Our national technical collection system is deployed worldwide. Its deployment represents an attempt to try to get comprehensive coverage around the nuclear test areas in both the Soviet Union and in China.

Senator PELL. These are all seismic recording sites?

Dr. STEVENS. Yes, sir.

There are [deleted] sites with various types of seismometers deployed there, which have continually been in a state of development and improvement through the years.

Seismic estimates of Soviet underground nuclear explosions are really derived from the input of this detection system. [Deleted.]

The yield estimates that we make are the result of comparing the results that we get from measurements by these stations of detonations from within the Soviet Union and China with seismic magnitude and known yields from other places in the world. So, we do a comparison job; that is, we compare the seismic results that we get from these stations with the seismic measurements that we make on known yields in the United States.

## UNCERTAINTIES INVOLVED IN ESTIMATING PROCESS

There are a number of uncertainties, however, involved in this estimating process.

Dr. STEVENS. The recorded strength of the seismic signal is affected by the transmission of the explosive energy into the Earth itself. This is the coupling that occurs when the energy of the explosion is actually transmitted into the Earth. The depth of the explosion has an effect and uncertainties on our part about how deep the explosion occurred causes difficulties in determining yield.

Similarly, uncertainties about the propagation of the seismic signal from the source to the receiving station through the Earth medium causes problems. Finally, the quality of the seismic receiving network itself is a very, very important factor in the yield determination.

## DATA EXCHANGE PROVISIONS IN TTb TREATY PROTOCOL

In order to minimize the errors associated with yield measurement, a number of data exchange provisions have been incorporated into the protocol to the TTb Treaty. These are important to us.

Each side will be allowed to test only at specifically declared test sites.

Second, information on the geological and physical properties of each geophysically distinct region with these test sites must be provided to the other side.

Third, the geographic coordinates of each underground test must be provided to the other side after the test occurs.

Finally, the yield date, time, depth, and coordinates for two nuclear tests in each geophysically distinct region of the test site must be provided to the other side for calibration purposes.

[Deleted.]

The information that is called for in the treaty would also help us estimate coupling, which is always a problem, and verify the estimates of geology at the test depth, and establish the geophysical parameters of the Soviet test site itself.

[Deleted.]

Senator PELL. So in other words, many of the tests they have been conducting have been above the threshold?

Dr. INGLEY. I am talking historically, now, that is, up until March 31, 1976.

[Deleted.] I should point out that the uncertainty factor consists of two components. One is a random contribution due to the inherent uncertainties in the measurement technique itself. The second is a systematic or a bias contribution due to regional difference between different areas of the Earth. This really represents a systematic difference that exists in the coupling of the seismic energy into the Earth and its propagation in various regions which is, of course, dependent upon the geology of the region itself.

[Deleted.]

The bias component could be reduced to practically zero, in theory at least, with accurate calibrations data; that is, if we can really determine with some precision how we relate one area to another, then we could reduce that bias component substantially.

[Deleted.]

#### PROBLEM OF ACCOMMODATING PEACEFUL USES TESTS UNDER TREATY

I would like to turn to the problem of accommodating peaceful uses tests under the treaty.

The purpose of the separate PNE Treaty is really to preclude any weapons benefits from a PNE test that could not already be obtained under the TTB treaty. Hence, individual PNE explosions are to be limited to 150 kt, or less. For groups or salvos of explosions, which may be required by some peaceful uses projects, each explosion must be 150 kt or less, and the total yield of the salvo must be 1,500 kt or less—1½ megatons. Of course, this is to preclude hiding the seismic signal of a weapons test in the detonation of the salvo.

PNE's of course, represent a particular problem because they will be conducted under a wide variety of geological conditions and therefore verifications provisions incorporated into the PNE Treaty are much more extensive and rigorous than those of the Threshold Test Ban Treaty. You can see from this chart (indicating) that there have been [deleted] peaceful uses tests in the Soviet Union and their purposes have ranged from such things as putting out gas well fires to stimulating oil and gas wells, storage cavity creation, and so on.

An exchange of test-related data is a part of the more extensive requirements of the PNE Treaty. This exchange of data increases in scope and detail as the planned yield increases. This exchange of data is required both before and after the tests.

For planned yields between 100 and 150 kt, the verifying side may request onsite observation rights if circumstances surrounding the test indicate that it is necessary in order to verify the yield of the explosion.

For planned salvo yields exceeding 150 kt, the verifying side has absolute on-site observation rights to: Confirm the stated peaceful purpose of the experiment; to confirm the geological and geophysical conditions which obtain at least the test site; to measure the yield of individual weapons explosions; and finally, if necessary, to deploy local seismic network whenever aggregate yields are greater than 500 kt to preclude the hiding of the seismic signal from a clandestine test.

To insure the ability of the observer team to carry out these functions, the PNE Treaty contains extensive provisions governing the size of the observation team, the rights of access and movements, duration of stay, the transportation and use of scientific equipment, photographic coverage, security, and transmission of collected data, and finally communications itself.

The sum of these provisions is such that our capability to monitor compliance with terms of the PNE Treaty is at least as good as that under the TTB Treaty itself.

#### CHANGES IN MONITORING REQUIREMENTS AND CAPABILITIES RESULTING FROM CTB

I would like now to discuss in a qualitative way the changes in monitoring requirements and capabilities that result in going from a threshold to a comprehensive test ban arrangement.

[Deleted.]

Under a threshold test ban, our seismic network is required to measure as accurately as possible the yield of tests that are in the range of the threshold limit, and we are little concerned with low-yield tests.

On the other hand, in a comprehensive test ban situation, we are faced with the problem of detecting low-yield tests and distinguish those low-yield tests from earthquakes.

These difficulties open up a completely different set of evasion scenarios from those which we have previously been concerned with. It might be possible, for example: To hide a nuclear test in the seismic signals from a large earthquake; to conduct a multiple device test that would produce earthquake-like seismic signals; or, finally, to conduct a nuclear test in a large cavity or in low-coupling material so as to muffle the seismic signal and make it undetectable.

[Deleted.] We are currently studying the feasibility and utility of these evasion techniques under a Comprehensive Test Ban Treaty. At the same time, we are studying the use of automated seismic stations within the Soviet Union and onsite inspection techniques as supplements to the national means, which would enable us to cope with such possible evasion techniques.

We are constantly working to improve our earthquake discrimination capability against small seismic signals [deleted].

[Deleted.]

I would like to add that if PNE's are permitted under a comprehensive test ban, we have not yet identified a way, in terms of assured verification provisions, of assuring that weapon-related benefits are not obtained from such explosions regardless of their yield.

## ONGOING RESEARCH

In closing, I would like to briefly discuss some ongoing research aimed at improving our ability to estimate the yields of Soviet underground tests. This is the work that I referred to earlier, and it relates to our efforts [deleted].

This research includes all aspects of the conversion of explosive energy into seismic waves and the propagation of this signal through the Earth.

We will certainly keep you informed on this work as it progresses, and in response to Senator Pell's request, we will furnish you with the new yield estimates when they become available.

That, Senators, completes my prepared testimony.

Senator GLENN [presiding]. Fine. Thank you very much.

## COMMITTEE PROCEDURE

Senator Pell asked me to chair until he gets back. He had a telephone call he had to take. I will start on some of the questions.

We will stick with the 10-minute rule so that everyone will get a chance. Then we will open this up for more lengthy questioning later on.

## RISK OF EVASION

What are the risks of successful evasion of the threshold limitation of 150 kt? Do you think we can verify everything of that magnitude that is set off?

Dr. STEVENS. As I pointed out, I think the highest risk in evasion of that limit really relates to very, very small increases in yield beyond that limit. We think, however, that those dangers are well balanced by the fact that the advantages that obtain by exceeding the limit to that degree are very small.

Senator GLENN. How low a kiloton can we detect?

Dr. STEVENS. Pardon?

Senator GLENN. How low a kt equivalent can we detect at most of the sites there? I know it would be affected by the distance from the borders and where our seismic locations are. But in general, how low can we detect? Can we detect down to 2 kt, as opposed to 150, for instance?

Dr. STEVENS. Would you answer that, Jack?

Dr. INGLEY. Generally, we can detect and identify nuclear tests well below the threshold limit.

In a test which is strongly coupled into the earth, we can detect and identify with high competence [deleted].

[Deleted.]

Senator GLENN. Is seismic the only way we have to detect underground tests?

[Deleted.]

Senator GLENN. But this only covers the 150 kt and up, the treaty.

Dr. INGLEY. The Threshold Test Ban Treaty covers only 150 kt and above, where detection and identification is no problem. What the requirement is to measure the yield is actually impossible to relate the seismic signal magnitude to a yield value.

Dr. STEVENS. The problems you are addressing become particularly acute in a Comprehensive Test Ban Treaty.

Senator GLENN. Yes, there is an interest here in both of them. We look at this as sort of a first step, we hope. I realize that this is a giant first step to even get an agreement like this, although I look at it as very minimal compared to what we are trying to eventually get control of. That is the reason I was questioning you on how low we could go.

[Deleted.]

#### ONSITE INSPECTIONS

Senator GLENN. Do we have any onsite inspections as part of this?

Dr. STEVENS. Not at the present time, though there are provisions, of course, in the Threshold Test Ban Treaty for onsite inspection under certain circumstances.

[Deleted.]

Senator GLENN. Thank you, Mr. Chairman. My time is up.

Senator PELL. Thank you, Senator Glenn.

#### CALIFORNIA EARTHQUAKE

I have a few somewhat elementary questions.

I know that there is no such thing as an average earthquake, but let's consider the earthquake that hit California a while back. How many kilotons was that? I do not mean the famous one, but the one of a few years ago.

Dr. INGLEY. When you get up to the magnitude of 6 and above, which I think is what that earthquake that you referred to was approximately, that is up in the hundreds of kilotons and would produce that type of seismic signal.

Senator PELL. So, what kind of earthquake would be the equivalent of 150 kt? Can you describe that to me? What would give the same kind of seismic reaction?

[Deleted.]

Senator PELL. In the course of a year, how many earthquakes of that size would we have in the United States, if any?

Dr. INGLEY. Well, worldwide it would be perhaps less than 10.

Senator PELL. So perhaps one in America?

Dr. INGLEY. Yes, or that equivalent.

Senator PELL. Can you tell the difference between an earthquake and a nuclear explosion?

[Deleted.]

Senator PELL. I see.

#### RESPONSIBILITY FOR AND DIFFERENCE BETWEEN MONITORING AND VERIFICATION

In connection with your organizational structure, as you may know, at the time of Mr. Warnke's confirmation hearings there was some criticism of the dismantling of the separate Office of Verification. My understanding, however, has been that the main responsibility for verification through the years has rested on your shoulders. Is that correct?

Dr. STEVENS. The main responsibility for monitoring activities—

Senator PELL. Excuse me, but what is the difference between monitoring and verification?

Dr. STEVENS. Verification usually involves a final judgment as to whether or not in our view, the view of the U.S. Government, an actual violation of the treaty provisions has occurred. The most that we do in the intelligence business is to provide what information we can obtain about what has actually occurred and whether or not that is to be interpreted as a violation of the provisions of the treaty really requires something beyond our intelligence input.

Senator PELL. In other words, if this went into effect and you found a 250-kt explosion, you would then not say that there has been a violation that you would submit to ACDA or another Government agency. You would say that there has been an explosion of 250 kt in our estimation and you make your own conclusions. Is that so?

Dr. STEVENS. I think that is important because if we were, for example, to determine that there was a 250-kt detonation, there would be some uncertainty associated with that.

Senator PELL. This shows my own lack of clear understanding because I had not realized that. I thought that ACDA, its verification section, in the past had actually gone in and done some of this work itself and analyzed it. But they did not apparently.

Dr. STEVENS. No.

They have been in close association with the intelligence community; but they have not been responsible for the intelligence analysis.

#### MUFLING OF NUCLEAR EXPLOSION

Senator PELL. Another fascinating thing you said was that nuclear explosions can be muffled. Would you describe how to muffle a nuclear explosion, please?

Dr. STEVENS. I guess the origin of the muffling-decoupling theory goes back to the original underground test ban agreement with the Soviet Union. It essentially is a technically developed argument that says that if you explode a nuclear weapon in a cavity of precisely the right size, [deleted] you can greatly reduce the coupling, if not eliminate entirely the coupling of that energy into the earth itself. It is, I guess, a mathematically sound argument that has never yet been proven to be totally effective. But it is an interesting thing and there is no question but that you can reduce the coupling between an explosion and an earth, which would reduce the seismic signal.

Senator PELL. What exactly is decoupling?

Dr. INGLEBY. If you have a cavity that is large enough, compared to the yield of the device, and is such that the pressure generated by the explosion within this cavity is less than the static overpressure of the earth pushing on the cavity, then you will generate essentially no seismic signals. That would be complete decoupling and you would get no detectable signal. This requires cavities for large-sized explosions, say in the tens of kilotons, of millions of cubic feet.

The United States has done smaller cavity decoupling experiments in which we have detonated a kiloton-sized device in a cavity produced in a salt dome by a previous detonation. We got a decoupling factor there of 70. In other words, the seismic signal that we got made the device look like it was 70 times less than what it really was. This is compared to a theoretical factor of decoupling of 100.

So, in small yields it has been proved feasible.

[Deleted.]

Senator JAVITS. May I ask one question, please, Mr. Chairman?

Senator PELL. Please, Senator Javits.

#### ADEQUACY OF TREATIES

Senator JAVITS. Do I understand that you gentlemen recommend these treaties?

Dr. STEVENS. Well, sir, we believe that with the provisions of the treaty we have fairly high confidence in our ability to monitor Soviet compliance with the treaties.

Senator JAVITS. Therefore the absence of onsite inspection, et cetera, should not be a reason for rejecting the treaties?

Dr. STEVENS. Well, onsite inspection is included in the provisions.

Senator JAVITS. I understand that. I mainly meant the way in which the inspection is handled.

Dr. STEVENS. Yes sir. We believe that that is adequate to meet our needs.

Senator JAVITS. Good.

Thank you so much, Mr. Chairman.

#### DECOUPLING PROBLEMS

Senator PELL. The decoupling problems are fascinating. You say that you could reduce the detection of the explosion to 1/70th of its impact, a small explosion in a huge, vast cavity. Doesn't this mean, if you carry that through, that you would be able to do it with bigger explosions if you had a big enough cavity?

Dr. INGLEY. It is a question of how large a free-standing cavity you can construct underground and not have it collapse on you. That is why people who talk about salt cavities, because salt behaves better under these kinds of conditions than other types of materials.

Senator PELL. I have a series of specific questions, but I will yield first to Senator Glenn to continue his questioning.

Senator GLENN. Thank you, Mr. Chairman.

Dr. STEVENS. There is one thing, if I may interrupt.

On the decoupling theory, in the case of the Threshold Test Ban Treaty, the problem of decoupling detonations at the yields we are talking about are, of course, immense, because of the size of the cavities, as Jack has pointed out.

In the case of a Comprehensive Test Ban Treaty, where we are no longer concerned about specific yield but about the fact that a detonation has occurred, there it might appear to be more appealing because you could reduce the level substantially; but the detection of any seismic activity resulting from a detonation of any yield, of course, would be a violation of those circumstances.

## MAIN VALUE OF TREATIES

Senator GLENN. Good. That feeds into the question that I was going to ask next.

You look at this as a necessary step toward the total test ban, don't you? Here is what I am thinking.

One hundred and fifty kilotons is a very large boom. I question whether we or the Soviets really want to develop anything above that area now. Everybody has the big boom things if we want to use them. I question whether setting this 150-kt level is really an accomplishment other than as a step to a more comprehensive test ban, because it is so large. When we make that the cutoff and we are concentrating on developing smaller and smaller nuclear weapons both here and in the Soviet Union, is the main value of what we are talking about here today a step toward the total test ban, as opposed to what this treaty would actually involve? That is a long and involved question, and I'm sorry.

[Deleted.]

Senator GLENN. You get what I am driving at, don't you.

Dr. STEVENS. Yes.

Senator GLENN. I am saying that I have looked at this sort of tongue-in-cheek. If we approve this, it will be very good. But it really does not accomplish anything except that it is a first step at a very high level which will let us get on to the second step of negotiating the lower levels and a complete test ban treaty later on. I look at this as a step in that direction, and a necessary step. I am not talking this down, but the actual limitations this puts on either our or their testing I look at as being very minimal.

Dr. STEVENS. I think that may be right. I do believe that the Soviets must have felt that concluding this treaty came at some cost to them in terms of testing that they would have otherwise done. But I would agree that the amount of that testing and the significance for the future is being diminished.

## FIVE MAIN POINTS OF OPPOSITION

Senator GLENN. Some of the objections against this treaty which has been raised by some organizations and people I think are worthy to bring up and get your views on.

There are five main points of opposition that some of the different groups have raised. The following are examples.

The threshold of 150 kt has no relationship to verification capabilities and permits continued testing of nuclear weapons of considerable magnitude, more than 10 times the size of the weapon that devastated Hiroshima. I think we would agree with that one.

Another is the PNE Treaty would give peaceful nuclear explosions new respectability and this justification could be used by other countries as an excuse to justify nuclear weapons development. Do you have any comment on that?

Dr. STEVENS. Well, the Soviets, as we have pointed out, have really done a fair number of peaceful nuclear explosions for genuine applications. I think that requirements really had to be addressed pretty squarely.

In addition to that, there is a worldwide interest in the peaceful uses of nuclear explosions, and while one can understand the argu-

ment that to allow peaceful uses is to allow a kind of degradation in the threshold of using nuclear weapons at all, I think there is a force behind that that really had to be addressed and faced. I think that the accommodation for peaceful uses was one that genuinely had to be made.

Senator GLENN. Another item of concern is the following:

The 150-kt limit may be maintained for years to come since there is no provision for systematically lowering the threshold or the number of tests to zero. I would be concerned about that, too. Are we setting up a false sense of security by setting up a 150-kt limit when the threat is really below that? I believe that gets back to my previous comment.

In the negotiations were there efforts made, or do you think we can systematically use this as a means to cover the lower yield testing also?

Dr. STEVENS. I think the next step toward that has been taken in opening discussions for the comprehensive test ban.

Senator GLENN. Yes, for the comprehensive.

Do you look at this onsite inspection as being a breakthrough or as providing any real benefit? The next comment on this was that the onsite inspection provision is no breakthrough since it deals with specialized circumstances but has essentially no relevance to a nuclear test ban.

Dr. STEVENS. I guess I don't quite understand that. It has no relevance to the nuclear test ban?

Senator GLENN. They said that the onsite inspection provision was no breakthrough. I guess they refer there to the very limited access that this would provide because it is so specialized.

Bill, did you have something on this?

Mr. ASHWORTH. Yes, Senator.

They were talking about the Comprehensive Test Ban Treaty. I think they were saying that the onsite inspection requirement in the Peaceful Nuclear Explosions Treaty does not really set a valid precedent for the comprehensive test ban.

Dr. STEVENS. It is true that there were a lot of thoughts early in the game that the willingness of the Soviets to allow onsite inspections in the PNE Treaty represented a big departure from their past positions on any kind of arms limitations. Of course there is a distinction between those two. These are not weapons tests.

#### POSSIBILITY OF VERIFYING COMPLIANCE

Senator GLENN. With your technical expertise, are you happy that everything we are agreeing to in this treaty can be positively verified?

Dr. STEVENS. Our belief is that we can indeed verify it, given the provisions of the treaty and our capabilities.

Senator GLENN. That has been my main concern in any of these treaties and anything that we may work out with SALT talks, indeed throughout the whole issue. I will vote against anything around here that cannot be verified because I do not trust the people with whom we are dealing any more than does anyone else. I think that has been the big hangup so far. It has been the hangup with SALT. I think it is in the minds of most Senators and most of the people with whom I talk back home and across the

country. The big question is, can we verify these things. As long as we make an agreement and know when they violate it, then we are not in bad shape and we have made some progress. But just to take a "pig-in-a-poke" assumption that they are going to abide by something because we abide by it is not realistic.

Is it your feeling that we can verify everything to which we are agreeing?

Dr. STEVENS. Yes, sir.

The intelligence community as a whole was deeply involved in the whole process of arriving at the treaties. A tremendous amount of attention was given to the problems of verification and so on. I think those issues were dealt with in detail and at great length. The treaty, as it has finally been put together, is one that we believe will provide the basis for real verification of compliance.

Senator GLENN. Thank you, Mr. Chairman.

Senator PELL. I appreciate those thoughts, Doctor.

#### ASSURING NO WEAPONS BENEFITS FROM PEACEFUL USE TESTS

If we have a comprehensive ban on tests, but there are a small number of peaceful explosions allowed, is there any way you could tell if the explosions were really peaceful, or would you have to have onsite inspections?

Dr. STEVENS. That represents a real problem. So long as peaceful use tests are allowed, unless there are what appear to be extremely intrusive provisions included, we see no way now of being assured that no weapons benefits accrue from those peaceful tests.

Senator PELL. In other words, if there is a Comprehensive Test Ban Treaty, you believe it should not allow for peaceful explosions unless they are monitored on the spot?

Dr. STEVENS. Yes.

Senator PELL. But that is presently included, I believe, in the treaties before us. Is that not correct?

Dr. STEVENS. We are now talking about the Comprehensive Test Ban Treaty, which is different from the Threshold Treaty and the one for peaceful uses.

Senator PELL. But when we were talking about peaceful uses explosions, I recalled somewhere in there is a provision for onsite inspections. Isn't that correct?

Dr. STEVENS. Yes, sir. The Peaceful Uses Treaty is really aimed at preventing either side from gaining weapons benefits by testing at higher yields than is allowed by the Threshold Test Ban Treaty. In other words, there should be no way by using peaceful uses tests or peaceful uses explosions that you could gain any weapons benefits that are not already automatically available to you under the Threshold Test Ban Treaty.

So, the provisions that are in the Peaceful Uses Treaty are essentially aimed at making sure that no detonation under that treaty is greater than 150 kt.

Senator PELL. Thank you.

Dr. STEVENS. That is different than the comprehensive test ban problems.

Senator PELL. Understood.

[Deleted.]

UNITED STATES ASSESSMENT OF SOVIET NUCLEAR ARSENAL  
CAPABILITIES

Senator PELL. Has our improved understanding of the Soviet test program caused us to change in any major way our assessment as to the capabilities of the Soviet nuclear arsenal?

Dr. STEVENS. Their underground test program has not been the only basis on which we have made estimates of yield and so on in particular weapons systems. [Deleted.]

Senator PELL. Thank you.

Senator CASE.

Senator CASE. Thank you, but I have no questions.

SANITIZATION OF RECORD REQUESTED

Senator PELL. Before closing this session, I wonder if you would give thought as to whether we could sanitize this hearing and include the points that are not of a classified nature in the general hearing record, so that when the treaties come before us for consideration and voting for ratification, we will be able to have at least the flavor of your testimony today and the conclusions at which you have arrived, and as much of the specific reasons for the conclusions as you believe can be safely put into the record. Do you think you would be able to do that?

Dr. STEVENS. Let me re-look at the thing and see what we can do.

Senator PELL. Obviously you are the doctor.

But we would appreciate, as would the general public, the benefit of your views and your conclusions, the fact that you believe it is verifiable. Please include whatever reasons you can.

Dr. STEVENS. I understand, Mr. Chairman.

Senator PELL. Do you have any further questions?

VERIFICATION IN PNE AREA

Senator GLENN. The PNE area disturbs me somewhat. The PNE area cannot really be verified under 150 kt. Is that correct?

In other words, there is no way that we can distinguish between a PNE and a weapon of under 150 kt.

Dr. STEVENS. No, sir.

Senator GLENN. Nothing would ban any testing they would want to do. They could make, let's say, a 140-kt explosion, call it a PNE, and we would have no way of verifying and nothing in this treaty would give us any verification rights on this. We would have to just accept their word that it is a peaceful nuclear explosion to build a canal for themselves.

Senator PELL. But I thought if the PNE Treaty went through, we had the right of onsite inspections.

Senator GLENN. Not if it is under 150 kt.

Dr. INGLEY. They could do the same thing at their weapons test site.

Dr. STEVENS. Yes, it really does not make any difference. Any weapon test that they want to undertake they can undertake, below 150.

Senator GLENN. What if it is over 150 kt but they say it is a PNE, would that be covered under this?

Dr. STEVENS. Yes, sir. The provisions of the treaty, the onsite inspection provisions and so on, make sure that they cannot test under PNE aegis a weapon of greater than 150 kt. We indeed cannot tell whether it is a device built just for peaceful uses or whether indeed it is a device that they may be intending to use otherwise.

Senator GLENN. These are not really covering anything under 150 kt for whatever use?

Dr. STEVENS. That's right.

Senator GLENN. Boy, that is a minimal step. I am for it, but I hope everybody does not feel very protected by the fact that we will sign this treaty.

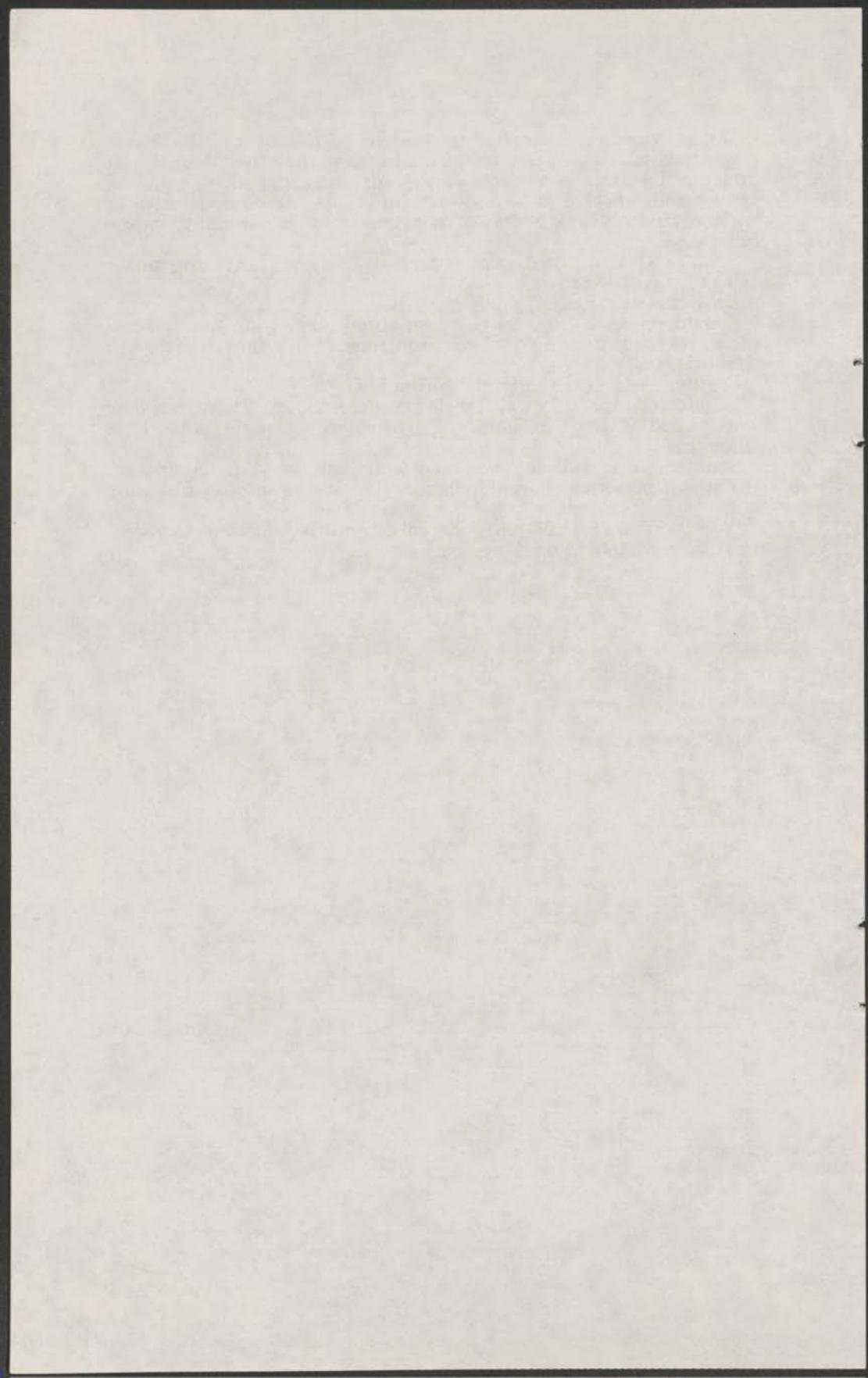
Senator PELL. It is really just a first step.

Senator GLENN. It is well labeled as "threshold". There is a long walk ahead of that threshold to get to where we ought to be. That is for sure.

Senator PELL. I thank you gentlemen all very much, indeed.

Without objection, I would suggest that we go into open session now.

[Whereupon, at 11:03 a.m., the subcommittee recessed, to reconvene immediately in open session.]



## THRESHOLD TEST BAN AND PEACEFUL NUCLEAR EXPLOSION TREATIES

### Open Session

Senator PELL. The Committee on Foreign Relations will come to order.

#### OPENING STATEMENT

We are going to move quite rapidly because we do not have permission to meet after half past 11 this morning. We are holding this second hearing on the proposed Threshold Test Ban and Peaceful Nuclear Explosions Treaties.

Witnesses will be Assistant Secretary of Defense, David McGiffert and Vice Adm. Patrick Hannifin.

We had a hearing last Thursday, when we heard from Under Secretary Habib and Director Warnke. Two further hearings will be held in September. Testimony will be received from the Energy Research and Development Administration on the third hearing, on Friday, September 9, and the final hearing will be on Thursday, September 15, with testimony from outside witnesses.

I will put the rest of my statement in the record, if there is no objection, and would ask each of you to proceed, bearing in mind, as I said, that we have a very short period of time for any questions.

Any statements you make will be put in full in the record.  
[Senator Pell's opening statement follows:]

#### OPENING STATEMENT OF SENATOR CLAIBORNE PELL

Today the Committee on Foreign Relations is holding its second hearings on the proposed Threshold Test Ban and Peaceful Nuclear Explosions Treaties. The Committee has just heard in executive session representatives from the Central Intelligence Agency on verification aspects of these two proposed treaties.

Our witnesses in open session this morning will be the Honorable David E. McGiffert, Assistant Secretary of Defense for International Security Affairs, accompanied by Vice Admiral Patrick J. Hannifin, Director of the Joint Staff of the Joint Chiefs of Staff.

Last Thursday the Committee heard from the Honorable Philip C. Habib, Under Secretary of State for Political Affairs, and the Honorable Paul C. Warnke, Director of the Arms Control and Disarmament Agency. Two further hearings will be held in September.

The proposed Threshold Test Ban Treaty would bind the United States and the Soviet Union to nuclear tests no greater than 150 kilotons. When this treaty was signed in 1974, it was envisioned that it would go into effect on March 31, 1976. Although Senate consideration of the treaty was delayed pending agreement on the proposed Peaceful Nuclear Explosions Treaty, the two sides have limited their tests to 150 kilotons in these last 15 months as though the Threshold Test Ban Treaty were in force.

On the surface, a test limit of 150 kilotons seems a relatively modest achievement. This limit is roughly 10 times as great as the weapons that destroyed Hiroshima and Nagasaki more than three decades ago.

These two treaties, however, are at the heart of one of the most important arms control initiatives now under way—the search for a comprehensive ban on all

nuclear explosions. The goal of a comprehensive ban is one the United States has adhered to with other nations over a number of years, but progress has been slow and tortuous. In the course of its hearings, the Committee is taking a fresh look at the question of a comprehensive ban and is seeking informed judgments as to whether a comprehensive ban is in our national interest, and whether this goal would be supported by ratification of these two treaties.

I would like to welcome our witnesses this morning, Secretary McGiffert and Admiral Hannifin. Would you begin, please, Mr. Secretary?

**STATEMENT OF HON. DAVID E. MCGIFFERT, ASSISTANT SECRETARY FOR INTERNATIONAL SECURITY AFFAIRS, DEPARTMENT OF DEFENSE; ACCOMPANIED BY VICE ADM. PATRICK J. HANNIFIN, DIRECTOR, JOINT STAFF ORGANIZATION, JOINT CHIEFS OF STAFF**

Mr. MCGIFFERT. Mr. Chairman, we both have quite short statements, and I will try to shorten them some more, if I can, as I go, and then Admiral Hannifin will follow me.

I am pleased to have the opportunity to be here today to talk about the two treaties which your committee is now considering, the Threshold Test Ban Treaty and the PNE Treaty.

You have already heard from Phil Habib, the Under Secretary of State and Paul Warnke, the Director of Arms Control and Disarmament Agency. They testified that these treaties would promote the U.S. objectives of curbing nuclear arms competition and proliferation, would help us in our negotiations to achieve a comprehensive test ban, act as a hedge against delays in that negotiating process, and would establish important verification precedents.

I agree with their conclusions that these treaties are valuable in their own right, and, further, may aid in obtaining a comprehensive test ban. I don't intend, however, to repeat the substance of their remarks, and will confine my statement to the security implications of these two treaties.

**SECURITY IMPLICATIONS OF TREATIES**

Both treaties preclude underground nuclear explosions above 150 kt. As you are aware, the Soviet Union has consistently relied upon larger-yield warheads, many in the megaton range, than has the United States. By limiting the Soviet Union, a ceiling on the testing of large-yield nuclear devices will aid us in the long term in maintaining the strategic balance and serve to enhance the survivability of our retaliatory ICBM force.

Further, although the United States and, we believe, the Soviet Union, have observed the constraints of the proposed Threshold Treaty since March 31, 1976, we did test some preliminary designs for larger weapons prior to that time. Based on this past testing, and that which would be permitted under the proposed treaties, we will be able to provide suitable warheads for those future delivery systems which are now under consideration, as well as assure the reliability of our present stockpile.

This situation will, in our view, hold—barring a radical shift in national strategy and targeting philosophy which would require large-yield warheads of types not tested in the past. Such a shift in our defense requirements would undoubtedly be preceded by drastic changes in our relationship with the Soviet Union or in the evolution of Soviet strategic capabilities.

This, of course, would call for a thorough reexamination of our strategic policy vis-a-vis the Soviet Union, including the viability of existing arms control agreements.

#### QUESTION OF VERIFICATION

I will skip the paragraph in my prepared statement on proliferation and turn, at the top of page 3, to the question of verification. An important aspect of any arms control agreement is our ability to verify Soviet compliance. Monitoring of Soviet weapons tests will be accomplished primarily by the Atomic Energy Detection System, about which you have had a briefing earlier today.

Nuclear explosions and earthquakes generate sound waves which travel through the Earth's mantle and deep interior. By detection and analysis of these waves, it is possible to distinguish a nuclear explosion from natural events and to estimate its explosive power. There are, of course, several factors which cause uncertainties in this process of estimation.

In spite of such limitations, however, the detection system is, in our view, good enough to provide adequate assurance that Soviet testing significantly above the treaty threshold would be recognized as such, especially if it were repeated over time.

I believe that verification means for monitoring underground nuclear testing under the terms of the TTBT, are, and will continue to be, adequate to protect U.S. security interests.

In considering the verifiability of the TTBT, one must also consider the companion treaty on underground nuclear explosions for peaceful purposes. The Soviet Union has a large PNE program and has proclaimed its intention of performing truly heroic tasks by this means.

One of these, the diversion of the Pechora River from its northward flow into the Arctic Ocean to a southward flow into the Caspian Sea, could require 200 to 300 nuclear excavation charges, many of which were at one time planned by the Soviet Union to be larger than 150 kt.

Quite aside from the fact that such excavation explosions may not be permissible under the Limited Test Ban Treaty, it became evident during the negotiation of the PNE Treaty that employment of PNE's provides an opportunity for the achievement of various military benefits. The PNE Treaty restricts this by placing limitations on PNE's similar to those placed on weapons testing.

Incidentally, the United States does not conduct any PNE tests so, at the present time, the operational restrictions would be imposed entirely on the Soviet Union. Our security interests are thus protected by a limit on PNE's, which requires that they not exceed 150-kt ceiling on weapons tests.

The importance of the PNE Treaty goes beyond setting a ceiling on yields, however. It establishes, for the first time, the right of U.S. observers to monitor, with instruments, Soviet experiments in order to supplement those verification capabilities provided by national technical means. This important precedent may prove very useful; in other negotiations.

## RATIFICATION IN BEST INTERESTS OF U.S. NATIONAL SECURITY

In summary, Mr. Chairman, the Department of Defense believes that ratification of these two treaties would be in the best interests of our national security.

[Mr. McGiffert's statement follows:]

## PREPARED STATEMENT OF HON. DAVID E. MCGIFFERT, ASSISTANT SECRETARY OF DEFENSE, INTERNATIONAL SECURITY AFFAIRS

Mr. Chairman, I am pleased to have the opportunity to appear before you to discuss the two treaties which your committee is now considering—the Treaty on the Limitation of Underground Nuclear Weapon Tests or what is commonly called the “Threshold Test Ban Treaty” (TTBT) and its companion—the Treaty on Underground Nuclear Explosions for Peaceful Purposes (PNET). The Committee has already heard from the Undersecretary of State, Philip Habib, and the Director of the Arms Control and Disarmament Agency, Paul Warnke. They testified that these treaties would promote the U. S. objectives of curbing nuclear arms competition and proliferation; would assist us in our negotiations to achieve a comprehensive test ban and act as a hedge against delays in the negotiating process; and would establish important verification precedents. I agree with their conclusions that these treaties are valuable in their own right and, further, may aid in obtaining a comprehensive test ban. I do not intend to repeat the substance of their remarks and will confine my statement to the security implications of these two treaties.

Both treaties preclude underground nuclear explosions above 150 kt. As you know, the Soviet Union has consistently relied upon larger yield warheads, many in the megaton range, than has the United States. By limiting the Soviet Union, a ceiling on the testing of large yield nuclear devices will aid us in the long term in maintaining the strategic balance and serve to enhance the survivability of our retaliatory ICBM force.

Further, although the United States and the Soviet Union have observed the constraints of the proposed TTBT since March 31, 1976, the United States did test some preliminary designs for larger weapons prior to that time. Based on this past testing and that which would be permitted under the proposed treaties, we will be able to provide suitable warheads for those future delivery systems which are now under consideration, as well as assure the reliability of our present stockpile.

This situation will hold barring a radical shift in national strategy and targeting philosophy which would require large yield warheads of types not tested in the past. Such a shift in our defense requirements would undoubtedly be preceded by drastic changes in our relationship with the Soviet Union or in the evolution of Soviet strategic capabilities. This, of course, would call for a thorough re-examination of our strategic policy vis-a-vis the Soviet Union including the viability of existing arms control agreements.

The proliferation of nuclear weapons poses a different kind of risk. The defense of the United States, our alliance responsibilities and tasks, and the maintenance of world peace and stability will become increasingly difficult if nuclear proliferation goes unchecked. The TTBT, as a further step in international arms control agreements, will by example promote the principles of non-proliferation.

Let me now turn to the question of verification. An important aspect of any arms control agreement is our ability to verify Soviet compliance. Monitoring of Soviet weapons test will be accomplished primarily by the atomic energy detection system (AEDS). I believe that you have already heard about the results obtained from this network during this morning's briefing by the CIA. I will restrict my comments to the national security implications of the monitoring system.

Nuclear explosions and earthquakes generate sound waves which travel through the Earth's mantle and deep interior. By detection and analysis of these waves, it is possible to distinguish a nuclear explosion from natural events and to estimate its explosive power. There are, of course, several factors which cause uncertainties in this process of estimation. For example, naturally occurring earthquakes provide a background of noise which interfere with reception and analysis of signals.

In spite of such limitations, however, the detection system is good enough to provide adequate assurance that Soviet testing significantly above the treaty threshold would be recognized as such, especially if it were repeated over time. I believe that our verification means for monitoring underground nuclear testing under the terms of the TTBT are and will continue to be adequate to protect U.S. security interests.

In considering the verifiability of the TTBT, it is worthwhile to consider the companion treaty on underground nuclear explosions for peaceful purposes.

The Soviet Union has a large PNE program and has proclaimed its intention of performing truly heroic tasks by this means. One of these, the diversion of the Pechora River from its northward flow into the Arctic Ocean to a southward flow into the Caspian Sea, could require 200 to 300 nuclear excavation charges; many were planned to be larger than 150 kt.

It became evident during the negotiation of the treaty governing PNE's that employment of such devices provided too much opportunity for the achievement of various military benefits. The treaty controls this by placing limitations on PNE's similar to those placed on weapons testing. Incidentally, the United States does not conduct any PNE tests, so at the present time the operational restrictions would be imposed entirely upon the Soviet Union. Our security interests are thus protected by a limit on PNE's which requires that they not exceed the 150 kt ceiling of weapons tests.

The importance of this PNE companion treaty goes beyond setting a ceiling on yields. It establishes, for the first time, the right of U. S. observers to monitor, with instruments, Soviet experiments in order to supplement those verification capabilities provided by national technical means. This important precedent may prove very useful in other negotiations.

In summary, the Department of Defense believes that ratification of these two treaties would be in the best interest of our national security.

**STATEMENT OF VICE ADM. PATRICK J. HANNIFIN, DIRECTOR,  
JOINT STAFF ORGANIZATION, JOINT CHIEFS OF STAFF**

Admiral HANNIFIN. Mr. Chairman, and members of the committee, I welcome this opportunity to participate in the ratification process by providing the views of the Joint Chiefs of Staff with regard to the Threshold Test Ban Treaty and the Peaceful Nuclear Explosions Treaty.

The Joint Chiefs of Staff support ratification of these treaties, which are part of the trend toward restricting the competition in nuclear weapons.

In the Limited Test Ban Treaty of 1963, and again in the Non-Proliferation Treaty of 1968, the United States and the Soviet Union expressed a commitment to seek to achieve the discontinuance of all nuclear tests. While the LTBT prohibits nuclear explosions in the atmosphere, in outer space, and under water, differing views on verification had prevented inclusion of limits on underground tests.

At the Moscow summit meeting of July 1974, the two countries took the first step toward limiting underground tests by signing the TTBT. Subsequently, the Peaceful Nuclear Explosions Treaty was negotiated and signed.

The military risks associated with these closely linked treaties could be reduced to acceptable levels through adoption of appropriate safeguards.

Modifications of the safeguards which were adopted during the Limited Test Ban Treaty ratification are currently under interagency review to insure their adequacy under the TTBT and the PNET, as well as the Limited Test Ban Treaty. These safeguards include continuing underground nuclear test programs consistent with the treaty limitations, maintaining modern nuclear laboratory facilities, maintaining the basic capability to resume nuclear tests in prohibited environments, should they be considered essential, and a vigorous verification program.

Under the terms of the Threshold Test Ban Treaty, the United States will be prevented from confirming advances in higher yield

nuclear weapons design, as well as verifying yields and nuclear effects of some stockpiled weapons. There is also a possibility that some ERDA weapons development personnel would be drawn into other programs, so that prompt resumption of high-yield testing may be difficult, should that need arise.

Undetected testing above the threshold by the Soviet Union could result in an advantage, in that they could confirm advances in some higher yield strategic weapons. In order to minimize any such risks associated with the undetected violations of the TTBT and the PNET, increased emphasis on maintaining and improving our capability in the Atomic Energy Detection System will be required.

