

The Purposes, Achievements, and Priorities of Arms Control\*

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The Purposes of Arms Control

United States policy with respect to nuclear weapons is one of deterrence. There is a spectrum of views as to what the nature of deterrence should be. Some believe that a nation should maintain the minimum capability needed to inflict immeasurable harm in retaliating against an aggressor. Others believe that deterrence should work in a measured way to counter aggression at any level in order to limit the conflict to that level. U.S. policy reflects the latter thinking and the U.S. strategic doctrine for deterrence is called "Countervailing Strategy" (Reference 1). Our national security depends on the maintenance of an effective, reliable, and survivable nuclear force to deter potential adversaries from any act of aggression on the United States or its allies. Deterrence has worked for over forty years, in that major armed conflict between the superpowers has been avoided. Arms control can make deterrence work better.

Arms control serves a number of purposes. By placing limitations on the numbers and types of weapons that are developed and deployed, arms control can strengthen the framework of deterrence and reduce the threat that nuclear weapons would ever be used. Of particular importance is controlling and limiting weapon deployments that may be destabilizing in time of crisis. By promoting mutual trust and understanding among the participating nations, arms control can also serve to reduce the dangers of attack and accidental nuclear war. If deterrence were to fail, arms control could work to make the conflict less destructive. Finally, by managing the arms competition between nations, arms control can reduce military spending, allowing more resources for the civilian economy.

The premise of arms control is that nations realize that the deployment of more weapons and qualitatively different weapon systems will do little to enhance, and may even diminish, national security. Nations must also have confidence that their existing weapons are adequate to serve their national security needs. These realizations must be satisfied for nations to be enhanced, and may even diminish, national security. Nations must also have confidence that their existing weapons are adequate to serve their national

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security needs. These realizations must be satisfied for nations to be willing to negotiate arms control limitations. Of course, it is also important to realize that some qualitatively different weapon systems, such as the U.S. small mobile ICBM (SICBM), or the Soviet SS-25 missile, can enhance security and crisis stability.

An important aspect to arms control is the process. There is considerable value in the arms control process. It is certainly better to be sitting across from one another at the negotiating table than to be rattling sabers. As Winston Churchill once said, "jaw-jaw is better than war-war" (Reference 2). The negotiating process keeps the channels of communication open in case crises or other situations arise. The process has considerable appeal to other nations whose people may feel much more secure when the Soviets and Americans are negotiating, particularly when they are negotiating successfully.

There is a common perception that arms control is disarmament. Arms control may lead to disarmament at some future time. However, we must be realistic about what arms control can achieve in today's world. As long as we rely upon armed deterrence amongst nations, then the best we can expect from arms control is to make deterrence work better, increase world stability, and reduce the risks of war. These alone would be worthy achievements. Winston Churchill once said it very well (Reference 3),

"It is the greatest mistake to mix up disarmament with peace. When you have peace, there will be disarmament."

### The Achievements of Arms Control

I often hear some people say that arms control has accomplished little in the past forty years. And I hear others say that pursuing further efforts at negotiating new agreements is either not in the best interests of the United States or is simply a waste of time. I take a different point of view. One only has to examine the historical record to see what arms control has accomplished. Even though we certainly could have accomplished more with arms control, a number of successful treaties and agreements have been negotiated. While some of the treaties are unratified by the United States for various reasons, I believe that all of the treaties have been effective as arms control measures. I would like to briefly describe these accomplishments.

### The Limited Test Ban Treaty

The Limited Test Ban Treaty (LTBT) was first signed and ratified in 1963. The parties to the treaty agree not to carry out any nuclear explosion in the atmosphere, in outer space, or under water, or in any other environment that would cause radioactive debris to be present outside of the borders of the nation conducting the test. While the treaty was negotiated by the United States, the Soviet Union, and the United Kingdom, over 100 nations have since become parties to the treaty.

During the eight years prior to 1963, the nuclear nations had sought unsuccessfully to negotiate a complete ban on nuclear weapon testing. There

were difficulties in agreeing to the monitoring measures that would be necessary to verify such a ban. The Soviets considered some of those measure to be overly intrusive. Monitoring of the LTBT could be done by National Technical Means, and the treaty has been considered by some to be a compromise to substitute for the elusive Comprehensive Test Ban (CTB). In fact, once the three nations decided to pursue the LTBT, the negotiations took only ten days, and the text of the treaty filled only two pages.

I believe that the LTBT has been quite beneficial for environmental reasons in virtually stopping pollution of the atmosphere by radioactive debris from nuclear tests. Even China and France, nonsignatories to the treaty, have stopped testing in the atmosphere. The United States has had concerns over the years with some Soviet tests where radioactive gases were released and crossed international borders. While annoying, because these releases appear legally to violate the LTBT and suggest a lack of effort by the Soviets to contain the radioactivity, the releases seem to pose a limited environmental concern. (I should add that there has been some debate about the legal interpretation of what the treaty forbids. The English version of the LTBT prohibits "radioactive debris" from crossing international borders and debris is interpreted to mean all forms of radioactive contamination. The Soviets on the other hand claim that debris refers to particulate matter and not gaseous.) In any case, the Soviet releases are certainly orders of magnitude smaller than they would be from atmospheric tests. Because of serious concerns about domestic radioactive contamination, the United States goes to extensive measures to guarantee that radioactivity from a nuclear test will be contained within the ground. It may be that the Soviets do not share our concerns about such radioactive contamination. Since 1970 when the U.S. experienced a major sudden release of radioactivity in an event called Baneberry, the United States has experienced only two minor unexpected releases of radioactivity and these were seepages that were confined to the borders of the Nevada Test site.

When the LTBT was being discussed, concern was expressed on the impact the treaty would have on weapon development, weapon effects research, and ABM development. Since atmospheric testing stopped, and with it atmospheric sampling, a source of intelligence data on each side's weapon development capabilities also ceased. I believe that the treaty's limitations have had an impact, and we have learned to work within these bounds. I believe that the costs associated with these limits have been well worth the treaty's benefits. It is noteworthy that the LTBT was the first real achievement in U.S.-U.S.S.R. arms control and it was accomplished just after the Cuban Missile Crisis, which was a particularly strained time in U.S.-Soviet relations. The LTBT helped improve relations between the superpowers and it set the stage for further progress in arms control negotiations, particularly those leading to the Nonproliferation Treaty.

#### The Nonproliferation Treaty

The Nonproliferation Treaty (NPT) was first signed in 1968 and went into effect in 1970. Today, over 120 nations have agreed to abide by its terms. The NPT is intended to prevent the spread of nuclear weapons and to insure that the peaceful nuclear energy activities of the nonnuclear weapon states

will not be diverted to weapon development. In return, the NPT calls for the sharing of technology beneficial to the development of peaceful nuclear energy. The NPT is unique in that it was negotiated in a multilateral forum, the Eighteen Nation Disarmament Committee which was the predecessor to today's 40-nation Conference on Disarmament.

The goals of the NPT appear to have been achieved in the main. When the treaty went into effect, the number of nuclear weapon states was predicted to climb to thirty in a decade and the number of known nuclear nations today is generally acknowledged to be only six - U.S., U.S.S.R., U.K., France, and China, which have nuclear arsenals, and India, which has at least detonated a nuclear explosion. There are a few other nations who, according to newspaper reports, are either close to having or who already have nuclear weapons and do not appear to have conducted nuclear weapon tests.

The NPT has benefits which the U.S. and U.S.S.R. fully appreciate. The two countries have had little difficulty in agreeing on steps to enhance its viability. Perhaps a large factor that has supported the nonproliferation of nuclear weapons is the security experienced by some nonnuclear nations through their alliances with the superpowers. Some nations are more willing to abide by the NPT when they see potentially hostile neighbors also accepting the treaty's terms.