In conclusion, gentlemen, the Joint Chiefs of Staff believe that there would be benefits in continued nuclear testing. But on balance, it would appear to be advantageous to ratify the TTBT and the PNET, since these treaties are equitable and if safeguards are adequate, certainly supportable by the Joint Chiefs of Staff.

Senator PELL. Thank you very much, Mr. McGiffert and Admiral Hannifin.

#### MEANING OF "IF SAFEGUARDS ARE ADEQUATE"

You say, Admiral, "if safeguards are adequate." What does that expression mean?

Admiral HANNIFIN. In the discussions which led up to the U.S. formulation of their position for the negotiations, the Joint Chiefs of Staff and the Secretary of Defense at that time, Mr. Rumsfeld, both agreed that there were certain safeguards which we felt would be necessary to continue our weapons system within the limitations of the treaties, as proposed.

Specifically, we felt that it was necessary for us to continue to conduct underground nuclear test programs within the limitations of the treaty, in order to both add to our knowledge and improve our weapons in all areas of significance in our future military posture.

#### WOULD CTB BE IN U.S. NATIONAL INTEREST?

Senator PELL. This leads me to my next question and that is, what would be your view with regard to a comprehensive test ban treaty applying to both sides? Do you think that would be in the national interest of the United States, or opposed to the national interest?

Admiral HANNIFIN. At the present time, I think the Joint Chiefs of Staff position is that a comprehensive test ban treaty would certainly inhibit some of the work that we are doing now under the limitations of the Threshold Test Ban Treaty, the 150-kt limitation, but that we could, with some less efficiency, utilize warhead designs which have already been developed for the weapons systems which are now programmed to be developed and to be deployed.

Senator PELL. But wouldn't that same lessening of efficiency apply to our adversary, as well?

Admiral HANNIFIN. Most certainly. I think our concern is that we really don't know the extent of the Soviets' weapons testing program. We know the size of the weapons that they have tested,

but we really don't know too much about the design or how well they are prepared to go on into advanced systems with the testing that they have already accomplished.

Senator PELL. Mr. McGiffert, I address the same question to you. Recognizing that these two treaties are rather timid steps in the direction of a comprehensive test ban treaty, what would be your view as to whether such a treaty would be in the national interests of the United States?

Mr. MCGIFFERT. I think it is possible—and by saying that, I don't mean to make a judgment about what is feasible in the negotiating forum, but I think it is certainly possible conceptually to have a treaty which would be in the best interests of the United States.

#### ENVIRONMENTAL IMPACT STATEMENT CONCERNING PECHORA RIVER DIVERSION

Senator PELL. Following up your testimony, Mr. McGiffert, where you referred to the plans of the Soviet Union for diverting the flow of the Pechora River from the Arctic Ocean into the Caspian Sea, the natural follow-on of that is, what would be the effects on the world if they did it? From a climatic viewpoint, as you know, you would have less fresh water going into the Arctic Sea, you have more salt water; you hence have a smaller Arctic ice-cap; you have less heat refracted; and you have the Earth's climate substantially warmer.

Would your department be supportive of my proposal embodied in S. Res. 49, stating that when a nation makes an environmental change of such a nature that it affects its neighbors of the global commons, that it should file some form of environmental impact statement?

Mr. MCGIFFERT. Senator, I don't have an official departmental position on that proposal. It does seem to me interesting and useful.

Senator PELL. It would not prevent a country doing it, but at least it would mean if the Soviet Union went ahead with this program, it would file with UNEP, the United Nations environmental program, a statement of it and an assessment as to how many degrees centigrade—by that time—the temperature would be increased in the world.

Mr. MCGIFFERT. I am, incidentally, grateful for the education you are giving me. I hadn't realized that that would be one of the results of diverting the flow.

Senator PELL. I wish you would study this proposal. It sounds a little far out now, but some other proposals that have been advanced by the subcommittee were thought far out, and have actually become part of our body of international law.

Senator CASE?

Senator CASE. Thank you, Mr. Chairman.

#### HANDLING PEACEFUL EXPLOSIONS UNDER CTB WITHOUT RISK OF CHEATING

You said, Mr. Secretary, that conceptually you think that a comprehensive test ban treaty would be in the interests of the United States, or that one could be devised which would. Is there

any workable way of handling peaceful explosions with the ban in force on testing under which the risk of cheating wouldn't be present?

Mr. MCGIFFERT. Senator Case, I don't want to prejudge the exploratory discussions that have been taking place in Geneva, and I am not sure it is appropriate to get into any detail. I will give you my personal view that I think it is very doubtful that a comprehensive test ban which did not include or cover PNE's could be a viable proposition.

#### REQUIREMENTS TO MAKE CTB IN U.S. INTERESTS

Senator CASE. Again, I don't want to press you beyond anything you think you ought to say or can't say, as far as the state of knowledge and everything else goes. When you say, "conceptually", what are the broad requirements of such a treaty that would have to be met in order to make it actually in the interests of the United States?

Mr. MCGIFFERT. If you will accept my own view, phrased very generally because we are in open session and because this is a matter still under negotiation, my own view is, first, as I stated, that inclusion within the coverage of such a treaty of PNE's would probably be necessary; and second, without trying to get into the detail of what constitutes adequate verification, it seems to me clear that we will need satisfactory arrangements for verification.

Senator CASE. This is in a general way, too. It would make necessary something more than national verification, by national means?

Mr. MCGIFFERT. It seems to me, again on the basis that I indicated, that is probably so.

Senator CASE. Therefore, is there a connection between that proposition and your support for these treaties, that they may get both parties used to a kind of verification that, up to now, has not been acceptable?

Mr. MCGIFFERT. Yes. As I said in my statement, I think that provision in the PNE Treaty for onsite inspection, limited as it is, is nevertheless an important precedent.

Senator CASE. Thank you, Mr. Chairman.

Senator PELL. Thank you very much.

Senator Church?

Senator CHURCH. Mr. Chairman, let me defer to Senator Glenn.

Senator PELL. Fine. Go ahead, Senator Glenn.

#### U.S. VERIFICATION CAPABILITY

Senator GLENN. How good is our verification capability? I am particularly concerned about verification. Are you happy that we can verify everything that is covered in this treaty?

Admiral HANNIFIN. Is that a question to me, sir?

Senator GLENN. Either one. Go ahead, Admiral.

Admiral HANNIFIN. I believe the CIA people covered this this morning, to a certain extent.

Senator GLENN. Yes.

Admiral HANNIFIN. We are confident that we can both detect the explosions and can verify, if they occur in the test sites, with a considerable amount of accuracy as to the size of the explosion.

Senator GLENN. How low a kt equivalency are you fully confident we can detect anywhere in the Soviet Union, whether in one of the so-called prepared sites or where they develop a new one in, I guess we would say, an unprepared site?

Admiral HANNIFIN. I am not sure about the classification of this, but I would guess something around 10 kt, assuming no attempts are made to conceal the event.

Senator GLENN. So you don't feel that anywhere in the Soviet Union there would be a possibility of them setting off an explosion that would not be detectable at the 150-kt level?

Admiral HANNIFIN. I think that there might be circumstances in which they could hide some explosions, but at the 150-kt level, I would suspect that it would be detectable.

Senator CASE. Excuse me, John.

Senator GLENN. Go ahead.

Senator CASE. Would it be identifiable as a man-made explosion, as opposed to natural?

Admiral HANNIFIN. I think so.

Senator GLENN. When we get up in the 150-kt range, we can pretty well discriminate between earthquakes and nuclear explosions?

Admiral HANNIFIN. I should think it would be very difficult for them with premeditation to try to hide an explosion of that range within an earthquake. It is possible, but I would think improbable.

#### REASON FOR CHOOSING 150-KT LEVEL

Senator GLENN. Why was the level of 150 kt chosen? Do you know?

Admiral HANNIFIN. I think that that was related to our present test program at the time, and also a range at which there wasn't any question about the—

#### EFFECT OF 150-KT LEVEL ON U.S. TESTING

Senator GLENN. This gets a little bit into your previous comment, but will the limit on tests of 150 kt allow us to conduct all our tests for our weapons programs now?

Admiral HANNIFIN. Not completely, but I think satisfactorily, so that we can handle those that are programed now. There are some tests. I think the ERDA people would be better suited to answer more precisely on this, Senator.

#### EFFECT OF CTB ON U.S. TESTING

Senator GLENN. Do we have any testing now being conducted or scheduled on any system which would be held up by a comprehensive test ban treaty?

Admiral HANNIFIN. I believe that we answered that in the classified questions, Senator, to a pretty good extent. There are some—depending on when it went into effect. There are some in process now that, if it went into effect tomorrow, or very soon, it would have a more severe effect than later on.

## VALUE OF TREATIES

Senator GLENN. How valuable do you look at this as a real ban? Do you think this treaty is a real step forward?

Admiral HANNIFIN. I think it is, quite frankly. I think it is the first step of a path that we should take, that this country should take.

Senator GLENN. Is it a path? This is not the end product, I presume, as you would view it.

Admiral HANNIFIN. I certainly do not see it as the end product. I see it, as I think Mr. Habib and Mr. Warnke indicated, as the first step, and a concrete step.

Senator GLENN. Mr. McGiffert, would you care to comment?

Mr. MCGIFFERT. I agree with that, Senator. I see it as valuable, standing on its own legs, but I also see it as a step, hopefully, toward further restrictions.

Senator GLENN. I would think its only value lies in that direction, myself. I think 150 kt is a mighty big explosion, and I look at this a little bit like the Vladivostok agreements that set our limits on missiles way above what anybody in the world had. We had to build like crazy to get up to the limits.

It is a little bit like setting a limit and saying, we are coming all out for motherhood and sunshine tomorrow, or something, because we have set the limits on this thing high enough that we are not giving up anything really.

We term this a threshold test ban treaty. I think Chairman Pell a little while ago indicated it was a very timid thing. We might say those initials are for timid test ban treaty; that TTBT can be timid test ban treaty, at 150 kt. So I look at this as valuable, really, only in that it is the first step to get some agreement in this direction, moving on toward a comprehensive test ban treaty.

Development of nuclear weapons, I think, is going to smaller and smaller weapons and hopefully, we can get some control over that kind of development, and this is certainly only a first step. The 150 is so high that I really hope that Americans and people around the world don't think we have suddenly protected them in our whole nuclear program by setting a 150-kt limit, when we remember that Hiroshima was only 20 kt and all that mushroom cloud was from a 20-kt boom.

We are talking about limits on 150 and up, and everything under that comes under no ban whatsoever. We are talking about seven and a half times the boom of Hiroshima and up being the only thing that is limited under this, so I think we should be under no illusions. This is a first step and a first step only. I think most of us would probably agree with that.

You commented on our capability. Do we have indications whether this will really limit planned Russian testing.

Mr. MCGIFFERT. We don't know, Senator. It is true that, in the past, they have relied more on higher yield weapons than we have.

Senator GLENN. They have, but I believe there have been indications—and I don't believe this is in the classified area—that they have been developing smaller and smaller weaponry also available for artillery and smaller units for MIRV and MARV work on their missiles.

So I would presume that most of their big testing, as most of our big testing, has been done. Would that be a fair assumption, in your estimate?

Admiral HANNIFIN. I think you may be correct, Senator. They certainly are moving more toward MIRV'ed systems, which then require a larger number of smaller size reentry vehicles.

Senator GLENN. I don't mean to indicate—and I hope it is not so interpreted—that I am being so critical of the treaties proposed here or that I will not support them. Unless I find out something in the meantime, I do plan to support them, but I don't think we should be under any illusions about what these treaties do. They are so minimal to the problem that I hope no one thinks we are being protected much by these in the development that is obvious in this country and the Soviet Union.

Thank you, Mr. Chairman.

Senator PELL. Senator Church?

Senator CHURCH. I think Senator Glenn has said it for me. That was generally what I wanted to say. He said it very well and I can't embellish it.

I wonder why we call it an arms control agreement, when it is obvious that it doesn't control the arms plans on either side. It may be that there will be some political benefit to be derived from ratifying the agreement, inasmuch as both Governments have entered into it. I can't see what harm it would do. I am equally hard put to see what good it will do, except as it may create a climate that will permit us to move forward to a treaty that does accomplish something in the way of arms control.

On that basis, I think I will support it.

Senator CASE. Mr. Chairman, I think that our colleagues have done a great job of denigrating this treaty and the only thing that I think they ought to do to be fully logical is to support the organizations that are opposed to it.

#### TREATIES AS FIRST STEP

Senator GLENN. The first step on a long journey may not be the final step. We have to make these first step, and I hope this is a first step, on a road that will lead to real control of nuclear power and nuclear weapons around the world.

I don't want my remarks to be interpreted as denigrating it or that it is completely unnecessary. It is a first step, and it is just that, a first step, and no more.

Senator CASE. A toddle.

Senator PELL. A timid first step into the water, but once you have made that step—

Senator CASE. It isn't quite as cold after you have done it, except that as it rises higher. [General laughter.]

Senator PELL. I don't want to trespass on the time constraints we are under. I have one final question.

## REASON FOR 150-KILOTON FIGURE

Why was the figure of 150 kt plucked out originally, as opposed to 15 or 200? What was the magic about 150?

Mr. McGIFFERT. Senator Pell, I asked that question yesterday, when I was preparing for this hearing, and my first answer is, I am not sure, but as I understand it, it was a number that came out of the negotiating process and was more driven, therefore, I gather, by political considerations at the time, of which I am not aware, than it was by particular military considerations.

I assume those apply to the Soviet side, as well as to us.

Senator CASE. Isn't it roughly that figure below which it is difficult to verify?

Mr. McGIFFERT. No, it is a good deal higher than that, Senator Case. Now, what the situation was in 1973 and 1974, I am not entirely clear.

Senator CASE. I have no brief for the figure at all. I am just trying to explore this question with you.

I think probably you are right, that it came out of a political process in which it didn't matter too much where you put it exactly, within wide limits, and that the chief benefit of this thing isn't the establishment of that figure, but rather, the things that go with it in the way of opening into some verification on site, and that kind of thing.

## FUTURE HEARINGS

Senator PELL. The next hearing on this subject will be, as I said earlier, to hear the ERDA witnesses on Thursday, September 8 and the outside witnesses in opposition—some because they feel it goes too far and others because they feel it doesn't go far enough—will be heard on Thursday, September 15.

The hearing is adjourned.

[Whereupon, at 11:40 a.m., the hearing adjourned, subject to the call of the Chair.]

# THRESHOLD TEST BAN AND PEACEFUL NUCLEAR EXPLOSIONS TREATIES

THURSDAY, SEPTEMBER 8, 1977

UNITED STATES SENATE,  
COMMITTEE ON FOREIGN RELATIONS,  
*Washington, D.C.*

The committee met, pursuant to notice, at 10:06 a.m., in room 4221, Dirksen Senate Office Building, the Honorable Claiborne Pell, presiding.

Present: Senators Pell, Glenn, and Case.

## OPENING STATEMENT

Senator PELL. Today the Committee on Foreign Relations is holding its third hearing on the proposed Threshold Test Ban and Peaceful Nuclear Explosion Treaties.

Our first witnesses this morning will be the Honorable Robert W. Fri, Acting Administrator of ERDA; Mr. Alfred Starbird, Assistant Administrator for ERDA; and Mr. Mahlon Gates, manager of the Nevada Operations Office for ERDA.

Following a few questions and answers with these witnesses, the committee will hear Dr. Harold Agnew, Director of the Los Alamos Scientific Laboratory, and Dr. Roger E. Batzel, Director of the Livermore Laboratory.

In the two prior hearings we heard representatives of the Department of State, ACDA, the CIA, the Office of the Secretary of Defense, and the Joint Chiefs.

Alas, our time is limited this morning since we must end this hearing at 11:15 in order for the members to attend a reception for the Latin American dignitaries who have come to Washington for the signing of the new Panama Canal Treaty.

I will say nothing further at this point in order to allow the witnesses a little more time. We may have to submit some of our questions in writing for the record. I hope that the witnesses will be as brief as possible and summarize their statements. [See p. 76]

I apologize for the time pressures. In my own case, I was late because I was marking up a bill in another subcommittee. I fear this is the usual business of trying to be in several places at one time.

Dr. Fri, would you please begin?

STATEMENT OF HON. ROBERT W. FRI, ACTING ADMINISTRATOR,  
U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

Mr. FRI. Thank you, Mr. Chairman.

We appreciate the time pressures and will try to be as brief as possible. I will summarize my general statement and then Mr. Starbird, on my immediate right, who is our Assistant Administrator for National Security, will discuss the effects of the treaties on ERDA's nuclear weapons program. Mr. Gates, on my immediate left, who manages our Nevada operations office, will then describe our preparations for the in-country monitoring provided for in the Peaceful Nuclear Explosion Treaty, or the PNET. Then, as you requested, the Directors of the nuclear weapons laboratories, Dr. Agnew of Los Alamos, on my far left, and Dr. Batzel of Livermore, on my far right, and Dr. Morgan Sparks behind me, are also available to give their statements and to answer questions.

I wish to establish at this time my support of the President's objectives in achieving effective arms control measures and my belief that these treaties are, in fact, a step in that direction.

These treaties affect two areas for which ERDA is responsible by law: Nuclear weapons and nuclear explosions for peaceful purposes. Let me first briefly touch on the nuclear weapons program.

#### ERDA AND U.S. NUCLEAR WEAPONS PROGRAM

Since 1946, first the Atomic Energy Commission, and then ERDA, have worked closely with the Department of Defense to develop, produce, and maintain nuclear weapons in support of U.S. defense policy.

As the numbers and sophistication of our nuclear weapons increased, our nuclear weapon program grew in size and complexity. Since 1953, we have had two nuclear weapon design laboratories, an engineering laboratory that assists in weaponizing nuclear devices, and a separate organization that operates test facilities. Specialized production facilities fabricate the nuclear materials and other components of the weapons, and the parts are brought together and assembled at yet another facility. This complex is operated by contractors, but it is owned and controlled by ERDA.

#### TTBT's EFFECT ON NUCLEAR WEAPON DESIGN PROGRAM

Against that background, let me touch first on the Threshold Test Ban Treaty.

The TTBT has already had some constraining effect on our nuclear weapon design program, because we have agreed with the Soviet Union that both parties would abide by the terms of the treaty pending the outcome of the ratification process. The United States has conducted no tests above a 150-kt design-yield limit since March, 1976. Mr. Starbird will provide details of the direct impact of the TTBT on new weapon design, development, and modification.

#### UNITED STATES AND SOVIET PNE PROGRAMS

The second area in which ERDA has statutory responsibility is the use of nuclear explosions for peaceful purposes, or PNE's.

The U.S. PNE program began in 1957 under the name "Project Plowshare," an effort to apply nuclear explosive technology to the recovery of natural resources and large earth moving projects. Eleven nuclear engineering field experiments were carried out and

over \$150 million was expended. But there is no money in the fiscal 1978 budget for the nuclear explosive applications program because of uncertainties as to economic feasibility, lack of public acceptance, and nonproliferation concerns.

The Soviets, on the other hand, have an active PNE program. Since 1965, they have conducted over 40 nuclear explosions off the established weapon test sites. They have announced 16 of these as PNE's. The Soviets have reported at international technical reviews their intention to pursue the application of PNE's for the recovery of gas and oil, storage of hydrocarbons and waste, mining and large-scale nuclear excavation projects, such as the widely publicized Pechora-Kama Canal. They have proposed a Comprehensive Test Ban Treaty in the United Nations and the conference of the Committee on Disarmament that would prohibit nuclear weapon testing but would allow PNE's.

#### QUESTION OF VERIFICATION

The problem we must face with the PNE Treaty is the question of verification. In our judgment, the verification methods of the PNET will assure both parties that no weapon-related benefits can be obtained through PNE projects that could not be available through testing on nuclear weapon test sites under the terms of the TTBT.

However, these two treaties are specifically linked to the 150-kt limit on weapon testing and, if the TTBT threshold is reduced, there must be a corresponding reduction in the PNE limit.

#### TREATIES SUPPORTED

Mr. Chairman, let me conclude by reiterating my support for these treaties. They are the first agreements since the Limited Test Ban Treaty of 1963 to impose direct restraints on nuclear explosions.

Cooperation between the two major nuclear powers in implementing these treaties should set a hopeful precedent for future arms control negotiations. I would recommend that the Senate give its advice and consent to the ratification of these treaties.

Thank you.

[Mr. Fri's prepared statement follows:]

#### PREPARED STATEMENT OF ROBERT W. FRI, ACTING ADMINISTRATOR, U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

It is a pleasure to appear before you today on behalf of the Energy Research and Development Administration (ERDA) to testify in support of the treaties on the Limitation of Underground Nuclear Weapon Tests and on Underground Nuclear Explosions for Peaceful Purposes. For simplicity, I will refer to the former as the TTBT and to the latter as the PNET.

After my brief general statement, Mr. Alfred Starbird, Assistant Administrator of ERDA for National Security, will discuss the effects of the treaties on ERDA's nuclear weapon program. Mr. Mahlon Gates, ERDA Manager of the Nevada Operations Office, will describe ERDA's preparations for the in-country monitoring provided for in the PNET. As you requested, the Directors of the nuclear weapon laboratories, Dr. Harold Agnew of the Los Alamos Scientific Laboratory, Dr. Roger Batzel of the Lawrence Livermore Laboratory, and Dr. Morgan Sparks of Sandia Laboratories are also available for discussion and questions during the course of this hearing.

I wish to establish at this time my support of the President's objectives in achieving effective arms control measures and my belief that these treaties are a step in that direction. However, we are also responsible for providing a scientific and technical assessment of the impact of these treaties on ERDA responsibilities.

The TTBT, with the protocol which is integral to it, was signed in Moscow July 3, 1974. This treaty provides for a limitation of 150 kilotons on all underground nuclear-weapon tests carried out by the two parties. National technical means are to be employed for verification, but the treaty also calls for an exchange of data on the geography and geology of nuclear-weapon test sites as well as the yields of two actual nuclear explosions conducted on each weapon test site. This exchange of data supplements and enables us to refine our information obtained by national technical means.

The PNE Treaty, including its protocol, was signed May 28, 1976. The PNE Treaty was negotiated to assure that weapon-related benefits precluded by the TTBT could not be obtained by one of the parties as a result of conducting PNE projects. Therefore, it establishes a limit of 150 kt on all individual underground nuclear explosions for peaceful purposes. It establishes also an aggregate yield limitation of 1.5 megatons on near simultaneous group nuclear explosions for peaceful purposes.

The PNET includes provisions to ensure verification that are unique in that they provide, for the first time, on-site observer rights to monitor group explosions with aggregate yields greater than 150 kt. If both parties agree, on-site observers will be permitted to confirm the geology and the peaceful purpose of the explosion when the aggregate yield is between 100 and 150 kt. The PNET protocol also stipulates in detail that the party conducting the explosion will provide, in advance, information on the peaceful purpose, time, location, geography, and geology at the site of the explosion. As in the case of the data required by the TTBT, all of these PNET requirements are designed to provide verification that all individual explosions are below 150 kt.

These treaties affect two areas for which ERDA is responsible by law: nuclear weapons and nuclear explosions for peaceful purposes. The first area I will discuss is the nuclear-weapon program.

Since 1946, first the Atomic Energy Commission, and then ERDA, have worked closely with the Department of Defense to develop, produce, and maintain nuclear weapons in support of U.S. defense policy. As the numbers and sophistication of our nuclear weapons increased, our nuclear-weapon program grew in size and complexity. Since 1953 we have two nuclear-weapon-design laboratories, an engineering laboratory that assists in weaponizing nuclear devices, and a separate organization that operates test facilities. Specialized production facilities fabricate the nuclear materials and other components of nuclear weapons, and the parts are brought together and assembled at yet another facility. This complex is operated by contractors, but owned and controlled by ERDA.

The TTBT has already had a constraining effect on our nuclear-weapon-design program, because we have agreed with the Soviet Union that both parties would abide by the terms of the treaty pending the outcome of the ratification process, and the U.S. has conducted no tests above a 150 kt design-yield limit since May of 1976. Mr. Starbird will provide details of the direct impact of the TTBT on new weapon design, development, and modification.

The second area in which ERDA has statutory responsibility is in the use of nuclear explosions for peaceful purposes, or PNEs. The U.S. PNE program began in 1957 under the name "Project Plowshare," an effort to apply nuclear-explosive technology to the recovery of natural resources and large earth-moving projects. Eleven nuclear engineering field experiments were carried out and over \$150 million was expended. There is no money in the FY 78 budget for the Nuclear Explosive Applications Program because of uncertainties as to economic feasibility, lack of public acceptance, and nonproliferation concerns.

The Soviets, on the other hand, have an active PNE program. Since 1965 they have conducted over 40 nuclear explosions off the established weapon test sites. They have announced 16 of these as PNEs. The Soviets have reported at international technical reviews their intention to pursue the application of PNEs for the recovery of gas and oil, storage of hydrocarbons and waste, mining and large-scale nuclear excavation projects such as the widely publicized Pechora-Kama Canal. They have proposed a Comprehensive Test Ban Treaty in the UN and the Conference of the Committee on Disarmament that would prohibit nuclear-weapon testing but allow PNEs.

The 150 kt limit on underground nuclear-weapon tests established by the Threshold Test Ban Treaty does not provide for some PNE applications that require multiple, near-simultaneous explosions aggregating in yields into the megaton range

to accomplish the engineering job involved, particularly those requiring the excavation of earth or the crushing of large amounts of ore.

It was not possible to allow higher-yield individual nuclear explosions to take place off the test site because there is no way to assure that weapon benefits are not being obtained from PNEs when nuclear explosions at the weapon test site are limited to 150 kt by the TTBT. It was, therefore, necessary to negotiate the PNE Treaty limiting individual PNEs to 150 kt and aggregate yields to 1500 kt. This combination would allow most PNEs to take place within reasonable engineering limits and also provide a limit that would facilitate the placement of necessary equipment and on-site-observation teams to monitor compliance with the treaty and protocol.

In our judgment, the verification methods of the PNET will assure both parties that no weapon-related benefits can be obtained through PNE project that could not be available through testing on nuclear-weapon tests sites under the terms of the TTBT. However, these two treaties are specifically linked to the 150 kt limit on weapon testing and, if the TTBT threshold is reduced, there must be a corresponding reduction in the PNE limit. We will discuss separately the significance of the PNET on-site-observer rights in considering ways and means of extending our national technical means of verifying that all nuclear explosions could be effectively banned.

I reiterate my support for these treaties. They are the first agreements since the Limited Test Ban Treaty of 1963 to impose direct restraints on nuclear explosions. Cooperation between the two major nuclear powers in implementing these treaties should set a hopeful precedent for future arms control negotiations. I recommend that the Senate give its advice and consent to ratification to these treaties. Mr. Chairman, this concludes my prepared statement. I would be pleased to respond to any questions.

Senator PELL. Thank you, Mr. Fri.

Next we will hear from Mr. Starbird.

Please proceed, sir.

**STATEMENT OF ALFRED D. STARBIRD, ASSISTANT ADMINISTRATOR FOR NATIONAL SECURITY, ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION.**

Mr. STARBIRD. Thank you, Mr. Chairman. I appreciate the opportunity to be here. I would like to have my full statement submitted for the record, if I may, and I will summarize by primarily reading the parts of my statement which have not been given to you by witnesses earlier.

Senator PELL. Without objection, that will be done.

Mr. STARBIRD. I will discuss the TTBT and PNET and how they impact on the Energy Research and Development Administration's capability to develop nuclear weapons to meet Department of Defense requirements, and the precedents they establish in verification procedures.

In starting, let me interpolate that I would like to state my support for ratification of these two treaties.

**NUCLEAR WEAPONS DESIGN AND DEVELOPMENT METHODS**

I will discuss briefly nuclear weapons design and development methods.

Nuclear explosives differ from conventional explosives in many important respects. Each is a part of a complex weapons system and each must be designed to survive and perform reliably in different environments and under specific combat conditions. Each must be configured to fit the carrier that would deliver it.

This has generally meant that the U.S. weapon designs are continually advancing the state of the art to insure that weapon systems demands can be met.

The nuclear weapon development process begins with a basic concept that is linked to a specific DOD requirement. The proposed conceptual design undergoes many iterations, each being checked against calculations, against nonnuclear experiments, and some nuclear tests.

Once the feasibility of a design has been established, the Department of Defense may formally request that it be weaponized. It is then that the device must be fully adapted to meet the Department of Defense specifications to include safety, yield, and the other constraints of the delivery system.

Slight changes in design made to accommodate such specifications can significantly affect the performance of the device. Consequently, one or a few more tests may be required at this stage before a device can be certified for the stockpile.

It is not possible to fully evaluate the performance of a new design by calculations. Our final means of evaluation must be nuclear testing, including, usually, at least one test of a weaponized device at near full yield.

If the weapons laboratories cannot conduct actual experiments in any specific yield range at near full yield through the complete nuclear weapons testing cycle, there is no reliable way to complete the full test cycle required to put the new designs into the stockpile.

Under these conditions, new, higher-yield weapons would have to be developed based on generally conservative designs adapted by extrapolating from previously tested designs.

#### IMPACT OF TTBT LIMIT ON PRESENT WEAPONS STOCKPILE

It is also necessary to speak of the impact of the TTBT limit on weapons already in the stockpile. It will be necessary to modify some existing weapons with yields over 150 kt. There is a wide range not only of age but of sophistication of higher yield weapons in the stockpile. Most strategic weapons are high yield-to-weight ratio designs and, therefore, sensitive to change with age. Many of the modifications, corrective actions, or component replacements required could be accomplished within the 150-kt design yield limit.

We believe this will be particularly true during the first 5-year period of the treaty. However, if the treaty is extended and as aging effects progress over longer periods, chemical and physical changes will demand that we replace the weapons and rebuild them, sometimes using new materials. This situation could result in the need for a full-scale test or, alternatively, for accepting some degradation of confidence in stockpile reliability.

#### SUPPLEMENTATION OF NATIONAL MEANS OF VERIFICATION

The Threshold Test Ban Treaty and the Peaceful Nuclear Explosives Treaty were designed to give assurance that nuclear explosions above the 150-kt limit were not taking place.

In both treaties, unique procedures have been established to supplement our national means of verification. In the case of both

the TTBT and the PNET, advance exchanges of detailed data are required. In the case of PNE projects, increasing degrees of observation and measurement using relatively complex seismic and electronic instruments are required to measure the yield in a group explosion having an aggregate total of over 150 kt.

Although these procedures do not in any way establish verification measures that allow us to distinguish between nuclear weapons and peaceful nuclear explosives, they may establish precedents in extending or supplementing national technical means of verification. I believe these procedures are adequate for the TTBT and the PNET now under consideration. I believe also that this could be a significant precedent in the search for adequate measures to verify a comprehensive test ban.

However, we know of no way to preclude military benefits from accruing to a party allowed to conduct nuclear explosions for peaceful applications.

#### SUMMARY

In summary, Mr. Chairman, the TTBT impacts directly on the development capability for higher yield designs, constraining yield and limiting testing and experimentation to a design limit of 150 kt. It would preclude our testing of new weapon designs exceeding the 150-kt threshold.

But, we should be able to meet presently stated Department of Defense weapons requirements.

It also may impact increasingly with time on stockpile modification and aging, but we should be able to maintain confidence levels for the first 5-year term of the treaty.

The TTBT and PNET constraint to 150-kt limit for all nuclear explosions can be verified with relatively high assurance.

Thank you, Mr Chairman. That is the summary of my statement.

[Mr. Starbird's prepared statement follows:]

#### PREPARED STATEMENT OF ALFRED D. STARBIRD, ASSISTANT ADMINISTRATOR FOR NATIONAL SECURITY, U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

Thank you for the opportunity to discuss the treaties on the Limitation of Underground Nuclear Weapon Tests and on Underground Nuclear Explosions for Peaceful Purposes. I will discuss the implications of these treaties; how they impact on the Energy Research and Development Administration's capability to develop nuclear weapons to meet Department of Defense (DoD) requirements; and the precedents they establish in verification procedures.

#### NUCLEAR WEAPON DESIGN AND DEVELOPMENT

Nuclear explosives differ from conventional explosives in many important respects. Each is part of a complex system which must be designed to survive and perform reliably in different environments and under specific combat conditions. Design features must be incorporated with other requirements for safety, command-and-control features to prevent unauthorized use, delivery-vehicle constraints, and survivability. Cost and maintenance are also critical parameters. Compromises must be made in the design in order to produce a nuclear weapon that most nearly meets the required DoD military characteristics without undue cost. This has generally meant that U.S. weapon designs are continually advancing the state of the art to assure that weapon systems demands can be met. This has been particularly true for the highly sophisticated strategic-weapon systems, which also require higher-yield warheads and are directly impacted by the TTBT.

The nuclear-weapon-development process begins with a basic concept that is linked to a specified DoD requirement. The proposed conceptual design undergoes many iterations, each being repeatedly checked against calculations, non-nuclear

experiments, and some nuclear tests. Analysis of the large amount of information collected during the nuclear tests of the basic design tells us whether the nuclear device should perform satisfactorily. If satisfactory performance of the device is not indicated, the experimental data usually tells us what changes need to be made.

Once the feasibility of a design has been established, the DoD may formally request that it be weaponized. It is then that the device must be fully adapted to meet DoD specifications to include safety, yield, and the constraints of the proposed delivery system. Slight changes in design made to accommodate such specifications can significantly affect the performance of the device. Consequently, one or a few more tests may be required at this stage before a device can be certified for the stockpile. It is not possible to fully evaluate the performance of a new design by calculations. Our final means of evaluation must be nuclear testing including, usually, as least one test of a weaponized device at near full yield. A few designs have been stockpiled without such full-yield tests, but this can be done with high confidence only if successful tests of similar designs have been conducted.

#### IMPACT OF THE TTBT ON DESIGN

The TTBT yield limit prevents fully weaponizing nuclear devices with design yield above 150 kt. If the weapon laboratories cannot conduct actual experiments at near full yield through nuclear-weapon testing, there is no reliable way to complete the full test cycle required to put the new designs in the stockpile. Under these conditions new higher-yield weapons would have to be developed based on generally conservative designs adapted by extrapolating from previously tested designs. Adapting already tested warheads to new weapon systems may result in decreased effectiveness, increased system payload, or increased size, which may also involve increased systems costs, particularly in the case of sophisticated multiple-reentry-vehicle systems like MIRV and MARV. Design parameters for adapting warheads to these systems normally require some design changes which, even though small, can impact on warhead performance critically.

In addition to considering constraints on incorporating new designs with yield above 150 kt, it is necessary to review the impact of the TTBT limit on weapons already in the stockpile. It will be necessary to modify some existing weapons with yields over 150 kt. Some modifications required for safety, reliability, or operational needs will be necessary. In addition, although it is difficult to generalize about the problem, aging inevitably affects some weapon components. There is a wide range not only of age but of sophistication of higher-yield weapons in the stockpile. Most strategic weapons are high-yield-to-weight-ratio designs and, therefore, sensitive to change with age and consequently may require proof testing when modified. Many of the modifications, corrective actions, or component replacements required could be accomplished within the 150 kt design-yield limit. We believe this will be true particularly during the first five-year term of the treaty. However, if the treaty is extended and as aging effects progress over longer periods, chemical and physical changes will demand that we replace the weapons and rebuild them, sometimes using new materials. This situation could result in the need for full-scale tests or, alternatively, for accepting some degradation of confidence in stockpile reliability.

#### VERIFICATION IMPLICATIONS

The TTBT and PNET were designed to provide assurance that nuclear explosions above the 150 kt limit were not taking place. In both treaties, unique procedures have been established to supplement our national means of verification. In the case of both the TTBT and the PNET, advanced exchanges of detailed data are required. The weapon test sites will be calibrated by an exchange of data on previous explosions. In the case of PNE projects, increasing degrees of observation and measurement using relatively complex seismic and electronic instruments are required to measure the yield in a group explosion with aggregate yield over 150 kt and to assure that clandestine collateral explosions are not masked by the PNE.

Although these procedures do not in any way establish verification measures that allow us to distinguish between nuclear weapons and peaceful nuclear explosives, they may establish precedents in extending or supplementing national technical means of verification. I believe these procedures are adequate for the TTBT and PNET now under your consideration. I believe also this could be a significant precedent in the search for adequate measures to verify a comprehensive test ban.

We cannot, however, accept direct carry-over of TTBT/PNET verification procedures as adequate to a comprehensive ban on nuclear-weapon testing. We know of no way to preclude military benefits from accruing to the party allowed to conduct nuclear explosions for peaceful applications. Further, in the case of the PNET, on-site monitoring was only required to establish that the yield of individual explosions

did not exceed 150 kt. The rights secured for PNET do not provide assurance that we can detect and identify explosions at lower yield ranges from seismic events.

If a violation should occur, we will need hard evidence to establish that an unauthorized nuclear explosion has taken place. The ERDA laboratory and test-site expertise we are calling upon to implement the TTBT and PNET protocols can also be utilized if we take further steps to establish only necessary rights under the terms of a CTBT.

#### SUMMARY

I have explained the process of nuclear-weapon design and testing and its relationship to weapon-system characteristics. Sophisticated weapon-system requirements have demanded that we push the state of the art in nuclear-explosive technology. The TTBT impacts directly this capability by constraining yield and limiting testing and experimentation to a design limit of 150 kt. It would preclude our testing of now weapon designs exceeding the 150 kt threshold. It also may impact increasingly with time on stockpile modification and aging, but we should be able to maintain confidence levels for the first 5-year term of the treaty. The TTBT and PNET constraint of 150 kt limit for all nuclear explosions can be verified with relatively high assurance. Although there is no direct carryover of the protocol procedures, the precedents established for securing adequate data and for in-country operations may provide a precedent as we search for adequate means to verify a comprehensive test ban. Thank you gentlemen. That completes my statement.

Senator PELL. Thank you, Mr. Starbird.  
Dr. Gates, we will hear from you next.

#### STATEMENT OF MR. MAHLON E. GATES, MANAGER, NEVADA OPERATIONS OFFICE, ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

Mr. GATES. Thank you, Mr. Chairman.

Mr. Chairman and Senator Case, it is a pleasure to appear before you here today. I, too, plan to give a summarized version of my testimony and I request that the full testimony be inserted in the record.

Senator PELL. Without objection, that will be done.

#### MANAGEMENT RESPONSIBILITY ASSIGNED NEVADA OPERATIONS OFFICE

Mr. GATES. In December 1975, ERDA headquarters assigned management responsibility to the Nevada Operations Office for organizing, equipping, training, and deploying peaceful nuclear explosion observation teams to the Soviet Union. This responsibility includes assembling ERDA's task force and coordinating and directing all onsite observation activities.

Individuals have been designated and trained, equipment has been assembled, and plans have been formulated covering both logistics and team operations in the Soviet Union. This training, equipment, and planning have been tested through field exercises.

We believe that we could credibly carry out the observation mission now if notification were received of a Soviet PNE project.

#### FUNCTIONS OBSERVATION TEAMS WILL PERFORM

Depending on the planned aggregate yield of the PNE, observation teams will perform these functions.

For group explosions with a planned aggregate yield in excess of 150 kt, instrumentation will be placed in each emplacement hole to determine the yield of each individual explosive.

For group explosions with a planned aggregate yield in excess of 500 kt, observation teams will also install and operate a local seismic network to assist in confirming that no unannounced explosion has taken place under cover of the other explosions.

Brochures which describe our program and equipment have been provided to the committee for its use and distribution according to its wishes. We have also provided a classified supplement which describes additional equipment features and verification capabilities.

Advance preparation is required to maintain the flexibility necessary to respond to a variety of distinctly different Soviet PNE projects on the short notice specified in the treaty. A cadre has been designated which includes the talents foreseen as necessary to field a variety of observation efforts. Cadre members are regular employees of the three ERDA weapon laboratories, the U.S. Geological Survey, and the Nevada Operations Office and its contractors.

Each cadre member devotes most of his time to his regular job at his parent organization. The observation teams will gather and return to the United States the bulk of that data allowed under the protocols to the treaty. Only that data reduction required to ascertain proper functioning of the equipment will be done by the team while in the Soviet Union.

There are a number of details of deployment which have not yet been resolved. Most of these await the treaty requirement for establishment of a joint consultative commission to promote the objectives and provisions of the treaty; and, of course, this commission will not be formed until after ratification.

In summary, personnel required to man PNE observation teams have been identified, trained, and field tested.

Mr. Chairman, this concludes my summarization.

I am available for your questions.

[Mr. Gates' prepared statement follows:]

PREPARED STATEMENT OF MAHLON E. GATES, MANAGER, NEVADA OPERATIONS  
OFFICE, ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

PEACEFUL NUCLEAR EXPLOSIONS TREATY

Mr. Chairman, Senators, it is a pleasure to appear before you today to discuss the ERDA onsite observation capabilities for insuring Soviet compliance with the provisions of the PNE Treaty.

In December, 1975 ERDA Headquarters assigned management responsibility to the Nevada Operations Office for organizing, equipping, training and deploying Peaceful Nuclear Explosion observation teams to the Soviet Union. This responsibility includes assembling ERDA's Task Force, coordinating and directing all onsite observation activities, and publishing the analyses of collected data.

At this time individuals have been designated and trained, equipment has been assembled, and plans have been formulated covering both logistics and team operations in the Soviet Union. This training, equipment, and planning have been tested through field exercises. Although we expect to improve our capability for verification of PNE Treaty compliance with time through the continuing R&D efforts of Los Alamos Scientific Laboratory, Lawrence Livermore Laboratory, and Sandia Laboratories and through our planning and training programs, we believe that we could credibly carry out the observation mission now if notification were received of a Soviet PNE project.

OBSERVATION TEAM FUNCTIONS

For group peaceful nuclear explosions having a planned aggregate yield above 150 kilotons and for individual or group explosions having an aggregate yield between

100 and 150 kilotons if deemed appropriate by the two parties, there are two general functions which observations teams will perform: 1. Confirmation of geological and geophysical information that will have been provided in advance; and 2. Confirmation that the local circumstances are consistent with the information provided and the stated peaceful purpose.

Depending on the planned aggregate yield of the PNE, observation teams may also perform additional functions. 1. For group explosions with a planned aggregate yield in excess of 150 kilotons, instrumentation will be placed in each emplacement hole to determine the yield of each individual explosive. 2. For group explosions with a planned aggregate yield in excess of 500 kilotons, observation teams will also install and operate a local seismic network to assist in confirming that no unannounced explosion has taken place under cover of the other explosions.

To carry out these functions, different types of observation teams will be required to be present at various times during the course of the project.

Brochures which describe our program and equipment have been provided to the committee for its use and distribution according to your wishes. We have also provided a classified supplement which describes additional equipment features and verification capabilities.

#### PERSONNEL

Advance preparation is required to maintain the flexibility necessary to respond to a variety of distinctly different Soviet PNE projects, on the short notice specified in the treaty. A cadre has been designated which includes the talents foreseen as necessary to field a variety of observation efforts. Team selection from this cadre will be tailored to the particular PNE project after notification. Cadre members are regular employees of the three ERDA weapon laboratories, the United States Geological Survey, and the Nevada Operations Office and its contractors. Members include scientists and engineers who have experience in our own PNE experiments, weapon testing, yield measurement, and seismic phenomena; technicians with experience in the operation of yield measuring and seismic instrumentation; geologists; interpreters; and physicians. Team Chiefs will be members of the Nevada Operations Office management staff, experienced in the conduct of US nuclear explosive tests. They will be responsible for all activities of the team in the Soviet Union.

Each cadre member devotes most of his time to his regular job at his parent organization. Since individuals were chosen on the basis of current related professional activities, this approach should provide a highly qualified cadre over a period of years during which there may be little activity for the observation teams. Continuation of team training, refresher courses, and exercises will occupy only a small fraction of their time; however, those individuals named as team members for a particular PNE project will devote considerable time to the project from notification to deployment, and for three to six months following deployment.

#### DATA HANDLING

This philosophy has been adopted for data handling. The observation teams will gather and return to the US the bulk of that data allowed under the protocols to the treaty. Only that data reduction required to ascertain proper functioning of the equipment will be done by the team while in the Soviet Union.

Detailed analysis of all data collected will begin promptly upon the return of the team to the US. This data will be analyzed by the ERDA weapons laboratories and interchanged with other responsible interested government organizations for their independent analysis.

Both the data and the analyses will then be published and distributed to those organizations having responsibility for judging treaty compliance.

#### PROBLEM AREAS

There are a number of details of deployment which have not yet been resolved. Most of these await the treaty requirement for establishment of a Joint Consultative Commission to promote the objectives and provisions of the treaty and, of course, this commission will not be formed until after ratification. Article X of the protocol states that the Joint Consultative Commission shall establish procedures through which the parties will, as appropriate, consult with each other for the purpose of ensuring implementation of this protocol. Specific areas in the protocol require Joint Consultative Commission action but are not considered to be of sufficient magnitude at this time to obstruct our planning for future deployments.

Other protocol areas are ambiguous and will require resolution prior to deployment. This includes back-up team member status, interactions with a host agency,

medical supplies and treatment, logistics support items, ports of entry and exit, to name a few. These should all be solvable once the treaty is ratified.

#### SUMMARY

In summary, personnel required to man PNE observation teams have been identified, trained and field tested. Yield determination and local seismic network equipment has been assembled, primarily by adapting equipment used for similar purposes at the NTS for many years. There is an active R&D program to develop better equipment, both to enhance our capabilities and to reduce costs. We are now capable of deploying a team and its associated equipment necessary to fulfill our obligations as set forth in the protocol to the PNE treaty.

Mr. Chairman, this concludes my prepared testimony.

Senator PELL. Thank you very much, indeed, Dr. Gates.

I think it would probably be best if we heard from Doctors Agnew and Batzel and then asked questions of the whole panel.

Dr. Agnew, would you start off, please?

#### STATEMENT OF HAROLD M. AGNEW, DIRECTOR, LOS ALAMOS SCIENTIFIC LABORATORY, LOS ALAMOS, N. MEX.

Mr. AGNEW. Thank you, Mr. Chairman.

I appreciate the opportunity to bring personally to your attention a few points relative to the issues at hand which I believe warrant your consideration.

Testing under the constraints of the Treaty Banning Nuclear Weapon Tests in the atmosphere, in outer space, and under water, is not done in a capricious manner. These tests are carried out to understand better the basic technology and science of nuclear explosions, to be prepared to fulfill anticipated Department of Defense requirements, to provide warheads for bombs and missiles for which firm commitments have been made, to add to the inventory of our Armed Forces, and on occasion to remedy problems which arise in our stockpile of deployed weapons.

#### TREATY'S IMPACT ON U.S. DEFENSE POSTURE

The treaty under consideration will have its greatest impact on the latter test objectives. If it is the considered opinion of the Senate that the United States has no further needs now or in the future for new untested types of warheads having yields substantially greater than the 150-kt limit of this agreement, then the treaty will have no appreciable impact on our defense posture in the immediate future.

However, if you believe that there will be requirements for new untested designs of yields considerably larger than 150 kt, then, if this treaty is ratified, our defense systems eventually will have to bear a penalty in payload weight, physical size, and perhaps even in the additional use of fissile materials. These penalties will accrue because under the treaty the high-yield warheads of the future will of necessity be the same ones which have been developed in the past.

These penalties are ultimately reflected in large dollar costs for fixed military effectiveness or reduced military effectiveness at fixed cost. It simply will not be prudent to put into the stockpile designs which represent a large extrapolation from tested designs. Nor would it be prudent to assume that our near-term defense efforts can be lessened in virtue of constraints the treaty places on

the Soviets. Rather, we must assume the Soviets have completed any high-yield testing they regard as useful to them.

#### NECESSITY OF OTHER ARMS CONTROL PROGRESS

To me, whether we will require high-yield warheads to maintain our defense posture will depend very heavily upon several related events which may or may not transpire. One is a meaningful SALT (Strategic Arms Limitation Talks) agreement. Another is an MBFR (Mutual and Balanced Force Reductions) agreement; still another is a clearer understanding of the extent and implications of the apparent increasing Soviet civil defense program. This proposed treaty was drafted when the outlook for SALT, a meaningful SALT, was very bright. Today the situation appears cloudy.

Consequently today, I personally would not support any treaty further limiting nuclear testing until meaningful agreements on SALT and mutual balanced reduction of forces have been ratified. To me, a meaningful agreement at a minimum would be the Vladivostok numbers; but hopefully, as proposed in the past by a number of Senators, the numbers in both categories—launchers and MIRV'ed launchers—would be reduced by an additional 30 to 50 percent.

I stress this relation to other arms control progress because we need some clear sign of Soviet restraint in their weapons build-ups and because our own nuclear posture must be appraised as a consistent whole.

Since the second war, we have wisely considered the security of our major allies as inseparably linked to our own, and our nuclear deterrence as the answer to unmatched Soviet conventional forces in Europe.

Constraints on nuclear capabilities upon which our vital interests are staked should be paced against reductions in the capabilities that pose threats to us. The advent of what could prove to be a massive civil defense effort on the part of the Soviets could necessitate a radical departure from our present deterrent strategy, necessitating appreciable increases in our deliverable megatonnage, and even further improvement in the accuracy of our delivery systems.

For those of you who may wish to remind me of the destruction caused by a nominal 15-kt bomb, may I remind you that I flew on the Hiroshima mission, and have participated in the major thermonuclear tests which this country has conducted.

As an aside, I firmly believe that if every 5 years the world's major political leaders were required to witness the in-air detonation of a multimegaton warhead, progress on meaningful arms control measures would be speeded up appreciably. To the majority of you, and your colleagues throughout the world, a megaton is simply a word. It conveys no personal experience which they can relate to the actual phenomenon, which I believe they would find to be a very sobering experience.

#### NATIONAL TECHNICAL MEANS OF VERIFICATION

A point in favor of this treaty is that our national technical means of verification do supply at least some degree of deterrence against evasion. In contrast to other nuclear test proposals under

consideration, tests considerably in excess of 150 kt will be noted and held suspect.

Recent past experience leads me to believe that the Soviets will take full advantage of the treaty and test to the maximum yield which they believe they can conduct without abrogating the agreement.

We will not follow this path. There should be no question in your minds that if this treaty is enacted there is serious danger of an asymmetry between the United States and the Soviet Union in favor of the latter. Even today, while we are operating under the spirit of the agreement, there have been repeated very strong endeavors on the part of some to impose restrictions on the United States which would even preclude our testing devices with a design yield very close to 150 kt.

If this treaty is ratified, it should be clearly stated by the Congress that we intend to abide by the treaty and the understanding developed with it which allows testing at a design yield of 150 kt. I personally believe we must be prepared to assume that on occasion the Soviets will conduct tests somewhat in excess of 150 kt, but do not believe this will affect our relative military postures because of our ability to detect yields which will exceed the treaty by a substantial amount.

You should keep in mind that over the past 10 years the Soviets have conducted many more megaton tests than we have. We have not conducted very many high-yield tests in support of our strategic deterrent forces. Thus the Soviets may believe they enjoy a military advantage in this area which we will not be able to address if future events should so require.

#### EQUAL TREATMENT OF PNE's

Another point in favor of the treaty is that peaceful nuclear explosions are treated no differently from any other nuclear explosions and adequate means are provided, including onsite participation, to guarantee that individual yields appreciably in excess of the threshold of 150 kt are not hidden in a salvo of PNE's.

The potential value of co-participation in the peaceful utilization of nuclear explosives has decided value in my opinion. So does the precedent of onsite inspection, whose application, I would hope, may be broadened in the future.

However, in the long run, the concept that the West should provide PNE's for the East, and vice versa, is to me a much more attractive and effective mechanism to minimize the potential military gains which may accrue to a nation through an active PNE program.

#### SUMMARY

In summary, today, if I were advising the President, I would suggest that he defer enactment of this treaty until meaningful SALT and MBFR agreements have been agreed to by the Soviet Union and the United States. I would support enactment after these first conditions are met if the responsible military members of the Defense Department have stated that taking into account the Soviet civil defense program and other military activities, the

United States will have no further requirements for new types of warheads having yield appreciably in excess of the 150-kt limit.

I would also urge that the Congress make it clear that it is the policy of the United States that continued nuclear testing, whenever required, will be carried out within the limitations of the treaty and that no "restrictive bias" will be inflicted on our endeavors which would require that our test yield maximum be less than a nuclear laboratory design yield of 150 kt.

EXCHANGE OF CORRESPONDENCE WITH REPRESENTATIVE JACK KEMP

I have here attached for your consideration an exchange of correspondence between Representative Jack Kemp and me, covering my philosophy and rationale for nuclear testing, which may be of interest to you and is, in my opinion, relevant to this discussion.

Thank you very much.

Senator PELL. Thank you.

The correspondence to which you have referred will be included in the record, without objection.

[The information referred to follows:]

CONGRESS OF THE UNITED STATES,  
HOUSE OF REPRESENTATIVES,  
Washington, D.C., March 29, 1977.

Dr. HAROLD AGNEW,  
*Director, Los Alamos Scientific Laboratory, University of California,  
Los Alamos, N. Mex.*

Dr. ROGER BATZEL,  
*Director, Lawrence Livermore Laboratory, University of California,  
Livermore, Calif.*

DEAR DES. AGNEW AND BATZEL: There has been considerable recent discussion in the Congress about the subject of negotiating a comprehensive ban on nuclear weapons testing and/or on nuclear explosions for any purpose. There are a number of important technical issues which require explanation and resolution prior to congressional evaluation of such test-ban proposals. As the nation's senior scientific officials with responsibility for our nuclear weapon development program, your views on these issues must be solicited.

(1) Is a comprehensive ban on underground nuclear explosions now verifiable by national technical means?

(2) If nuclear explosions cannot be detected and identified below some level of nuclear yield, what will be the military significance if the Soviet Union continues to conduct nuclear explosions that cannot be detected and identified?

(3) If the United States does not conduct any nuclear explosions of any yield, under the terms of a comprehensive test ban, what will the implications be for: (a) Our national technology base? Could we preserve necessary scientific and engineering personnel with experience adequate to continue research in this field without testing? (b) Our weapons stockpile? Can we preserve the ability of the United States to maintain confidence that existing weapons will operate properly if circumstances require their employment? Could we solve potential future stockpile problems without testing? Without testing, what alternatives would we have should stockpile problems develop? Could an aging stockpile confidently be rebuilt or replaced without testing? Would non-nuclear testing alone suffice in all cases? (c) The stability of the deterrent balance? What is the result if the Soviets continue nuclear explosions below our capability to detect and identify them while the United States totally abstains from testing?

(4) If the Soviet Union were to conduct peaceful nuclear explosions (PNEs) while the United States abstained from any nuclear explosions, would it be possible for the Soviets to maintain a viable nuclear explosives technology base? Would this be sufficient to maintain and perhaps to improve the military effectiveness of their nuclear forces, at the theater or strategic level or both?

(5) To what extent has low-yield testing in the past been a factor in the development or maintenance of stockpile of weapons in the United States? Could testing at levels below the verification threshold be significant or critical in the future?

(6) Although this question is less narrowly technical than those posed above, I would be grateful for any observations you may care to offer as to the extent you believe that further limitations on testing should be linked to meaningful results in arms-limitation negotiations, specifically, the Strategic Arms Limitation Talks and the discussions on Mutual and Balanced Force Reductions, as well as other efforts to redress the Soviet-American military balance in the non-nuclear arena?

Sincerely,

JACK F. KEMP,  
Member of Congress.

UNIVERSITY OF CALIFORNIA,  
LOS ALAMOS SCIENTIFIC LABORATORY,  
Los Alamos, New Mex., April 19, 1977.

HON. JACK F. KEMP,  
House of Representatives,  
Washington, D.C.

DEAR CONGRESSMAN KEMP: In response to your letter of March 29, 1977, and the specific questions which you raised, I have the following comments.

(1) I do not believe that a comprehensive ban on underground nuclear explosions is now verifiable by national technical means. However, I believe a threshold ban at a yield about five to ten kilotons in hard rock is verifiable unless deliberate evasion techniques are used. With low yields the probability of detection by national technical means becomes more and more unlikely. Higher yields, of course, could be tested in media having lower seismic coupling efficiency than hard rock.

(2) The military significance to either the USSR or the USA of conducting clandestine tests below five or ten kilotons is per se of relatively little importance today. More important are the long term implications of such activity which might be conducted by the USSR but not by the USA; such activity would enable the USSR to maintain a viable nuclear weapons design capability. I do not believe the USA can maintain a nuclear weapons design capability for more than a few years if nuclear device testing is not allowed.

(3) a. As mentioned in (2), I do not believe we can maintain a technology base or the necessary cadre of first-class scientists and engineers to enable the USA to have a nuclear weapons design capability for more than a few years if testing ceases.

b. I expect that with ample money, no restrictions on materials, and adequate non-nuclear testing the stockpile could be maintained as is for a period of at least ten years. However, stockpile problems do arise, as they have in the past, and in time there may be no experienced personnel available to assess the severity of the problems or with a background adequate to provide a fix if one is indeed possible. In addition, there are examples in the past where the fix has required nuclear testing.

c. Clearly, if the Soviets are in a position to test or equally important are able to maintain a cadre of trained personnel because of their planned society, they can assess potential problems and deal with them in a professional manner. This will assure to them a level of confidence in their nuclear forces that will eventually be denied to the U.S. if we were to lose our design capability.

(4) Again, the ability to test will enable us to maintain a weapons design capability. I don't believe testing below say five or ten kilotons can do much to improve (as compared to maintaining) strategic posture, but clearly it can provide improvements at the theatre level, where yields of less than five kilotons are important. Being able to test up to a few kilotons allows a dynamic program for maintenance and development of theatre nuclear forces. Also, if there is no restriction on PNE development or testing, then both a viable strategic and theatre nuclear weapons research and development program can be maintained.

(5) Tests at five kilotons and below have played a very important role in our past program, particularly in the realm of nuclear weapon safety and stockpile fixes. To me, the most significant aspect of continuing to test is the ability to maintain the nuclear weapon design and development capability on which much of our defense posture is now based.

(6) Unless really meaningful reductions are agreed to by the USSR both in nuclear delivery systems and in conventional forces, I would oppose any further restrictions on nuclear testing. So far, we have been able to counter the Soviet quantitative advantage in both nuclear and conventional weapon systems through our qualitative advantages. However, as Custer found out, there comes a time when there is no substitute for quantitative advantage.

I believe it is to our mutual advantage for both the USSR and the USA to agree to meaningful reductions in our nuclear and conventional forces. However, if such agreements are not forthcoming then I believe any restrictions on nuclear testing—even the proposed 150 KT TTB—will be to our disadvantage.

I trust that your colleagues in the Congress will appreciate that what is at issue is whether or not they wish the USA to maintain a viable nuclear weapons design capability and a nuclear weapon stockpile that is reliable. Clearly, if through SALT and a significant reduction in conventional forces we have no need for a nuclear stockpile or a nuclear design capability, then there will be no need for testing. But to me a limitation on testing without a real SALT and MBFR agreement would eventually be disastrous for the free world.

In a nutshell, if the USA wishes to have a nuclear weapon design capability and a reliable stockpile, then it must be able to conduct nuclear tests. If this capability is not desired, then forbid nuclear weapon testing with the understanding that a similar loss of capability may not be imposed on the Soviet Union.

Sincerely,

H. M. AGNEW,  
*Director.*

[Staff note: Dr. Batzel provided for inclusion in the record his own response, which follows, to Congressman Kemp's letter of March 29, 1977.]

LAWRENCE LIVERMORE LABORATORY,  
*April 11, 1977.*

HON. JACK F. KEMP,  
*House of Representatives,  
Washington, D.C.*

DEAR CONGRESSMAN KEMP: Thank you for your letter of March 29. The issues you raise concerning the comprehensive nuclear test ban are indeed of major importance. I will attempt to address them briefly in this letter. A great deal more can be said about each one of them, however, and I would be happy to provide more information on any of them.

(1) A comprehensive ban on underground nuclear explosions is now verifiable by national technical means for explosions with a yield of a few kilotons or more, if these explosions are carried out according to normal Soviet practices; that is, without any attempt at evasion and in hard rock geological formation. If the tests are carried out in a more absorbing geological formation, nuclear explosions cannot be detected and identified below ten to twenty kilotons. Appropriate geological formations are considered to be available to the Soviets for these yields.

The foregoing estimates are based on the best worldwide teleseismic methods. If the Soviets allow the use of seismic stations of our own design and at our own choice of emplacement in their country, the detection and identification level probably could be about one or two kilotons no matter what the geological formation in which the shot was carried out.

Non seismic means of verification, whether national or on-site, increase the costs and risks of cheating, but cannot give a high confidence of detection and identification.

Various evasion schemes, such as shooting in a natural earthquake or in a large preexcavated hole, can make an occasional fairly large explosion (up to tens of kilotons) very hard to detect and identify. Such evasion schemes have been evaluated in some detail. A somewhat more extensive discussion of them and of verification in general is enclosed.

(2) A program consisting of nuclear explosions with yields in the kiloton range, augmented with an occasional explosion with a yield of tens of kilotons, would allow the Soviet Union to fix many potential problems associated with stockpile aging, safety of handling, and vulnerability, as well as to make some limited adjustments in dimension and in the amount of special nuclear material used in each weapon. It would permit them also to maintain a variety of essential skills among the scientists and engineers working on nuclear weapons. Such a program would also permit the development of low yield weapons for battlefield use, naval defense use and close-in ABM. It would not permit them to design new strategic weapons or new tactical weapons above a few tens of kilotons. Nor would they carry out overall vulnerability tests of large structures such as missile silos.

(3) If the U.S. does not conduct any nuclear explosions of any yield, under the terms of a CTB:

(a) Our national technology base in the nuclear explosion area will decay within a few years, both because the most skilled people, especially the younger ones, will leave, and because the ones who are left will not be able to keep learning by experiment what they can and cannot do in nuclear explosives. It has been the universal experience also, so far as I know, that practitioners in any technical field who are not regularly faced with experimental results are unable to maintain any level of competence. In fact, they eventually become unable to recognize that they are becoming incompetent.

(b) It would be very difficult to maintain confidence that existing weapons would operate properly if circumstances required their employment. In theory, of course, as deterioration is observed in a deployed weapon (and in the course of a decade or two, deterioration of key components inevitably occurs) the weapon could be rebuilt exactly as it was built in the first place. In practice, changes are always made. These changes are dictated by such apparently trivial causes as unavailability of the old materials, more stringent requirements for safety, major economies to be effected in the systems by apparently minor modifications, and generally speaking, the pressure associated with maintaining a large scale nuclear weapon deployment under stringent budget restrictions and in an environment where the technologies that affect the performance of the system as a whole are constantly changing.

At present, minor changes are made in nuclear weapon systems sometimes with the help of nuclear test, sometimes without. When they are made without nuclear test, they are evaluated by groups of scientists and engineers who are constantly immersed in an on-going nuclear test program affecting items closely related to the one being changed. The judgment that a test is not required in order to effect the change can, therefore, be made with considerable confidence. Without tests, in my view, there would be no basis for such confidence.

In several cases in the past a nuclear test was needed solely to fix a stockpile problem. Many more cases would have occurred were it not for the fact that we have normally replaced existing nuclear weapon systems with new ones well before the nuclear warhead reached the age when it would begin to undergo significant deterioration.

Non-nuclear testing is, of course, very helpful. However, it is limited in its scope. Many of the changes which are made in nuclear warheads cannot be evaluated on the basis of non-nuclear testing.

The above is a brief summary of a very complex subject. I would be pleased to go into the necessarily classified details of our history in this regard and into the detailed basis of my concern at any time you think appropriate.

(c) With regard to the stability of the deterrent balance, in the event the Soviets continue nuclear explosions below our capability to detect and identify them while the U.S. totally abstains from tests I find it very difficult to state a clear-cut conclusion. So many factors affect the stability of the deterrent balance, including historical accidents which no one can possibly foresee, that an assessment of its stability under these circumstances would necessarily be guesswork. All I can say is that we will be taking a chance of unknowable magnitude with regard to our nuclear capability. Such a chance might or might not turn out to be important, depending on what else happens.

(4) If the Soviets were to conduct peaceful nuclear explosions while the U.S. abstains from any nuclear explosions (PNEs), it would certainly be possible for them to maintain a viable nuclear explosives technology base. The design and improvement of explosives for PNEs taxes all of the capabilities necessary for designing and building nuclear weapons. Further, in many applications, it would be impossible to determine whether a special purpose explosive, useful only for PNEs, or a military weapon of appropriate yield had been used. Such is the case in particular for the so-called contained PNEs, in which all of the radioactivity remains underground, so that detailed diagnosis of the device design is impossible. The Soviet Union has several applications programs which utilize fully contained explosions: putting out gas well fires, creating storage cavities, etc.

As a result, a PNE program would be an excellent and detection-proof cover for carrying out a valuable military program aimed at maintaining nuclear forces and improving such things as nuclear material use, military effectiveness, etc. The program would be limited in that weapons with yields large compared to the yields appropriate to the peaceful applications could not be developed. The development of radically new weapons requiring extensive testing might also be limited, depending upon the limitations placed on testing new devices for PNE use.

(5) Low yield testing, that is from one kiloton to a few tens of kilotons, has in the past been a major factor in the development and maintenance of nuclear weapons in the U.S. We can provide you on a classified basis a graph showing how many weapons have been fired and at what yields. Testing at levels below the verification

threshold would certainly be significant and might be critical to our future capability.

(6) With regard to your last question, the existing limitations on testing associated with the Threshold Test Ban Treaty already foreclose some options, especially for new ballistic and cruise missile systems, which the country may have wished to pursue in its response to the Soviet build-up. Further limitations, and in particular, a drastic lowering of the yield threshold would seriously limit our ability to deploy new nuclear weapon systems. It seems to me that we should not accept further limitations until it is clear what meaningful arms control measures can be obtained in negotiations with the Soviet Union, and what the scope and capability of their on-going deployment will be.

Sincerely,

ROGER E. BATZEL,  
*Director.*

Enclosure:

STATEMENT OF ROGER E. BATZEL, DIRECTOR, E. O. LAWRENCE LIVERMORE  
LABORATORY

I appreciate the opportunity to discuss with you the proposed Threshold Test Ban Treaty which limits nuclear weapons tests to yields less than 150 kt, and the associate treaty regulating Peaceful Nuclear Explosions.

I recognize that treaties such as these have many sides to them, involving political as well as technical matters. Your judgment of these treaties must weigh all of these aspects. However, the purpose of my testimony, as Director of the Lawrence Livermore Laboratory, is to comment only on the technical issues which these treaties present. I hope my remarks will assist you in your task.

The Lawrence Livermore Laboratory is one of the two laboratories whose duties include the design and development of nuclear weapons. The responsibilities of the laboratories include: maintaining the reliability of the weapons in stockpile; meeting specific requirements for new warheads for military systems, and understanding the underlying technology of nuclear weapons and developing new design concepts.

The threshold limit of 150 kt prevents developing new high yield concepts. Without the opportunity to test new ideas by actual experiments—conducting nuclear explosive tests—there is no reliable way to put basically new designs in the stockpile. Generally speaking, the path from a new concept to a workable explosive design involves a number of nuclear explosive tests. A threshold test ban—above 150 kt in this instance—severely inhibits that development process for warheads of higher yield. In some cases we will be able to meet warhead requirements by extrapolating previously tested designs. In other cases we will not be able to meet those requirements. In all cases, it will make the job harder and the product less satisfactory.

The armed services have studied some possible future systems that would require warheads with yields above 150 kilotons. Especially if the Soviet arms buildup continues, one or more of these systems could be required.

Some warheads can be provided from designs tested in anticipation of the Threshold Test Ban Treaty. The Lawrence Livermore Laboratory undertook the development of several high yield weapons in an intensive development program in which we compressed a normal development time of four years into two years. These weapons can have important effects on our national defense and could not have been developed under the TTBT.

In some cases we may be able to adapt a previously tested design to a new requirement. The compromises to accommodate previously tested warhead designs can be costly. Adapting weapons systems to use previously tested nuclear weapon designs may well involve decreased effectiveness or increased system payload, with significantly increased system cost. There would also be some risk in accommodating an existing warhead design to a new weapon. Accommodation would normally require some design changes. Some of the changes could not be tested. Of course, we would make any such changes only with great caution. However, our experience has been that "small" design changes can sometimes have unexpected major consequences.

We would expect also to be able to provide some new warheads at yields somewhat greater than the threshold for some special classes of designs based on extensive partial yield tests. Again, there will usually be some penalties in yield, weight, safety, use of scarce special nuclear materials (SNM), cost or confidence in performance.

We believe we will be able to reliably maintain the existing higher yield weapons in stockpile under the initial five-year term of the Treaty. If there are successive renewals of the Treaty, the time will arrive when some high yield units in the stockpile will have to be retired because of chemical and physical deterioration. Military requirements at that time could call for rebuild of these units with new materials. However, the exact processes and materials used in the original build may be unavailable. The key personnel involved in the original design and build will probably have left the program. In most cases low yield (less than 150 kt) testing can be expected to provide confidence in higher yield performance; however, there may be other cases where a high yield test would be needed to warrant the same confidence in performance that existed for the original build.

These problems arising from the cessation of nuclear weapon tests above 150 kt could, over a period of time, diminish our confidence in the reliability of our high yield weapons in stockpile. I believe this is an unavoidable consequence of this treaty.

We do not know the potential effect of the Treaty on the Soviet Union. What we know of their weapon systems indicates that they have higher yield strategic warheads than we do. The U.S. estimates that Soviet strategic warheads are greater in yield than 150 kt and many above 1 MT. They have conducted many more very high yield tests and appear to have completed and tested the designs for their new systems. (In addition they should have a broader technology base for high yield designs.)

What plans they might have for meeting their future needs we do not know. The terms of the Treaty are such that they could simply elect to terminate it after five years, giving six months' notice but with no explanation required. They could in fact, at any time, withdraw on 6 months' notice with an explanation. There is no limitation in the Treaty on the planning and preparation that they could carry out between now and then for a resumption of high-yield testing.

The verification provisions of the threshold treaty are intended to give assurance that high yield weapon tests at yields substantially above 150 kt are not being carried out. However, the basic means of verification, teleseismic determination of yield, is inherently uncertain. It would be desirable to have a more precise method of determining the yields of weapons tests than is provided for, although as a practical matter I do not know of any such method. With the present capabilities, a few explosions with yields substantially above 150 kt might be carried out by the Soviets without the U.S. being able to unambiguously determine that the treaty had been violated. Systematic violation could probably be ascertained.

Additionally, a weapons test with a design yield near 150 kt runs a chance of actually exceeding 150 kt by a small amount, a circumstance which could only be determined after the fact and by precise radiochemical measurements. The precision of teleseismic yield determination is not sufficient to determine such accidental excursions. The probability of such occurrences has been recognized in an agreed understanding with the Soviet Union, which allows for the possibility of one or two such slight unintended breaches per year.

The existence of these verification uncertainties should not force the U.S. to test at design yields lower than the 150 kt specified in the treaty. Such an action would result in an asymmetric situation relative to the Soviet Union.

The PNE Treaty is an adjunct to the threshold treaty. PNE's accommodated under any limitation on nuclear weapon testing require special provisions to assure that no weapon benefits additional to those available under the weapons testing limitations are obtained. We note that the USSR has a vigorous, extensive ongoing PNE program. The U.S. has no such program. The length and complexity of the PNE Treaty demonstrates that this task of accommodation is not a trival matter. I believe that the provisions that have been worked out are reasonable for the purpose. Our Laboratory will play a role in the verification procedures and we believe we have useful contributions to make and will give this responsibility our best effort.

I should emphasize that these verification provisions would clearly not be adequate for a lower threshold, or for a CTB. With respect to a CTB, I do not now know of any verification provisions which would be adequate to accommodate PNE's.

In summary, the TTBT, PNET, and associated protocols would limit the Laboratories' ability to develop warheads at yields above 150 kt. In time, there will also be decreasing confidence in the performance of high yield weapons in the stockpile.

Prudence requires that we monitor any agreements thoroughly and stay prepared to resume testing above 150 kt if required. Our best safeguard is a vigorous and effective research, development and test program below 150 kt.

Senator PELL. Our next witness will be Dr. Roger Batzel. Please proceed, sir.

STATEMENT OF ROGER E. BATZEL, DIRECTOR, LAWRENCE  
LIVERMORE LABORATORY, LIVERMORE, CALIF.

Mr. BATZEL. Thank you, Mr. Chairman.

I have decided to limit my comments to the technical issues that relate to the laboratory capabilities with respect to nuclear weapons design technology.

As you know, the responsibilities of Livermore and Los Alamos include tests for stockpile reliability, development of new warheads, and the issue of understanding what is potential and what is possible in nuclear weapons technology.

CONSEQUENCES OF 150-KT LIMIT TO NEW DESIGN CONCEPTS

One of the things which will be precluded by the Threshold Test Ban Treaty will be the development of new design concepts much above the 150-kt limit. What that means is that our ability to evaluate what is possible in that yield regime will not exist.

If new high-yield concepts are to be developed, there will be a requirement for tests. There is no way around this. This treaty precludes invention in that yield area, and what that means technically to the people in the laboratory is that they just won't think about the kinds of concepts which one might implement and develop in the future in that yield range. The consequence of that I cannot evaluate.

I think there is an excellent chance that new systems with yields above 150 kt will be required by the Department of Defense for new military commitments. We will be able to provide some options to them on the basis of past designs.

In general, there will be consequences of such reliance on older designs. There will be decreased effectiveness, increased system cost, and increased risk with respect to the adaptation of these warheads for new systems.

I agree with General Starbird that there is not much question that for the next 5-year period we can maintain the higher-yield weapons which are now in the stockpile. With time, after the 5-year period—and I don't know what that time really turns out to be, but history will tell us—there will be some decrease in confidence in reliability of these high-yield warheads. How much, and how severe, I cannot tell you at this stage of the game.

The consequences for the Soviet Union we cannot evaluate. Again, they have tested significantly more in the high-yield regime; they have had significantly more experiments above the 500-kt yield regime, for example.

My view, based on the technical evidence is that the Soviets have done the relevant tests to provide the new warheads for their new systems which are being deployed.

VERIFICATION PROVISIONS

As far as the verification provisions are concerned, I believe that even with the uncertainties in teleseismic measurement of yield, yields much above 150 kt, if conducted very often, would be detect-

able, and that in general the verification provisions will protect the interests of the United States in that regard.

Again, I would second Dr. Agnew's comment that it is important that there not be an asymmetric situation established. The Soviets, I am sure, will take full advantage of the agreement to test design yields up to 150 kt. I think the United States has to have that same flexibility. There will be forces which would propose to erode that because of someone's worry about possibly going slightly above that particular yield. This possibility is recognized in the treaty, and I think it should be specifically recognized that the 150 kt is something with which we are allowed to work.

As far as PNE's, the peaceful nuclear explosives, are concerned, it seems to me that the verification procedures are sufficient to preclude weapons developments and gaining weapons related information from that particular mode of detonation of nuclear explosive.

That is not to say that if we did not have the flexibility of testing, or they did not have the flexibility of testing up to the 150-kt limit anyhow, that that would still be true. If there were, for example, a lower threshold yield or a comprehensive test ban treaty, there is no way we know to prevent a nation from deriving weapons-related information from peaceful nuclear explosives.

#### SUMMARY

In summary, the treaty will limit the laboratories' abilities to develop new high-yield explosives. It will limit our capability to explore new possibilities, new inventions in that area, and I think for the first approximation it will prevent any significant high-yield developments in our nuclear program.

As far as safeguards are concerned, I think the most effective safeguard we can have at this time would be the continued vigorous test program, nuclear weapons development program, within the constraints of the 150-kt limit.

Thank you, Mr. Chairman.

Senator PELL. Thank you very much indeed, gentlemen.

#### IMPACT OF CTBT ON LABORATORIES' WORKLOAD

I was struck by the difference in views between the ERDA witnesses and the laboratory witnesses. I will address this question to Dr. Agnew and Dr. Batzel. What would be the impact if we eventually moved towards a Comprehensive Test Ban Treaty? I think we all recognize that this is a first, or a second, step in that direction, and that it is a general hope to ultimately have a comprehensive treaty. If that comes along, what will it do to the workload of your laboratories if no testing is permitted whatsoever?

Dr. Agnew?

Mr. AGNEW. Mr. Chairman, I think the relevant question that the Senate and the Congress should consider in that matter is, is it the intent that we have a nuclear weapons design development capability in this country or not. Also, are we interested in maintaining the reliability of the stockpile? Those two are really the issues which I think are paramount. Concerning the workload in the laboratory, we are less than 50 percent in weapons right now.

There are many tasks that we can do and we are very proud of our technical competence at all of our three weapons laboratories. There are many national programs in which we could be involved.

I believe that if we enter into a CTB, there is no question but that the United States would honor completely the letter of the treaty. But there are questions that we have in our mind—and I am sure that Dr. Batzel shares these—with regard to the future stockpile reliability. Weapons last some 20 years, perhaps, so there is no question that you are going to have to eventually either forget nuclear weapons or rebuild them. There are many questions involved, and if you cannot test at all at any level, the stockpile may be very much questioned.

I should say that it is my firm opinion that at yields in the vicinity of 5 kt and below, one can evade and test with essentially a complete certainty of not being detected. That could present a very serious asymmetry between our way of life in our open society and our adherence to the rules, as compared with the Soviet Union.

Senator PELL. To answer my question directly, please, what percentage of your present workload would no longer be carried out if there were no testing?

Mr. AGNEW. Assuming that we still maintain a weapons capability, I would say that of the 50 percent of the laboratory which is weapons, about 20 percent or perhaps one-third of that is directly connected with specific weapon tests. The rest of it is in basic physics, basic understandings, local hydrodynamic testing. That type of work could continue and would be relevant to maintaining the type of people you may wish to have for a number of years in order to resume testing if it should be required.

Senator PELL. But if you did not do that 30 percent which was testing, after a period of years there would not be much point in maintaining the other 70 percent, would that be correct?

Mr. AGNEW. One still has the question of maintaining the reliability of the stockpile. There will be problems which will arise. You will need a corporate memory so that people, in their eagerness to improve the situation, do not do things which could have devastating results. These devices are very, very sensitive.

Senator PELL. Would the situation be the same at the Livermore Laboratory, Dr. Batzel?

Mr. BATZEL. I think it would be pretty much the same. I would like to elaborate on that just a little bit.

My view is that a major responsibility of the laboratories would be to maintain as long as possible the nuclear weapons capability within the laboratory so that we could assure the continued reliability of the stockpile as long as possible. To provide that continued capability, I believe that some 60 percent, 70 percent, or 80 percent—I don't know exactly what it is—of our existing effort—and that means no testing—would be required and should be supported if one is serious about trying to maintain the viability of the stockpile.

#### STOCKPILE LIFE OF NUCLEAR WEAPONS

Senator PELL. Dr. Agnew, you mentioned that nuclear weapons, have a life of only 20 years. That is not the nuclear components, but rather the other components. Isn't that correct?

Mr. AGNEW. The total systems essentially have a planned stockpile life of about 20 years. There have been instances where certain of the nuclear components, as I will call them, have been shown to start to degrade in shorter times.

Now in the past we have had the ability to correct those situations through a very vigorous surveillance program. In fact, I should have mentioned that if one is going into such a CTB situation, probably I was wrong in saying that one would reduce the present weapons effort, the testing work, by about 30 percent. You may have to compensate for that with a very vigorous surveillance program to make certain that you don't get into a situation before it is too late. But there have been instances where nuclear components have become questionable and they have had to be refabricated.

Now under the present rules under which we operate, we could indeed test to make sure that in the refabrication process, since processes do change and materials do change, and there are OSHA regulations and FDA regulations which preclude using the same materials, that our new product is completely satisfactory.

Senator PELL. Please try to keep your answer as simple as possible. I would hope our questions are easy to understand.

Would it be a correct statement to say that if no new nuclear weapons were built for 20 years, we would then have successfully put the genie back into the bottle because all nuclear weapons would have lost their utility?

Mr. AGNEW. No. I think they can be rebuilt.

Senator PELL. Then what do you mean by a useful life of 20 years?

Mr. AGNEW. There are components which simply have to be replaced.

If you bought a new car and jacked it up in 20 years, your tires would be useless. You would have to replace certain components.

Senator PELL. Are you saying that you would have to replace the nuclear components or the nonnuclear components after 20 years?

Mr. AGNEW. You may have to replace certain nuclear components. It just depends.

Mr. BATZEL. I would share that view.

Materials with which we build nuclear weapons are chemically very reactive. They have to live together in a confined space for the length of time in stockpile. The obvious consequence of having unstable reactive materials is that after a while they corrode, they erode, they chemically change. So, after 20 years there will be some decrease in terms of reliability of those weapons. It may not go to zero, but there could well be some major fraction of those warheads which plain would not work.

Senator PELL. I thought that the nuclear half-life—in other words, when it deteriorates—is quite long.

Mr. BATZEL. It is 24,000 years for plutonium, for example. But the chemical half-life of these systems—it is the chemistry, it is the environment in which they live that makes life so tough.

Senator PELL. That is what I am driving at. It is not the nuclear components; it is the nonnuclear components.

Mr. AGNEW. No. Nuclear components can, let us say, oxidize and corrode and things can go wrong just because of the incompatibility

sometimes of the materials with which they are associated. We try to prevent that, but experience has shown, not only for our own weapons systems but for those of our allies, problems have been experienced even though these components were presumed to be in a very benign environment.

NUMBER OF TESTS BEING MADE TO MAINTAIN STOCKPILE  
CREDIBILITY

Senator CASE. Do you have in the record anywhere the number of actual tests of nuclear weapons now being conducted in connection with your job of maintaining the stability and the credibility and the reliability of the stockpile of weapons? How many do you make now?

Mr. STARBIRD. May I answer that?

Senator CASE. Sure.

Mr. STARBIRD. In answer to questions by the committee chairman that were sent over to Secretary Vance in April, answers were prepared and sent back. There are several questions that refer to the numbers of tests and the purposes of the tests. For example, for the breakouts requested, one was the breakout of the number of tests by development tests, weaponization tests, effects tests. Another breakout that was requested was by strategic weapons tests, tactical weapons, and the like.

When you get into that detail, it is classified. Therefore the classified information is available, but it is in the form of the answers that were sent back in July.

Senator PELL. In that regard, perhaps ERDA and administration officials might be able to declassify some of that material which is not already in our files. We think it would be of general help to both our colleagues and to the country as we move ahead with consideration of the treaty.

Senator CASE. What is the reason for classification of that information?

Mr. STARBIRD. The reason for the classification is that it would be of assistance to the Soviet Union in understanding our stockpile and it also would be an indication of any trend that was taking place because of the tests in particular years.

It has been carefully reviewed. I will have it reviewed again, Senator Pell and Senator Case.

[The relevant correspondence and the unclassified answers as provided by the executive branch are shown below:]

APRIL 18, 1977.

HON. CYRUS R. VANCE,  
*Secretary of State*  
*Washington, D.C.*

DEAR MR. SECRETARY: As soon as the schedule eases, I anticipate setting hearings by the Subcommittee on Arms Control, Oceans and International Environment of the Committee on Foreign Relations on the proposed Threshold Test Ban and Peaceful Nuclear Explosions Treaties.

Since the two proposed treaties are closely tied to the question of a comprehensive test ban, it is important that the Subcommittee's review encompass in a careful and thorough way all aspects of the testing issue.

Accordingly, I would appreciate very much your providing coordinated Administration responses to the attached questions. The coordinated answers should provide the Members with useful background information on our testing programs and requirements, and help the Subcommittee in its preparation for hearings.

Thank you very much for your help on this matter.

Ever sincerely,

CLAIBORNE PELL,  
Chairman, Subcommittee on Arms Control,  
Oceans, and International Environment.

DEPARTMENT OF STATE,  
Washington, D.C., July 8, 1977.

HON. CLAIBORNE PELL,  
Chairman, Subcommittee on Arms Control, Oceans, and International Environment,  
Committee on Foreign Relations, U.S. Senate.

DEAR SENATOR PELL: The Secretary has asked me to reply to your letter of April 18, 1977, requesting coordinated Administration responses to a series of questions in anticipation of ratification hearings on the Threshold Test Ban Treaty.

We have reviewed the questions and prepared coordinated Administration responses to them. The responses are enclosed.

I hope this information will be helpful to you and the Members of the Subcommittee in preparing for the hearings on these two treaties.

Sincerely,

DOUGLAS J. BENNET, Jr.,  
Assistant Secretary for Congressional Relations.

Enclosure. [See below.]

DEPARTMENT OF ENERGY,  
Washington, D.C., October 7, 1977.

HON. CLAIBORNE PELL,  
Chairman, Subcommittee on Arms Control, Oceans, and International Environment,  
Senate Foreign Relations Committee, U.S. Senate.

DEAR MR. CHAIRMAN: The answers to your questions for the record of September 21, 1977, relating to the Threshold Test Ban and Peaceful Nuclear Explosives Treaties, are transmitted herewith as Enclosures 1 to 5 inclusive.

Also, as requested by the Subcommittee during the hearing of September 8, 1977, I have reviewed for possible declassification all classified answers to questions asked by the Chairman's letter of April 18, 1977, to Secretary Vance. The answers were transmitted initially to the Chairman by a letter dated July 8, 1977, from Assistant Secretary for Congressional Relations, Department of State.

a. The answer to question number 3, as transmitted was neither stamped classified nor unclassified. A copy of this question and answer is Enclosure 6. The answer is unclassified.

b. An unclassified version of the answer to question number 1 was forwarded to the Chairman by letter of September 15, 1977, from the General Counsel, Department of State. A copy, which is unclassified, is attached as Enclosure 7.

c. Also the answer to question 13 can be declassified. An unclassified copy of this question and answer is attached as Enclosure 8.

d. Finally, an unclassified answer was prepared for question 16 and forwarded attached to the letter of September 15 from the General Counsel, State Department. A copy of the unclassified answer is at Enclosure 9.

If I can be of further assistance, please let me know.

Sincerely,

ALFRED D. STARBIRD,  
Acting Assistant Secretary for Defense Programs.

[Staff note: In addition to the unclassified answers cited by Mr. Starbird, the answers to questions 2, 15, 17(a) and 17(c) were provided to the committee in unclassified form by Assistant Secretary of State for Congressional Relations Douglas J. Bennet, Jr., on July 8, 1977.]

Question 1. How many announced and unannounced nuclear tests has the United States conducted since the Limited Test Ban Treaty was signed? How does this compare with the number of Soviet tests? Please provide breakdowns by year and magnitude. How much of this information and future information in regard to United States testing programs could be on the public record?