Most of the parties to the NPT have been particularly dissatisfied with one aspect of the NPT, that having to do with Article VI. Nuclear arsenals have grown considerably since the NPT went into effect and I believe that these nations have reason to be concerned. Article VI of the NPT commits each of the signatories "to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament...." In other words, Article VI addresses the issue of vertical proliferation as contrasted with horizontal proliferation. Many nations believe that the best way to satisfy the goals of Article VI would be for the superpowers to negotiate a cessation of nuclear testing. I believe that the current proposals in Geneva for major reductions in nuclear arsenals are more effective ways of achieving the goals of Article VI and of directly attacking vertical proliferation. Regarding the role of nuclear test limitations, I believe that such limitations must be considered in the context of major arms reductions, and I will say more about this subject later.

#### The Antiballistic Missile Treaty - SALT I

The Antiballistic Missile Treaty (ABMT) was first signed and ratified by the U.S. and the U.S.S.R. in 1972 and then modified in 1974 by a protocol effective in 1976. The ABMT was negotiated in the first set of Strategic Arms Limitation Talks (SALT I), along with a five-year Interim Agreement to limit certain strategic arms. The ABMT and its protocol limit each side to a single ABM site consisting of 100 launchers and 100 interceptor missiles. Even more importantly, both parties agreed to limit qualitative improvement of their ABM technology in a number of areas - the capability to launch multiple interceptors, the capability for rapid reload, and MIRVed interceptors. The ABMT also placed restrictions on the development of exotic new technologies and on sea-based, air-based, space-based, and mobile land-based ABM systems.

The five year Interim Agreement was structured to complement the ABMT and limit the offensive arms competition until a permanent strategic arms limitation agreement could be negotiated. The Interim Agreement essentially froze the number of ballistic missile launchers on both sides, allowing for some tradeoffs of older launchers for an agreed number of new submarine launchers. Both sides also agreed not to convert launchers for light ICBMs into launchers for heavy ICBMs. The Agreement allowed modernization and replacements, without any significant changes in launcher dimensions (less than 10-15% of existing dimensions).

The ABMT has been an effective treaty. It has effectively limited defensive deployments, which in turn could have spurred a spiral of offensive-defensive counterdeployments. Unfortunately, the goal (Reference 4) at the time of the ABMT and Interim Agreement to restrain offensive deployments per se was unfulfilled.

There have been recent concerns about the continued viability of the ABMT. On the one hand, certain Soviet actions have brought into question their continued compliance with the ABMT - their most noteworthy action being the construction of the Krasnayorsk radar. While the individual Soviet actions appear to constitute only a limited military threat, taken together with their extensive research efforts on defensive technologies, the total effect has been an undermining of U.S. confidence regarding Soviet intentions. There has been particular concern that the Soviets may be moving toward a nation-wide ABM system, which is strictly prohibited by the ABM Treaty.

On the other hand, the Soviets have expressed considerable concern about the U.S. Strategic Defense Initiative (SDI). They have demonstrated their concerns in the positions they have taken in current arms control negotiations. I expressed my own beliefs regarding SDI research two years ago here in Castiglione (Reference 5). To summarize what I said then, I believe that SDI must remain a research program until it becomes apparent that we have something worthwhile to deploy. I believe that all SDI research should be done within the limits of the ABMT and that any research departures from the ABMT be negotiated according to the provisions of the Treaty. Further, any deployments beyond what is allowed by the ABMT must first meet the Nitze criteria (Reference 6) of "survivability and cost-effectiveness at the margin" and must be subject to negotiation.

In the last two years, issues have arisen regarding the interpretation of the ABMT and early SDI deployments. The ABMT language could have been more precisely worded in places, and arguments can be made either way (Reference 7) about the interpretation of some of the articles and agreed statements. However, when I read what is in the treaty and what has been written and said on the intent of the wording, particularly by those who were involved in the treaty negotiations, I conclude that the strict, as opposed to the broad, interpretation of the ABMT is the correct one.

Regarding early SDI deployments, I am concerned about the impact such a move would have on the political future of the ABMT, in the absence of Soviet agreement to amend the treaty to allow such deployments. I am also concerned about the technical merits of early deployments. Such a move would jeopardize

the research nature of the SDI program and could seriously undercut research progress on promising advanced technologies that will be necessary for truly effective defenses.