Answer. As of August 1, 1977 the U.S. had announced a total of 297 nuclear tests since the Limited Test Ban Treaty was signed on August 5, 1963. The total number of U.S. tests is presently classified. The need for the classification of the number of U.S. tests is under review in light of the Protocol to the TTBT.

Although the Soviet Union rarely announces tests, the U.S. has publicly identified 124 seismic signals as presumed nuclear tests during the same period. This number should not be considered definitive for two reasons: (1) current U.S. national technical means of detection cannot provide assurance that all tests conducted by the Soviet Union are detected and, (2) information about the exact number and yields of Soviet tests is classified to protect our intelligence sources, capabilities, and methods.

*Question 2.* How much money is being requested during Fiscal Year 1978 for nuclear weapons research and development and testing? How much will be spent in Fiscal Year 1977 and how much was spent in the preceding three Fiscal Years in those categories?

Answer. The following is a tabulation of the costs for nuclear weapons research, development, and testing.

[Dollars in millions]

	Actual (fiscal year)			Estimated fiscal year 1977	Requested fiscal year 1978
	1974	1975	1976		
Operating outlays:					
Research and development.....	\$243.1	\$257.7	\$281.9	\$324.7	\$356.1
Testing of atomic weapons.....	160.9	179.7	207.9	221.0	225.2
Subtotal.....	404.0	437.4	489.8	545.7	581.3
Plant and capital equipment.....	59.8	69.2	63.5	74.0	99.6
Total.....	463.8	506.6	553.3	619.7	680.9

Research and development includes the nuclear R&D conducted by the two national nuclear weapons laboratories, Los Alamos Scientific Laboratory and Lawrence Livermore Laboratory, and the engineering and development conducted by Sandia Laboratories. This research and development is essential to advance nuclear weapons technology and to apply the advances in the design and engineering of nuclear weapons.

Testing is an integral part of R&D and is conducted by the laboratories mentioned above at the Nevada Test Site. The test costs include the laboratory costs in preparing the tests including designing and procuring the test devices and the field operating costs at the Nevada Test Site.

The plant and capital equipment costs are to provide the capital facilities at the laboratories and at the Nevada Test Site needed to conduct the R&D and testing. This includes the construction of laboratory and office facilities and the acquisition of research machines and computers.

*Question 3.* Has the 150-kiloton limitation in yield specified in the Threshold Test Ban Treaty been respected by both sides since March 31, 1976—the originally proposed effective date of that treaty? Please provide full details on Soviet nuclear tests since March 31, 1976, including estimated yields.

Answer. The U.S. has respected the 150 kt threshold and, taking into account the uncertainties in our monitoring systems, the weight of evidence supports the judgment that the USSR has respected this threshold also. As discussed in the answer to question 4, the yield estimative process is currently under review and detailed information on Soviet nuclear tests since March 31, 1976, will be forwarded as soon as possible.

*Question 4.* Has new information been developed which indicates that Soviet nuclear test yields have been overestimated in past years? If so, please provide the latest information in regard to this matter and in particular any steps being taken to improve verification of Soviet tests and yields.

Answer [Deleted.]

*Question 5.* Which warheads and what numbers of those warheads have been given off-the-shelf confidence tests? Which such tests have been at full yield? Describe the methodology of test procedures for assured reliability of all of our stockpile on the basis of the testing done.

Answer. [Deleted.]

*Question 6.* What are the general purposes of our tests in FY 1974-FY 1978? Please give a breakdown on the number of tests which are (a) purely weapons development tests; (b) purely "effects tests"; (c) purely confidence tests; (d) a combination of "weapons development tests", "effects tests", and "confidence tests", (please specify the combination); and, (e) some other purpose (please specify).

Answer. [Deleted.]

*Question 7.* For FY 1974-FY 1978, please give the breakdowns on the numbers of tests related to (a) strategic weapons, (b) tactical weapons, and (c) other (please specify).

Answer. [Deleted.]

*Question 8.* If the relative proportions of the categories in (6) and (7) above varied significantly from year to year, please give the information so as to indicate the trend.

Answer. [Deleted.]

*Question 9.* Would the strategic balance be fundamentally different today if we had negotiated a comprehensive test ban treaty in 1963 and both sides had complied with it? Under the same circumstances, what would have been the result if we had complied and the Soviet Union had successfully conducted all of the tests it has since conducted with yields below 4.5 on the Richter scale?

Answer. [Deleted.]

*Question 10.* What are the major technological possibilities now on the horizon which would require testing to exploit their full potential? Would the realization of any of these (a) make a difference in the strategic balance between the United States and the Soviet Union; (b) make a significant difference in United States or Soviet tactical capabilities if both sides were free to exploit them; (c) make a significant difference in the prospects for nuclear deployments in Europe; (d) inhibit or induce other countries, and, in particular, the non-nuclear-weapons states, to emulate us in developing, testing and deploying new weapons?

Answer. [Deleted.]

*Question 11.* Is there any known system now in any stage of development which you could not equip with a satisfactory warhead without further nuclear testing?

Answer. [Deleted.]

*Question 12.* Under TTBT restraints, would the United States develop and deploy warheads with yields substantially greater than 150 kilotons? If so, please identify those weapons. How would reliability be assured in the instances of weapons having substantially greater yields than 150 kilotons?

Answer. [Deleted.]

*Question 13.* Under a comprehensive test ban, what procedures would be implemented for retaining confidence in stockpiled nuclear warheads over time? Would there be development and deployment of new warheads under a comprehensive test ban? If so, please specify likely programs. How would reliability be assured?

Answer. Procedures would probably involve the following: (a) At the three weapons laboratories, at least in the early period (three to five years), assigning all employees currently assigned to the testing program to nuclear weapons R&D to maintain Scientific and technical expertise, and those individuals whose duties are now primarily associated with testing would be utilized in other tasks directly related to weapons design and engineering (e.g., simulation and calculational efforts; non-nuclear testing) or in other laboratory programs of applicable scientific disciplines and technology; and (b) Retaining a capability to maintain, rebuild or replace stockpiled weapons.

Under a moratorium or CTB, safeguards cannot preclude but can delay this degradation of the stockpile. It is highly unlikely that new warheads would be developed under a CTB.

*Question 14.* Are there new technologies which would help the United States and Soviet Union assure reliability under a comprehensive test regime?

Answer [Deleted.]

*Question 15.* What would be the relative effects of a comprehensive test ban over time upon the United States and Soviet strategic arsenals?

Answer. Assuming compliance, a CTB would effectively prevent either side from introducing significantly different or improved nuclear warheads, which had not already been tested, into their strategic arsenals. In addition over a period of time, each side would inevitably have somewhat degraded confidence in the reliability of its nuclear weapons.

*Question 16.* Assume that a comprehensive ban on testing were to go into effect one, two, three and five years from now, What would be the priorities in our testing program under such circumstances? What would be the effect upon the reliability of weapons?

Answer. If a comprehensive ban on testing were to go into effect one to two years from now, the priorities in our test program would be to complete the testing needed to develop nuclear warheads for currently identified defense needs. This would put priority on weaponizing designs using current technology at the expense of curtailing development of more advanced concepts. If the CTB were implemented three to five years from now, more advanced concepts could be developed and tested for the currently identified and other defense needs.

*CTB in one year.*—If a CTB is implemented in about one year, priority would be given to tests to provide an acceptable nuclear design for a number of systems. Tests could be completed, but some design compromises might be necessary.

*CTB in two years.*—If the CTB were implemented in two years, the essential testing to provide warheads for the systems referred to in the preceding paragraph could probably be completed without design compromises. In addition, it might be possible to conduct sufficient tests to provide warhead options for several more systems with some design compromises.

*CTB in Three to Five Years.*—If a CTB were to be implemented three to five years from now, warheads could be tested for the systems referred to in the preceding two paragraphs plus other specific defense needs not yet identified. Also more advanced safety and security concepts could be integrated into the nuclear components and the life of certain components could be extended for new designs.

In regard to reliability, new weapons tested prior to implementation of a CTB will not have reduced reliability. Unreliable weapons would not be stockpiled, although yield uncertainty greater than normal might be acceptable, and unavoidable, particularly if the required and planned testing is not completed.

*Question 17(a).* What progress has been made in the area of seismic detection and identification?

Answer. A major program of improvement for the AEDS\* seismic monitoring system is underway. This program is expected to be completed in 1981. A parallel program of research begun in 1973, which included the design and procurement of new seismic detection equipment, establishment or improvement of new seismic facilities around the globe, and the design and development of a data management system. Development of the equipment, obtaining the necessary approvals of foreign governments, and preparing installations in foreign countries have required three years of effort. This phase of the research is almost complete at the present time, and new data from several stations are beginning to be received. Data from a statistically valid number of seismic events should be available to complete the research during FY 1979.

Continuing studies of earthquake and explosion signals through theoretical modeling have resulted in potentially useful new discriminants for separating explosions from earthquakes. Similarly, improved digital data analysis techniques have been developed which show promise for improving discrimination of seismic events.

*Question 17(b).* What are our current capabilities for monitoring events from outside the Soviet Union?

Answer. [Deleted.]

*Question 17(c).* What would be the benefits resulting from on-site inspection?

Answer. Under a comprehensive test ban, on-site inspection techniques are the most effective means for detecting unequivocal signs of testing activity. A determined nuclear test ban evader could take steps to reduce the utility of on-site inspection. As a result, on-site inspections would be expected to have limited utility. However, the option of performing on-site inspections in an area where suspicious seismic indications were detected would provide an important deterrent.

*Question 17(d).* What would be the benefits of various emplacements of unmanned seismic stations?

Answer. [Deleted.]

*Question 1. a.* In its testing program under a Threshold Test Ban regime, what steps would the Energy Research and Development Administration (Department of Energy) take to ensure that no more than one or two accidental violations of the threshold occurred in any year?

b. What special steps would be taken to make certain that tests at or near a design yield of 150 kilotons would remain within the specified limitation?

Answer. Although warheads are being developed to provide operational yields in excess of 150 kt, the testing necessary for that development is conducted at yields as far below the 150 kt Threshold Test Ban Treaty limitation as is possible. This is accomplished by testing with dilute or substitute fuels. If they must be in excess of 125 kt, a special Threshold Treaty Review Panel is convened to review the design

\*Atomic Energy Detection System

and provide reasonable assurance that the device yield will not exceed the 150 kt limit.

DOE makes prompt yield measurements of all tests with yields 125 kt or larger as well as later available more precise radiochemistry measurements of the detonation products. In the event a device yield should possibly exceed 150 kt, detailed post-test analysis of the test would be conducted to establish the basis for the apparent disparity.

*Question 2.* The Peaceful Nuclear Explosions Treaty clearly envisions the possibility of group explosions. The Committee has received the considered judgement that large group explosions would only be applicable to excavation projects, and that excavation projects involving groups of explosions have a high probability of venting and releasing radioactive debris into the atmosphere. If this is correct, how will provisions in this treaty be reconciled with the limitations imposed by the LTBT?

Answer. The Soviet Union has described applications other than excavation projects that would require group explosions, for example, gas stimulation and deep mining of bodies of ore. For such applications, the group explosions could be fully contained if the firings were deep enough underground.

Large-scale excavation projects involving group explosions could present a risk of dispersing radioactive debris beyond the borders of the state conducting the explosions. This would be a violation of the LTBT. However, the Soviet Union is a party to the LTBT, and we would expect them to abide by its provisions. Further, Article III, paragraph 2(d) of the PNET requires that any underground nuclear explosion conducted by either the U.S. or the Soviet Union comply with the provisions of the LTBT.

*Question 3.* What specific changes in the testing program, including a possible increased number of tests, does the Energy Research and Development Administration envisage in preparation for the eventuality of a comprehensive ban on all nuclear explosions?

Answer. The number of nuclear tests has not been increased. However, DOE and DOD have jointly reviewed systems development priorities and development testing requirements, and DOE has scheduled its FY 1978 test program accordingly. The test program forwarded to the President for his approval is structured to assure early completion of those tests applicable to highest priority Department of Defense requirements.

*Question 4. a.* How much has been expended so far in programs to prepare the United States to conduct on-site inspections of group Soviet explosions as provided for under the Peaceful Nuclear Explosions Treaty? Please provide a breakdown by category.

b. What future spending is contemplated for preparations, as distinct from spending for actual required inspections?

c. How much might the first such single inspection cost, and how many people and how much equipment might be involved?

d. Roughly, how much might subsequent inspections cost?

Answer a.

	Fiscal year 1976 and 1976†	Fiscal year 1977
Yield determination .....	\$200	\$825
Local seismic network .....	315	1,440
Equipment development and procurement .....	1,155	1,475
Operational preparation and training .....	425	1,760
Subtotal .....	2,095	5,500
Total .....		7,595

b. In FY 78 we have allocated \$2.5 M for PNET Verification. This funding will be used for verification equipment improvement and maintenance, cadre training and deployments if they are required. In the event we do not deploy we plan to use this funding as shown below.

	<i>Fiscal year</i>
Yield determination .....	711
Local seismic network .....	619
Equipment development and procurement .....	626
Operational preparation and training .....	544
<b>Total .....</b>	<b>2,500</b>

c. See attached deployment estimate. The deployment estimates are based upon assumed yields of 500-1500 kilotons. Costs for lower yield events would be somewhat smaller, since less equipment and fewer personnel would be deployed.

d. We do not anticipate substantial reductions in cost for subsequent deployments.

#### *Deployment estimate*

Kilotons .....	500-1,500
Personnel .....	23
Materiel (number) .....	1,500
Slifer vans and running gear .....	2
Seismic vans and running gear .....	2
Diesel generators .....	8
Transportainers .....	6
Reels cable .....	32
Antenna mast sections .....	20
<b>Transportation:</b>	
Personnel to POE and return .....	\$24,000
Materiel to POE and return .....	15,000
Familiarization equipment .....	350,000
Verification equipment .....	650,000
In-country .....	470,000
<b>Subtotal .....</b>	<b>1,509,000</b>
Per diem in-country .....	83,000
Site preparation .....	100,000
Diesel fuel .....	18,000
Increase in salary costs .....	46,000
<b>Total .....</b>	<b>1,756,000</b>

*Question 5.* Has the Energy Research and Development Administration taken specific steps, or does it envision taking steps to maintain the reliability of the stockpile under a comprehensive ban?

Answer. The impact of a CTB on stockpile reliability is a matter of great concern to the DOD and the DOE. Studies that have been conducted to determine what might be done to offset the inability to test conclude that confidence in the stockpile will eventually decline but that several steps can be taken that would delay it or reduce its rate. Those include: maintaining nuclear design competence by expanding related programs such as laser fusion research, non-nuclear testing of components, basic nuclear research, and theoretical calculations; sustaining production capabilities by small but continuous replacement programs; and continuing the current stockpile evaluation program pertaining to the non-nuclear component reliability. With these actions the confidence in the reliability of the stockpile will remain high in the short term (up to 5 years) but will suffer significant degradation after 10 or 20 years. However, these actions will not allow the certification of the reliability of any new nuclear designs which are based on unproven technology.

Senator CASE. It is kind of hard to answer questions on the policy side without knowing just what we are talking about. To the extent it can be done without compromising proper security matters, it is most desirable that we have as much information of this kind as we can. Otherwise, we are just talking about words. How many tests are really made and just how important are such tests really to the credibility of the stockpile and to its maintenance? This is important.

I think we are all seeking the same objectives and the more we have the same information, the better it will be. This is not just for us, but for the public as well, because the public has to be satisfied that we are making sense in this matter. Otherwise we will not get any support for our policy and for action on treaties.

I would be happy if you would review these questions to see if you cannot give specific numbers. If not, could you give any information that would satisfy what we are trying to get at, at least?

Mr. STARBIRD. We will. These are not just one agency's numbers, incidentally. They were checked, indeed all of the questions of fact were checked by State, by ACDA, by Defense, by ERDA, and in certain cases by the CIA.

Senator CASE. Thank you.

Thank you, Mr. Chairman. I am sorry for interrupting.

Senator PELL. Not at all. Thank you.

#### U.S. TESTS ABOVE THRESHOLD LEVEL BEFORE MARCH 31, 1976

Following the agreement on the Threshold Test Ban Treaty 3 years ago, in June 1974, we embarked on an accelerated testing program since we expected that there would be an effective date 2 years later of the TTBT. I understand that since March 31, 1976, our country has not conducted any tests above the threshold level. Were there some tests conducted above this threshold level before March 31, 1976?

Mr. STARBIRD. There were.

The actual word "accelerated" is probably not a good word in the sense of having a lot of additional tests. There was emphasis placed during that period of time on testing goals to meet requirements that were foreseen or that could become possible in Defense's viewpoint over the next few years. As you pointed out, subsequent to March 30, we have conducted no tests above that threshold.

The treaty itself provided that the threshold would go into effect at the date that it finally did go into effect. It so provided at the time of signature.

Senator PELL. Were the goals of this testing program achieved, or do you regret that you had the deadline of March 31, 1976?

Mr. STARBIRD. We had cases where we did not achieve successes. That is the basic reason why testing is carried out, to find out whether or not you have a successful design or whether there is a failure in the design.

I would say that overall we generally had a successful test series. There are things we would have liked to do that we were unable to do because the provision of the treaty was to terminate—actually it was to terminate on March 30, 1 day before the end of the month.

#### FITTING FUTURE WEAPONS WITH WARHEADS UNDER TTBT

Senator PELL. Can future weapons now being discussed be fitted with satisfactory warheads under the TTBT?

Mr. STARBIRD. There are a great many warheads that are discussed, Mr. Chairman, that are considered and studied. I used the words, I believe, in my statement that we could meet the Department of Defense requirement currently stated to us. Also, I believe that the Defense witnesses indicated that there were advantages to

continuing testing; but on balance they supported these two treaties and believed they could complete the testing required on the systems they required in the near term.

#### EFFECT OF 150-KT LIMIT ON REQUIRED WEAPONS TESTS

Senator PELL. Do you think that the 150-kt limit will allow us to conduct the tests required for our weapons systems?

Mr. STARBIRD. It will, for a period of a few years, allow us to conduct the ones for which the Department of Defense now has the systems in planning for production and deployment. The treaty does have provisions for consultation and for termination by either party upon notice no later than 6 months prior to the end of each 5-year period of the treaty. I use the words, therefore, that we could meet the requirements over the next 5-year period.

I cannot say, that if there were some lack of progress in ever reaching additional real arms control measures, there would not be a situation that would be so serious that we would have to consider the desirability of going above the 150-kt limit. If that occurred, of course, we have the right of withdrawal under the treaty, but I don't think that right would be lightly used. We also have the right, in the case of our extreme national interest being endangered under the subject matter of the treaty to withdraw from the treaty. The U.S.S.R. would have the same right.

Senator PELL. Under the TTBT restraints, do you see the United States developing warheads with more than 150 kt, that is, developing and applying warheads with more than 150-kt destructive power?

Mr. STARBIRD. I am not sure that I understand the exact question that you are asking, sir. But I would agree that we are pretty well limited now to 150 kt. We were not so limited before. The U.S.S.R. should be, if it abides by the treaty, somewhat comparably limited. The treaty therefore is, to me, a real limitation on the testing and consequently the deployment of weapons of extremely high yield.

#### COMPARATIVE EFFECT TTBT ON SOVIET UNION

Senator PELL. Since the Soviet Union puts greater emphasis on its yield than it does on its accuracy, wouldn't the Soviet Union suffer more in this treaty than we would?

Mr. STARBIRD. That is a question that we debate periodically, but the trouble is that we really don't know that much about the Soviet Union. We do know that they have been testing, as was brought out by both of the lab directors, in the higher yields much more than we have, indeed significantly more than we have. Whether they have now satisfied all of their requirements or not, we cannot say.

#### HAVE SOVIETS HAD EXPLOSIONS ABOVE 150 KT SINCE MARCH 31, 1976?

Senator PELL. Have they had any explosions above 150 kt since March 31, 1976?

Mr. STARBIRD. There is an answer to this question also in the written questions, but I think I can summarize our current judgment.

Based on an extremely intense interagency study that has been done, the balance of the evidence leads to the judgment that they probably have not.

#### POSSIBILITY OF SOVIET PROGRAM WHICH YIELDS TO ONSITE INSPECTION

Senator PELL. The Peaceful Nuclear Explosions Treaty includes provisions for onsite inspection of group explosions with an aggregate yield above 150 kt. Do you believe that if these treaties are ratified, the Soviet Union would ever have the kind of peaceful explosion program which would yield to such an onsite inspection?

Mr. STARBIRD. They have explained projects in international groups and in bilateral discussions with us that would be more economic to carry out with group explosions of over 150 kt. These are large excavation projects for use in mining operations or break-up of rock, or some other such purpose.

Now, whether or not they would ever do it—in other words, cause the provision for onsite observation to occur—I cannot forecast.

#### INTENDED LOCATION OF PEACEFUL EXPLOSIONS

Senator PELL. Could such a peaceful explosion occur in the atmosphere, or are all peaceful explosions intended to be underground?

Mr. STARBIRD. Under the provisions of the treaty, they must be underground. In fact, there is a minimum depth that is set forth in a formula which says, in brief, that an explosion will be underground, measured in meters, by a distance equal to 30 times the 3.4 root of the yield. I believe that is the formula and it is in the treaty. I will correct it for the record if that is inaccurate.

In any case, one of the provisions of the treaties is that those treaties, the current ones under consideration, will not violate the provisions of any existing treaty in force. The Limited Test Ban Treaty currently in force, of course, precludes tests in the atmosphere, in space, and the like.

Senator CASE. Does this not lead to the question of the value of the treaties in helping us discover ways of verifying explosions. Therefore the inspection provision won't come into effect? Is that the thrust of this line of inquiry, that it is leading to a minimization of the value of the treaties?

Mr. STARBIRD. I am not trying to lead to that, but it is a possibility that it would never be called into effect because the U.S.S.R. decided that it did not want to go through with the larger group explosions of over 150 kt. They did spend a great, great deal of time, though, as did our people, in trying to negotiate the protocol to the PNET. It was one of the conditions that they actually placed, and language was carried, in the TTBT and its protocol to indicate that the parties would attempt to negotiate a peaceful nuclear explosion accommodation.

They could keep all their tests under 150 kt.

Senator CASE. This leads to a question on which I would be happy to have any of you comment.

POSSIBILITY OF DIFFERENTIATING BETWEEN PNE AND WEAPONS  
EXPLOSION

Let's assume that the Russians wanted to test a weapon up to, but not exceeding, 150 kt. Could they not put this in a hole and say it was a peaceful explosion, and would you know whether it was a weapons test or not? How would you know?

This is on the question of verification.

Mr. STARBIRD. Well, they would have to declare it.

Senator CASE. Yes, let's assume that they declare it as an explosion.

Mr. STARBIRD. If it were less than the 150 kt, they would be getting no weapon benefit that they could not also get under the TTBT by testing on a nuclear weapon test site. The whole purpose of the treaty was to limit the benefits they could get from peaceful nuclear explosions to the same benefits they could get on the test sites.

Senator CASE. I think I see your point. But, is it possible to tell whether an underground test is a weapons test or not? Let's not talk specifically about anything concerning 150 kt.

Mr. STARBIRD. You can tell that there is an appearance that a peaceful nuclear explosive has some peaceful application. But the difficulty is that the reverse is not true. You cannot tell, we have found no way of telling, that a peaceful nuclear explosive will not give significant military benefit. That is the whole reason that the two yields were coupled.

Senator CASE. I have one other general question, Mr. Chairman, and I do have to go. In fact, I guess that we all have to go.

Senator PELL. Please ask it.

Senator CASE. Thank you.

## ACTUAL EFFECT OF 150-KT LIMIT

It relates to the question of the actual effect of this so-called 150 kt limit. In the President's letter of transmittal he includes the letter he received from the Department of State dealing with this question, among many others. In article I of that letter from the State Department to the President it is pointed out that there may be breaches, slight, unintended breaches, of the 150-kt threshold, and the parties have discussed the problem and have agreed that one or two slight, unintended breaches would not be considered as a violation of the treaty.

What I am getting at here is whether the 150-kt limit is really the limit. Certainly we couldn't, nor could the Russians, test consistently at 150-kt and stay within the limit because of the fact that you cannot always predict the kind of results you are going to get from the test. Therefore you have to be considerably under in order to stay under on the average.

Mr. STARBIRD. As I think you can note on the prior page at Roman numeral VI, according to the document to which you are referring, that is, the letter from Secretary of State, that was a question brought up by the Soviet Union. It was discussed, and the statement that was agreed to between the parties, though not formally incorporated in the protocol or in the treaty, is that breaches of the threshold would be considered a matter of concern

by the parties, and those parties would be expected to consult on them. However, it does state that one or two slight unintended breaches per year would not be considered a violation of the treaty.

Senator CASE. All right, but how about 10, 12, 15, or 20? What about a greater number?

Mr. STARBIRD. I can tell you that we don't conduct a single test without Presidential approval. We tell the President at that time what is the design yield of that weapon. We do that twice a year. If we depart from that design yield, or depart significantly in any other way, we must go back to the President and secure approval.

So, it does get the highest review in the United States.

Senator CASE. Yes, of that I am sure.

But my point is this. As a practical matter, isn't the actual yield to which you are going to permit yourself to shoot less than 150 kt?

Mr. STARBIRD. No, sir, it is not. If the situation really requires it—however, we do review extremely carefully to make sure that the chances of going above are very small. Also, we review all of our tests to try to keep them at the minimum yield to achieve the objective. Both laboratory directors, I believe, spoke to the fact that we should not have built a bias into our situation so that we could have a cushion and never exceed the threshold. We have no idea of what the U.S.S.R. would do.

Senator CASE. Thank you, and thank you, Mr. Chairman.

#### KILOTONS NECESSARY TO DIG ANOTHER PANAMA CANAL

Senator PELL. So that we laymen can understand the forces involved here, and since the Panama Canal is very much in everybody's mind today, what would be the number of kilotons necessary to dig another Panama Canal—in very rough terms?

Mr. STARBIRD. Lawrence Livermore Laboratory has studied this. In fact, the Commission on a Second Canal had Livermore study the number. I think Dr. Batzel would probably not want to volunteer that from memory; but we would certainly provide it for the record.

Mr. BATZEL. I would like to provide it. I don't recall the numbers.

Senator PELL. What would it be in very rough terms—1,000—100?

Mr. BATZEL. About 100 to 200 Mt. A few hundred megatons.

Senator PELL. A few hundred megatons to build a Panama Canal.

Mr. BATZEL. That is my impression.

Senator PELL. What I can't get through my head is this. How many kilotons destroyed Hiroshima?

Mr. BATZEL. You are in a situation of digging dirt out of the ground and ejecting it. We know what yields are required to produce what size craters and canals, and the yields required to move relatively large hills is large.

Senator PELL. In other words, while it took only 20 kt to destroy a city, it takes many, many, megatons to build a city or build a canal.

Mr. BATZEL. To build a canal.

Senator CASE. But this is by underground explosion.

Mr. BATZEL. These are cratering explosions.

Senator CASE. This is one I don't get through my head at all.

Mr. BATZEL. In other words, you bury the explosive at a depth where it is underground, but the force of the explosion essentially kicks the dirt out of the way and leaves you with a crater.

Senator PELL. Then the thing collapses.

Mr. BATZEL. Yes, part of it is collapsed, but most of it is throw-out of rocks and dirt.

Senator CASE. Is there any emission of radio-activity?

Mr. BATZEL. There is some emission of radio-activity and that is the issue that has so far hung up the issue with respect to the Limited Test Ban Treaty, as to whether one can indeed conduct crater experiments and live within those constraints.

Senator CASE. If you dig this kind of hole, you are not going to have a hard rock bottom, but just a lot of loose stuff, which is the fall-in of the overburden.

Mr. BATZEL. Yes, sir, that is right.

Senator PELL. Thank you very much.

[STAFF NOTE: Dr. Batzel provided the following material in response to an inquiry by Senator Pell concerning devices and their yields which would be required to construct a typical sea-level Panama canal.]

#### MEMORANDUM

To: Roger E. Batzel.

From: Milo D. Nordyke.

Subject: Nuclear explosive requirements for a sea-level canal.

During recent Senate hearings, a question was asked regarding the nuclear explosive requirements for excavating an interoceanic sea-level canal through the American Isthmus. During the study of this project by the Atlantic-Pacific Interoceanic Canal Study Commission, which was completed in 1970, a number of routes were considered for possible construction with the aid of nuclear excavation. These routes are identified on the attached map as Routes 17, 23, and 25. The size, number, and total yield requirements for these routes are summarized in the following table.

	Route 17	Route 23	Route 25
Maximum individual nuclear explosive yield (Mt) .....	3.0	1.5	3.0
Maximum salvo yield to be fired at one time (Mt) .....	11.0	7.5	13.0
Number of salvos <sup>1</sup> .....	19	74	17
Total number of nuclear explosives <sup>1</sup> .....	178	386	115
Total yield <sup>1</sup> (Mt) .....	103	399	106

<sup>1</sup>Exclusive of nuclear explosives requirements for river diversion.



Fig. 1. Proposed routes for the sea-level canal.

## QUESTIONS FOR THE RECORD

We have some other questions for the record. I see that Senator Glenn has come in and I would submit the rest of my questions for the record for your reply.

I do have one question which is not in the record which I would like to ask.

## INCLUSION OF PNE's IN FUTURE CTBT

If the testing level is reduced to zero in a comprehensive ban treaty in the future, do you think that peaceful nuclear explosions should also be reduced to zero? This is addressed, I guess, to Dr. Fri. In other words, if we have a comprehensive test ban treaty in the future, does that also mean an elimination of PNE's?

Mr. FRI. For the reasons that Mr. Starbird stated in linking the limits under the Threshold Treaty and the Peaceful Nuclear Explosive Treaty at 150 kt, that same link should apply all the way down. So, the answer is "Yes."

Senator PELL. Thank you.

Senator Glenn, I leave the rest of the hearing to you.

Senator GLENN [presiding]. Thank you, Mr. Chairman.

## ACCURACY OF YIELD MEASUREMENT

I would like to follow up a little bit the line that Senator Case was discussing.

I have not understood, nor do I now understand, exactly how we measure these things and get them down to such accuracies.

General, in your statement I believe you indicated that these were done on design; that the TTBT yield limit prevents fully weaponizing nuclear devices with design yield above 150 kt. That may be their design, but how do we know they are staying within that design limit? That is the first question. And, how do we know that once the thing is set off it has been within the design limit. How accurately can we measure this? What is the range of inaccuracies here? If it is a design we are talking about, are we given copies of their design before the test? Otherwise, how do we know what was tested?

Mr. STARBIRD. We don't get the design. Each party must invoke the restrictions that it requires on itself to insure that it will not have a design yield higher than the threshold yield.

Senator GLENN. If I could interrupt you for a moment, do you mean that we are relying on them to say that they will not go above this design on their tests and we are taking their word for it, and they are doing the same with us?

Mr. STARBIRD. No, sir, not quite. If they go significantly above the yield, and particularly if they repeat, then I believe we will detect it. You see, they must give us the calibration data for each of their sites, which gives us a significant improvement over the situation we would have with no such data. They must also tell us the coordinates of the firing so that we can relate it to the calibration data that we have.

Both laboratory directors brought out—and I agree with that—that they may go somewhat over the design limit and they may go somewhat over the threshold. However, from the point of view of

real significance in changing the picture as far as their military capabilities are concerned, if they do not go up to a point where we can detect it, we probably are not going to lose a great deal relative to them with respect to their military capability.

I mentioned that the President reviews each one of planned tests. Before the President reviews it, an interagency group reviews the submitted request for tests which is sent up by ERDA each year. We try to keep that list to the minimum to meet the DOD requirement.

An interagency review is conducted by the National Security Council, and recommendations by the National Security Council are made to the President as to whether or not those specific tests will be permitted at the design yield we are speaking to, or whether they will need further review. Then, internally within ERDA, after we have the device all ready, we run a separate review again, and that separate review makes its evaluation without any of the designers participating in the review. This is another precautionary measure that we take. But we cannot tell what the Soviet Union does.

Senator GLENN. What would be your estimate of the level of uncertainty of gaging the size of an explosion? Can we come consistently, say, within 1 percent, 20 percent, 50 percent? Can you give us a figure on that?

Mr. STARBIRD. Well, with respect to gaging our own here, we can come to within a very few percent—not 1 percent or 2 percent. We get that confirmation progressively through various steps.

The first thing we get is information from an electric sensing device, and it is contemplated that for peaceful nuclear explosions having an aggregate yield of over 150 kt, we would use that device for measuring the Soviets' tests. We have not released the estimated accuracy yet, though in discussions with the Soviet Union we discussed it as being in a general bracket of plus or minus 30 percent.

That is not the best way to determine yield. The best way to determine yield is to drill back and actually take samples. There I would have to ask one of the laboratory directors to give that information and to ask them also to please consider whether it is still classified.

Mr. BATZEL. I don't think there is any classification on this, though.

Mr. STARBIRD. Oh, all right.

There is a third way, and that is from the extensive calculations they know how the various pieces are supposed to behave, and they can from sensors carried in the device tell whether those behaved in the same way and get that information from their drillback.

Senator GLENN. But those are on our own tests, right? You are talking about our own tests here, aren't you?

Mr. STARBIRD. Right.

Senator GLENN. Let me back up a bit.

#### VERIFICATION OF WEAPONS AGREEMENTS

I went over as one of the Senate representatives to the SALT talks and I spent a few days over there. My major hangup in a lot of these areas is on verification. How do we know what is going on?

Obviously we are all concerned about that. I expressed myself very straightforwardly to that in all discussions with the Soviets and the representatives at the SALT talks. My same concerns apply here. If we sign an agreement, I have a queasy feeling about how well we know what it is we are actually agreeing to, whether we can check what is being agreed to. In other words, verification in this field is the same concern to me that I have concerning the other weapons agreements we may be making at the SALT talks. How do we know what they are doing? How do we verify it after it has been done? How do we know they have lived up to it?

Mr. Agnew, did you have something?

Mr. AGNEW. I would say that through national technical means, regarding verification of what the Soviets do, we can guarantee that we will know their yields within a factor of two. We can guarantee that.

Senator GLENN. Did you say 2 percent?

Mr. AGNEW. No, sir—to a factor of 2. That is, from 75 to 300. But I don't think this has any military significance vis-a-vis our own position. That is an absolute guarantee that they won't exceed the treaty by more than a factor of two. That is my own personal opinion. But I don't think it matters.

Senator GLENN. We are talking about slight, unintended breaches which would not be considered a violation of the treaty. By slight, unintended breaches are we talking about a variation of from 75 to 300?

Mr. AGNEW. Not for us.

Senator GLENN. What would we consider a violation if the Soviet set one off? Would it be of that factor of two?

Mr. AGNEW. I would defer here to General Starbird.

Mr. STARBIRD. If there were any factor that was major. I would have to go back to the fact of what would we do. We would report it to the Joint Consultative Commission.

If we suspected that there were a violation, or repeated violations, that was or were much, much less than a factor of two from the data that we got from our national technical means, we would go to the Joint Consultative Commission and ask for an explanation on those devices.

Mr. FRI. Senator Glenn, I think it is important here to make a couple of points. One would be to take Dr. Agnew's personal assurance as a starting place. He is talking about an absolute guarantee of a factor of two. Obviously there is a probabilistic distribution in there and, with somewhat less certainty we can narrow that range. So, it is not just a big, black box of from 75 to 300. We do know a lot more about what is within that range within the guarantee limits that Dr. Agnew suggested.

So, you do have that information and you do have the pattern of excursions if there are excursions over the limits. Either they happen on every other test or one crops up once a year with the mean value of the thing being maybe 170 kt. You do have better data because of the exchange of data on the nature of the geology under the test site and the coordinates of the shots, and all that kind of thing. Finally, you have the question of, given all of that, even if they are a few kilotons over the limit, does it increase their military capability. I think generally all the witnesses have said

that in that range there is not much to be gained in a military way. You are working with that whole body of information.

We think that is really sufficient to determine whether what we see, if these events occur, are infrequent and relatively minor excursions over the limit because they tested a weapon at a design yield of close to 150 and it jumped over the threshold, or whether there is a pattern of violation.

So, I think we all feel fairly confident that we could detect any pattern of violation that was intended to give them an edge. Conversely, they could do it for us as well, although we clearly, as General Starbird described, do our very best to abide by the treaty.

#### HOW LOW A YIELD CAN WE DETECT?

Senator GLENN. With the NTM, the National Technical Means, that you mentioned a moment ago, how low a yield do you feel we can detect?

Mr. AGNEW. That is a very complicated question. It depends upon the conditions under which you assume the tests are being conducted. Earlier on Senator Case mentioned if you put something in a hole, could you essentially decouple or muffle the effect of the explosion. In my personal opinion, as I mentioned, at yields of perhaps between 5 and 10 kt, a country that can control its population could evade detection, at least by seismic means and could test pretty much at will if it wanted to spend the money. Clearly at that sort of level, around 5 kt, I think there are many opportunities to test undetected if you are willing to be evasive and to spend the money.

Senator GLENN. Under 5 kt, then, it would be very questionable as to whether or not we would even detect it?

Mr. AGNEW. That is right, in my opinion.

#### WHY THIS HIGH A MAXIMUM-YIELD LIMIT?

Senator GLENN. Assuming, then, that we could detect everything from 5 to 150, why, then, did we go to this high a maximum.

Mr. STARBIRD. A question like that was asked of earlier witnesses. I think that all of the witnesses replied that it was a negotiated figure. I don't know exactly why it was chosen.

It is true, though, that at that yield limit, the National Technical Means could clearly be sure of detecting and identifying a nuclear explosion.

Senator GLENN. This, like the SALT talks, taken as a first step hoping to lead on to something else, then makes sense. Taken only by itself, it seems to me, it does not give us much protection, especially considering that Hiroshima was a 20-kt bomb and we are talking about limits of 150 kt. We are talking about some very, very huge limits. It is like in the SALT talks. Some of the negotiating there concerns the very grossest kinds of limits. It is like the Vladivostok agreements, where we would all have to build like crazy to get up to the levels we set. We say we have made some great new breakthrough in weapons control when we all had to build to reach the new level to which we had agreed. I am hoping that when we pass this—and I have no doubt that we will—that this will be only the first step toward getting much better controls,

because when we are talking about 150-kt limits, we are talking about very, very high limits as far as really accomplishing any cut-down on weaponry or testing. I am, of course, as we all are, concerned about the lower end of the scale and the smallness of some of the weapons, and I am hoping that we can use this as a step to get to those.

#### ACCURACY OF VERIFICATION PROCESSES

I am still bothered by the verification matter and how accurately we can verify what is going on.

You indicated a while ago on measurements that your tests were being applied to our own tests here. Of course, we don't have that same kind of test data from Soviet tests. So we would only be doing it by our National Technical Means, a remote way which verifies largely by seismic means. So, I question whether our verification processes are going to be as accurate as we would like for them to be.

Let me bring up another question here.

In 1973, when this committee was considering a comprehensive test ban resolution, the executive branch provided information indicating that the teleseismic detection threshold was as low as 3.9 on the Richter scale, which would be roughly 1 kt in hard rock.

Has our seismic detection improved measurably over the past several years, and how much can you say in open session now about our current ability to detect and identify seismic events? You have already commented on that a little bit earlier.

From that 1973 estimate do you feel that our seismic detection has improved measurably?

Mr. STARBIRD. I will answer that, although I am not a seismic expert. However, I have spent a lot of time working on the subject. You did have classified testimony given to you by the CIA this year.

That is not the number that was used by the CIA, even when they were speaking of hard rock.

I believe that 1 kt is correct. However, I also believe that there has been some improvement made in our capability since 1973. I know both lab directors follow this quite carefully and I would like to ask, if it is agreeable, sir, if they have any counteropinions to mine.

Senator GLENN. Sure. Gentlemen, what do you say?

Mr. BATZEL. I have no counteropinion to yours. There clearly have been advances in our seismic capabilities. The issue and detailed discussion I think had better be done in a closed session.

Senator GLENN. Yes. Mr. Agnew?

Mr. AGNEW. I have commented that I believe that one can evade. But in hard rock we certainly have made improvements. But, as Dr. Batzel says, this is being continuously reviewed and the information is available. I assume that there are mechanisms by which you can obtain it.

#### PREPARATIONS FOR COMPREHENSIVE TEST BAN

Senator GLENN. The administration is conducting active negotiations on a comprehensive test ban. Is ERDA taking any steps,

including revision of the testing program, to prepare for a comprehensive test ban? If so, what is being done?

Mr. STARBIRD. We have consulted with the Department of Defense and have attempted to pick out those things that are priority items with them. Those items are cleared with the President as the approved test program. In general, there has been no overall speed-up in the testing involved. Rather, there has been some selectivity.

Senator GLENN. I see.

Is there any testing now being conducted or scheduled to be conducted on any weapons system which would hold up a comprehensive test ban?

Mr. STARBIRD. I would have to answer that the other way, Senator Glenn. I don't know what might hold up a comprehensive test ban. We have systems that we are working on right now which require further tests if we are to take them into the stockpile. Whether we complete those or they are interrupted would depend on the time that a comprehensive test ban would come into play.

Incidentally, those systems have been named in one of the classified answer to questions.

Senator GLENN. Is there anything else anyone would like to add in summary this morning?

I am sorry that I was late. We had some other matters involving Mr. Lance this morning in another committee on which I serve and that required my presence for a little while. I am sorry that I was late getting here this morning.

Yes, do you have a comment?

Mr. AGNEW. Senator, there is one thing I would like to enter for the record.

#### PAST TRACK RECORD ON TESTING WEAPONS FOR STOCKPILE RELIABILITY

Senator Case asked a question with regard to the track record in the past on testing weapons with regard to the stockpile reliability. I should caution the staff and the Senator in using the numbers which ERDA will provide to keep in mind that our requirements in the past for this type of activity were not the same as they might be in the future. In the past, when a particular weapon system perhaps was encountering difficulties in the stockpile, it was assessed whether or not a fix needed to be made in that weapons system or would the timeframe be such that a new weapon system would be coming in so that one could retire those particular units which looked as though they might be deteriorating. So, the necessity of actually conducting additional proof tests on a specific thing for stockpile reliability was not as urgent as it might be in the future. So, I wish to warn you that those statistics could be misleading because the environment in which we had been working in the past where we were able to test and bring in the new systems is different compared with the future.

#### ACCURACY OF PREDICTING YIELD

Senator GLENN. I have a closing comment. You made a comment about the accuracy of being able to predict yield—I guess it was detection that we were talking about. I hope our accuracies of

being able to predict our own yield are considerably more than the detection accuracies you indicated; otherwise, if we try to dig a Panama Canal, we may eliminate Panama entirely. There may not be any problem there one of these days. [General laughter.]

Mr. AGNEW. I gave an absolute figure, as Mr. Fri mentioned earlier.

Senator GLENN. I appreciate that. But even if we took the traditional bell-shaped curve, that would leave a considerable excursion, even in the middle half or third of that area, too.

Mr. FRI. Under the present circumstances, Senator, I don't think we would want to take that risk. [General laughter.]

Senator GLENN. I concur with your learned judgment. [General laughter.]

Mr. STARBIRD. to answer your question, though, Senator, with the close-in observation methods, the drill-back and the like, it is much, much better than the factor that was given.