A system of space-based rockets called kinetic kill vehicles (KKVs) has been proposed as a first-tier strategic defense that could be deployed in the 1990s. Analysis done at our laboratory (References 8 and 9) has shown that while early deployments of space-based KKV's might provide an effective defense against the current Soviet ICBM force consisting mostly of SS18 missiles, the defense would require an order of magnitude more KKV's in order to defend against a modernized Soviet force with significant numbers of SS-24 and SS-25 missiles. The analysis further shows that Soviet countermeasures employing faster burning boosters and more rapid post-boost deployment would require even greater numbers of KKV's. We have concluded that the Soviets would readily be able to implement cost-effective countermeasures to currently proposed early deployments within the same time frame as those deployments.

I believe that the ABMT has been a successful treaty in preventing a spiraling competition between offensive and defensive counterdeployments. Both superpowers will have to proceed very cautiously in the future if we are to preserve the benefits that the treaty has to offer.

### SALT II

The SALT II treaty took almost seven years to negotiate and was signed in 1979. The treaty, which was to last until 1985, was never ratified. Initially, this was due in part to U.S. disillusionment with other Soviet actions in the world, and in part to an intense debate in the U.S. between the treaty's proponents and opponents about the merits and flaws of the treaty and its verifiability. Although the Senate never gave its consent to ratify the treaty and President Carter withdrew the treaty from the Senate after the Soviets invaded Afghanistan, Carter, and President Reagan after him, agreed to abide by the provisions of the treaty as long as the Soviets agreed to do so. The Soviets made similar expressions of intent. SALT II was to last until 1985, and both sides agreed to abide by its limits, as well as by the limits of the Salt I Interim Agreement, until a follow-on, permanent agreement could be achieved. The Reagan Administration called this policy with respect to the SALT II treaty "Mutual Interim Restraint."

SALT II was made possible because it was perceived at the time that parity in strategic strength existed between the U.S. and U.S.S.R., even though the forces of the two countries had different structures. SALT II placed quantitative and qualitative limits on a variety of strategic systems. Other than calling for a small reduction in 1981 of the ceiling for strategic nuclear delivery vehicles (SNDVs), SALT II did not call for major arms reductions. Both sides did agree in the next stage of talks (assumed at the time to be SALT III) to seek substantial reductions in strategic arms along with further qualitative limits. The Strategic Arms Reduction Talks (START) have, in effect, become the next stage.

The United States has developed over the years considerable concern (References 10, 11) about Soviet compliance with the unratified SALT II

treaty. These concerns have focused on several issues. The U.S. has claimed that: 1) the encryption of telemetry in Soviet missile tests has impeded U.S. NIM capability for verifying compliance with the treaty, 2) the SS25 ICBM was a second new type of missile and therefore not allowed by the treaty, and 3) the Soviets have exceeded the number of SNDVs allowed by the treaty. The Soviets have replied to these concerns. For example, they have claimed that the SS25 was simply a modernization of the older SS13 ICBM. And, of course, the Soviets have expressed concerns of their own.

The U.S. also expressed concern about a number of other issues relating to Soviet compliance with other treaties, particularly the ABM treaty. These concerns have all been vigorously discussed in the Standing Consultative Commission (SCC). The SCC had been established in SALT I and later extended to SALT II to provide a forum where the two sides could work out problems that they perceived regarding compliance with the SALT treaties. The two sides have been unable to resolve many of their differences on the U.S. concerns. The Reagan Administration announced that it would continue the policy of Mutual Interim Restraint only if the Soviets stopped their noncompliant actions. After repeated efforts to resolve the issues failed, the Reagan Administration announced in May of 1986 that it would no longer bind itself to the limits of SALT II. The U.S. said that it would reconsider this action if the Soviets stopped those activities which the U.S. considered to be not in compliance with the treaty.

I believe that these developments were quite unfortunate. SALT II had its drawbacks, because it stopped short of large cuts in weapon systems. However, it did have significant benefits, because it set ceilings on strategic systems and thereby helped insure that parity between the two countries would be maintained. At the same time, SALT II allowed both sides to proceed with needed weapon modernization programs and to address issues relevant to the asymmetric structure of their forces. In the process of doing these things, SALT II helped set a degree of predictability in the strategic balance between the two countries.