Senator GLENN. Yes, but that would be on our own tests.

Mr. STARBIRD. That's right. And our ability to predict is also much, much better.

Senator GLENN. The only problem is that we do not have that capability yet on Soviet territory.

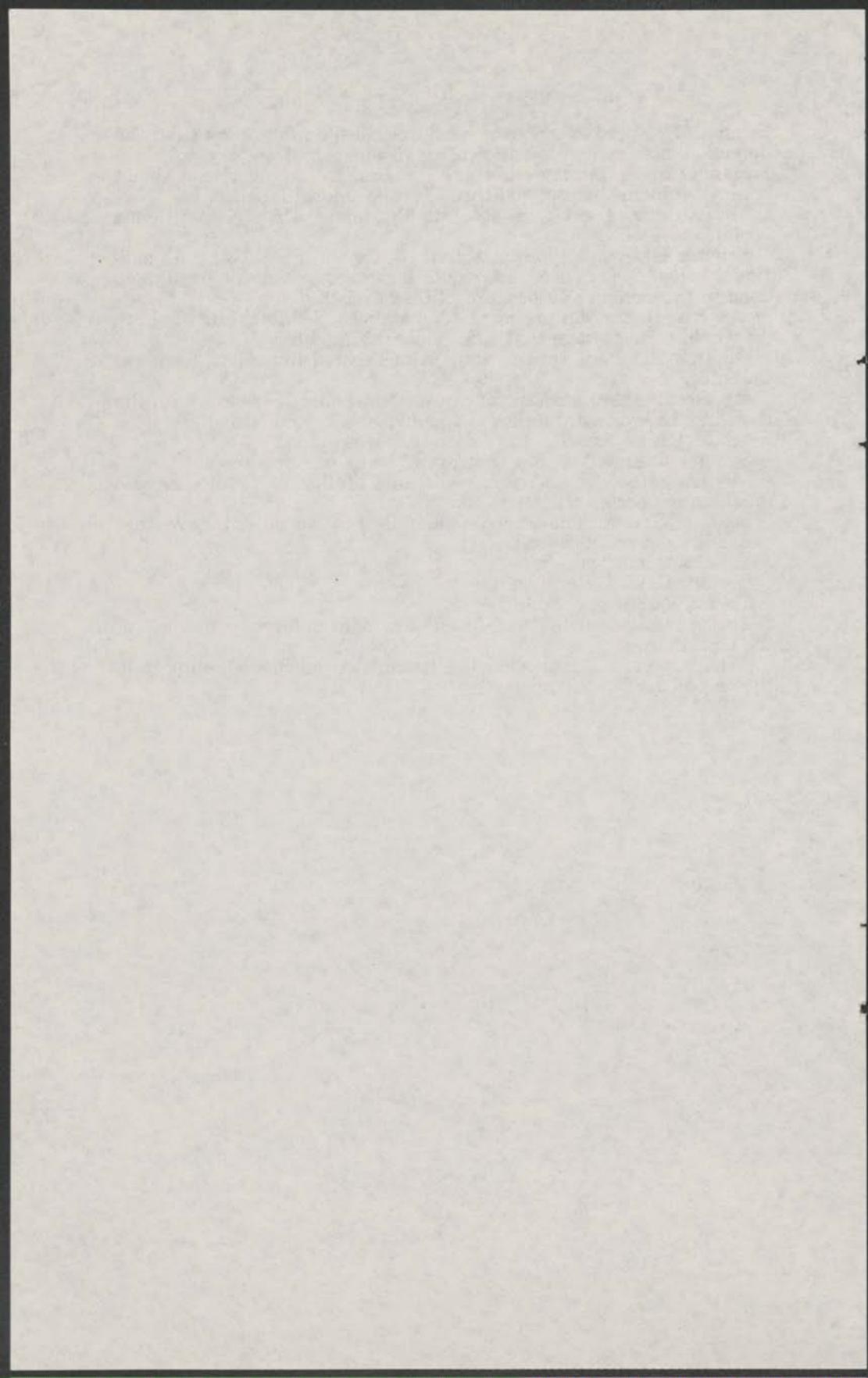
Mr. STARBIRD. Yes, sir.

Senator GLENN. Very well.

Thank you all very much.

This committee will stand in adjournment subject to the call of the chairman.

[Whereupon, at 11:40 a.m., the committee adjourned, subject to the call of the Chair.]



## THRESHOLD TEST BAN AND PEACEFUL NUCLEAR EXPLOSIONS TREATIES

THURSDAY, SEPTEMBER 15, 1977

UNITED STATES SENATE,  
COMMITTEE ON FOREIGN RELATIONS,  
*Washington, D.C.*

The committee met, pursuant to notice, at 10:06 a.m., in room 4221, Dirksen Senate Office Building, the Honorable Claiborne Pell presiding.

Present: Senators Pell, McGovern, Clark, and Case.  
Senator PELL. The committee will come to order.

### OPENING STATEMENT

Today the Committee on Foreign Relations is holding its fourth and final hearing on the proposed Threshold Test Ban and Peaceful Nuclear Explosions Treaties.

At the previous hearings, the committee heard representatives from the State Department, ACDA, the CIA, the Secretary of Defense, the Joint Chiefs, ERDA, and the two nuclear weapons laboratories.

Our committee has explored a number of key questions in the course of its hearings on the two treaties:

Is a complete end to nuclear explosions—a comprehensive test ban treaty—in the national interests of the United States?

Would ratification of the Threshold Test Ban and Peaceful Nuclear Explosions Treaties support efforts to achieve such a comprehensive test ban?

Would the national security interests of the United States, including the preservation of nuclear deterrence, be maintained under the TTB and PNE treaties?

Would these two objectives further U.S. non-proliferation objectives?

The other members and I have gained a much better understanding of the two treaties and their arms control and proliferation implications. The question we ask ourselves is whether these treaties are really worth anything, particularly the Threshold Test Ban Treaty, since it does not seem to be banning much that we would be using in any case.

Following this hearing the committee is scheduled to consider these treaties in open session this coming Tuesday.

Since we have five witnesses, two of them representing interested organizations, I think it would be best if we heard from them in two separate groups, beginning with Dr. Scoville and Dr. Rathjens.

I hope the witnesses will limit their testimony to 10 minutes. I can assure them that the full text of their testimony will appear in the record after their summarization.

We will begin with Dr. Rathjens.

**STATEMENT OF GEORGE RATHJENS, CHAIRMAN, FEDERATION OF AMERICAN SCIENTISTS, WASHINGTON, D.C.**

Mr. RATHJENS. Thank you, Mr. Chairman.

Although I appear before you as chairman of the Federation of American Scientists, much of what I say should be taken as a personal statement. This is because, with a membership of 7,000 scientists, we have within our organization a broad range of views.

**FEDERATION'S POSITIONS ON RATIFICATION OF TREATIES**

I believe the majority would be sympathetic to most of what I shall say, but I would be reluctant to predict how our members would vote if called on to take a position for or against ratification at this time of the Threshold Test Ban Treaty, or TTBT, and the Peaceful Nuclear Explosions Treaty.

I expect that there would be a substantial fraction in each camp.

The situation would have been different prior to last year's election. We would have unequivocally recommended against ratification with, I believe, the support of a large majority of our members. Indeed, we did urge rejection of the TTBT and a reopening of the negotiations in 1974 for reasons indicated in the second attachment to my statement of today.

Now, however, for reasons which I shall develop subsequently, an affirmative vote may be justified, notwithstanding the fact that there is almost nothing good, and much that is bad, that can be said of these treaties. It was a mistake that they were negotiated in the first place. The Nixon administration should have set its sights higher and striven for a treaty that would have banned all nuclear tests, including all peaceful nuclear explosions. It is quite likely that Soviet interests in peaceful nuclear explosions would have made it impossible to reach an agreement on such a treaty, but we nevertheless should have tried, even if to obtain Soviet adherence it would have been necessary, as it probably would have been, to accept a treaty of limited duration because of likely nonacceptance by China, and to rely solely on so-called national means of verifying compliance, that is, to rely principally on instrumentation outside the countries of origin to determine whether suspicious seismic signals had their origins in earthquakes or nuclear explosions.

**TTBT's RISKS AND BENEFITS**

The risks implicit in such a treaty, arising from the fact that verification of compliance could not be totally foolproof, would, in our judgment, have been small and more than offset by the benefits, as we indicated in our position statement of 1972, which I have appended.

First, it should be noted that there is some possibility that clandestine tests however low in yield, would be disclosed by other than seismic means.

Second, and much more significant, is the fact that improvement in ability to discriminate between seismic signals from nuclear explosions and earthquakes has improved dramatically since the negotiation of the partial test ban treaty—improved to the point where it is now likely that discrimination can be effected in the case of nearly all explosions at yields of above about 10 kt and earthquakes of equivalent magnitude.

Third, there is the fact that nuclear weapons technology has matured to the point where the marginal improvements that can be made with additional low-yield testing, particularly over a period limited to 5 years or so, are not likely to be militarily significant.

With remote detection and verification capabilities having developed to this degree, any threshold treaty would have seemed a poor second choice in recent years, compared to a comprehensive test ban treaty. One with a threshold of 150 kt seems outrageous from an arms control perspective, for setting the threshold at that level must be seen as having been dictated not by efforts to limit tests to the maximum extent consistent with verification capabilities, as had always been the previous policy, but rather by the interests of the weapons developers—a view that finds confirmation in the fact that implementation of even the 150-kt limit was delayed so that weapons tests above that limit could be completed.

It is hardly surprising that the negotiation of the TTBT was seen by many not as a step toward a comprehensive treaty, but as an alternative to it, including possibly as a way of undercutting interest in it; and, as a way of conveying an impression of progress in arms control when it was politically expedient to do so—without, in fact, much affecting military programs.

The effect has been to produce cynicism among many in this country and in the rest of the world about Soviet and American sincerity in efforts to limit arms programs.

#### RESPECTS IN WHICH PNET IS EVEN WORSE

In some respects the PNET is even worse. It, and the fact that the Threshold Treaty itself deals only with weapons tests rather than with nuclear explosions of all kinds, suggests that the potential of peaceful nuclear explosions is substantial in the view of the superpowers, when, in fact, this is certainly not justified by American analysis and experience.

Thus, the PNET is contrary to interests in limiting nuclear weapons proliferation in that it lends credence to the claims of India, and potentially of other countries as well, that it is reasonable for them to go ahead with the development and test of nuclear devices, even while denying any interest in acquisition of nuclear weapons capabilities. In addition, some of the applications envisaged for peaceful nuclear explosions, notably excavation—and it is hard to envisage other justification for the provision in the PNET for multiple explosions—would likely violate the conditions of the Limited Test Ban Treaty. Thus, the PNET has been construed by some as a threat to the existing treaty regime, notwithstanding the perambular affirmation regarding adherence to and strict observance of the Limited Test Ban Treaty.

## EFFECT OF DIFFERENCE IN ADMINISTRATIONS

Bad as they are, particularly in producing cynicism about American and Soviet interests in real arms control and disarmament and in providing a rationale for nuclear weapons proliferation, the Carter administration has been saddled with them—treaties it would not have negotiated itself. The President now advocates their ratification, certainly not as an alternative to a comprehensive treaty, but, presumably at most as a step on the way to a comprehensive treaty, and in a belief that were he not to do so, there could be adverse effects on Soviet-American relations, the Soviets claiming, as they do, that they negotiated the treaties in good faith and with the presumption that agreements reached with one American administration would, in general, be accepted by its successors.

Much of the undesirable effect of the treaties has already been realized, but their ratification will have further adverse effects if they are seen as the end points in the efforts to limit nuclear tests. The damage will be particularly great if they are announced and defended as significant arms control achievements. That is exactly what might have been expected had they been ratified under the previous administrations—recall the hyperbole with which the SALT and Vladivostok agreements were announced—and that is why we would have opposed ratification at that time.

But now the situation is different in that there is a good chance that the additional adverse effects of ratification will be much reduced and perhaps can even be offset by the White House, with the support of the Senate, making it clear that they are not to be seen as the end of the line, and that the United States is committed to the early achievement of a comprehensive treaty.

## SUMMARY

In summary, the TTBT and the PNET are unfortunate legacies. Their negotiation has been harmful to U.S. interests, and further harm seems inevitable.

If they are rejected, the effect on Soviet-American relations will be adverse; if they are ratified, the effects on the rest of the world, particularly on our nonproliferation efforts, are likely to be adverse.

The latter effects can be mitigated if there is rapid progress on a comprehensive treaty, and with the President being clearly committed to such an objective, there is a case for ratifying the two treaties before you—unenthusiastically and certainly without fanfare, particularly if you attach substantial weight to the negative Soviet reaction that is to be expected in the event of rejection.

In the event of ratification, it would be highly desirable that the record show—and a resolution or other instrument might be appropriate—that the treaties are not to be seen as meaningful arms control measures, and particularly not as alternatives to the comprehensive treaty, and that it is the desire of the Congress to see the TTBT and the PNET replaced by a comprehensive treaty as quickly as possible.

On the other hand, if you discount the Soviet reaction to rejection rather heavily, and if you fear that a comprehensive treaty is

not in the cards, notwithstanding the President's best efforts, and that ratification of these treaties may even reduce the prospects, then a negative vote is clearly indicated.

The judgments are very much political ones which you and the President are better qualified to make than are we. My personal judgment is that the balance is so close that I would prefer to make no recommendations as to ratification or rejection.

Thank you.

[Dr. Rathjens' prepared statement follows:]

PREPARED STATEMENT OF GEORGE W. RATHJENS ON BEHALF OF THE FEDERATION OF AMERICAN SCIENTISTS

Mr. Chairman and Members of the Subcommittee, although I appear before you as chairman of the Federation of American Scientists much of what I will say should be taken as a personal statement. This is because, with a membership of 7,000 scientists, we have within our organization a broad range of views. I believe the majority would be sympathetic to most of what I shall say, but I would be reluctant to predict how our members would vote if called to take a position for or against ratification at this time of the threshold test ban treaty (the TTBT) and the peaceful nuclear explosions treaty (the PNET). I expect that there would be a substantial fraction in each camp.

The situation would have been different prior to last year's election. We would have unequivocally recommended against ratification, with, I believe, the support of a large majority of our members. Now, however, for reasons which I shall develop subsequently, an affirmative vote may be justified, notwithstanding the fact that there is almost nothing good, and much that is bad, that can be said of them.

It was a mistake that they were negotiated in the first place. The Nixon Administration should have set its sights higher and striven for a treaty that would have banned all nuclear tests, including all peaceful nuclear explosions. It is quite likely that Soviet interests in peaceful nuclear explosions would have made it impossible to reach agreement on such a treaty, but we nevertheless should have tried, even if to obtain Soviet adherence it would have been necessary, as it probably would have been, to accept a treaty of limited duration because of likely non-acceptance by China, and to rely solely on so-called "national means" of verifying compliance, i.e. to rely principally on instrumentation outside the countries of origin to determine whether suspicious seismic signals had their origins in earthquakes or nuclear explosions. The risk implicit in such a treaty, arising from the fact that verification of compliance could not be totally foolproof, would in our judgment have been small and more than offset by the benefits. First, it should be noted that there is some possibility that clandestine tests, however low in yield, would be disclosed by other than seismic means. Second, and much more significant, is the fact that improvements in ability to discriminate between seismic signals from nuclear explosions and earthquakes has improved dramatically since the negotiation of the partial test ban treaty—improved to the point where it now seems likely that discrimination can be effected in the case of nearly all explosions at yields of above about 10 KT and earthquakes of equivalent magnitude. Third, there is the fact that nuclear weapons technology has matured to the point where the marginal improvements that can be made with additional low yield testing, particularly over a period limited to five years or so, are not likely to be militarily significant.

With remote detection and verification capabilities having developed to this degree, any threshold treaty would have seemed a poor second choice in recent years compared to a comprehensive test ban treaty (a CTBT) which we have strongly supported in the past. One with a threshold of 150 KT seems outrageous from an arms control perspective, for setting the threshold at that level must be seen as having been dictated not by efforts to limit tests to the maximum extent consistent with verification capabilities, as had always been the previous policy, but rather by the interests of weapons developers—a view that finds confirmation in the fact that implementation of even the 150 KT limit was delayed so that weapons tests above that limit could be completed. It is hardly surprising that the negotiation of the TTBT was seen by many not as a step toward a CTBT but as an alternative to it, including possibly as a way of undercutting interest in it; and as a way of conveying an impression of progress in arms control when it was politically expedient to do so—without, in fact, much affecting military programs. The effect has been to produce cynicism among many in this country and in the rest of the world about Soviet and American sincerity in efforts to limit arms programs.

In some respects the PNET is even worse. It, and the fact that the TTBT itself deals only with weapons tests rather than with nuclear explosions of all kinds, suggests that the potential of peaceful nuclear explosions is substantial in the view of the superpowers, when, in fact, this is certainly not justified by American analysis and experience. Thus, the PNET is contrary to interests in limiting nuclear weapons proliferation in that it lends credence to the claims of India—and potentially of other countries as well—that it is reasonable for them to go ahead with the development and test of nuclear devices, even while denying any interest in acquisition of nuclear weapons capabilities. In addition, some of the applications envisaged for peaceful nuclear explosions, notably excavation—and it is hard to envisage other justification for the provision in the PNET for multiple explosions—would likely violate the conditions of the limited test ban treaty. Thus, the PNET has been construed by some as a threat to the existing treaty regime.

Bad as they are, particularly in producing cynicism about American and Soviet interests in real arms control and disarmament and in providing a rationale for nuclear weapons proliferation, the Carter Administration has been saddled with them—treaties it would not have negotiated itself. The President now advocates their ratification, certainly not as an alternative to a comprehensive treaty but, presumably at most as a step on the way to a CTBT and in a belief that were he not to do so there could be adverse effects on Soviet-American relations, the Soviets claiming, as they do, that they negotiated the treaties in good faith and with the presumption that agreements reached with one American administration would in general be accepted by its successors.

Much of the undesirable effect of the treaties has already been realized, but their ratification will have further adverse effects if they are seen as end points in the efforts to limit nuclear tests. The damage will be particularly great if they are announced and defended as significant arms control achievements. That is exactly what might have been expected had they been ratified under the previous administrations—recall the hyperbole with which the SALT and Vladivostok agreements were announced—and that is why we would have opposed ratification at that time. But now the situation is different in that there is a good chance that the additional adverse effects of ratification will be much reduced and perhaps can be even offset by the White House, with the support of the Senate, making it clear that they are not to be seen as the end of the line, and that the United States is committed to the early achievement of a comprehensive treaty.

In summary, the TTBT and the PNET are unfortunate legacies. Their negotiation has been harmful to U.S. interests, and further harm seems inevitable.

If they are rejected, the effect on Soviet-American relations will be adverse: if they are ratified, the effects in the rest of the world, particularly on our non-proliferation efforts, are likely to be adverse.

The latter effects can be mitigated if there is rapid progress on a CTBT, and with the President being clearly committed to such an objective, there is a case for ratifying the two treaties before you—unenthusiastically and certainly without fanfare, particularly if you attach substantial weight to the negative Soviet reaction that is to be expected in the event of rejection. In the event of ratification, it would be highly desirable that the record show—and a resolution or other instrument might be appropriate—that the treaties are not to be seen as meaningful arms control measures and in particular not as alternatives to a CTBT, and that it is the desire of the Congress to see the TTBT and PNET replaced by a CTBT as quickly as possible.

On the other hand, if you discount the Soviet reaction to rejection rather heavily and if you fear that a comprehensive treaty is not in the cards, notwithstanding the President's best efforts, and that ratification of these treaties may even reduce the prospects, then a negative vote is clearly indicated.

The judgements are very much political ones which you, and the President, are better qualified to make than are we. My personal judgment is that the balance is so close that I prefer to make no recommendations as to ratification or rejection.

[F.A.S. Newsletter, January 1972]

#### FAS CALLS FOR TOTAL TEST BAN WITHOUT ONSITE INSPECTION

We believe that the United States should now seek to negotiate a treaty banning all underground nuclear tests without requiring any on-site inspection. The risks are minimal and the gains could be very substantial.

Given recent improvements in seismology and other means of detection, we believe that the United States would detect Soviet violation of a test ban treaty long

before the Soviets could carry out enough tests to score a breakthrough that would threaten the stability of the nuclear balance. Indeed, we are aware of no persuasive argument explaining how even unrestricted Soviet testing below the level easily detected by seismic means could threaten the balance. Moreover, the Soviet leaders could not be given any confidence by Soviet scientists that even a single violation would go undetected.

Without any on-site inspections, clandestine cheating is far less plausible now than it would have been in 1963 with on-site inspections when President Kennedy urged such a treaty. Indeed, we believe on-site inspection would be of only marginal significance, amongst other present methods, in monitoring Soviet test activity. We urge greater declassification of nonseismological methods (and seismological ones also) to permit the public a better appraisal of our ability to monitor a ban.

Much of the opposition to the Test Ban Treaty in the United States does not arise from fear of Soviet cheating. It springs from the desire to continue American nuclear testing in order to develop new weapons, to retest existing weapons and to keep our laboratories vigorous.

We see no need to develop new weapons to maintain the reliability of the American deterrent. A SALT agreement banning ABMs, or restricting them to low levels, would eliminate the need for much planned additional testing to develop improved MIRV and ABM warheads. But even without a SALT agreement, existing warheads would be sufficient. The vigor of the weapons laboratory is not an end in itself. And we can design around any uncertainty which may be created in the future by our inability to test old or modified designs.

There are a variety of means, all consistent with American interests, of dealing with peaceful explosions; our goal should be to find the means which have the greatest international support.

The positive advantages of a Test Ban Treaty are obvious and need not be labored. The treaty could slow down the strategic arms race indirectly. It would greatly reinforce the nonproliferation treaty and decrease the probability that additional nations would seek to develop nuclear weapons. It would eliminate the ecological dangers of further testing. It would inhibit the development of cheaper weapons whose technology might spread to other nations. Finally, it would contribute to an environment in which further steps leading to nuclear disarmament would be possible.

[F.A.S. Public Interest Report, September, 1974]

#### FAS REJECTS TEST BAN TREATY: URGES REOPENING NEGOTIATIONS

FAS has long been firmly committed to an end to nuclear tests. Our organization first fought for the partial test ban treaty signed in 1963. It prevented all but underground tests. For the next nine years we struggled to get the superpowers to fulfill their commitment to "determinedly" negotiate for a complete test ban. During this period, the U.S. negotiating position did not change one iota.

In January, 1972, we saw a ray of hope. We released a newsletter explaining how much and how favorably the technology of inspection had changed. We called for a total test ban without on-site inspection. It was endorsed by eight leading observers of this problem, all ex-highly-placed Governmental scientists. Within a few days, a New York Times editorial quoted and endorsed our approach. A few weeks later, on January 24, 1972, Senator Edward M. Kennedy introduced S. Res. 230 calling for an immediate moratorium on underground nuclear weapons testing with a view to the opening of prompt negotiations for a comprehensive test ban. Two weeks still later, on February 4, the Washington Post reported that the Nixon administration, spurred by Senator Kennedy's initiative, was taking a new look at the test ban.

#### HOPE FADED

But then there was nothing. Rumor had it that the Nixon Administration considered strategic weapons agreement the central issue; the test ban was something to be put off until that was solved.

Two and one half years later, in June 1974, the dying Nixon Administration felt intensely interested in some kind of agreement at the Moscow Summit. It became evident that agreement could not be reached on any important aspect of strategic arms limitations. For one thing the Administration was too weak to bring the State and Defense Departments into agreement.

Attention was turned to the test ban. Leaks had it that there would be an attempt to negotiate a "threshold" test ban agreement in which underground tests would be banned only above a certain size. On May 21, FAS held a press conference warning

that such an agreement was more complicated to monitor than even a complete test ban—and much less desirable. We assumed that the size of explosions permitted under the threshold would be at worst only those smaller than the size of the Hiroshima bomb, about 15 kilotons.

Imagine our distress when the threshold was set ten times higher, 150 kilotons. We knew there was no justification for such a high threshold in any inspection problem. We knew the non-nuclear powers would consider this a joke—and buttress their case for their own nuclear weapons accordingly. And then we noticed that peaceful nuclear explosions were to be permitted under a treaty not yet even negotiated. We knew very well that these explosions were ineffective, unnecessary, and sometimes dangerous despite 20 years of searching for a suitable application.

#### THE TREATY WAS WORSE THAN NOTHING

We thought it over. A great deal of telephoning went on and some visits. We reached the sober decision to oppose the ratification of the treaty and to urge the negotiators to return to the bargaining table. While they were negotiating the problem of peaceful uses, they might as well try again for a better treaty. We felt a subsequent Administration would have a better chance to negotiate the issue determinedly and steadily. We had waited ten years. We would wait longer.

When, and whether, this Moscow Test Ban Treaty will be presented to the Congress we do not now know. But we are convinced that it would be better for our Congress to reject the Treaty and reopen the negotiations. This would send a signal round the world that we are indeed determined and committed to end nuclear testing. The alternative is to approve the Treaty and thus announce that—after more than a decade of commitment to a complete test ban treaty—the U.S. had changed its policy; after a decade of arguing that inspection was the obstacle to a total test ban, the U.S. had negotiated much less than national inspection would permit.

Senator PELL. Thank you very much, Dr. Rathjens.

I think we might hear next from Dr. Scoville. Then we will proceed to question you both.

#### STATEMENT OF HERBERT SCOVILLE, JR., VICE PRESIDENT, ARMS CONTROL ASSOCIATION, WASHINGTON, D.C.

Mr. SCOVILLE. Thank you.

Mr. Chairman, we appreciate your invitation to present to this committee the views of the Arms Control Association, or ACA, on the Threshold Test Ban Treaty and the Peaceful Nuclear Explosion Treaty.

On May 28, 1976, the ACA issued a statement on these treaties and the views expressed in that statement were reaffirmed at a recent meeting of the board of directors of ACA.

I shall attempt to relate the ACA statement to the current situation, particularly with respect to the achievement of a comprehensive test ban treaty, which the association has long supported. I believe that my presentation will be in accord with the general views of the board, but of course the board cannot be responsible for all of the details, and particularly for the answers, I may give to any questions you may raise.

#### TREATIES REPRESENT DISHEARTENING STEP

The association believes that the two treaties represent a disheartening step backward from responsible arms control policies. By permitting continued nuclear tests of very sizable magnitudes and by establishing arrangements for conducting explosions for peaceful purposes, the agreements could delay indefinitely the achievement of a long-sought treaty banning all nuclear tests and would provide new respectability to the arguments of States that seek to develop nuclear weapons capabilities under the guise of an

interest in peaceful explosions. By so doing, the proposed treaties set back still further the prospects for preventing the spread of nuclear weapons to other countries and for countering the grave threat to world peace and security that such proliferation poses.

#### FIVE ASPECTS OF TREATIES OF PARTICULAR CONCERN

Five aspects of the proposed treaties are of particular concern:

One, the threshold. A limit of 150 kt has no relationship to verification capabilities, which now permit the reliable detection and identification of nuclear explosions underground at much lower yields, in most cases at such low yields that any tests which went undiscovered would be of little, if any, military utility.

Two, peaceful explosions given new respectability. It is clear that peaceful nuclear explosions, which are indistinguishable from nuclear weapons tests, can be used by other countries as an excuse to justify nuclear weapons development. By completing a treaty allowing such explosions separate from the treaty limiting weapons tests, the United States and the Soviet Union give new and unwarranted respectability to India and other nations, which can use and have used the new treaty to argue that their conduct of PNE programs has been legitimized.

I might just add a personal note at this point. I have just come back from a couple of meetings in Europe with representatives from many foreign countries, including India. This argument that the United States had signed two separate treaties, one dealing with weapons and another one dealing with peaceful nuclear explosions, was used very strongly on the part of these people to say that therefore a comprehensive test ban treaty should not include peaceful nuclear explosions. This separation of the two types of tests can be one of the biggest roadblocks to achieving a comprehensive test ban.

So, these two treaties are really a roadblock toward a comprehensive test ban treaty.

Three, a freeze on further test limitations. The proposed treaties, if adopted, could freeze the level of permissible tests at 150 kt for years to come. There is no provision for systematically lowering the threshold or number of tests to zero. Furthermore, U.S. acquiescence in tying peaceful explosions to the Threshold Treaty has made an eventual comprehensive test ban treaty hostage to the continued Soviet interest in PNE's.

It should be noted that the preamble to the Threshold Treaty at least reaffirms the principles of the 1963 Limited Test Ban Treaty, which bars the presence of radioactive material outside the national boundaries of states conducting underground explosions. This provision almost certainly will prevent the Soviet Union from legally carrying out announced plans to excavate a large canal using nuclear explosives. I might add, however, at this point that it is a little unfortunate that article I of the Protocol of the PNE Treaty specifically limits tests to a much lower depth, or a slighter depth, than is required to prevent venting. So this, in a sense, can be used as an argument, or imply an argument, that excavation can be permitted. I think it is most unfortunate that that article I was written that way. I am sure this will be a problem when we wish to hold the line on a limited test ban treaty.

Four, "On-Site Inspection" provision is no breakthrough. References to the inspection provisions of the PNE treaty as a breakthrough are misleading. The complex and highly specialized procedures for inviting designated observers to a predetermined location to witness a preplanned explosion bears little relationship to the onsite inspections sought in the late 1950's and 1960's in connection with test ban negotiations.

The principle that U.S. negotiators then sought to establish involved the right to dispatch United States or Soviet inspection teams, upon acquisition of suspicious information suggestive of nuclear testing, to any location, anywhere in the U.S.S.R. or United States at any time.

Furthermore, the science of nuclear test identification has now reached the point where almost all seismic events which can be detected can also be identified, either as earthquakes or explosions, by national technical means. Therefore, since an event must be detected but not identified to trigger an onsite inspection, there would hardly ever be any occasion to call for an inspection.

Five, commitment to the Non-Proliferation Treaty. The United States and the Soviet Union have been criticized widely in recent years for the nonimplementation of their obligations under the Non-Proliferation Treaty, not only to end all nuclear testing, but also to bring about more rapid and meaningful progress at SALT and provide security assurances to parties to the treaty which have been asked to forego nuclear weapons.

The two superpowers have often responded in the past by saying, in effect, that how they handle their arms race is nobody's business but their own. But that is not true. The ending of all nuclear weapons' tests is an essential goal of all nations; any test ban treaty requires the participation of as many nations as possible. Bilateral actions by the two superpowers affect the world's future security and well-being and cosmetic arms control agreements drawn solely up for their mutual convenience, to keep all possible options open, are not good enough.

The association is very pleased that the administration has not waited until the Threshold and PNE Treaties have come into force before resuming serious discussions on a ban on all tests. We await eagerly the resumption of the trilateral negotiations between the United States, the U.S.S.R., and the United Kingdom in October, and hope that they will lead to an early halt to all nuclear testing.

#### SIGNIFICANCE OF TREATIES TO SOVIET GOVERNMENT

We can understand the point expressed to this committee by Mr. Warnke that the Soviet Government attaches great significance to the early entry into force of these treaties and that there could be severe reactions in the Soviet Union were the new United States administration to ignore them.

I must say that I think this is really the only excuse for going ahead with these treaties at this time, that is, in order to satisfy Soviet desire to complete action on these treaties on which much political capital had been spent and to avoid another example of the U.S. Government changing its arms control position after reaching an agreement. Our history in recent years is not very good on that score.

## MAKING CLEAR TREATIES ARE ONLY STEPS TOWARD CTBT

Nevertheless, we still believe for the reasons I have just stated that the treaties are not steps forward and should not be ratified. If, however, the Senate decides to consent to their ratification, we believe that it should do so only if it makes clear that the Senate approves them as steps toward a total ban and that they will not be allowed to become an excuse for delay in achieving such a ban. In such a contingency, the committee's recommendations to the Senate could contain language expressing its understanding that advice and consent is premised on the negotiation of a CTBT without delay and its further belief that these treaties are not in lieu of CTBT.

Unfortunately, the experience with earlier arms control treaties, particularly the Limited Test Ban Treaty of 1963 and the SALT I agreements, provide a strong cause for concern on this score. The LTBT led only to 14 years of inaction on halting nuclear tests and in fact was followed by an increase in the rate of nuclear testing. The SALT I agreements have not yet produced any permanent restrictions on offensive strategic delivery vehicles, and the strategic weapons programs of both the U.S. and the U.S.S.R. have expanded markedly since 1972.

## NEGOTIATING CTBT WITHOUT DELAY

Furthermore, we see no reason for delay in negotiating a CTBT. We believe that the verifications capabilities are now much superior to what they were before and are satisfactory for a CTBT. We believe that the problem of handling peaceful nuclear explosions is soluble, perhaps by including them in the comprehensive test ban, but with a provision that their future resumption should be reviewed after a 5-year moratorium. Peaceful nuclear explosions really do not look very promising. This moratorium would provide an opportunity to study these further, would not foreclose peaceful nuclear explosions forever, and nevertheless would permit going ahead now with the urgently needed Comprehensive Test Ban Treaty.

I have discussed both of these points more fully in my paper, but in the interest of saving time I have gone over them rather rapidly.

Finally, the other roadblock to a comprehensive test ban has been the question of what parties need to be involved initially in order for it to come into operation. The Soviet Union has insisted, at least publicly in the past, that all nuclear weapons states, particularly France and China must be parties, but this automatically means that there would not be a treaty for a long time to come since I think it is clear that neither of these countries are initially likely to become parties.

However, I believe, again, that this roadblock can be dealt with satisfactorily in negotiations with the Soviet Union, perhaps by the normal escape clauses that appear in arms control treaties, for example, withdrawal allowed if events related to the subject matter of the treaty occurred to jeopardize vital national interests. I cannot personally foresee any event which could require resumption of United States or Soviet nuclear testing. It could also be solved by having a review at the end of a 5-year period to see

whether the fact that all nuclear nations were not parties had seriously affected the workings of the treaty.

This should be a compromise which could be worked out and allow us to go ahead.

So, we see no reason at all why a CTBT cannot be negotiated in the immediate future and we believe this is where our attention should lie.

#### CONCLUSION

In conclusion, the Arms Control Association believes that the Comprehensive Test Ban Treaty, not the faulty Threshold and Peaceful Nuclear Explosion Treaties, should be the focus of our efforts at this time. Instead of the Senate taking action of these latter treaties now, the President should be notified of Senate support for the early completion of the negotiations on the CTBT.

Thank you.

[Mr. Scoville's prepared statement follows:]

#### PREPARED STATEMENT OF HERBERT SCOVILLE, JR. ON BEHALF OF THE ARMS CONTROL ASSOCIATION

Mr. Chairman, we appreciate your invitation to present to this Committee the views of the Arms Control Association (ACA) on the Threshold Test Ban Treaty (TTBT) and Peaceful Nuclear Explosion Treaty (PNET). On May 28, 1976 the ACA issued a statement on these treaties and the views expressed in that statement were reaffirmed at a recent meeting of the Board of Directors of ACA. If it is agreeable to the Committee, I shall refer to some of the key points in that statement and append the complete version to my testimony.

I shall also attempt to relate the ACA statement to the current situation, particularly with respect to the achievement of a Comprehensive Test Ban Treaty (CTBT) which the Association has long supported. I believe that my presentation will be in accord with the general views of the Board but of course the Board cannot be responsible for all details and particularly for answers I may give to any questions you may raise.

The Association believes that the two Treaties represent a disheartening step backward from responsible arms control policies. By permitting continued nuclear weapons tests of very sizeable magnitudes and by establishing arrangements for conducting nuclear explosions for peaceful purposes, the agreements could delay indefinitely the achievement of a long sought treaty banning all nuclear tests and would provide new respectability to the arguments of states that seek to develop nuclear weapon capabilities under the guise of an interest in peaceful explosions. By so doing, the proposed Treaties set back still further the prospects for preventing the spread of nuclear weapons to other countries, and for countering the grave threat to world peace and security such proliferation poses.

Five aspects of the proposed treaties are of particular concern:

(1) **The Threshold:** A limit of 150 kilotons has no relationship to verification capabilities, which now permit the reliable detection and identification of nuclear explosions underground at much lower yields, in most cases at such low yields that any tests which went undiscovered would be of little if any military utility. In the past the U.S. government has supported a ban on all tests that could be adequately verified so this is a step backward from previous U.S. positions.

(2) **Peaceful Explosions Given New Respectability:** It is clear that peaceful nuclear explosions (PNEs), which are indistinguishable from nuclear weapons tests, can be used by other countries as an excuse to justify nuclear weapons development. By completing a treaty allowing such explosions separate from the treaty limiting weapons tests, the United States and Soviet Union give new and unwarranted respectability to India and other nations, which can use and have used the new treaty to argue that their conduct of PNE programs has been legitimized.

(3) **A Freeze On Further Test Limitations:** The proposed treaties, if adopted, could freeze the level of permissible nuclear tests at 150 kilotons for years to come. There is no provision for systematically lowering the threshold or number of tests to zero; furthermore, U.S. acquiescence in tying peaceful explosions to the threshold test

ban has made an eventual comprehensive test ban treaty hostage to the continued Soviet interest in PNEs.

(It should be noted that the preamble to the Threshold Treaty at least reaffirms the principles of the 1963 Limited Test Ban Treaty which bars the presence of radioactive material outside the national boundaries of states conducting underground nuclear explosions. This provision almost certainly will prevent the Soviet Union from legally carrying out announced plans to excavate a large canal using nuclear explosives.)

(4) "On-Site Inspection" Provision Is No Breakthrough: References to the inspection provisions of the PNE treaty as a "breakthrough" are misleading. The complex and highly specialized procedures for inviting designated observers to a predetermined location to witness a preplanned explosion bears little relationship to the on-site inspections sought in the late 1950s and 1960s in connection with test ban negotiations. The principle that U.S. negotiators then sought to establish involved the right to dispatch U.S. or Soviet inspection teams, upon acquisition of suspicious information suggestive of nuclear testing, to any location, anywhere in the U.S.S.R. or United States, at any time.

Furthermore, the science of nuclear test identification has now reached the point where almost all seismic events which can be detected can also be identified, either as earthquakes or explosions, by national technical means. Therefore since an event must be detected but not identified to trigger an on-site inspection, there would hardly ever be any occasion to call for an inspection.

(5) Commitment To The Non-Proliferation Treaty: The United States and Soviet Union have been criticized widely in recent years for the non-implementation of their obligations under the Non-Proliferation Treaty, not only to end all nuclear testing, but also to bring about more rapid and meaningful progress at SALT and provide security assurances to parties to the treaty which have been asked to forego nuclear weapons. The two superpowers have responded by saying, in effect, that how they handle their arms race is nobody's business but their own. But that is not true. The ending of all nuclear weapons tests is an essential goal of all nations; any test ban treaty requires the participation of as many nations as possible. Bilateral actions by the two superpowers affect the world's future security and well-being and cosmetic "arms control" agreements drawn up solely for their mutual convenience, to keep all possible options open, are not good enough.

The Arms Control Association therefore called on the President on May 28, 1976 to reopen negotiations with the Soviet Union to obtain a treaty banning all nuclear weapons tests, and to instruct the United States delegation in Geneva to negotiate with all parties in the Conference of the Committee on Disarmament a comprehensive ban ending all nuclear weapons tests for all time.

The Association is very pleased that the Administration has not waited until the TTBT and PNET have come into force before resuming serious discussions on a ban on all tests. We await eagerly the resumption of the trilateral negotiations between the U.S., the U.S.S.R., and the U.K. in October and hope that they will lead to an early halt to all nuclear testing.

We can understand the point expressed to this Committee by Mr. Warnke that the Soviet Government attaches great significance to early entry into force of these Treaties and that there could be severe reactions in the Soviet Union were the new U.S. administration to ignore them. Nevertheless, we still believe for the reasons I have just stated that the Treaties are not steps forward and should not be ratified. If, however, the Senate decides to consent to their ratification, we believe that it should make clear that the Senate approves them only as steps toward a total ban and that they cannot be allowed to become an excuse for delay in achieving such a ban. In order to make this point the Committee's recommendation to the Senate regarding these Treaties could contain language expressing its understanding that advice and consent is premised on the negotiation of a CTBT without delay and its further belief that these treaties are not in lieu of the CTBT.

The experience with earlier arms control treaties, particularly the Limited Test Ban Treaty (LTBT) of 1963 and the SALT I agreements, provide a strong cause for concern on this score. The LTBT led only to 14 years of inaction on halting nuclear tests and in fact was followed by an increase in the rate of nuclear testing. The SALT I agreements have not yet produced any permanent restrictions on offensive strategic delivery vehicles, and the strategic weapons programs of both the U.S. and the U.S.S.R. have both expanded markedly since 1972.

Furthermore we see no reason for any further delay in negotiating a CTBT. Seismic means of detecting and particularly identifying underground events as earthquakes and explosions have now improved to the point that all but very low yield tests in the Soviet Union would incur a high risk of being detected. Moreover, seismic methods can be significantly supplemented by other national technical

means of verification, such as satellite observations. On-site inspections, on demand, no longer can play a significant role in verifying a CTBT, but some international mechanism similar to the Standing Consultative Commission of the ABM Treaty would be useful to resolve inevitable ambiguities in the operation of the Treaty.

We also agree with the Administration position that there is little prospect that any verification technique, even very intrusive on-site inspections, will provide any confidence that a so-called peaceful nuclear explosion (PNE) was not being carried out to satisfy some military need. However, in view of their limited promise, certainly for the next five to ten years, PNEs must not be allowed to become a roadblock to halting nuclear testing.

Finally while we urge that every effort be made to persuade as many nations as possible to become parties to a CTBT, we believe that such a treaty would still be very useful if the U.S., the U.S.S.R., and the U.K. were the only current nuclear weapons nations initially to become parties. It is inconceivable that any Chinese or French testing over the next five years or even longer could lead to developments which could require renewed testing by the U.S. or the U.S.S.R. to protect their security.

An agreement to halt all nuclear tests would finally end the competition to refine still further the already sophisticated nuclear explosives available to the U.S. and the U.S.S.R. A comprehensive treaty rather than ones which authorize significant continued testing would provide a much needed demonstration to the world that the U.S. was serious in its desire to bring the nuclear arms race under control and would therefore further our important non-proliferation goals.

The Arms Control Association believes that the Comprehensive Test Ban Treaty, not the faulty Threshold and Peaceful Nuclear Explosions Treaties, should be the focus of our efforts at this time. Instead of the Senate taking any action on these latter Treaties now, the President should be notified of Senate support for the early completion of the negotiations on the CTBT.

#### ACA STATEMENT ON NUCLEAR TEST TREATIES—THE THRESHOLD TEST BAN AND "PEACEFUL" NUCLEAR EXPLOSIONS: STEPPING BACK FROM RESPONSIBILITY

*On May 28, 1976, the Arms Control Association released the following statement.*

The Arms Control Association today reaffirmed its opposition to the "threshold" test ban treaty signed in Moscow in July 1974 by former President Nixon and Soviet General Secretary Brezhnev, and to the companion treaty governing the conduct of nuclear explosions for peaceful purposes, which President Ford and Secretary Brezhnev have just signed in separate ceremonies.