SALT II set the stage for major reductions in the follow-on START talks. Without the lid placed by SALT II on strategic systems and without a successful START agreement in the near term to take its place, we could see even larger numbers of strategic systems in the future. Even though the U.S. had legitimate concerns about Soviet compliance with the treaty, and these concerns diminished U. S. confidence in Soviet intentions, I believe that the political benefits for the U.S. to continue to adhere to the treaty should have outweighed the risks of the noncompliant actions. The U.S. might have continued to try to work out its concerns in the SCC, and the Soviets certainly could have been more accommodating in that forum. There is a more general question that relates to the SALT II compliance issue, as well as to other treaties: how to treat technical violations which do not appear to outweigh the overall value of a treaty. It is a question that will continue to arise in arms control deliberations.

Even with these events, I believe that the seven years of negotiations were an excellent learning process which paved the way for further progress in arms control. Many issues were identified. The treaty contained a

considerable amount of technical detail and precise definitions that can be applied to current and future arms discussions. We can also learn from the difficulties we experienced in the compliance area when addressing the verification requirements for future treaties like those we seek in START and INF.

### The Threshold Test Ban Treaty and Peaceful Nuclear Explosions Treaty

The Threshold Test Ban Treaty (TTBT) was negotiated and signed in 1974. Negotiations then began on the companion Peaceful Nuclear Explosions Treaty (PNET) which was signed in 1976. The TTBT sets an upper yield limit on underground explosions of 150 kt. The PNET sets the same limit on individual nuclear explosions for peaceful purposes, and makes other provisions for group explosions. The PNET also provides for the conduct of PNETs on the territory of other countries. It is important to note that the TTBT was negotiated in only five weeks. This reportedly was the result of desires by President Nixon and Secretary General Brezhnev to have a treaty in hand prior to their summit meeting in 1974. The two treaties have never been ratified. However, both countries agreed to abide by the terms of the TTBT with its effective date in 1976.

A major reason why the two treaties are especially noteworthy is that they marked a change in Soviet attitudes toward nuclear test verification. Prior to 1974, the Soviets had insisted that National Technical Means (NTM) of verification were adequate for monitoring test bans. In the TTBT negotiations, the Soviets accepted cooperative measures to enhance NTM in the form of exchange of data on geology, geography, and calibration yields. In the PNET negotiations, they accepted the need for in-country verification and allowed for the presence of personnel from the monitoring nation (the U.S. in this case) to verify the conditions of certain explosions and to directly measure the yields of individual explosions detonated as part of a group in order to guarantee that no individual explosion exceeded the 150 kt limit. The PNET also established a Joint Consultative Commission to address various issues regarding implementation of the treaties. The PNET has a technically complex protocol which was the product of 18 months of extended negotiations. The success in completing such an effort was the direct result of the desire on the part of both sides to conclude an agreement and the willingness to negotiate compromises to that end.

Ten years ago, the 150 kt threshold was considered to be militarily important because it restricted the development of very high yield weapons. Such weapons were considered to pose a particular threat in a first strike. Since then, as the accuracies of delivery systems have increased, the yields of warheads have decreased. So in general terms, the 150 kt limit has been only a limited restraint on the arms competition between the superpowers. In fact, the Directors of the U.S. weapons laboratories have testified (References 12 and 13) before Congress that their development programs can meet all current military requirements within the 150 kt limit.

An issue has arisen, however, that has diminished U.S. confidence in Soviet compliance with the TTBT limit. Verification of the TTBT is done by teleseismic means which has large inherent uncertainties. These uncertainties



were recognized when the treaty was negotiated. However, the body of seismic data from Soviet explosions is such that some analyses of the data conclude Soviet noncompliance with the 150 kt limit and the Reagan Administration has reported to Congress that the Soviets are in likely violation of the TTBT. Based on Livermore's assessment (Reference 14) of the relationship between yields and seismic magnitudes for the Soviet test sites and the patterns of Soviet testing, our scientists have concluded that the Soviets appear to be observing some yield limit. Livermore's best estimate of this yield limit, given the statistical nature of the problem, is that it is consistent with TTBT compliance. However, because of the uncertainty of teleseismic yield estimates and the uncertainty in extrapolating U.S. test experience to Soviet test sites, we cannot rule out the possibility that a few Soviet tests may have exceeded the limit. In short, we find it impossible to state with certainty that the Soviets have or have not violated the TTBT.