The Association believes that the two treaties represent a disheartening step backward from responsible arms control policies. By permitting continued nuclear weapons tests of very sizeable magnitudes and by establishing arrangements for conducting nuclear explosions for peaceful purposes, the agreements are likely to delay indefinitely the achievement of a long-sought treaty banning *all* nuclear tests, and to provide new respectability for the arguments of states which seek to develop nuclear weapon capabilities by professing an interest in peaceful explosions alone. By so doing, the proposed treaty sets back still further the prospects for preventing the spread of nuclear weapons to other countries, and for countering the grave threat to world peace and security such proliferation poses.

The Association continues to believe, as it did in 1974, that the President should not submit the treaties to the Senate for its consent to ratification. Instead, the President should reopen negotiations with the Soviet Union to obtain a treaty banning all nuclear weapons tests, and should instruct the United States delegation to the Conference of the Committee on Disarmament to undertake serious negotiations in that multilateral forum toward a treaty banning all nuclear weapons tests, in fulfillment of the commitment made by the United States government, along with all other parties, in the 1963 Limited Test Ban Treaty and the 1968 Non-Proliferation Treaty.

Five aspects of the proposed treaties are of particular concern:

(1) *The Threshold*—A limit of 150 kilotons has no relationship to verification capabilities, which now permit the reliable detection and identification of nuclear explosions underground at much lower yields, in most cases at such low yields that any tests which went undiscovered would be of small military utility. The 150 kiloton limit does, however, permit continued testing of nuclear weapons of considerable magnitude—more than ten times the size of the weapon that devastated Hiroshima.

(2) *Peaceful Explosions Given New Respectability*—Furthermore, it is clear that peaceful nuclear explosions (PNEs), which are indistinguishable from nuclear weap-

ons tests, can be used by other countries as an excuse to justify nuclear weapons development. There was widespread skepticism when India announced that its May, 1974 nuclear explosion was entirely for peaceful purposes. Brazil, Argentina, and others have all expressed an interest in PNEs. By completing a treaty allowing such explosions, the United States and Soviet Union give new and unwarranted respectability to India and other nations which undoubtedly will use the new treaty to argue that their conduct of PNE programs has been vindicated.

(3) *A Freeze On Further Test Limitations*—The proposed treaties, if adopted, are likely to freeze the level of permissible nuclear tests at 150 kilotons for years to come. There is no provision for systematically lowering the threshold or number of tests to zero; furthermore, U.S. acquiescence in tying peaceful explosions to the threshold test ban has made an eventual comprehensive test ban treaty hostage to the continued Soviet interest in PNEs.

The United States has quite properly, but belatedly, all but abandoned efforts to develop nuclear explosives for peaceful purposes. Years of experimentation and millions of dollars in research into ways of using nuclear explosives for excavation, underground engineering, and electric power generation have all led to the conclusion that PNEs cannot compete with conventional means of accomplishing the same objectives, when all economic environmental, and political considerations are taken into account.

The value of PNEs may be seen in a different light elsewhere, but in no case should the prospect that PNEs might prove useful some day, be used today as an excuse for preventing a total ban on all nuclear tests.

(It should be noted that the preamble to the Threshold Treaty at least reaffirms the principles of the 1963 Limited Test Ban Treaty which bars the presence of radioactive material outside the national boundaries of states conducting underground nuclear explosions. This provision almost certainly will prevent the Soviet Union from carrying out announced plans to excavate a large canal using nuclear explosives.)

(4) *"On-Site Inspection" Provision Is No Breakthrough*—References to the inspection provisions of the PNE treaty as a "breakthrough" are misleading. The complex and highly specialized procedure for inviting designated observers to a predetermined location to witness a preplanned explosion bears little relationship to the on-site inspections sought in the late 1950s and 1960s in connection with test ban negotiations. The principle that U.S. negotiators then sought to establish involved the dispatch of U.S. or Soviet inspection teams, upon acquisition of suspicious information suggestive of nuclear testing, to any location, anywhere in the USSR or United States, at any time. In any event, care should be taken in future arms control negotiations that on-site inspections not be made a condition where they are not necessary.

Furthermore, the science of nuclear tests identification has now reached the point where almost all seismic events which can be detected can also be identified, either as earthquakes or explosions, by national technical means, so there would hardly ever be any occasion to call for such an on-site inspection.

Finally, research on on-site inspection technology has shown that such inspections are easily made unreliable by a determined evader. Thus on-site inspection, as it was conceived years ago, would no longer contribute in any way to the verification of a comprehensive test ban. Such specialized verification techniques as have been devised for the PNE agreement might have some relevance to some equally specialized verification problems, but essentially none in the case of a nuclear test ban.

(5) *Commitment To The Non-Proliferation Treaty*—The United States and Soviet Union have been criticized widely in recent years for the non-implementation of their obligations under the Non-Proliferation Treaty, not only to end all nuclear testing, but also to bring about more rapid and meaningful progress at SALT and provide security assurances to parties to the Treaty which have been asked to forego nuclear weapons. The two superpowers have responded by saying, in effect, that how they handle their arms race is nobody's business but their own. But that is not true. The ending of all nuclear weapons tests is an essential goal of all nations; any test ban treaty requires the participation of as many nations as possible. Bilateral actions by the two superpowers affect the world's future security and well-being, and cosmetic "arms control" agreements drawn up solely for their mutual convenience, to keep all possible options open, are not good enough.

The Arms Control Association therefore calls on the President to reopen negotiations with the Soviet Union to obtain a treaty banning all nuclear weapons tests, and to instruct the United States delegation in Geneva to negotiate with all parties in the Conference of the Committee on Disarmament a comprehensive ban ending all nuclear weapons tests for all time.

## BIOGRAPHY OF HERBERT SCOVILLE, JR.

Born—March 16, 1915, New York, N. Y.  
 B.S.—Yale, 1937; Graduate work in Physical Chemistry, Cambridge University, England, 1937-39; Ph.D.—Physical Chemistry, University of Rochester, 1942.

## PROFESSIONAL POSITIONS

1969-71.—Carnegie Endowment for International Peace—Director, Arms Control Program.  
 1963-69.—U.S. Arms Control & Disarmament Agency—Assistant Director, Science and Technology.  
 1955-63.—Central Intelligence Agency—Assistant Director for Scientific Intelligence; Deputy Director for Research.  
 1948-55.—Department of Defense—Technical Director of the Armed Forces Special Weapons Project.  
 1946-48.—Atomic Energy Commission—Senior Scientist, Los Alamos Contract.  
 1941-45.—National Defense Research Committee—Variety of research contracts related to chemical warfare.

## OTHER POSITIONS

1971— —Arms Control Association, Washington—Board of Directors—Vice President.  
 1972— —Council on Foreign Relations Discussion Group on SALT II—Chairman.  
 1977— —*New Directions*—Board Member and Chairman of Task Force, *Reducing Risk of War and Violence*.  
 1975— —Center for Defense Information—Board of Advisors.  
 1970-72.—Atomic Energy Commission—Advisory Committee on Nuclear Materials Safeguards.  
 1967-68.—U.S. Delegates to Japan, Australia, South Africa, and Portugal to interpret the Non-Proliferation Treaty—Chairman.  
 1966-68.—U.S. Delegation, NATO Disarmament Experts' Meetings—Chairman.  
 1953— —U.S. Delegation, to the Geneva Conference of Experts to Study the Possibility of Detecting Violations of a Possible Agreement on Suspension of Nuclear Tests.  
 1955-62.—Air Force Science Advisory Board.  
 1957-63.—President's Science Advisory Committee—Consultant.

## SELECTED PUBLICATIONS

1970.—*Missile Madness*—co-author with Robert Osborn, Houghton Riffin.  
 1970.—*Forward a Strategic Arms Limitation Agreement*, Carnegie Endowment.

## SELECTED PUBLICATIONS

Verification of Nuclear Arms Limitations: An Analysis, Bulletin of the Atomic Scientists, October 1970.  
 International Safeguards: Technical Capabilities, Chapter in Non-Proliferation Treaty: Prospects for Control, \_\_\_\_\_, 1970.  
 The Limitation of Offensive Weapons, Scientific American, January 1971.  
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 Missile Submarines and National Security, Scientific American, June 1972.  
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 The Future of the Sea-Based Deterrent, MIT Press, 1973—Chapters I-V Control Is Still Possible, Survival, International Institute for Strategic Studies, March-April 1974.  
 Flexible Madness, Foreign Policy, Spring 1974.  
 SALT: The Moscow Agreements and Beyond, The Free Press, 1974—Chapter: A Leap Forward in Verification.  
 Is Espionage Necessary for our Security? Foreign Affairs, April 1976.  
 Witness before the Senate and House Armed Services and Foreign Relations Committees on Defense Budgets, Strategic Policies, and Arms Control.  
 Other writings on defense and arms control matters in the New York Times, Los Angeles Times, Washington Post, Christian Science Monitor, New Republican, etc.  
 The SALT Negotiations—Scientific American, Aug. 1977.

Senator PELL. Thank you.

## WITNESSES' POSITIONS CONCERNING RATIFICATION

So the record is clear, Dr. Rathjens, as I understand it, takes no position with regard to ratification. You, Dr. Scoville, and the Arms Control Association are recommending nonratification?

Mr. SCOVILLE. We are recommending nonratification. We are actually not recommending that it be turned down. We are recommending that essentially it be kept on the back burner and that instead the President be told to go ahead with the Comprehensive Treaty.

Senator PELL. I see.

Has the new administration's interest in a comprehensive test ban treaty changed in any way the view of the organizations you represent in regard to these treaties?

Mr. SCOVILLE. I don't believe significantly so. On the other hand, as I mentioned in my testimony, we do appreciate the argument that for the administration to ignore a treaty, that has been signed by the head of the United States Government and not to take any action on it, presents a serious problem in dealing with the Soviets and presents a serious concern of the United States Government's trustworthiness. Therefore, we do understand why the administration felt that it had to go forward with these treaties. But we do not believe that is an overriding consideration in requiring Senate ratification at this time.

Mr. RATHJENS. In our case, or at least in my case personally, I would say that it has made a difference in that I sense in this administration a greater commitment to a comprehensive treaty. To me, that makes ratification of these—

## EVIDENCE OF PRESENT ADMINISTRATION'S INTEREST IN CTBT

Senator CASE. I would be very happy, as a member of the minority, to have you develop your reasons for that sense. I am not sure where I detect that myself.

Mr. RATHJENS. Yes, sir.

My feeling is that if one were to regard these treaties as the end of the line or as a basis for deferral of any action on a comprehensive treaty, I would strongly oppose their ratification.

I believe that that interpretation was a plausible one during the previous administration, I think, far more plausible than it is now.

I believe that the present administration is strongly committed to a comprehensive treaty and that it does not regard these treaties as the end of the line, and for the reasons which Dr. Scoville has just given, because of the relationship with the Soviet Union, I think there is some case for ratification just now—not a very strong one—whereas before, I and our organization would have strongly opposed ratification.

Senator CASE. You have not answered my question of why you feel this. On whose statement and on whose credibility do you say that this administration is stronger for a comprehensive test ban treaty than any other?

Mr. RATHJENS. Well, from just talking with people within it and reading the statements of the President and others that have been published.

Senator CASE. Are you at liberty to say whom you were talking with?

Mr. RATHJENS. Persons in the Arms Control and Disarmament Agency, Mr. Keaney, and others, and from hearing from other spokesmen from the administration in recent weeks.

Senator CASE. I am one who shares your hope, yet I do not find any tangible evidence of this. I am not against it, of course. I think there have been good people in both administrations who are for this. One of them is sitting right back there [indicating] as a matter of fact.

Mr. SCOVILLE. May I comment?

Senator CASE. Please do.

Mr. SCOVILLE. That was not directed at me, but I do think that one can say that President Carter has made a very strong statement urging the immediate end of all nuclear testing. Furthermore, there have been serious negotiations resumed in the last 6 months which have changed the picture. The negotiations first between Secretary Vance and Gromyko in Geneva, the trilateral talks again in July in Geneva, and the forthcoming trilateral talks in October are all concrete actions to try to achieve a comprehensive ban. I regret to say that I saw no similar actions in the previous 15 years.

Senator CASE. I hope that your hope, you know, springing eternal from the human breast, will prove to be justified in the event.

Mr. SCOVILLE. We would not be in the arms control business if we were not perennial optimists. [General laughter.]

Senator CASE. OK. But I do suggest that this is a little bit of a political preconception and a hope, rather than anything based on any very tangible differences. I see the same faces in the Arms Control Agency, the same people behind it, both Republicans and Democrats, and the same people against it. I don't detect any great, springing up of anything new here. But I am hopeful, as you are.

Mr. RATHJENS. Let me make one more point in that connection, Senator, if I may.

Senator CASE. The reason I raise this is that I don't think it is a good idea to turn people off by this kind of comparison. I don't think it helps any.

Mr. RATHJENS. I appreciate that. But I would say—and I may be wrong, this is only supposition—but I doubt that President Carter would have signed these treaties. I think they are bad treaties and that their negotiation was a mistake.

Senator CASE. Do you mean that he did not mean it when he sent them up to the Senate for ratification?

Mr. RATHJENS. He sent them up, but he inherited them. They were a legacy from previous administrations and he was confronted with the issue of whether or not this Government, in dealing with the Soviet Union, will have some continuity in carrying on with agreements reached in the past. I think, in view of statements by him, that he probably would not have been enthusiastic about them.

The fact that President Ford signed the PNET and President Nixon the Threshold Test Ban Treaty suggest to me that they thought these were pretty good treaties. I think they are outrageous. The fact that he sent them up here I would not construe as meaning that President Carter thinks they are very wonderful.

Senator CASE. Forgive me, Mr. Chairman, for monopolizing this, but since I started this line of discussion, I would like to raise one other question.

[Senator Pell nods affirmatively.]

#### ARGUMENT THAT LTBT HAS PROVED SETBACK TO CTBT

Senator CASE. There is an argument in here that the Limited Test Ban Treaty has proved a setback to a really Comprehensive Test Ban Treaty. The argument I think was made in one of your statements—and please forgive me if I mix them up—that 13 years followed the Limited Test Ban Treaty and nothing happened. I think that is, you know, a post hoc ergo propter hoc argument. I wonder if that is sound.

In other words, I am not really enthusiastic about this thing. Indeed, who can be? And yet, isn't it better to take it and go on to the next thing rather than make a big flap about it?

Mr. SCOVILLE. Senator, I think I was the one who made that statement. I did not mean to imply by that statement that the Limited Test Ban Treaty was a bad treaty. What I am saying is that in the interim, after the Limited Test Ban Treaty, we saw virtually no action at all to move on to a comprehensive test ban treaty. Too often we have seen the experience where once we get a treaty, then everybody relaxes and says, well, now, we have done that so let's put it aside and not move forward.

Actually, we ended up by increasing the total number of nuclear tests, i.e., the rate of nuclear testing, after the Limited Test Ban Treaty, than we had before.

All I am trying to say is let's not let that experience occur again after this Threshold Treaty because it may well be that we would see renewed testing. In effect, we have an example of it in connection with the Threshold Treaty. In the 4 years previous to the signing of the Threshold Test Ban Treaty, I believe we had only conducted something like four tests—I am not sure of the precise number but it is something like four—higher than 150 kt. As soon as that was signed, we started an accelerated program of testing above 150 kt, and in the 1½ years afterward I think we conducted something like 15 to 20 tests above 150 kt.

[The following information was subsequently supplied:]

In 1973-74 the U. S. conducted only one test above 200 Kt while in 1975 and up to March 31, 1976, in the interim while the TTBT was going into effect, it conducted 12 such tests.

Mr. SCOVILLE. So, the Threshold Treaty ended up by accelerating the arms race during that time.

Senator CASE. Mr. Chairman, thank you, and please forgive my interruption.

Senator PELL. Certainly.

Senator McGovern.

Senator MCGOVERN. Thank you, Mr. Chairman.

#### PRESIDENT CARTER'S SUPPORT FOR TREATIES

Dr. Rathjens, did I understand you to say in your colloquy with Senator Case that you did not think President Carter would support these treaties?

Mr. RATHJENS. I think he has supported them. He has sent his emissaries up here asking that they be ratified.

What I meant to say was that I doubt— this is supposition on my part—I doubt that he would have negotiated them had he been given the opportunity to start with a clean slate. I think it is unfortunate that we have inherited them and unfortunate that he inherited them. But he is confronted with the dilemma of what to do with them.

As I said, I am very much on the fence as to whether or not if confronted with that problem I would recommend ratification or rejection. I think you lose both ways. I think it is a bad deal to start with.

Senator PELL. Excuse me, but I believe we are confused up here because I think you may have misspoken yourself earlier when you said that you did not think President Carter would sign the treaty. The treaty has to be signed before ratification.

Mr. RATHJENS. Yes, sir. I meant to say that he would not have negotiated them.

#### POLITICAL FACTOR INVOLVED

Senator MCGOVERN. That is, of course, possible. But I am deeply bothered by these treaties because I think, as you point out in the conclusion, what we are really making here is a political judgment having really very little to do with the merits of the arms control issues.

Do you suppose it is possible that the Carter administration, having taken a somewhat different view on the Vladivostok formula, where they sought a somewhat lower level than was negotiated tentatively at Vladivostok, and then being slapped down on that revised formula by the people in Moscow, is therefore reluctant to suggest a different formula now on these two treaties? It does seem to me that that must be one of the factors. We are asked to make a political judgment here, a sort of "don't rock the boat" in terms of what we talked about to the Soviets 3 years ago, otherwise we may have another rerun of the Moscow Conference.

Do you think that is one factor involved?

Mr. RATHJENS. I think, Senator, that very likely may be the case. I think if they are rejected, it will have an adverse effect on relations with the Soviet Union, probably with respect to the negotiation of a comprehensive test ban, and very likely with respect to other arms control negotiations. The Soviets may take the position that since these things have been negotiated and signed previously, we ought to go ahead.

I think that is the case for ratification.

The case against ratification is that by ratifying them, it hurts our nonproliferation efforts and our credibility with the rest of the world as being a Nation that is really interested in serious arms control.

Mr. SCOVILLE. I, too, personally agree with your judgment, Senator McGovern.

I believe it was the experience of Moscow in March over Vladivostok that prompted the administrator finally to move forward and ask for ratification of these treaties. Certainly, the history of its statements up to that time were quite different. President

Carter had made any number of scathing remarks about the Threshold and PNE treaties previous to that time. I think it was only the experience at Moscow that prompted his sending them up here. I think, frankly, that the only excuse for going ahead is that one. It is purely political. You cannot justify going ahead with these treaties on any kind of arms control basis. Clearly the decision on arms control criteria would be that these treaties are bad and we should not move forward with them.

#### WHOSE VIEWS TESTIMONY REPRESENTS

Senator McGOVERN. Both of you gentlemen have been testifying on behalf of associations. I assume, though, that what you are saying here today reflects your own personal views. Would you like to comment on that question?

Mr. SCOVILLE. Senator, my statement is essentially the views of the Arms Control Association. I have interspersed some personal remarks. As far as I know, they would be agreed to essentially by all of the board of directors, but there are obviously differences of nuances in personal opinion.

Senator McGOVERN. What about you, Dr. Rathjens?

Mr. RATHJENS. In my case I think that the great majority of our members and of our elected officers, certainly, would agree that these are bad treaties. Confronted with the issue of what to do with them, my guess is that they would split, and to the extent that I have been able to query them, I have gotten both kinds of reactions.

We would all, I think—well, not all of us, perhaps, but the very large majority—feel strongly that a comprehensive test ban treaty is what we ought to be trying to achieve, rather than something like these two treaties.

#### CTBT'S IMPACT ON LIKELY NUCLEAR WEAPONS' COUNTRIES

Senator McGOVERN. If we had a comprehensive nuclear test ban treaty, what would be its impact on countries we now see as candidates for nuclear weapons?

What would be the impact of such an agreement on those countries most likely to have nuclear weapons? Does it mean they will not get them? Can they get them in other ways?

What is the impact of a comprehensive agreement?

Mr. RATHJENS. I would think it would be very desirable. I don't think it would guarantee that these other nations would not acquire weapons. Some of them might not sign the treaty and might go ahead and test anyway. Some of them might sign it but still develop weapons in violation of it. But I think it would be constructive in at least two senses. Some would sign it and that would strengthen the hands of those in those countries opposed to going ahead with weapons. It would also be useful particularly if it would—as I would hope it would and by definition it would if it is truly comprehensive—prohibit peaceful nuclear explosions. It would eliminate, or at least greatly reduce, the credibility of that argument, the argument that the Indians have used and which may be used elsewhere.

We are willing to forego peaceful nuclear explosions. If a very large number of other nations committed themselves to do likewise, then I think the credibility of that argument would be substantially diminished everywhere.

Mr. SCOVILLE. I would agree with that, too. I think it would have a very positive effect, but it won't guarantee that you are going to stop proliferation.

I think that unless you have a comprehensive test ban treaty, it is clear that you will not stop it.

#### WHAT TREATIES DO

Senator MCGOVERN. Dr. Scoville, if conversely you permit the continued so-called peaceful testing of nuclear weapons and you also permit underground military tests up to 150 kt, doesn't that, in effect, invite any other country that wants to get into the nuclear race to do so?

Mr. SCOVILLE. Yes, it does.

Senator MCGOVERN. So these two treaties really do not buy us a lot, do they?

Mr. SCOVILLE. They just make more legitimate the activities of these countries to go ahead and develop their own nuclear weapons.

Senator MCGOVERN. In effect, what you are doing is giving official legal sanction to what would probably be about what they would be doing anyway in the absence of any treaty. Is that not so?

Mr. SCOVILLE. Exactly.

It looks like a cynical attempt on the part of the two nuclear giants to rationalize going ahead with their own nuclear programs.

Senator MCGOVERN. So, while testing weapons many times the size of the Hiroshima bomb and while carrying on so-called peaceful pursuits with nuclear explosions, the ratification of these treaties then tends to make all of these things that much more respectable.

Mr. SCOVILLE. Absolutely.

Senator MCGOVERN. Thank you, Mr. Chairman.

Senator PELL. Senator Clark.

Senator CLARK. Thank you, Mr. Chairman.

I gather we are pretty much all on the same wavelength and have the same general kind of problem about which way to go. I kind of come down to the position of Mr. Rathjens, although unfortunately I have to vote on this.

I have one question for Mr. Scoville.

#### RISKING DIFFICULTIES RESULTING FROM MOSCOW EXPERIENCE

Granting the problem George McGovern raised and George Rathjens talked about, namely the difficulties that the President might face as a result of the Moscow experience in March. You grant that problem I think quite accurately. Do you still feel that having considered that, we would be better off risking that kind of problem and doing it?

Mr. SCOVILLE. Yes, sir, I do.

Senator CLARK. Would you expand on that a little, please?

Mr. SCOVILLE. I think, in a sense, the administration, by having asked for the ratification, has essentially told the Soviet Union that it has not ignored the previous commitments of the then-existing U.S. administrations.

I don't believe that one has to go through the complete process of ratification and coming into force of these treaties in order to go ahead with other arms control agreements.

I think I would not recommend a negative vote. What I would recommend is that it essentially be kept on the back burner and that tremendous pressure be put on the achievement of a comprehensive test ban treaty, which would be a really good agreement and really have a positive arms control effect.

I don't see how the Soviet Union could object on any kind of legitimate basis to that kind of a policy.

Senator CLARK. So, you would not expect them to react in a very adverse way and say, "If you are not prepared to ratify this, you are certainly not going to be prepared to sign something stronger."

Mr. SCOVILLE. Well, I would never guarantee how the Soviet Union would react.

Senator CLARK. No, of course not.

Mr. SCOVILLE. But I think that if it is done properly, I don't see why that could not be handled.

Senator CLARK. Thank you very much.

Senator PELL. Senator Case, did you have anything further?

Senator CASE. Yes, thank you.

#### INCREASE IN ABILITY TO DETECT AND IDENTIFY EXPLOSIONS

What is the great increase in capacity, to detect and identify explosions, that has occurred over the last 6 or 8 years?

Mr. SCOVILLE. In 1963, when the Limited Test Ban Treaty was signed, we really had very, very poor methods of differentiating between seismic signals from explosions and earthquakes. The detection capability was relatively good, although it has been very markedly improved since then. But what we did not have was criteria for identifying explosions and separating out explosions from earthquakes, and there were large numbers of unknowns which were detected, but not identified.

Since then, as a result of very extensive research, for which one scientist, I think, deserves the major credit, though it was a cooperative effort of many scientists, primarily in this country, one has developed very good criteria, such as depth of focus of the explosion, such as looking at the other characteristics of seismic waves, rather than just the so-called body wave, which was used in the 1963 period. So now, almost every seismic event that is clearly detected with enough stations so that you have some data to work with can be identified as either an explosion or an earthquake. You can argue whether this capability goes down to 1 kt, 2 kt, or 5 kt, but it is somewhere in that order of magnitude or capability. In 1963, we were talking of 20 kt with still a large number of unknowns.

Senator CASE. Has there been a significant increase in common knowledge as to geographical and geological characteristics of more parts of the Soviet Union, for instance?

Mr. SCOVILLE. I guess I cannot really answer that authoritatively. But I believe we have done a lot of studies and we know what happens seismically in possible areas where testing could occur. Perhaps we have better knowledge now. One of the proposed methods of evading the test ban would be to test in very soft alluvium material, dry alluvium material, which would muffle the blast, and therefore make a 10-kt explosion look like only a 1-kt explosion.

I think we know now as a result of these studies that it is most unlikely that this kind of material would exist at depths which would avoid producing a crater so that the Soviets could take advantage of this. I believe that Dr. Lucasik has testified to this effect before the Joint Committee on Atomic Energy around 1970. He really studies this subject very carefully and came to the conclusion that this kind of technique would not be useful above 1 or 2 kt, I believe.

#### TREATIES' PROVISIONS CONCERNING EXCHANGE OF INFORMATION

Senator CASE. It is quite a while since I have looked at these treaties, frankly, but are there provisions in them that have to do with exchange of information that might be a useful thing?

Mr. SCOVILLE. Yes. Exchange of information is a very useful provision in these treaties and presumably the kind of thing you would like to see where it applies. But it is not quite so easy to see where it applies to a comprehensive treaty. But the idea is very good and certainly should be promoted.

The onsite inspections of the PNE Treaty I do not believe have much application at all. I must say that I look upon those onsite inspections with great amazement, wonder, and admiration for those who must have had to negotiate those kind of arrangements with the Soviet Union. My only regret is that this great talent was wasted on such an unimportant project.

Mr. RATHJENS. I might say that I looked hard to find anything good about these treaties and I think you have put your finger on the one thing that is desirable, that is, the exchange of information.

Senator CASE. Do you think if we sat around for a while we might find something more in them? [General laughter.]

Mr. RATHJENS. I don't know.

Senator CASE. Thank you.

Senator PELL. Thank you very much, indeed, gentlemen.

Now may we have the remaining witnesses come up to the table as a group.

#### COMMENDATION OF DR. IKLE

Dr. Ikle, I had the best of relations with you when you were Director. I congratulate you on the way you used to keep us informed. I am delighted to see you again.

Dr. Panofsky, welcome to the committee this morning. Dr. Long, we are also, of course, delighted to have you with us today.

Dr. Ikle, would you kindly lead off.

STATEMENT OF HON. FRED C. IKLE, FORMER DIRECTOR, ARMS CONTROL AND DISARMAMENT AGENCY—ACDA, WASHINGTON, D.C.

Mr. IKLE. Mr. Chairman, I am pleased to appear again before you to discuss these twin treaties which your committee is now considering.

These treaties represent a positive step forward, judged by each of the four criteria against which, in my view, arms control agreements must be tested:

One is what they contribute to this Nation's security and to arms control; two is how well they can be verified and enforced; three is what political impact they might have; and four is whether they will remain viable agreements for the long term.

TREATIES' CONTRIBUTION TO NATIONAL SECURITY AND ARMS CONTROL

Measured by the first criterion, their contribution to national security and arms control, these treaties are constructive. They prohibit all underground nuclear explosions with a yield in excess of 150 kt.

Now, critics of these treaties have pointed out how large, how utterly destructive, yields of this magnitude would be. It is true that the yield of the bomb that destroyed Hiroshima was some 10 times smaller. Let us recall that President Truman and his arms control adviser, Bernard Baruch, tried to grapple with the perils of a nuclear age in which weapons of 150 kt did not even exist. But things have gotten much worse since then.

Prior to the atmospheric test ban, the Soviets tested a device with a yield of some 50,000 kt. And, until these two new treaties came along, the Soviet Union kept testing yields of several megatons, 15 to 20 times larger than this treaty would permit.

Mr. Chairman, if I may digress for a moment from my prepared testimony, I think this is a very important point.

If these treaties were rejected and if the Soviet Union then went back to testing weapons 15 to 20 times larger than would be permitted under this treaty, how would we feel? What would that do for the progress of arms control?

While we are waiting for the conclusion of a comprehensive test ban, should we not prevent the possibility of such larger tests?

Senator CASE. In other words, you are saying, in effect, that we should not sacrifice the better for the best.

Mr. IKLE. Precisely. The better, the comprehensive test ban, is not entirely under our control. It depends also in part on decisions taken in Moscow, decisions which even this administration does not fully control.

These treaties, of course, will neither abolish the existing high yield weapons nor erase the old test data and design information in the laboratories. Above the 150-kt threshold, however, new devices could not be proven through full-scale tests, and weapons in the existing stockpile could never again be tested as long as these treaties remain in effect.

This would make increasingly uncertain the planning of a first strike against targets for which these high yield effects would be important, such as hardened or mobile retaliatory forces.

As a result, the treaties would help strengthen the stability of deterrence. This, Mr. Chairman, seems to me to be a sound step forward in arms control.

#### VERIFICATION AND ENFORCEMENT

The second criterion by which we must judge a proposed arms control agreement is how it can be verified and enforced.

I understand that this committee has received testimony in executive session on our monitoring capability. The critical question is whether we would gather evidence on the basis of which we could take action in the event the Soviets tested yields in excess of the threshold. That is to say, the question is not whether we could garner some vaguely suspicious hints, but whether we could collect some sufficiently convincing evidence.

The larger the excess yield, and thus the more serious its military implications, the more confident could we be of the fact of violation.

#### POLITICAL IMPLICATIONS OF TREATIES

The third criterion concerns the political implications of these treaties.

Here, too, my assessment is positive. The treaties are symmetrical in their effect on both parties. The Soviet Government wants the United States to ratify these treaties, presumably as an indication that our arms control negotiations have continuity and that the Congress still supports formal agreements with the Soviet Union. So, ratification may be of some slight help in our relations with Russia.

On the other hand, the reaction to these treaties by the American news media and the public has been cool, and if anything, in my view, perhaps too skeptical. So we are not risking a euphoric over-reaction in this country. These treaties will not be over-estimated or misjudged in their importance. They are of limited importance. None of our allies objected to these treaties. On the contrary, they seem to welcome the elimination of high-yield tests, as well they should.

#### LONG-TERM IMPACT OF TREATIES

The fourth and last criterion concerns the long-term impact of these treaties.

As has been pointed out, the Treaty on Peaceful Nuclear Explosions sets valuable precedents on verification, even though they are not directly applicable to other types of arms control agreements. For the first time ever, we have obtained Soviet agreement to onsite inspection, thus the objection has been broken in the precedent.

The treaties also establish a reliable and clear relationship between weapons tests and nuclear explosions that may serve civil engineering purposes. These principles should prove useful in the current negotiations on a comprehensive test ban.

Concern had been expressed that the Threshold Treaty might get in the way of a comprehensive ban. I fail to follow the logic of this argument.

We must recognize, however, that a comprehensive ban will create far greater difficulties of verification than a threshold ban. Negotiations of a verifiable comprehensive ban therefore may require more time until we can further develop new monitoring schemes and induce the Soviet Union to accept these procedures.

Therefore, we should consider an intermediate option in the meantime that might be readily attainable today, while a verifiable comprehensive ban is being negotiated.

I have in mind a substantial lowering of the threshold, perhaps down to 70 or 50 kt, or lower. This could be accomplished through a rather simple revision of the two treaties under consideration here. With such a lower threshold, the arms control impact of the two treaties would be more beneficial.

#### CONCLUSION

In concluding, Mr. Chairman, let me note a bit of recent history.

The first of the two treaties under consideration, the Threshold Test Ban Treaty, was signed by President Nixon at his last summit meeting in Moscow in July 1974.

The second treaty, on peaceful explosions, required prolonged and careful negotiations. It was signed almost 2 years later by President Ford, in May 1976.

Now, President Carter has decided to resubmit the request to the Senate for its advice and consent to the ratification of these treaties.

I do not take a jaundiced view of this bipartisan continuity. On the contrary, I think this kind of continuity and bipartisan support should be welcome. Indeed, I think it is essential for sound arms control policy.

Mr Chairman, I believe this committee and the Senate face an easy choice here. The two treaties deserve to be ratified.

Thank you.

[Dr. Ikle's prepared statement follows:]

#### PREPARED STATEMENT OF HON. FRED C. IKLE, FORMER DIRECTOR OF THE U.S. ARMS CONTROL AND DISARMAMENT AGENCY

Mr. Chairman, I am pleased to appear before you to discuss the twin treaties limiting nuclear weapon tests which your Committee is now considering. These treaties represent a positive step forward, judged by each of the four criteria against which, in my view, arms control agreements must be tested: what they contribute to this nation's security and to arms control; how well they can be verified and enforced; what political impact they might have; and, whether they will remain viable agreements for the long term.

(1) Measured by the first criterion—their contribution to national security and arms control—these treaties are certainly constructive. They prohibit all underground nuclear explosions with a yield in excess of 150 kilotons. (The underground environment is the only one in which the 1963 Treaty still permits testing.) Critics of these treaties have pointed out how large—how utterly destructive—yields of this magnitude would be. It is true that the yield of the bomb that destroyed Hiroshima was some ten times smaller. President Truman and his arms control advisor, Bernard Baruch, tried to grapple with the perils of a nuclear age in which weapons of 150 kilotons did not even exist. But things have gotten much worse since then. Prior to the atmospheric test ban, the Soviets tested a device with a yield of some fifty thousand kilotons. And until these new treaties came along, the Soviet Union

kept testing yields of several megatons—fifteen to twenty times larger than this treaty would permit.

These treaties, of course, will neither abolish the existing high yield weapons nor erase the old test data and designs in the laboratories. Above the 150 kiloton threshold, however, new devices could not be proven through full-scale tests and weapons in the existing stockpile could never again be tested as long as these treaties remain in effect. This would make increasingly uncertain the planning of a first strike against targets for which these high yield effects would be important, such as hardened or mobile retaliatory forces. As a result, the treaties will help strengthen the stability of deterrence.

Mr. Chairman, this is a step forward for sound arms control.

(2) The second criterion by which we must judge a proposed arms control agreement, is how it can be verified and enforced. I understand that this committee has received testimony in executive session on our monitoring capability. The critical question is whether we would gather on the basis of which we could take action, in the event the Soviets tested yields in excess of the threshold. That is to say, the question is not whether we could garner some vaguely suspicious hints, but whether we could collect sufficiently convincing evidence. The larger the excess yield, and thus the more serious its military implications, the more confident could we be of the fact of violation.

Could we take corrective action if we found out? We would have to consider a range of responses. Simply resuming similar large yield tests on our own might not be the most meaningful way to respond. A flagrant violation of such an arms control agreement would, of course, be a most serious signal, requiring us to alter many assumptions about our adversaries. It would clearly put into question all our other agreements with them.

(3) The third criterion concerns the political implications of these treaties. Here, too, my assessment is positive. The treaties are symmetrical in their effect on both parties. The Soviet government wants the United States to ratify these treaties, presumably as an indication that our arms control negotiations have continuity and that the Congress still supports formal agreements with the Soviet Union. So ratification may be of some slight help in our relations with Russia.

On the other hand, the reaction to these treaties by the American news media and the public has been cool—if anything, perhaps too skeptical. So we are not risking a euphoric overreaction in this country. And none of our Allies objected to these treaties; on the contrary, they seem to welcome the elimination of high yield tests, as well they should.

(4) The fourth and last criterion concerns the longterm impact of these treaties. As has been pointed out, the treaty on peaceful nuclear explosion sets valuable precedents on verification. For the first time ever, we obtained Soviet agreement to on-site inspection. The two treaties also establish a reliable and clear relationship between weapons tests and nuclear explosions that may serve civil engineering purposes. These principles should prove useful in the current negotiations on a comprehensive ban.

Concern has been expressed that the threshold treaty might get in the way of a comprehensive ban. I fail to follow the logic of this argument. We must recognize, however, that a comprehensive ban will create far greater difficulties of verification than a threshold ban. Negotiation of a verifiable comprehensive ban may require more time until we can develop new monitoring schemes and induce the Soviet Union to accept them.

Therefore we should consider an intermediate option in the meantime, that might be more readily attainable today than a verifiable comprehensive ban. I have in mind a substantial lowering of the threshold, perhaps down to 70 or 50 kilotons. This could be accomplished through a rather simple revision of the two treaties under consideration here. With such a lower threshold, the arms control impact of the two treaties would be even more beneficial.

In concluding, Mr. Chairman, let me note a bit of recent history. The first of two treaties under consideration, the threshold test ban, was signed by President Nixon at his last summit meeting in Moscow, in July 1974. The second treaty, on peaceful explosions, required prolonged and careful negotiations. It was signed almost two years later by President Ford, in May 1976. Now, President Carter has decided to re-submit the request to the Senate for its advice and consent to the ratification of these treaties. This kind of continuity and bipartisan support should be welcome; indeed, it is essential for sound arms control policy.

Mr. Chairman, I believe this Committee and the Senate face an easy choice here: the two treaties clearly deserve to be ratified.

Senator PELL. Thank you very much, Dr. Ikle.

I think we will hear from all of the witnesses and then we shall have questions for each of you.

Next we will hear from Dr. Long.

**STATEMENT OF FRANKLIN A. LONG, DIRECTOR OF THE PROGRAM ON SCIENCE, TECHNOLOGY AND SOCIETY, CORNELL UNIVERSITY, ITHACA, N.Y.**

Mr. LONG. Mr. Chairman and members of the committee, it is a privilege to be here.

I have chosen as my particular area to talk about the utility of peaceful nuclear explosions and particularly the U.S. experience with this. I also want to make a few remarks about the arms control implications.

**UTILITY OF PNE PROGRAM**

As you know, the PNE program for the United States has been a substantial one. It has gone on for two decades and involves at a very minimum \$160 million. A number of tests have been made, and there have also been substantial tests in the Soviet Union.

Up to very recently, almost the only analyses that we have had of this program came from the people who were conducting the program, from the enthusiasts and the supporters. Within the last 2 or 3 years, and thanks in some measure to Dr. Ikle, we have a good deal more in the way of objective analysis of the utility of PNE's. There was a large report done by the Gulf University's Research Consortium of Texas, which is called the GURC report. I chaired a committee which reviewed that and some other related material.

The International Atomic Energy Agency has just released a rather large analysis of PNE and it relied in large measure on an economic analysis by Professor Rowen of Stanford. So, there is a good deal of new information on the utility of PNE, particularly for the United States.

I will be speaking not from my entire text but from the synopsis on the first pages of my material.

As a first point, the studies on PNE reveal a score or so of situations where conceivably PNE might be useful, where it might be applied to problems of either technical or commercial significance. Some of these applications have had a good deal of analysis and some hardly any.

As far as I can see, the available data on all of these various proposals do not, however, permit anything more than the most rudimentary and tentative judgment on the economic utility of PNE for these various applications.

This says something about the complexity of the problem, of course, and the incompleteness of the studies so far. But it also is a somewhat interestingly negative statement in that it also says that there is no single use that stands out as obviously a great thing, as obviously economic and important.

Given this lack of obvious economic interest, there are a number of noneconomic reasons to consider, and on the whole, it seems to me that these militate against the use of PNE. These are pretty well known: The fact that PNE release radioactivity, the fact that

products involved in the PNE's will be contaminated with radioactivity, the fact that there will be ground shock or seismic effects which damage buildings and force people to be moved away from the sites of the explosion and so on.

Quite in addition to these there is a general problem of delays and costs that go with the close regulation of PNE tests. This regulation is virtually inescapable simply because the nuclear explosives that are used for PNE are essentially the same explosives as are used for nuclear weapons. This means, therefore, that they tend to be made by the very same government monopolies that make nuclear weapons, and the security provisions that apply for nuclear weapons tend to be carried over to the nuclear explosives used for PNE.

The regulations have been and will surely continue to be very tight.

For the United States in particular, as we went through the numerous possibilities for use of PNE we concluded that in pretty much every case there exists non-PNE alternatives to the PNE applications. In general, I think I can state that we concluded that over the next decade or two U.S. industry was far more likely to utilize these non-PNE alternatives than to turn to PNE.

#### CONTAINED AND UNCONTAINED USES OF PNE

In discussing this in a bit more detail I ought to distinguish between what are called contained uses, which really means underground—where, if they go right, radioactivity is not released to the atmosphere in any significant amounts—and the so-called uncontained, which are the excavation uses of PNE where material is flung up into the atmosphere and this contains radioactivity.

Senator CASE. Let me interrupt, please, to ask you a sort of technical question.

My understanding is that it is argued that you can have excavations without emission into the atmosphere. Would you please explain a little bit about that?

Mr. LONG. That is not an argument I would be prepared to make. I think the evidence is pretty strong that excavations will and do emit substantial amounts of radioactivity into the atmosphere. There has been some improvement in design to lower the amount of fission radioactivity from the bombs. There have been some improvements in design which reduce the amount of induced reactivity that comes from the neutrons acting on the rock that the test is in. But these are only improvements. There is still a lot of radioactivity generated.

Senator CASE. I see. Somebody said to me the other day that you can put these things very deep; it makes a hole, and then the surface material falls into it. Therefore, you have an excavation. Is that it?

Mr. LONG. That is a way to do an essentially underground test and get up on the surface a rather modest impression. It is not a way to build a canal or build a harbor.

Senator CASE. So you can't do that?

Mr. LONG. No.

Of the contained applications in the United States, the three best studied are: First, stimulating so-called tight formations of rock

which contain natural gas to get a greater yield; second, having PNE explosions deep down in oil shale formation to cause a mass of rubble underground down to which you can go and do retorting in the ground, so-called in situ retorting; third, and the best studied, is explosion of PNE deep underground to produce a cavity which, in turn, can be used as a storage cavity for oil or gas.

These three have been subject to quite detailed analyses by the GURC people and also by us, and in every case the conclusion was that the likelihood that they would be used for the next decade or two was very small. This is for the United States.

There are a number of other less studied and more speculative applications which have also been looked at by the GURC people and by us. Again, for these, the likelihood of use in the next decade or two by the United States is even smaller.

So, we conclude the likelihood of utilization of PNE to the United States is really quite small for up to roughly the year 2000.

The other kind of PNE is the kind used for excavation. These would appear to be infeasible, for just the reasons that Senator Case brought out, namely that if they do generate radioactivity in the atmosphere—and I think they almost inevitably do—they would lead to violations of the 1963 Limited Test Ban Treaty which prohibits radioactivity in detectable amounts to cross national borders.

So, the United States, at least, has concluded that that pretty much stops any possibility of excavation uses.

Even before that, however, the United States was pretty skeptical of the utility for excavations primarily because of the very extensive and careful analysis of the possibility of using PNE's to help construct a sea-level alternative to the Panama Canal. Use of PNE had been touted as a very attractive alternative. This careful study ended up concluding that PNE offered little, if any advantage, and indeed the Commission concluded by recommending that conventional explosives be used if a sea-level canal were to be built.

So, the United States has not really done anything since, on excavation.

#### WHAT OTHER COUNTRIES HAVE DONE ABOUT PNE'S

Now I will turn very briefly to what other countries have done.

As has been said by other people, the Soviet Union has been interested in PNE, has conducted a number of tests, has labeled a number of their tests as "successful."

On the other hand, when one tries to decide if they would be labeled "successful" by our kind of analysis, it is very hard to tell for the simple reason that we have very little data indeed. We have only the most rudimentary technical data on the Soviet tests. We have virtually no economic analysis of the comparative utility of these uses. And, we may never have because clearly the Soviet approach to economic analyses is different from ours and I am not at all sure we will ever get an analysis that we would recognize as useful.

This is really significant because as far as I can see, the PNE treaty at which you are looking simply would not be on the books were it not for the desire of the Soviet Union to continue with PNE for reasons that we do not fully understand.

The other program on PNE which has occurred in recent years has the characteristic of opening up this loophole that previous speakers have referred to. This was the test by India in 1974 of an underground nuclear explosion in the Rajasthan Desert. It was announced by the Indian Government to be a part of a PNE program, a program of development of peaceful nuclear explosives.

No details have ever been given as to what were the particular projects that the Indians had in mind or the economic analysis which justified the use of PNE, and, of course, everyone recognizes that the nuclear explosive that is developed, labeled PNE or not, still is essentially the explosive that one could use in a bomb. Not surprisingly, India's neighbors have been fairly worried by this, and not at all surprisingly, Pakistan has started down the path of nuclear power reactors and, more importantly, a nuclear fuel reprocessing plant which, if it does come, will give Pakistan in a decade or so the capability of having plutonium and being able itself to begin to make nuclear explosives which it, too, might very well label "for peaceful purposes."

So, there is a loophole, we suddenly realize, in the business of a nonnuclear nation developing nuclear explosives for PNE, and unavoidable, inescapably, learning how to make nuclear explosives that could be used for bombs. It is that element, I think, to which other people have referred and which is concerning in any moves made that seem to give PNE's more importance and more significance than they might economically or technically deserve. It leads me to the feeling that, if there is not a strong case for technical and economic attractiveness to PNE, then these I think somewhat negative arms control and nonproliferations arguments, which would be against anything that seems to encourage PNE's, become important and compelling.

It is for that reason that I join with some of the earlier speakers in saying that I really don't like a treaty which seems to say that the Soviet Union and the United States think PNE's are sufficiently important to merit this special test if, in fact, the economics do not really support it, simply because I think it gives the wrong message to the rest of the world.

#### PUSHING AHEAD ON CTBT URGED

Where do I personally come out on all of this? My own preference would be one that is close to Dr. Scoville's position. I would personally prefer to see action on these treaties pushed aside or postponed with a strong urging to push ahead on negotiations toward a comprehensive test ban treaty. I would like that comprehensive test ban to ban all tests, including PNE's.

Now, it may be that from the standpoint of the U.S. Senate the good faith argument, the continuity argument, that Dr. Ikle has just expressed will loom large. It may be that this will lead the Senate to believe that it should ratify these treaties. If this is the political decision, I very much hope that the ratification is accompanied by a statement that says this act does not imply that PNE's are, in themselves, an item of technical and economic importance. Also, I would hope that there would be an accompanying statement urging that treaties perhaps be treated as a step toward a compre-

hensive test ban, and with a Senate resolution urging the administration to push ahead on negotiations for a comprehensive treaty.

Senator PELL. In other words, this should not be accompanied by the same hoop-la as was the Panama Canal Treaty signing.

Mr. LONG. I am afraid that that is what I am saying.

#### EXTENDED SURFACE EXPLOSION QUESTIONED

I have only one minor, almost footnote, comment of a technical nature, which is that I really am somewhat worried about the fact that in the PNE Treaty there is an elaborately spelled-out provision, which would permit a coupled set of successive, or even simultaneous, 150 kt explosions, up to a total megatonnage limit of 1.5 Mt.

The only reason I can see for this is to permit PNE to be used for excavation, and it carries with it an implicit assumption, which I believe to be false, that this sort of extended surface explosion would not lead to a violation of the Limited Test Ban Treaty. I would be very interested in seeing more explanation, more probing with the negotiators as to what was in their minds. Do they really think that excavation is going to be economically sensible and not in violation of the LTB Treaty? That seems to be very doubtful.

That concludes my remarks, Mr. Chairman.

[Mr. Long's prepared statement follows:]

#### PREPARED STATEMENT OF PROF. FRANKLIN A. LONG, CORNELL UNIVERSITY

Mr. Chairman, Members of the Committee, I greatly appreciate the opportunity to appear before you today to discuss the two treaties on nuclear weapons tests now under consideration, Threshold Test Ban Treaty (TTBT), and the Peaceful Nuclear Explosion Treaty (PNET). I shall give particular attention to the economic and technical significance of peaceful nuclear explosions (PNE) to the United States but will also comment briefly on their utility to other nations of the world. I shall make a few remarks on the arms control implications of the proposed treaty and of the PNE programs of other nations.

My personal interest in nuclear test ban treaties goes back to 1962 and 1963 when as an assistant director in the Arms Control and Disarmament Agency, I was involved in negotiating the Partial Test Ban Treaty. I have continued to study these matters as a private citizen. I chaired a committee which in 1975 reviewed for the Arms Control Agency the technical and economic significance of PNE for the U.S. My remarks today will be based on our findings during this study and on some more recent analyses by Professor Henry Rowen of Stanford and by an Ad Hoc Committee of the International Atomic Energy Agency (IAEA).

My statement follows:

#### SYNOPSIS

Although the U.S. program on Peaceful Nuclear Explosions (PNE) has now virtually ceased, enough studies have been made over the past two decades to permit a reasonable analysis of the economic and technical potentials of PNE. PNE tests have also been made within the USSR and information on them has been reported to the International Atomic Energy Agency (IAEA). The available technical data and recent analyses of their economic significance have led me to the following conclusions:

1. There are roughly a score of situations where PNE could conceivably be applied to a problem of technical or commercial significance.
2. The available data do not permit more than a rudimentary judgment of the economic feasibility of PNE for the several proposed applications.
3. There are a variety of non-economic reasons which militate against use of PNE: radioactivity release; ground shock effects; delays and costs from close regulation because the nuclear explosives are essentially the same as those of nuclear weapons.
4. For the interesting applications of PNE which have been studied in the U.S., there exist non-PNE alternatives, and it would appear that over the next decade or two these latter are the more likely to be chosen by U.S. industry.

5. The three best studied applications of PNE in the U.S. are: (a) stimulation of "tight" rock formations containing natural gas; (b) in situ retorting of oil shale rubble formed by PNE; (c) creation of underground storage cavities for oil and gas. Detailed analyses of technologies for these three indicate that there is little likelihood that PNE will be commercially used for these purposes in the U.S. by 1990.

6. Other, more speculative applications for PNE, have been analyzed more briefly and the likelihood of use of PNE for these by 1990 is smaller still.

7. Use of PNE for surface excavation would appear to be infeasible because of likely conflict with the provision of the Partial Test Ban Treaty which prohibits release of radioactivity that crosses national borders, but the USSR and other nations still express interest in excavation applications.

8. The USSR has made a number of PNE tests and has reported successful outcomes. However, virtually no economic analyses or technical details are available on these tests.

9. India detonated an underground nuclear explosion in 1974 which was announced to be part of a PNE program but no details have been given on the possible applications of technical or economic interest to India.

10. Development and testing of nuclear explosives for any use, peaceful or otherwise, by nations which do not have nuclear weapons lead unavoidably to knowledge on nuclear bombs. There is no way to be certain that a nuclear test stated to be for PNE is not a test of a military device.

11. If the various possible uses of PNE are not economically attractive or only marginally so, then the arms control and nonproliferation arguments against a treaty which formalizes their acceptance and use become compelling.

#### RECENT ANALYSIS OF PNE

There have been two recent U.S. studies on prospects for utilization of PNE in the U.S. Both studies were sponsored by the U.S. Arms Control and Disarmament Agency. The larger of the two was performed in 1974-75 by the Gulf Universities Research Consortium of Galveston, Texas, and will here be called GURC Report. A later and briefer study was done in 1975 by a special panel chaired by the author of this testimony. This second study was partly designed to evaluate the GURC Report for the U.S. Arms Control and Disarmament Agency, but the panel was asked also to give its own assessment of the feasibility and utility of PNE for various technical applications.

Between late 1975 and August 1977, an Ad Hoc Advisory Group on Nuclear Explosions for Peaceful Purposes of the IAEA studied the general problem of PNE and issued a report dated 26 August 1977. The report considers health and safety aspects of PNE as well as economic and technical aspects. It analyzes a variety of specific applications of PNE, treating two categories of them, Contained Applications, i.e., underground uses, and Excavation Applications. This Ad Hoc Group also commissioned a study of The Economics of Peaceful Nuclear Explosions by Professor Henry Rowen of Stanford University. The analyses and conclusions of this report, which became available in early 1976, form a large element of the final report from the Ad Hoc Committee of the IAEA.

#### ADVANTAGES AND DISADVANTAGES OF PNE

A striking feature of nuclear explosive devices is their very high energy density, on either a volume or a weight basis. A 100 kt explosive device, equivalent in energy to 100,000 tons of a conventional chemical explosive, need occupy no more than a few cubic feet and need weigh no more than about a ton. In other words, size and weight can both be much less than 1/10,000 of the equivalent chemical explosive. Since energy density, not energy *per se*, is the critical property for opening cavities deep in the earth, and since small size links to simple emplacement, this high energy density is of major importance to use of PNE for underground engineering.

Nuclear explosive devices are also comparatively cheap relative to chemical explosives. Virtually all nuclear devices so far produced have been for military purposes and, since neither characteristics nor costs of nuclear weapons are normally revealed, it is not easy to be definite about the costs of nuclear explosive devices for peaceful uses. However, it seems clear that PNE's will be relatively inexpensive, costing no more than perhaps 1/10th, and possibly considerably less, than that of the equivalent conventional explosive for devices to yield 10 kt or higher. As an example, in 1964 the Atomic Energy Commission gave an estimated cost of \$460,000 for a 100 kt nuclear explosion device for peaceful excavation uses, complete with casing, safety attachments, etc. A similar estimate in 1974 suggested that the current price would be somewhat larger, perhaps in the order of \$700,000, but either

of these prices is considerably less than the cost of 100,000 tons of chemical explosive.

A special feature of nuclear explosive devices is that their costs do not vary much with size, i.e., a 1000 kt device (1 megaton) costs much less than ten times that of a 100 kt device and a 10 kt device costs a good deal more than 1/10th that of a 100 kt. Apparently if nuclear explosive devices are constructed with an energy release as small as 10 or 100 tons, the equivalent cost becomes quite comparable to that of conventional explosives. Because of this "flat" cost characteristic almost all projected uses of PNE's have been for explosions of from 10 kt up.

Because of their immense energy and their potential for damaging side effects, arrangements for firing PNE's are decidedly expensive. As a very rough rule, one can say that the cost of special preparations and safety precautions for underground firing of a PNE device will be about equivalent to that of the device itself. However, this two-fold increase in total cost would still leave a large sized PNE device considerably less costly than that of the equivalent chemical explosive. Comparatively low cost and high energy density are thus the two principal advantages of PNE. But there are disadvantages also and we now turn to these.

#### PRODUCTION OF RADIOACTIVITY

Radioactivity is an inescapable concomitant of a nuclear explosion. Some of this comes from the explosion process itself, i.e., radioactive fission products from the explosion of U-235 or U-239 and unreacted radioactive isotopes including tritium from explosive devices utilizing fusion energy. But in addition, there is also induced radioactivity from the interaction of the neutrons released by the explosion with the materials of the device and with the surrounding earth or rock. When the nuclear explosion occurs deep underground, the radioactivities can be effectively contained, i.e., kept more or less within the area of the underground cavity produced by the explosion. Except for accidental venting, release will be only slow, e.g., by flow of underground water or gas. In contrast, when nuclear explosions are used for excavation purposes of comparatively large amount of radioactivity is inevitably released to the atmosphere. Since the U.S., along with 105 other nations, adheres to the 1963 Partial Nuclear Test Ban Treaty, which prohibits release of atmospheric radioactivity in significant quantities, U.S. experiments with PNE for excavation have ceased.

#### GROUND SHOCK

The other significant effect from nuclear explosions is the development of severe ground shock, i.e., "seismic" effects. The ground shock from an underground nuclear explosion is very similar to that generated by earthquakes and the potential for damage is much the same as for an earthquake of comparable location and energy release. The magnitude of the ground shock and the distance to which it can cause severe damage also depend very much on the character of the rock, the stability of the surface structures, etc., but a rough statement is that explosion of an underground 100 kt device in rock can cause damage to ordinary residential structures that are as far as 30 or 40 miles away. The intensity of the seismic waves can be considerably decreased by exploding the nuclear device in a large underground cavity (a phenomenon known as "big hole decoupling"), but for many of the most important projected uses of PNE close coupling of the explosion with the ground is essential, e.g., to break up rock or to assist in excavation. The consequence is that the damage from the seismic waves of nuclear explosions is a serious constraining element for their peaceful use.

#### OTHER CONSTRAINT

Two important additional constraints are: (a) The normally very large size of PNE and the accompanying radioactivity give to them a characteristic "take it as is" aspect. One must accept the particular consequences of a given explosion, designed for example to develop an underground cavity or a "chimney" of underground rubble, with little opportunity for subsequent tailoring or readjustment.

(b) A different group of constraints on nuclear explosives for peaceful uses arises from the inescapably close linkage of these devices to the nuclear explosives that are used as weapons. Nuclear weapons have been the prime objective of most of the efforts on nuclear explosions, and development and production of weapons has invariably been a government monopoly, subject to severe secrecy classification and security precautions. Similar precautions and government control will apply also to PNE devices.

## U.S. PROGRAM ON PNE

The U.S. effort on PNE became an official program of the Atomic Energy Commission in 1957. The effort centered at the Lawrence Research Laboratory in Livermore, California, and was given the apt name Project Plowshare. With the demise of the AEC the program has come under the control of the Energy Research and Development Administration (ERDA). The name Plowshare has been dropped in favor of the simple descriptive title, Peaceful Nuclear Explosions. The program has been a substantial one with expenditure of about \$160 million since 1957. It has involved laboratory and analytical efforts, but the heart of the program has been a series of test explosions of PNE, mostly at the Nevada site for nuclear weapons testing.

There have been no test explosions of PNE by the U.S. since 1973 and none is contemplated. Indeed the current and projected budget for PNE programs in the U.S. are so small that it is fair to say that the program is effectively suspended.

Roughly 20 applications for PNE have been more or less seriously suggested. Only about 10 of these have had very detailed analysis in the U.S. and only about half of these have been involved in experimental PNE field tests. Initially, the U.S. was quite interested in excavation uses for PNE and a good deal of work was done on their possible application to modifying the Panama Canal or digging a sea-level alternative to it. However, once the 1963 Partial Test Ban Treaty had been agreed to, with its provisions that it is a violation of the Treaty if significant radioactivity from a nuclear explosion crosses national borders, the U.S. has ceased doing any work on excavation uses.

Three applications of contained, i.e., underground, PNE have had extensive analysis by the U.S. and two of them have been subjected to field tests. We turn next to these three.

## STIMULATING PRODUCTION OF NATURAL GAS

By far the greatest U.S. effort on applying contained PNE has been that for the stimulation of natural gas recovery in the Rocky Mountain Basins. Estimates suggest that basin areas in Colorado, Utah, and Wyoming contain reserves from 100 to 600 trillion cubic feet of natural gas. If recovered, this could make an important contribution to U.S. energy needs. Unfortunately, the formations that contain this gas are notably "tight," which in technical terms means that the permeability of the containing rock to the gas is very low. The economic consequences is that yields are low and harvesting the gas is not feasible unless gas prices rise very considerably or unless some method of stimulating the yield of the gas wells is devised.

There have been three U.S. tests in which PNE were lowered into a well drilled into a gas formation and then fired in an attempt to open up a "chimney" of rubblelized rock and cause the development of cracks out into the adjacent rock. The hope was that additional gas would diffuse into the well as a consequence of this opening up of the collection area. The results from the three tests were disappointing. There was some stimulation of gas yield but not to the extent expected. No further gas stimulation tests with PNE are currently planned, but the abandonment (or indefinite postponement) of further tests relates only partially to the disappointing results of the first three experiments. One contributing factor is that there are technical alternatives to the use of PNE, alternatives that at the moment look economically more attractive. At least as important, however, is a strongly negative reaction of segments of the U.S. public to the last two field tests.

Precautions for all three of these field tests of PNE for gas stimulation were substantial. The AEC-industry group strengthened weak nearby buildings, moved some people away from close-in sites, and in general worked diligently to minimize seismic damage. Nevertheless, public opposition, particularly by environmental groups, was substantial for the first test in Colorado and vehement for the Rio Blanco test. Even though both tests went off without serious incident, opposition remained high and ultimately the State of Colorado passed a Constitutional amendment requiring a statewide referendum on any subsequently proposed nuclear explosion within the state. In response to the widespread concern, Congress in 1974 added a restriction to the budget for the Energy Act forbidding any of the funds to be used for PNE tests. The consequence has been that no further PNE field tests have occurred and none is scheduled.

## RETORTING OIL SHALE

Another application of PNE that has been studied in some detail by scientists and engineers at Livermore is utilization for in situ retorting of oil shale. It has long been known that a very large source of "oil," perhaps equivalent to several hundred million barrels of petroleum, is present as an organic material called kerogen in the

oil shales of Colorado, Utah, and Wyoming. To recover the oil, shale must be heated enough to break down the kerogen into a fluid that can be recovered and ultimately refined much as petroleum is. There are many problems since the concentration of kerogen is not especially high and retorting into oil uses substantial water. There are also environmental difficulties. As a response to these problems, *in situ* retorting is attractive. The general idea is to produce an internal cavity within a bed of oil shale that contains a controlled amount of rubble that can be burned by pumping in air to maintain an advancing combustion front. Oil yield is lower than for above-ground retorting, but there is no disposal problem for the spent rock and operating costs may be lower.

The application of PNE to this problem calls for exploding a nuclear device at the bottom of a deep bed of water-free shale, perhaps at 2,000 feet below the surface. The desired result is a vertical "chimney" of rubble shale that could be retorted *in situ*.

The technical uncertainties for this process are so extensive that the GURC analysts found it impossible to make any reasonably firm estimates of cost effectiveness. There are a number of uncertainties including the actual effect of a PNE in oil shale, the character of the rubble, and its combustibility and permeability. There are also concerns about the considerable ground effects from the PNE even if the test is formally contained. Finally, even with the best of planning, only about 25 percent of a given bed of shale can be retorted *in situ* by the PNE procedure, without danger of a blow by into another chimney. Without some PNE testing, it will be virtually impossible to resolve some of these uncertainties. Fortunately, there are a number of alternate technologies to this PNE-linked process and much R&D activity is now underway on them.

#### PRODUCTION OF UNDERGROUND STORAGE CAVITIES

The most straightforward and best understood of the technological applications of PNE is the construction of underground cavities to be used for storage of oil or gas. Data from the many U.S. underground nuclear explosions give relatively firm knowledge on sizes of cavities that will be generated in various media, on the needed depth of emplacement of the explosions for the cavities to be fully contained, and on the resulting levels of radioactivity and temperatures. Hence, cost analyses for storage cavities generated by PNE should be substantially firmer than for most other applications. The analyses reported by GURC suggest that generation of cavities by PNE can be cost effective or close to it, compared to most of the more obvious technical alternatives, such as leaching cavities in salt domes or constructing above-ground steel or concrete storage tanks. In spite of this, GURC concludes that the probability is small for utilizing PNE by 1990 for developing underground storage for oil or gas in the U.S.

A major difficulty in the use of PNE's is that the need for underground storage is highly location-specific. For example, gas storage is much more desirable if it is located near the consumer end of the pipeline so as to maximize the utility of the long distance transmission lines. This frequently means that the desired storage should be close to populated areas, precisely where utilization on PNE runs into the greatest difficulties of safety precautions, regulation, and public acceptance. In addition, there are a number of alternatives to newly generated underground cavities. Given also the inescapable difficulties and time delays which arise from the generation of radioactivity and the seismic effects, the potential gains from the use of PNE do not appear sufficient to make their use any more than marginally interesting.

#### OTHER USES FOR CONTAINED PNE

A number of other uses for PNE fired underground have been discussed but not examined in great detail and not yet subjected to any test explosions. One is the rubbleizing and leaching of copper ore, the PNE technology for which is rather like that for *in situ* retorting of oil shale. Since there are many uncertainties and since there appear to be interesting alternatives to the use of PNE, it appears unlikely that this will have more detailed study in the near future. An innovative proposal, called Project PACER, suggests use of sequential nuclear fusion explosions in a deep cavity for the generation of steam for electric power and for the "breeding" of uranium-233 or plutonium-239, as an alternative to a breeder reactor. The uncertainties about this proposal are very considerable and the analysis so far has not been adequate to even permit decisions as to feasibility. Little work is now being done on this project and one can conclude that serious examination of it lies well into the future.

## EXCAVATION WITH PNE

The United States has not given much consideration to this application of PNE for many years, but it remains one of the most appealing to many other nations, perhaps due to the early U.S. experiments and optimistic analyses.

As a consequence of the early U.S. tests, cratering effects from PNE in various solid media are fairly well understood, especially for explosions of less than 100 kt. In addition, design improvement of the explosive devices has reduced the amount of radioactivity which is generated. Even so, there remains a severe inhibition to excavation by PNE because of the concern that the radioactivity generated will be sufficient to lead to a violation of the Partial Nuclear Test Ban Treaty.

The major reason for interest in PNE for excavation is the considerably lower cost of PNE per unit energy, as compared to chemical explosives. The obvious drawbacks are the associated seismic effects and the problems of radioactive fall-out. Less obvious, but of great significance, are uncertainties about crater depth and crater lip stability. Persuasive evaluation of the costs and benefits of the use of PNE for excavation will clearly depend upon the character of the specific project. By far the most detailed analysis of use of PNE for an excavation project, with careful comparison of their costs to those of conventional alternatives, was done by the Canal Study Commission of the U.S. which was charged to examine sea-level alternatives to the current canal across the Isthmus of Panama. Prior to the efforts of this commission, proponents of PNE for this application had argued that savings of up to one or two billion dollars were available if PNE were used. After a several year study completed in 1970 at a cost of \$22 million, the Commission concluded that the costs of using PNE along the most favorable route for their application actually exceeded by \$200 million the updated costs of the most favorable conventional route. In other words, the more detailed analysis led to an actual reversal in relative costs. The final recommendation of the study commission was that if a sea level canal were built, it should be along a route which required only conventional excavation procedures. Since this careful and pessimistic analysis, there has been little further attention in the U.S. to utilization of PNE's for excavation purposes.

## PROSPECTS FOR THE USE OF PNE IN THE UNITED STATES

The 1975 GURC analysis, the special study group to review this analysis and the later study of the economics of PNE by Professor Henry Rowen agree that the prospects for commercial use of PNE in the U.S. in the next couple of decades are very small. There are two elements in this pessimistic conclusion. The first is that it seems quite doubtful whether there will be a persuasive demonstration of cost effectiveness for any of the proposed applications in the next decade or so. The second reason is that even if cost effectiveness is demonstrated, there will be a number of political and social uncertainties and regulating delays which would still make commercial utilization rather unlikely.

## PNE PROGRAMS IN OTHER NATIONS

This discussion will deal sequentially with the situation with nations that have already developed nuclear weapons and those that have not. The situation in the USSR is of particular interest since it started a PNE program soon after that of the U.S. and the program remains a vigorous one. The USSR has reported successful use of PNE in three areas: extinguishing a gas well fire; stimulating an oil field; developing an underground storage cavity for gas. Although the USSR has called these tests successful, there have been no economic analyses presented to support the case that these procedures are cost effective, compared to the non-nuclear alternatives.

The USSR has also evinced considerable interest in applying PNE to excavation, specifically to help in the construction of a canal between the Kama and Pechora Rivers in order to reverse water flow from the Arctic to the Caspian Sea. There are no data available to make any judgment as to the technical and economic feasibility of this project. Indeed, since the approach of the USSR to economic analyses tends to be on rather different bases from those of the U.S., it may be that the kind of data of interest which the West would want to see will never become available.

The different conclusions which the U.S. and the USSR have apparently reached on the utility of PNE is of considerable consequence since it now seems that without strong USSR interest, there almost surely would be no presentation to the U.S. Senate of a Treaty on PNE applications.

From the point of view of arms control, specifically of minimizing the proliferation of nuclear weapons, the worrisome aspect of any efforts of currently non-nuclear nations to develop nuclear explosives for PNE is that unavoidably the nuclear explosive devices are essentially the same as those for a nuclear bomb. The

development program which alerted the world to the implications of this fact is that of India which exploded a nuclear device, stated to be of 12 kt. yield, in the Rajasthan desert in 1974 and simultaneously announced that the device was part of an Indian program on the development of Peaceful Nuclear Explosions. This even was of deep concern to India's neighbors, particularly Pakistan which not surprisingly was acutely conscious of the fact the Indian development program on nuclear explosives inescapably led to information on an explosive device which could make a nuclear bomb as well as a PNE, and hence, represented a threat to Pakistan. Since Pakistan has recently persuaded France to export to it nuclear reactors for energy and a nuclear fuel reprocessing plant which will generate supplies of plutonium, the world is concerned that in the not too distant future there will be two nations in South Asia which have information on procedures to develop plutonium-based nuclear explosives.

There is a prima facie case against PNE being of much interest to developing nations. Both the development of nuclear devices and their application are capital-intensive, whereas developing nations typically are short of capital and have surpluses of labor. Furthermore, IAEA has for some years expressed willingness to take on a "servicing role" for exploding peaceful nuclear devices for non-nuclear countries which want to do tests of PNE. However, this idea has not attracted much interest among the developing nations.

#### CONCLUDING REMARKS

Recent studies of the U.S. programs for application of PNE conclude that PNE are not currently very attractive to the U.S. and indicate that there is no significant likelihood that PNE will have commercial utilization in the U.S. by 1990. Even though situations may be somewhat different in other countries, there do not appear to be any obvious technical or economic reasons why this negative conclusion on the desirability of PNE should not apply to virtually all other nations. These points do not constitute an argument to prohibit research and development on possible peaceful uses of nuclear explosives since there are many technical unknowns and economic uncertainties. They do, however, strongly suggest that if continued testing of PNE represents a substantial interference to desirable arms control or disarmament objectives, the potential benefits from PNE would not appear to be sufficient to permit their testing to stand in the way. It is difficult, for example, to see why concern about PNE should interfere with negotiations toward a Comprehensive Test Ban Treaty (CTBT), which banned all tests of nuclear explosive devices. At the very minimum, a 10-year moratorium on testing of PNE in context of a CTBT would seem to be a modest price to pay for the significant progress towards arms control nonproliferation that a Comprehensive Ban could represent.

The immediate problem facing the U.S. Senate is the requests for ratification of a pair of treaties, the TTBT and the PNET. My own strong preference would be for these treaties to be put aside and for negotiations to proceed vigorously on obtaining a Comprehensive Test Ban. I am aware, however, that the fact that these earlier treaties were negotiated in good faith by the USSR and the U.S. constitutes a reason why there is pressure toward their ratification. I am particularly concerned about the proposed treaty on PNE since I do not believe it represents a significant accomplishment in itself, and I do believe that its submission and ratification will make it more difficult for the U.S. and the USSR to argue effectively against programs of development of nuclear explosive devices for PNE applications of the sort which India has already carried out. To the extent that such programs would lead still more nations of the world to obtain the capability to manufacture nuclear explosive devices including bombs, it would be a step backward in our effort to slow down proliferation of nuclear weapons.

Senator PELL. Thank you very much, Professor Long.  
Dr. Panofsky, we will now hear from you.

#### STATEMENT OF WOLFGANG K. H. PANOFSKY, DIRECTOR STANFORD LINEAR ACCELERATOR CENTER, STANFORD, CALIF.

Mr. PANOFSKY. Thank you very much, Mr. Chairman. I appreciate very much the opportunity to present my views on Senate ratification of the TTBT and the Treaty on Peaceful Nuclear Explosions, or PNE's.

It is characteristic of the problem before your committee that remarkably little has changed during the period, commencing in

1958, in which this country has deliberated and negotiated on the question of cessation of nuclear tests.

#### SIGNIFICANCE OF LTBT

The agreement reached in 1963, the LTBT, has indeed all but eliminated the adverse environmental consequences, primarily radioactive fall-out, of nuclear testing. It has done, however, very little, if anything, to impede the development of nuclear weapons in the United States and the Soviet Union, nor to affect stockpile confidence firings and most nuclear weapons effects tests.

The LTBT has had one militarily very significant result and that is it has prevented complete tests of single or multiple nuclear explosions as they affect the resistance of hardened missile silos to nuclear attack.

Thus, the LTBT has made it more difficult for a military planner to gain the information required to destroy ICBM's in their silos with very few survivors left to retaliate. In this sense, the LTBT has contributed to the maintenance of Minuteman as a viable arm of the U.S. deterrent forces for a very long time to come.

#### IMPACT OF NUCLEAR TEST RESTRICTIONS AT THIS TIME

Most would agree that had we been able to reach agreement in 1963 on a comprehensive nuclear test ban treaty, adhered to by both the Soviet Union and the United States, and monitored by national means utilizing the detection and identification capabilities which an improved seismology and other surveillance technologies can provide, then U.S. national security would have been stronger today.

Nuclear weapons technology is a mature art, and therefore further nuclear weapons development may lead to some increases in efficiency or to adaptation to specialized missions, but is not apt to result in qualitatively new developments. Even numerical improvements in such quantities as yield to weight ratio are approaching a limit.

I would like to add here parenthetically that I consider the much discussed neutron bomb, the W-70 Mod. 3 warhead for the Lance system, to be in the category of a specialized adaptation rather than a substantial departure from the role of other tactical nuclear warheads.

The detailed performance of most weapons systems, both in strategic and tactical fields, is apt to depend much more strongly on the evolution of the nonnuclear components of the system, rather than on improved design of the nuclear warhead.

Accordingly, any nuclear test restrictions at this time are not likely to have a significant impact on the arms competition between the United States and the Soviet Union. However, the principal motivation for pursuing a comprehensive nuclear test ban treaty, or CTBT, relates to the issue of nuclear non-proliferation.

Here the linkage is both political and technical. By agreeing to the preamble of the NPT, and as a signatory to the Limited Nuclear Test Ban, this country has undertaken a solemn obligation to strive in good faith toward the attainment of a CTBT. The lack of progress on the part of the Soviet Union and the United States in

reaching a CTBT has added to the cynicism with which the NPT is viewed by some nations and individuals. This cynicism would not be alleviated in itself, once this country has ratified the TTBT now before the Senate.

On the contrary, ratification of the Threshold Test Ban Treaty would actually be counterproductive to the cause of nonproliferation if it served to diminish the pressure toward attainment of a comprehensive ban.

#### RECOMMENDATION

My recommendation, therefore, is that the Senate ratify the TTBT, but in a strongly expressed context that ratification is given with the full understanding that the TTBT is a step toward a comprehensive ban rather than a terminal objective in its own right.

The technical reason why a comprehensive test ban agreement would serve the cause of nonproliferation is, of course, the fact that nonnuclear nations could not with confidence develop a nuclear explosive without nuclear testing.

The LTBT of 1963 currently has more than 100 signatories, and it would be expected similarly that a comprehensive ban would be adhered to by a very large number of other nations.

Accordingly, a CTBT would constitute a direct limit on the number of nations which could acquire nuclear explosives.

#### ARGUMENTS AGAINST CTBT

The previous remarks outline some of the main reasons for strongly supporting the thrust toward a CTBT. This committee has, of course, heard and will continue to hear arguments expressing the opposite point of view. The arguments tend to fall into four categories:

One, the possibility that the Soviets would cheat under a CTBT while the United States would not do so;

Two, the reliability of the U.S. nuclear weapons stockpile could not be verified under a comprehensive ban;

Three, the U.S. weapons laboratories would deteriorate under a comprehensive ban, while the Soviet laboratories could be maintained by coercion to function effectively;

Four, a comprehensive ban would interfere with programs currently planned for certain U.S. military systems.

Let me comment on each of these four items briefly in turn.

#### POSSIBLE EVASION

There is no question that regardless of the progress which has been made in verification technology, to which previous witnesses have referred, it will always be possible for a determined evader to carry out a small number of tests at low yield that cannot be identified by national technical means alone. Onsite inspection offers very little incremental verification capability. However, some residual risk of detection always remains, even if technical verification means have not detected the violation.

It is exceedingly unlikely that results of such testing would be of substantial military significance. This conclusion is based upon

some of my remarks made before about the maturity of nuclear weapons technology. As a result of this situation, the incentive to take the risk of evasion is very small, and the military consequences of evasion are minimal.

#### STOCKPILE VERIFICATION

As far as this argument is concerned, the committee should note that it has been amply demonstrated that stockpile verification can be carried out without benefit of nuclear testing.

On a longer time scale, there may well be a gradual deterioration of confidence which military planners have in the reliability of the nuclear weapons stockpile.

I believe on balance that this is a beneficial effect because it would tend to discourage preemptive counterforce strikes against the deterrent forces of the opponent. In contrast, the deterrent value of nuclear weapons is hardly affected by small decreases in reliability.

#### WEAPONS LABORATORIES

A frequently heard argument against a CTBT relates to the viability of the weapons laboratories. Indeed, in the absence of nuclear testing the viability of nuclear weapons laboratories would be downgraded in time.

However, I believe that this argument applies at least as much to the Soviet Union; the very essence of arms control is that the military R. & D. capability of all parties be impacted.

I do not believe in the assertion that the Soviet Union would be in a position under a CTBT to coerce highly productive weapons R. & D. while the United States would not. Creativity cannot be coerced.

In fact, wisely, the U.S. ERDA-supported weapons laboratories, namely Livermore and Los Alamos, have diversified their activity so that roughly half of their funding is now dedicated to direct energy-related programs. Some of the technology involved in such programs overlaps that of weapons technology. Moreover, the United States has facilities superior to those of the Soviet Union in the field of computation related to weapons design and in simulation of weapons phenomena.

#### EFFECT ON PRESENT PROGRAMS

The military impact of an arms control measure should be judged by a net assessment rather than simply by its effect upon planned U.S. programs. In this respect, I believe that on balance, a CTBT would be a net gain to U.S. security.

#### TTB TREATY

Were it not for the assumption that the Threshold Test Ban Treaty should be viewed as a step toward a comprehensive test ban, and were it not also for the fact that the Threshold Test Ban Treaty now before you has been negotiated in good faith by this Government, I would be opposed to its ratification.

Viewed as an agreement in isolation one might consider the TTBT to be worse than nothing. The threshold of 150 kt is set so high that it bears little relation to the much lower threshold which might be related to confident verification.

Therefore the conclusion that the magnitude of the threshold of 150 kt was defined by the desire of weapons designers to have the treaty offer a minimum impediment to their work is inescapable. Moreover, the very fact that the TTBT exempts peaceful nuclear explosions is a poor precedent for progress toward a CTBT.

As has been amply discussed before this committee, even with extensive and probably unacceptably intrusive and expensive inspection measures, there is no known way in which one can prevent military benefits from accruing from peaceful nuclear explosions. Once a nonnuclear nation has detonated a nuclear explosion, be it for peaceful or military purposes, it has joined the ranks of nuclear weapons states.

#### INCLUSION OF PEACEFUL NUCLEAR EXPLOSIONS

Notwithstanding this criticism of the TTBT if viewed in isolation, there is one constructive aspect of the inclusion of peaceful nuclear explosions in the TTBT and of the subsequent history leading to the treaty governing the conduct of PNE's.

As the TTBT was framed in 1974, the design of the detailed rules governing the conduct of PNE's was relegated to a separate negotiation. At that time, Mr. Chairman, it was not clear whether this separate negotiation would lead to the establishment of a different and possibly higher threshold for PNE's relative to the threshold of 150 kt specified for military explosions.

After labeling for well over a year to arrive at a higher threshold for PNE's than for military explosions, the negotiators finally concluded that they were unable to do so in a manner which could be adequately verified. Therefore the PNE Treaty and its annexed protocol now before the Senate constitute an instrument which is designed to assure the nations of the world that the thresholds permitted for single peaceful nuclear explosions and for military explosions correspond to the same yield. The treaty does not assure that peaceful nuclear explosions are, in fact, peaceful.

The negotiations preceding the treaty failed in arriving at mutually acceptable criteria which would distinguish military from peaceful nuclear explosions. This is an important lesson. It means that as we proceed to a comprehensive nuclear test ban treaty, and I believe we must, Mr. Chairman, peaceful nuclear explosions must be excluded entirely. There is no valid reason to extend hope that the negotiating effort which failed to achieve its goal of distinguishing peaceful from military explosions in the context of the TTBT will succeed in the context of a treaty in which military explosions are banned entirely.

Professor Long has elaborated on the merit or lack of merit from the economic point of view of peaceful nuclear explosions. I would only like to add one remark which, to me, is a controlling point, and that is, should the exploitation of PNE's for resource recovery projects, such as oil and gas stimulation, turn out to be economical, this could only be true on a scale which requires nuclear explosions to be carried out at a rate of hundreds or thousands per year. This,

in turn, would demand an industrial technological base and traffic in nuclear explosives of a volume which involves dangers of diversion, highjacking, and so forth, which would dwarf the risks which are now under so much discussion both before the Congress and the people in connection with the plutonium economy inherent to civilian nuclear power using reprocessing of fuel rods for the plutonium breeder reactor.

Discussions of the possibility of verifying that peaceful nuclear explosions are indeed peaceful tend to ignore the enormous volume of explosions which would have to be conducted, should PNE's really reach a state of productivity.

#### RECOMMENDATION

Let me relate these observations to my recommendation on the PNE treaty.

I recommend that the Senate ratify the treaty. In so doing the Senate should emphasize that this ratification in no way endorses a future PNE exemption or other special consideration for PNE's in connection with a comprehensive test ban treaty.

Rather, the Senate should emphasize that the very nature of the PNE Treaty now being ratified is such that it does not distinguish between peaceful and military nuclear explosions. Instead, the treaty establishes criteria and procedures assuring that the yield of military and single peaceful nuclear explosions be essentially equal and thereby removes any incentive toward abuse of peaceful nuclear explosions for military purposes.

Thank you, Mr. Chairman.

[Mr. Panofsky's prepared statement follows:]

#### PREPARED STATEMENT OF W. K. H. PANOFSKY

I appreciate very much the opportunity to present my views on Senate ratification of the Threshold Test Ban Treaty (TTBT) and the Peaceful Nuclear Explosions Treaty (PNE). I have had the previous opportunity to testify on the TTBT before this Committee on September 12, 1974, and I also testified on the desirability of a Comprehensive Nuclear Test Ban before a Subcommittee of this Committee on May 1, 1973. As before, I am testifying today as a private citizen who has maintained contact with the nuclear test ban problem since 1958.

It is characteristic of the problem before your Committee that remarkably little has changed during the period, commencing in 1958, in which this country has deliberated and negotiated on the question of cessation of nuclear tests. As you know, agreement was reached in 1963 on a Limited Nuclear Test Ban (LTBT) which banned nuclear explosions, military or peaceful, in the atmosphere, in space, or under water. This treaty has all but eliminated the adverse environmental consequences, primarily radioactive fall-out, of nuclear testing by its signatories. However, it has done little, if anything, to impede the development of nuclear weapons in the U.S. and the USSR, nor to affect stockpile confidence firings and most nuclear weapons effects tests. The LTBT has had the militarily significant result of preventing complete tests of single or multiple nuclear explosions as they affect the resistance of hardened missile silos to nuclear attack. Thus the LTBT has made it more difficult for a military planner to gain the information required to destroy ICBM's in their silos with very few survivors left to retaliate. In this sense, the LTBT has contributed to the maintenance of Minuteman as a viable arm of the U.S. deterrent forces for a long time ahead.

The LTBT has thus had a useful effect environmentally and, to a limited extent, has contributed to strategic stability. Yet most would agree that had we been able to reach agreement in 1963 on a Comprehensive Nuclear Test Ban (CTBT), adhered to by both the Soviet Union and the United States, and monitored by National Means utilizing the detection and identification capabilities which an improved seismology and other surveillance technologies can provide, then U.S. national

seismology and other surveillance technologies can provide, then U.S. national security would have been stronger today.

As I have testified before this Committee on the earlier occasions cited, I believe that nuclear weapons technology is a mature art and that further nuclear weapons development may lead to some increases in efficiency or to adaptation to specialized missions, but is not apt to result in qualitatively new developments. Even numerical improvements in such quantities as yield-to-weight ratio are approaching a limit. I would like to add here parenthetically that I consider the much discussed "neutron bomb" (the W-70-Mod. 3 warhead for the LANCE System) to be in the category of a specialized adaptation rather than a substantial departure from the role of other tactical nuclear warheads.

Since nuclear weapons technology is a mature undertaking, the detailed performance of most weapons systems, both in the strategic and tactical fields, is apt to depend more strongly on the evolution of the non-nuclear components of the system than on improved design of the nuclear warhead. Accordingly, any nuclear test restrictions at this time are not likely to have a significant impact on the arms competition between the U.S. and the Soviet Union. However, the principal motivation for pursuing a Comprehensive Nuclear Test Ban Treaty (CTBT) relates to the issue of nuclear non-proliferation. Here the linkage is both political and technical. By agreeing to the preamble of the Nuclear Proliferation Treaty (NPT), and as a signatory to the Limited Nuclear Test Ban, this country has undertaken a solemn obligation to strive in good faith toward the attainment of a Comprehensive Test Ban Treaty. The lack of progress on the part of the Soviet Union and the United States in reaching a CTBT has added to the cynicism with which the NPT is viewed by some nations and individuals. This cynicism would not be alleviated in itself, once this country has ratified the Threshold Test Ban Treaty now before the Senate. On the contrary, ratification of the TTBT would actually be counterproductive to the cause of non-proliferation if it served to diminish the pressure toward attainment of a comprehensive ban.

My recommendation, therefore, is that the Senate ratify the TTBT, but in a strongly expressed context that ratification is given with the full understanding that the TTBT is a step towards a comprehensive ban rather than a terminal objective in its own right.

The technical reason why a Comprehensive Test Ban Agreement would serve the cause of non-proliferation is, of course, the fact that a non-nuclear nation could not with confidence develop a nuclear explosive without nuclear testing. The LTBT of 1963 currently has more than 100 signatories, and it would be expected similarly that a comprehensive ban would be adhered to by a very large number of other nations. Accordingly, a CTBT would constitute a direct limit on the number of nations which could acquire nuclear explosives.

The previous remarks outline some of the main reasons for strongly supporting the thrust toward a CTBT. This Committee has, of course, heard and will continue to hear arguments expressing the opposite point of view. The arguments tend to fall into four categories:

1. The possibility that the Soviets would cheat under a CTBT and develop nuclear devices while the United States would not do so. As a result, the United States would suffer a serious military disadvantage.

2. The reliability of the U.S. nuclear weapons stockpile could not be verified under a CTBT.

3. The United States weapons laboratories would deteriorate under a CTBT while the Soviet laboratories could be maintained by coercion to function effectively.

4. A CTBT would interfere with programs currently planned for certain U.S. military systems.

Let me comment on each of these four arguments in turn.

1. *Possible evasion.*—There is no question that, regardless of whatever progress is made in verification technology, it will always be possible for a determined evader to carry out a small number of tests at low yield that cannot be identified by national technical means alone. On-site inspection offers very little incremental verification capability. However, some residual risk of detection always remains even if technical verification means have not detected the violation.

It is exceedingly unlikely that results of such testing would be of substantial military significance. This conclusion is based upon the maturity of present nuclear weapons technology, and the fact that the performance of military systems is now largely controlled by the nonnuclear rather than nuclear hardware. As a result of this situation, the incentive to take the risk of evasion is very small, and the military consequences of evasion are minimal.

2. *Stockpile verification.*—As far as the second argument is concerned, the Committee should note that it has been amply demonstrated that stockpile verification

can be carried out without benefit of nuclear testing. On a longer time scale, there may well be a gradual deterioration on both sides in the confidence which military planners have in the reliability of the nuclear weapons stockpile. On balance, I believe this to be a beneficial effect in that it would tend to discourage preemptive counterforce strikes against the deterrent forces of the opponent. In contrast, the deterrent value of nuclear weapons is hardly affected by small decreases in reliability.

3. *Weapons laboratories.*—A frequently heard argument against a CTBT relates to the viability of the weapons laboratories and the maintenance of a general research and development base for nuclear weapons. Indeed, in the absence of nuclear testing the viability of nuclear weapons development will be downgraded in time. I believe, however, that this applies both to the United States and the Soviet Union; a component of successful arms control is that the military R&D capability of all parties be impacted. I do not believe in the assertion that the Soviet Union would be in a position under a CTBT to coerce highly productive weapons R&D while the United States would not. Creativity cannot be coerced. Wisely, the U.S. ERDA-supported weapons laboratories, namely Livermore and Los Alamos, have diversified their activity so that roughly half of their funding is now dedicated to direct energy-related programs. Some of the technology involved in such programs overlaps that of weapons technology; moreover, the United States has facilities superior to those of the Soviet Union in the field of computation related to weapons design and in simulation of weapons phenomena.

For these reasons, the assertion that a CTBT would impact the weapons R&D base of the United States more unfavorably than that of the Soviet Union is difficult to support. Moreover, should the treaty be abrogated, weapons competence could be restored to a present level permitting routine weapons verification tests to be resumed in a matter of a year or so, and full-scale development could be reestablished within several years. In addition, the abrogation of a treaty such as a CTBT would imply a major national emergency, and I should like to remind the Committee that in World War II nuclear weapons were developed starting from nothing but an idea in a period of only four years. If you combine these observations with the fact that the weapons stockpile based on existing designs will continue to be in existence, and also with the general maturity of nuclear weapons technology, I do not see how the matter of viability of the nuclear weapons laboratories can be a controlling factor or even a substantial consideration in judging the wisdom of proceeding with a CTBT.

4. *Effect on present programs.*—The military impact of an arms control measure should be judged by a net assessment rather than simply by its effect upon planned U.S. weapons systems. A CTBT would naturally affect current U.S. plans, but this would also be true of Soviet activities. On balance, considering the state of technology, a CTBT adhered to by both parties would lead to a small, but significant, gain in U.S. security, quite apart from its value in nuclear non-proliferation.

To summarize, for the reasons given above and those given in my previous testimony before this Committee, I strongly advocate a continuing major effort toward enactment of a CTBT, not as a significant tool in limiting the Soviet-U.S. arms race, but rather as a major step forward in limiting the proliferation of nuclear weapons.

Thus far I have been discussing the merits of a CTBT, rather than those of the TTBT and PNE treaties that are before your Committee. Let me turn now to the TTBT.

There is not for the assumption that the TTBT should be viewed as a step toward a CTBT, and were it not also for the fact that the TTBT now before you has been negotiated in good faith by this government, I would be opposed to its ratification. Viewed as an agreement in isolation one might consider the TTBT to be "worse than nothing." The threshold of 150 KT is set so high that it bears little relation to the much lower threshold which might be related to confident verification by national devices observing seismic events. Therefore the conclusion that the magnitude of the threshold of 150 KT in the TTBT was defined by the desire of weapon designers to have the treaty offer a minimum impediment to their work is inescapable. Moreover, the very fact that the TTBT exempts peaceful nuclear explosions is a poor precedent for progress toward a CTBT. As has been amply discussed before this Committee, even with extensive, and probably unacceptably intrusive and expensive, inspection measures, there is no known way in which one can prevent military benefits from accruing from peaceful nuclear explosions. Therefore any exemption of peaceful nuclear explosions would negate a major non-proliferation objective of a test ban treaty. Once a non-nuclear nation has detonated a nuclear explosion, be it for peaceful or military purposes, it has joined the ranks of nuclear weapons states. Thus the distinction between military and peaceful nuclear explo-

sions is fundamentally destructive to the non-proliferation objectives of any test ban treaty.

Notwithstanding this criticism of the TTBT if viewed in isolation, there is one constructive aspect of the inclusion of peaceful nuclear explosions in the TTBT and of the subsequent history leading to the treaty governing the conduct of PNE's. As the TTBT was framed in 1974, the design of detailed rules governing the conduct of PNE's was relegated to a separate negotiation. At that time it was not clear whether this separate negotiation would lead to the establishment of a different and possibly higher threshold for PNE's relative to the threshold of 150 KT specified for military explosions. After laboring for well over a year to arrive at a higher threshold for PNE's, the negotiators finally concluded that they were unable to do so in a manner which could be adequately verified. Therefore the PNE treaty and its annexed protocol now before the Senate constitutes an instrument which is designed to assure the nations of this world that the thresholds permitted for single peaceful nuclear explosions and for military explosions correspond to the same yield; the treaty does not assure that peaceful nuclear explosions are in fact peaceful. The negotiations preceding the treaty failed in arriving at mutually acceptable criteria which would distinguish military from peaceful nuclear explosions. This is an important lesson. It means that as we proceed to a Comprehensive Nuclear Test Ban Treaty peaceful nuclear explosions must be excluded entirely. There is no valid reason to extend hope that the negotiating effort which failed to achieve its goal of distinguishing peaceful from military explosions in the context of the TTBT will succeed in the context of a treaty in which military explosions are banned entirely. Therefore in moving towards a Comprehensive Nuclear Test Ban the nations of the world must realize that any conjectured benefits of peaceful nuclear explosions must be foregone.

As I have testified before, I do not believe that net benefits of peaceful nuclear explosions are significant, if they exist at all, and this point of view has now been generally accepted in the United States. Accordingly the "Plowshare" program formerly conducted vigorously by AEC/ERDA is now supported at a minimum level, and no U.S. nuclear test explosions for peaceful purposes are presently planned. This disillusionment stems from more realistic analyses relating to the economic aspects of nuclear explosions for peaceful purposes which have supplanted the more optimistic earlier assessments. Apparently the resultant pessimistic economic assessment is not fully shared by the Soviet Union. The Soviets are still continuing a PNE research and development program of moderate size and are reported to be insisting on an exception for PNE explosions in the negotiations now in progress which will hopefully lead to a Comprehensive Test Ban Treaty.

The interest in PNE's centers on excavation projects on the one hand, and a variety of underground engineering projects on the other; the USSR seems to be concerned with both. The Soviets have reaffirmed that they wish to adhere strictly to the terms of the Limited Nuclear Test Ban Treaty of 1963 (LTBT) which specifies among other provisions that underground nuclear explosions shall not lead to measurable radioactivity being propagated across the borders of the country conducting the detonation. Yet no one has demonstrated how excavation projects of any significance can be carried out which meet this criterion specified in the LTBT. Thus I do not believe that a PNE exception to a Comprehensive Nuclear Test Ban has any merit if its purpose is the conduct of excavation projects. Underground engineering projects, on the other hand, could be pursued in compliance with the LTBT. However, the economic incentives and even the feasibility for carrying out programs like gas and oil stimulation, reclamation of shale by in situ retorting, breeding of fissionable materials by thermonuclear explosions, and similar projects are very much in doubt. Moreover—and this to me is a controlling point—should the exploitation of PNE's for resource recovery projects such as oil and gas stimulation turn out to be economical, this would only be on a scale which requires nuclear explosions at a rate of hundreds or thousands per year. This in turn would demand an industrial technological base and traffic in nuclear explosives of a volume which involves dangers of diversion, highjacking, etc., that would dwarf the risks which are now under so much discussion in connection with the plutonium economy inherent to civilian nuclear power using reprocessing of fuel rods for the plutonium breeder reactor. Discussions of the possibility of verifying that peaceful nuclear explosions are indeed peaceful tend to ignore the enormous volume of explosions which has to be conducted, should PNE's really reach a state of productivity.

Let me relate these observations to my recommendation on the PNE treaty:

I recommend that the Senate ratify the treaty. In so doing the Senate should emphasize that this ratification in no way endorses a future PNE exemption or other special consideration for PNE's in connection with a CTBT. Rather, the Senate should emphasize that the very nature of the PNE treaty now being ratified

is such that it does not distinguish between peaceful and military nuclear explosions. Instead, the treaty establishes criteria and procedures assuring that the yield of military and single peaceful nuclear explosions be essentially equal and thereby removes any incentive toward abuse of peaceful nuclear explosions for military purposes.

BIOGRAPHY OF W. K. H. PANOFSKY, DIRECTOR, STANFORD LINEAR ACCELERATOR CENTER, PROFESSOR, SLAC

DEGREES

- 1938.—A.B. Princeton University.  
 1942.—Ph.D., California Institute of Technology.  
 1963.—D.Sc. (Hon.), Case Institute of Technology.  
 1964.—D.Sc. (Hon.), University of Saskatchewan, Canada.

EXPERIENCE

- 1942-3.—Director, Office of Scientific Research & Development Project, California Institute of Technology, Pasadena.  
 1943-5.—Consultant, Manhattan District, Los Alamos, New Mexico.  
 1945-6.—Physicist, Radiation Laboratory, University of California at Berkeley.  
 1946-8.—Assistant Professor of Physics, University of California at Berkeley.  
 1948-51.—Associate Professor of Physics, University of California at Berkeley.  
 1951-63.—Professor of Physics, Stanford University.  
 1953-61.—Director, Professor, Stanford High Energy Physics Laboratory.  
 1961.—Director, Professor, Stanford Linear Accelerator Center, Stanford University.

SPECIAL FIELDS

X-rays and natural constants; accelerator design; nuclear research; high-energy particle physics.

ACTIVITIES

- 1945-60.—Division of Military Application, U.S. Atomic Energy Commission.  
 1954-58.—Member, Physics Panel, National Science Foundation.  
 1955-57.—U.S. Air Force Scientific Advisory Board.  
 1919-51.—Consultant, Radiation Laboratory, University of California, Berkeley.  
 1958.—Consultant, Stanford Research Institute, Menlo Park, California.  
 1960.—President's Science Advisory Committee.  
 1959.—Office of Director of Defense Research and Engineering (member, Ad Hoc Group on Detection of Nuclear Explosions).  
 1959.—WAE Foreign Service Office, Department of State: Chairman, U.S. Delegation (Geneva), Technical Working Group on High Altitude Detection; Vice-Chairman, U.S. Delegation (Geneva), Technical Working Group 2.  
 1958-60.—Member, High Energy Commission of International Union of Pure and Applied Physics.  
 1958-60.—Review Committee for the Particle Accelerator Division and High Energy Physics Division, Argonne National Laboratory.  
 1959-61.—Advisory Council, Department of Physics, Princeton University.  
 1958-62.—Advanced Research Projects Agency, Consultant.  
 1963-66.—Physics Survey Committee, National Academy of Sciences.  
 1964.—Advisory Committee, 200-BeV Accelerator Study, Lawrence Radiation Laboratory, Berkeley.  
 1965-73.—Consultant, Office of Science and Technology, Executive Office of the President.  
 1965-73.—Steering Committee, JASON Division, Institute for Defense Analyses.  
 1959.—Consultant, Arms Control & Disarmament Agency.  
 1967-70.—Member, High Energy Physics Advisory Panel to the Atomic Energy Commission.  
 1968-72.—Advisory Committee, Brookhaven National Laboratory.  
 1968-71.—Advisory Committee, Cambridge Electron Accelerator Laboratory.  
 1968-71.—Advisory Committee, Physics Department, University of Rochester.  
 1969-71.—Advisory Committee, Physics Mathematics & Astronomy Depts., California Institute of Technology.  
 1969-70.—Co-Chairman, Stanford Mid-Peninsula Urban Coalition.  
 1973.—Board of Directors, Annual Reviews, Inc.

## SOCIETIES

Phi Beta Kappa; American Physical Society (Fellow and 1974 President); Sigma Xi; National Academy of Sciences; American Academy of Arts and Sciences' Council on Foreign Relations.

## AWARDS

Guggenheim Fellowships (1959 and 1973); Ernest Orland Lawrence Memorial Award (1961); Richtmyer Lecture (1963); California Institute of Technology—Alumni Distinguished Service Award (1966); California Scientist of the Year Award (1967); National Medal of Science (1969); Franklin Institute Award (1970); Annual Public Service Award, Federation of Amer. Scientists—1973; "Officier" of French Legion of Honor (1977).

## PUBLICATIONS

Classical Electricity and Magnetism (with M. Phillips), Cambridge, Addison-Wesley (1955); 2nd edition (1962); numerous scientific papers in professional journals.

## PERSONAL DATA

Name: Wolfgang Kurt Hermann Panofsky, Born April 24, 1919, Berlin, Germany; Entered U.S. September 1934, naturalized April 1942; Married (Adele Irene DuMond).

Children: Richard Jacob, October 13, 1943; Margaret Anne, October 13, 1943; Edward Frank, April 19, 1947; Carol Eleanor, January 12, 1951; and Steven Thomas, December 13, 1952.

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Senator PELL. Thank you very much indeed, Dr. Panofsky.

I would be interested in the comments of each of you on this next question.

## CONSTRAINT PROVIDED BY TTBT

Do you believe that the Threshold Test Ban Treaty will constrain the Soviets in any particular way?

Mr. IKLE. Mr. Chairman, as I have mentioned in my testimony already, the fact is that before these treaties constrained them they were testing higher yields. My expectation would be that if these treaties did not come into force and the present inhibitions would therefore expire, they would return to testing higher yields. I think it is this prospect that we must seriously consider as the pros and cons of ratification are being contemplated.

Senator PELL. Dr. Panofsky?

Mr. PANOFSKY. I believe in a minor way, yes. Particularly, I believe that the TTBT will constrain development of another generation of specialized warheads for the MIRV forces.

However, I would like to re-emphasize that neither the Threshold Test Ban Treaty nor, I believe, a comprehensive treaty will do a great deal in itself toward dampening the arms race between the United States and the Soviet Union.

I believe that considering where we are now in the state of maturity of the technology, the main impact of further constraints on testing relate to nuclear weapons proliferation rather than to the U.S.-U.S.S.R. arms competition.

Senator PELL. Dr. Long?

Mr. LONG. I agree with Dr. Ikle, that the TTBT would, in fact, constrain both sides in testing very large nuclear explosive devices, which there might be reasons to do. So it would represent a constraint.

It is a symmetrical constraint and I would like to point out as a supplement that apparently in the PNE area we would end up with a curious situation where the constraint did not seem to act symmetrically. We in the United States have pretty much decided that there is nothing much in PNE. If we ended up a few years from now with a situation where the Soviets were behaving as Dr. Panofsky just described, setting off literally hundreds of PNE's a year under the argument that they were in their purposes economic and we were setting off none, there would be a rather spectacular dissymmetry between the two countries.

#### NATIONS OUTSIDE SOVIET UNION INTERESTED IN PNE'S

Senator PELL. Dr. Panofsky, I was wondering if you believe that there are any nations outside the Soviet Union that are actively interested in the so-called peaceful nuclear explosions?

Mr. PANOFSKY. There have been at times. There had been an interest on the part of Indonesia for a certain canal. There had been an interest in a certain Australian harbor. But most of the interests have all but disappeared.

#### SOVIET DESIRE TO MAINTAIN PNE OPTION

I would also like to emphasize that those outside interests are mainly related to excavation projects. I would like to emphasize that it is my opinion—and I would like to express it somewhat stronger than preceding witnesses—that economic conduct of excavation projects is totally incompatible with the LTBT. The Soviet Union has reaffirmed its position that it would strictly adhere to the provisions of the LTBT, and it has never clearly explained how it considers its position on such adherence to the LTBT to be consistent with its position on wishing to maintain the option on PNE's for excavation.

Senator CASE. What do you think is the rationalization?

Mr. PANOFSKY. I believe it is a mixture. I believe they are interested in the underground engineering projects. I believe there is a fair amount of dissent within the Soviet Union on the question of economic merit of PNE's. In fact, the matter of PNE's is one of the few issues where that dissent on a vital public policy issue on the part of the Soviet Union has actually surfaced in public. I believe they simply have not resolved the matter and therefore wish to maintain their options open. I believe it is a matter which we should consider to be a negotiable matter rather than being a matter which we must accept as a fixed condition for future progress in arms control.

#### LIMIT WE CAN GET FROM SOVIET UNION

Senator CASE. Do any of you, including our first two witnesses, Dr. Rathjens and Dr. Scoville, think you can give us any indication as to whether this is the absolute limit we can get at the present time from the Soviet Union?

Mr. LONG. I think it is almost the other way. The fact that the Soviets have agreed to go back to negotiating a comprehensive test ban treaty, that those negotiations are underway, strongly carries the air that they are interested.

I must say that the time sequence down the line strikes me as mildly ridiculous. We go through a lot of gearing up of hearings in an effort to ratify a threshold test ban treaty and an accompanying PNE treaty, simultaneously studying a negotiating toward a CTBT which, if negotiated in the reasonably near future, would push these aside completely. This is an odd sequence of events.

Senator CASE. Yes, and we are asked to do it, too. We are just trying to do our duty.

Any time that a distinguished group of people, such as you gentlemen, is brought together, public discussion is not wasted. I really mean that. People forget about these things.

My own recollection of things that you have told me before in the past needs refreshing from time to time and I am personally very glad to see you, all of you.

POSSIBILITY OF SECURING CHINESE AND FRENCH ADHERENCE TO  
CTBT

Senator PELL. Do any of you see any possibility of securing Chinese and French adherence to a comprehensive test ban treaty? Do you have any thoughts on how we can move in that direction.

Mr. IKLE. I think that is one of the difficulties in making a comprehensive treaty universal. One may tend to exaggerate the proliferation benefits of a comprehensive treaty.

If you look at the countries that are still permitted to test, that is, at the countries which are not party to the Non-Proliferation Treaty; countries with nuclear interests are Brazil, Argentina, India, and Pakistan. All of the other countries, the nonnuclear weapons states, are already not allowed to test because they are party to the Non-Proliferation Treaty.

So, the question arises, would a comprehensive ban be joined in by these countries, and particularly, as you ask, Mr. Chairman, by China. My expectation would be that this may take a very long time, or, in the case of a country that continues weapons tests, as China would, would this at some point prove disruptive.

Now that is not a reason against going for a comprehensive ban, but it indicates that there are further difficulties ahead, even if we have reached that target.

Senator PELL. Dr. Panofsky.

Mr. PANOFSKY. My opinion is similar.

I believe there is no chance that in the near future the Peoples' Republic of China would join in a CTBT, and it is unlikely that France would. In fact, the suspicion is that the insistence by the Soviet Union, which was surfaced at some time though never very firmly voiced, to have China join was actually a move to embarrass the Peoples' Republic of China.

However, the general record of the PRC has been in respect, for instance, to nuclear nonproliferation, to oppose it publicly, as being a means for the super powers to preserve their hegemony, their supremacy. However, in fact, the Peoples' Republic of China has not proliferated nuclear weapons. Therefore, one can at least extend the forecast that the PRC would not join a test ban treaty and would, in fact, continue testing, but that in time the situation may well change. A possible response to this situation would be to consider a time limit or some similar provision to a CTBT.

Senator PELL. Dr. Long?

Mr. LONG. I agree.

Senator PELL. Thank you very much.

Senator Case.

EFFECT ON U.S. NATIONAL SECURITY OF REACHING 1963 CTBT

Senator CASE. First, Dr. Panofsky, you say in your statement that if we had had a comprehensive test ban treaty and had been able to reach one in 1963, assuming adequate monitoring which was possible, our U.S. national security would have been stronger today.

Would you please develop why you think that is so?

Mr. PANOFSKY. Yes, I can, though within some limits.

Clearly in 1963 there was little question that our technology, relative to that of the Soviets in respect to nuclear warheads, was more advanced in many respects. As an example, the Soviet ability to package very high-yield warheads in multiple reentry vehicle missiles would have been very much impaired and we would not have faced as much of a threat from the Soviet MIRV as we are facing today.

Similar remarks apply to some of the tactical weapons.

In general, I believe the difference in technology between the Soviet Union and ourselves was very much more in our favor at that time than it is today. This is a general situation pertaining to a maturing technology in which the United States leads initially.

Senator CASE. It is awfully hard to figure this advantage or disadvantage, though, isn't it really? Isn't there a general presumption that we are smarter, brighter, have more scientists, who work under freedom. Therefore we are going to do more without restraint than the Soviets are?

How do you reconcile the position that this is not so with the argument that democracy is a good idea?

Mr. PANOFSKY. In this particular case, Senator, I believe the situation is relatively clear. I believe nobody would claim that evasion is possible for these very large yields which are needed for warheads, for ICBM's as an example. Therefore, in the absence of testing at very high yields, I think one can argue persuasively that improvements which the Soviets have undertaken in high-yield warheads would not have taken place, while our improvements were needed to a lesser extent.

I think that can be done. I am not saying this is a general statement, but I think considering the particular situation. I believe my statement is correct that U.S. security would have been enhanced had a CTBT been enacted earlier.

Senator CASE. Did you want to comment on that particular point, Dr. Long?

Mr. LONG. Yes, just on that point, and very briefly.

It seems to me that in his testimony Dr. Panofsky mentioned aid to our national security. I think that would have been particularly important in terms of our relations with nonnuclear nations to support our general nonproliferation position. I think, had we had a CTB established in 1963, our position in urging nonproliferation upon the rest of the world would have been very much stronger.

Senator CASE. Yes. Of course, any time up to now, when we were ahead, if we could have stopped every body else, why we would still stay ahead. I think that probably is true, but I am not sure that we are saying very much when we say that because obviously we were not going to get a comprehensive test ban treaty back then. There is no question about it. It was not bad will on our part that defeated that.

Mr. PANOFKY. I think that is an important point.

Senator CASE. It is just an interesting observation about the condition of mankind, isn't it, I guess?

Mr. PANOFKY. [Nods affirmatively.]

It may be that a comprehensive nuclear test ban in 1963 would have ultimately proven nonnegotiable, even had we not insisted upon some of the verification provisions which were the nominal stumbling blocks in the negotiation. So, I am in no way saying that it would have been possible to negotiate such a treaty, even without the controversy on onsite inspections.

#### QUESTION OF FREEDOM OF INVESTIGATION

Senator CASE. We have pretty much dealt with these treaties and turned them inside out and upside down. I would like to get you all, if you would, to speculate on the general question of to what extent we should interfere with the free range of man's investigations. We have to talk about this as we have to talk about the business of changing our genes, our genetic makeup. Is there any relation here to the question of freedom of investigation?

Mr. IKLE. I think there is, Senator Case. We had quite a battle, actually, even here in Washington, to get agreement to inhibit peaceful nuclear explosions as much as they are being inhibited by this treaty. It was not self-evident to everybody a couple of years ago and the program was tapering off only slowly. Indeed, Professor Long's contribution was very instrumental in convincing a larger number of people that we should give up on that.

There is a strong parallel to the efforts that have been going on now, and have been going on for several years, on the question of plutonium uses. So, it is always very difficult to impose restrictions, understandably so, on science and technology, but in certain instances I think these restrictions are necessary for the greater benefit of our society.

Senator CASE. You don't mind coming up, do you, Herb and George, and getting into this discussion. Come on up to the witness table, please.

Mr. LONG. I can make a comment on that while they take their seats.

Sometimes it is a question of interfering with ability to do studies, research, and development. Sometimes it is a question of setting budgets which relate to national priority.

Supposing we decided as a nation to cut the military R. & D. budget in half. Some people would say that we are grossly interfering with our ability to do the things that some people would like to do on military R. & D. Someone else might say that that is a great readjustment of our priorities as it puts the money in some places that need it.

Senator CASE. Yes. Some of the astronomers did not like it at all when we cut down NASA's budget, if you remember.

Mr. RATHJENS. Senator, let me answer you, if I may.

It seems to me that the case for interference is an easier one to make the further down you go in the R. & D. spectrum toward application.

I have grave reservations about interfering with basic research because it is very hard to predict its outcome and how it might be used. It may be used for the benefit of mankind or to its detriment. It is hard to make those judgments. But as you move down into the areas where we are talking about real application—and incidentally, that is usually where larger amounts of money are involved—then it does seem to me that society just has to make hard choices, and if it looks like the effect is going to be bad, then it should say, "No." You either say no by prohibition or by denying resources.

Senator CASE. We are talking now, however, about a comprehensive test ban treaty, not about these things. What of the idea that we should have no nuclear explosions?

Mr. RATHJENS. There are those, Senator, who would argue that a lot of this is sort of "researchy" business. However, I think this is very much applied and, therefore, I think it is appropriate to prohibit these things.

Senator CASE. Dr. Panofsky, did you have something to add?

Mr. PANOFSKY. Yes. I would like to reinforce what Dr. Rathjens has said.

There is a continuous chain starting all the way with very basic research, applied research, development, and then finally leading to procurement, test, and evaluation, and then to actual deployment. I believe it would be very unwise to apply any constraints to the most basic side of the work simply because I believe we must have faith that if we have knowledge about nature, we will be able to make wiser decisions than if we don't.

On the other hand, once we know where this knowledge leads us, then our decisionmaking processes must have the courage to say that certain developments must be foregone if, on the basis of a net assessment, the negative impacts exceed the positive benefits. In this sense I believe the case can now be made amply that the world would be better off without the conduct of further nuclear explosions. I would like to point out that conduct of nuclear explosions is not basic research but serves development of specific applications.

Senator CASE. But really, aren't those just words?

Mr. PANOFSKY. Pardon?

Senator CASE. Can you say that you never learned anything from a nuclear explosion?

Mr. PANOFSKY. No. We will learn developmental, technological, product-improvement type facts. I do not believe that they are essential tools for the conduct of experiments which give us basic insight into nature.

Senator CASE. Herb?

Mr. SCOVILLE. Dr. Panofsky stated my views much more eloquently than I can myself. I fully subscribe to the idea that you cannot really control basic research. But over and over again we have to make the decision as to whether to allow continued development and actually going into the end-product work, which can be

harmful to mankind. I think there is no question that the world is better off without further nuclear explosions than with them. This is the same kind of decision you have to make in other areas. We have already decided it was better not to go ahead with developing biological warfare mechanisms. This is a basic decision that mankind ought to make after it sees where basic research could lead it if it were carried through into the development stages.

#### DISTINCTION BETWEEN BASIC AND APPLIED RESEARCH

Senator CASE. I suppose you people have a feel for what is basic and what is applied, but I am not so sure that I could tell so clearly.

Mr. SCOVILLE. It is a fuzzy line, not a fine line. But there are some areas where it becomes increasingly obvious as you get more and more into it.

Senator CASE. I didn't ask you to comment on the "genes" business yet.

Mr. SCOVILLE. Well, I am not an expert on that and will leave that to others.

Senator CASE. Dr. Ikle, did you have something to say about this?

Mr. IKLE. Thank you, but I have nothing to add.

Senator CASE. Gentlemen and Mr. Chairman, thank you very much for permitting me to depart a little bit from the main question.

Senator PELL. Senator McGovern.

Senator MCGOVERN. Thank you, Mr. Chairman.

#### NATIONS HAVING NUCLEAR WEAPONS CAPABILITY

This may be going over old ground a bit, but for the record, I wonder if one or more of you could tell us what nations now have a nuclear weapons capability in being and are at least capable of exploding nuclear devices?

Dr. Ikle, would you begin?

Mr. IKLE. Senator McGovern, plutonium has become more available and the material is available, I would guess, to several dozen nations, the industrialized nations that have a nuclear power program, such as Japan, Sweden, and Spain. Most of these have no governmental intention whatsoever to move toward a nuclear explosive capability. It is my impression over the last year or two, particularly more recently with the political changes in India and so on, that the actual intention at this time to move toward explosive capability cannot be seen in any country that is not now testing nuclear weapons.

But many of the countries want to hedge their bets and accumulate material, and the acquisition of a reprocessing plant by Pakistan must be seen in that light. If something broke down in the international order and nuclear weapons were used, you would then find that dozens of countries could in a very short time, half a year or a year, manufacture their own weapons.

Senator MCGOVERN. Dozens of countries could do that within 6 months, you say?

Mr. IKLE. Say within a year.

Senator MCGOVERN. They could actually mobilize nuclear weapons?

Mr. IKLE. That's right.

That is really a central concern of this administration's and the previous administration's efforts regarding the spread of plutonium.

Senator MCGOVERN. So, when we talk about half a dozen countries being in the "nuclear club," that is really a very limited view of it. What you are saying is that there are several dozen that could move into that club at any time they wanted to within 6 months or a year's time.

Mr. IKLE. And they could start accumulating weapons. But now actually, and this is, of course, a very fortunate state of affairs, the number of countries that do accumulate nuclear weapons is very limited, that is, the nuclear weapons states.

#### TREATIES' IMPACT ON PROLIFERATION PROBLEM

Senator MCGOVERN. What is the impact of these two treaties on the so-called proliferation problem? Do they slow it down in any substantive fashion? If we don't get on to a comprehensive test ban and we live with these arrangements, as long as we have the Limited Test Ban as far as atmospheric testing, what happens in your view, gentlemen, in terms of this proliferation?

Mr. IKLE. Well, in my view there is a small beneficial impact of the Peaceful Nuclear Explosives Treaty if it is properly explained. This is a very technical matter and can easily be misunderstood. I think you have to make a continuing effort to explain it in the way, for example, that Professor Panofsky explained it in his testimony, that is, that it does establish clearly, very clearly in the fine print of the treaty, that the same restrictions apply to explosions, whether they are alleged to be for peaceful purposes or not. This is something that was not self-evident when the negotiations began.

Now if we do that, I think we impose a further inhibition on countries—and this may already have worked in the case of South Africa—of pretending that peaceful explosions are something separate. It was easier for India to pretend 3 years ago that peaceful explosions are different when the position of our own Government was, in my view, somewhat more muddled on this issue than it is today.

Senator MCGOVERN. Dr. Long?

Mr. LONG. I would simply disagree with that point of view. I would think, on balance, that this pair of treaties would be a mild encouragement for currently nonnuclear nations to go down the path of developing PNE's which would end up giving them information on nuclear explosions.

It seems to me that the essential point of this treaty is that it seems explicitly to tell the world that the United States and the Soviet Union think that PNE's are technically important things which merit a separate treaty and an elaborate protocol to permit them to be carried on, presumably because they are of great technical and economic significance.

It seems to me that if I were a developing nation, that would be an "open sesame" for me to say that I am going to develop PNE's, too.

Mr. IKLE. May I please add a point, Senator, a historic point here?

Senator MCGOVERN. Please.

Mr. IKLE. I think in an ideal world we would have preferred, and in fact it was the U.S. position, to treat weapons tests and peaceful nuclear explosions in the same way in 1974. But the Soviet Union would not agree with that and insisted that peaceful explosions be exempted entirely. So this was a compromise that they be limited to the same yield. If it had not been for the Soviet interest in peaceful explosions, in 1974 we would have negotiated a treaty which would have covered them both in one fell swoop.

#### PNE'S AND TRADITIONAL NUCLEAR WEAPONS' POTENTIAL ARMS RACE IMPACT

Senator MCGOVERN. In terms of their potential impact on the arms race, is there much difference in the minds of you five gentlemen between peaceful nuclear explosions, as we call them, and traditional nuclear weapons? What is the difference as far as the spread of nuclear capability is concerned?

Dr. Scoville?

Mr. SCOVILLE. I don't think that there is any difference. I think this is a fundamental point and this is the reason why I disagree with Dr. Ikle and agree with Dr. Long that the PNE Treaty, in particular, and its relationship to the Threshold Treaty really is a major step backward as far as proliferation is concerned. If we do not get a comprehensive test ban treaty, then I think these treaties will really have done us a great deal of harm.

We see today examples of where countries like India and Brazil are using these two treaties as a justification for their position that PNE's are perfectly legitimate and can be carried out independent of weapons tests. So we are supporting this view by ratifying these treaties.

While I agree with Professor Panofsky's argument, it is in the fine print, as Dr. Ikle says, and the fine print does not get used in these international political arguments. It is just the basic fact that you have two different treaties which deal with PNE's and weapons that would allow PNE's being used to justify India's program, and then in turn would allow other countries to go the nuclear route through PNE's.

It is rather interesting to hear the South Africans use this argument. I don't know what was the truth behind it, but certainly the press reports talked about South Africa carrying out a PNE test. If that is the case, certainly this is another example of still another nation using this excuse to go ahead with what is really a weapons program.

Senator MCGOVERN. Dr. Panofsky.

Mr. PANOFSKY. First let me give you a technical answer. Once a nonnuclear nation has carried out a peaceful nuclear explosion, it has become a nuclear weapons state. Second, we have failed in negotiating with the Soviet Union to arrive at a formula—and I think it is fundamental that there is no such formula—which can prevent a nation from reaping military benefits from the conduct of a so-called peaceful nuclear explosion.

I think the reason why there is so much dissension among people who are basically sharing the same objectives signifies the important fact that the nonproliferation problem is fundamentally a political problem. There is no technical recipe which one can now think of which will prevent a nation which has made a political decision to acquire nuclear weapons from acquiring them. It is not necessary to go even the nuclear power route. In fact, those nations which have acquired nuclear weapons have done so by simply deciding that they want nuclear weapons, so they design reactors, and so forth, specifically to produce nuclear weapons material.

Therefore, it is a matter of political judgment whether the total context in which the Senate acts and in which the executive branch acts is such that it will give a net incentive towards further proliferation, or a disincentive. I think you have a great deal of influence in creating this context. Reasonable men can, of course, differ as to how this context should be created.

#### U.S. POLICY STATEMENT FOR SWEARING PNE'S

Senator McGOVERN. Dr. Panofsky, I take from the tenor of the testimony that you and Dr. Long would argue that there is not much advantage to the United States in peaceful nuclear explosions. If that is true, what would be the merit in our simply forswearing any further nuclear tests and say that as far as we are concerned, we are not going to engage in peaceful nuclear tests and invite other nations to do the same thing? That is what we did in terms of atmospheric testing. Why don't we do the same thing on the so-called peaceful nuclear explosions?

Mr. PANOFSKY. We have de facto done that because the budget within ERDA for PNE's has been reduced to such a negligible amount.

Senator McGOVERN. But we have not made any policy statements.

Mr. PANOFSKY. We have not made policy statements and we have not challenged the Soviets in public. So again, it is a matter of a political question whether it would be productive to challenge the Soviets in public or in private on this particular point since it is the Soviets who are at this time the chief advocates of peaceful nuclear explosions.

#### PUTTING TREATIES ON BACK-BURNER QUESTIONED

Senator McGOVERN. I think that Dr. Rathjens made the only real case that I can think of for these treaties, and that is because of the political problems with the Soviets. I think they are a very conservative, rigid government which does not respond to new ideas quickly. They have demonstrated that, it seems to me, in their anguish over our decision not to press for the same formula in Moscow last spring that we did at Vladivostok 3 years ago.

I suppose that is the problem, Dr. Rathjens, with following your course of the Senate simply putting these on the back burner and letting them simmer. That is what we did on the Genocide Treaty and it has been simmering for 28 years.

I don't know how to explain that. When colleagues, students, and constituents ask me why we have not ratified the Genocide Treaty, I find it very hard to explain. It seems that we are for genocide.

It does seem to me that we are accumulating a series of these things that we keep putting on the back burner. I can understand why it is frustrating for Soviet diplomats who think they have an agreement in being to see the Senate let it sit around for 3, 4, or 5 years and do nothing.

There does seem to me a point where we have to confront the political aspects of these agreements. We cannot forever have the executive branch negotiate what seems to be a kind of compromise step in the direction of a settlement and then have the Senate let it die.

That is one thing that does worry me.

However, I quite agree with the points that have been brought out here, that it would be a disaster if these treaties are as far as we are going to go in the next 5 or 6 years in terms of reaching an agreement on a comprehensive arms testing ban.

#### EFFECT OF TREATIES ON PROLIFERATION

Mr. RATHJENS. Senator, let me just add one point in response to your question about the effect of these treaties on proliferation.

My colleagues, I think, here have addressed mainly the issue of the PNE Treaty in the last few minutes. I think the Threshold Treaty also has undesirable effects in that it conveys the impression that we are not serious, that we and the Soviet Union are not serious about going as far as we can in limiting arms. I think that is unfortunate.

I think most of the unfortunate effect has already been achieved as a result of their negotiation, but ratification will add a little bit more. I think that the TTBT, as well as the PNE Treaty, is unfortunate as far as proliferation is concerned.

Senator MCGOVERN. Thank you, gentlemen.

Thank you, Mr. Chairman.

Senator PELL. Gentlemen, thank you all very much.

This concludes the final hearing on these two treaties. They will be further discussed by this committee and hopefully action will be taken on this coming Tuesday.

This hearing is adjourned.

[Whereupon, at 12:10 p.m., the committee adjourned, subject the call of the Chair.]

#### APPENDIX

##### STATEMENT OF JOHN NELSON WASHBURN, A WASHINGTON-BASED INTERNATIONAL LAWYER AND SOVIET AFFAIRS SPECIALIST, PROVIDED FOR THE RECORD

My position is in essence that these treaties now under consideration by you for advice and consent to ratification are tantamount to jokes, and bad jokes if they were not actually negotiated but contrived by the Nixon Administration.

I take this position on the basis of my personal experience, commencing with service (along with U.S. Senators Humphrey, Gore and Hickenlooper, among others) on the U.S. Delegation at the Discontinuance of Nuclear Weapon Tests Conference which began October 31, 1958 in Geneva, Switzerland.

On the occasion of Hearings before the U.S. Senate Government Operations Committee on The Export Reorganization Act—1975 during the spring of 1975 I stated that, in the light of my service as a U.S. Delegation advisor from October

1958 to March 1959 at the three-Power (U.K., U.S.A., U.S.S.R.) Conference on the Discontinuance of Nuclear Weapon Tests, which led to the conclusion years later of The Limited Test Ban Treaty, such international legal instruments as The Limited Test Ban Treaty had been grossly overevaluated as to their significance. I noted that with respect to that Treaty, the definitive text acceptable to the three Powers in 1963 constituted in effect what the U.S. Delegation of 1958-1959 considered merely prospective language for preambular provisions; accordingly, provisions for on-site inspection teams and posts of inspectors located within the territory of parties to such a legal instrument were absent when The Limited Test Ban Treaty was signed in Moscow, with key U.S. Senators in attendance.

Consequently, as I complained to the U.S. Senate Government Operations Committee in 1975, it is high time to eschew attempts by both Republican and Democratic Administrations to utilize the nuclear agreements negotiation process in a transparent effort to persuade the American public that foreign policy triumphs have materialized. In our American history the Administration approach requiring international agreement for the sake of outward appearances is not a new one. In this connection let me quote from former U.S. Secretary of State Elihu Washburne's letter of December 1, 1881 to his brother Israel, a member of the U.S. House of Representatives in the 1850s and late Governor of the State of Maine. Elihu focused on the betrayal to Great Britain by the loss of territory Maine had always claimed. Elihu charged that Secretary of State Daniel Webster engineered that betrayal under the Webster-Ashburton Treaty of 1842 establishing the northeastern boundary of our country:

"Dear Bro: . . . I have read your paper on the North Eastern Boundary with a real interest. . . . The arrogance and insolence of England in all that matter makes the blood boil. And then old Webster sold you out lock, stock and barrel. One strong bold, fearless man from Maine on the Commission to make the Treaty could have knocked the whole thing higher than Gilderoy's kite. But in the end they took to the timber, including my old friend John Otis." (Israel, Elihu and Cadwallader Washburn, A Chapter in American Biography, New York: Macmillan, 1925, p. 153)

My reference at the outset to the probability that these bilateral U.S.-U.S.S.R. nuclear treaties under consideration by you, Senator Pell, and your colleagues today were bad jokes needs explaining. As an attorney-adviser (international) from 1958 to 1966 in the Office of the Legal Adviser of the U.S. Department of State, and subsequently as a contract Russian-language escort interpreter for the Language Services Division of the Department, I had obtained first hand information concerning a nefarious scheme instituted in the Nixon White House by Henry A. Kissinger and his top Soviet expert Helmut Sonnenfeldt whereby the gifted Soviet interpreter for Brezhnev, Gromyko et al Viktor M. Sukhodrev gained and maintained a monopoly of the most sensitive negotiating assignments at U.S.-U.S.S.R. summit meetings. My attempts to expose that scheme which would appear to render suspect the credibility of the U.S. negotiating side to the production of the agreements up for your consideration today began at the time of the Brezhnev-Nixon Summit in the United States in 1973. In a statement published by the Ways and Means Committee in Hearings on H.R. 6767, The Trade Reform Act of 1973, I termed "ill-advised" Presidential acquiescence during the June 1973 Brezhnev Summit Visit to the United States in Brezhnev's wish to have his Soviet interpreter Viktor M. Sukhodrev monopolize the interpreting work at all Nixon-Brezhnev private seances. Since that testimony on the Trade Reform Act of 1973 appeared, I discovered through the Department of State interpreter excluded that it was not Nixon's acquiescence in Brezhnev's wish so much as Nixon's express desire under the influence of the Kissinger-Sonnenfeldt White House team.

If you Senators are interested in exploring my charge that these Nixon Administration nuclear treaties concluded without the benefit of Department of State Language Services Division regular participation do not constitute "negotiated" treaties worthy of your support, I refer you to my three "Unsolicited Statements" of August 1 and October 23, 1975 and May 17, 1976 which outline that charge and were published in the U.S. Senate Judiciary Committee Print of Subcommittee Hearings under the title Congressional Oversight of Executive Agreements—1975.

The complete negotiating record of the bilateral U.S.-U.S.S.R. nuclear treaties now under consideration would hopefully provide you with concrete information as to just how the ridiculously high ceiling for nuclear explosions was agreed to; I for one would not wish to approve a vital treaty provision solely on Mr. Warnke's reply (to Senator Glenn, I believe) on the opening hearing day before your Subcommittee, Senator Pell, to the effect that both sides found the figure of kiloton ceiling acceptable. My confidence in the assertions of the two Administration witnesses that day, Mr. Warnke and Mr. Habbib, was somewhat shaken by Mr. Habbib's sentence in his

prepared statement that in 1958 cessation of nuclear tests was the issue. "Cessation" was not, but "Discontinuance" was.

For almost nineteen years Administrations have called such treaties as you consider today "steps toward peace." May I echo the comments of uneasiness of Senator Church on opening hearing day as to whether these particular bilateral nuclear treaties are steps leading anywhere.