Are the few Soviet tests that appear to have exceeded the limit significant? The opinion of weapon scientists at Livermore is that the U.S. weapons program would gain very little of design significance by testing at the levels associated with the largest Soviet events. In assessing what is significant to the Soviets we are forced to use a "mirror image" approach because we know so little about Soviet design practices. We then conclude that the Soviets wouldn't gain much either. I emphasize that caveats must be placed on this answer because mirror imaging can involve faulty assumptions and be subject to large uncertainties.

Why then seek improved verification of the TTBT? We are dealing here with a fundamental issue of confidence building in the long term in the face of changing environments and value systems. The precision of TTBT yield estimates is insufficient to make it possible to render definitive judgments about Soviet compliance with the 150 kt limit. There are some in the U.S. who attach more military (and political) significance to the possible Soviet noncompliant actions with respect to the TTBT limit than others. An inability to distinguish reliably between compliance and violations of significance can undermine confidence in the arms control process and heighten international tensions. Means are available to improve the TTBT monitoring capability, and thereby create a situation of greater confidence. Regarding confidence, it should be noted that the Soviets have on occasion expressed concern about U.S. compliance with the TTBT limit. Seismic uncertainties are universal. Indeed, improved TTBT verification is the first priority goal which the U.S. has been seeking (Reference 15) in the current nuclear testing discussions with the Soviets in Geneva. I will say more later about these talks, which we call the Nuclear Test Experts Meetings (NTEM), and the decision on September 17, 1987 to begin full-scale negotiations on nuclear testing.

#### Treaties Establishing Nuclear-Free Zones

There have been a number of treaties that have established nuclear-free zones. These includes the Antarctic Treaty, the Outer Space Treaty, the Latin-American Nuclear-Free Zone Treaty, and the Seabed Arms Control treaty. All of these treaties have successfully limited the spread of nuclear weapons to areas that do not yet have such weapons.

The Antarctic Treaty, adhered to by some 23 nations including the U.S. and the Soviet Union, has successfully insured since 1959 that Antarctica will be used for peaceful purposes only. The Outer Space Treaty was modeled after the Antarctic Treaty and since 1967, over 100 nations have agreed to abide by its limits. The treaty keeps nuclear weapons and other weapons of mass destruction out of space and it ensures that the moon and other celestial bodies will be used exclusively for peaceful purposes. Similarly, the Seabed Arms Control Treaty, negotiated in 1971, has kept the ocean floor outside of each nation's territorial waters (agreed to in the treaty to be a 12 mile limit) free of nuclear weapons. About 100 nations have agreed to abide by the treaty's provisions.

The Treaty for the Prohibition of Nuclear Weapons in Latin America, effective in 1968, is similar to the other nuclear-free zone treaties. It differs in the respect that it applies to a populated area of the world and in that regard it works to prevent the proliferation of nuclear weapons. Twenty-five Latin American countries have agreed to abide by the terms of the treaty. In Protocol I of the treaty, the four nations (France, Netherlands, U.K., and U.S.) who have territories in the zone have agreed to abide by the terms of the treaty. In Protocol II, the five nuclear weapon states agreed to support the denuclearized nature of the Latin American zone.

I believe that the successes achieved in negotiating all these regional treaties indicates what can be achieved in arms control once nations recognize the mutual benefits to be derived for improved security and well-being.

#### Agreements to Reduce the Risk of War

There have been a number of successful agreements that the U.S. and U.S.S.R. have signed that have reduced the risks of war, and in particular nuclear war. These include the Hot Line Agreement, the Accident Measures Agreement, and the Prevention of Nuclear War Agreement. Rather than being treaties requiring an involved ratification process, these are executive agreements that are signed by the leadership or high level representatives of the two countries. The prime purpose of such agreements is to minimize the possibility for misunderstanding and its consequences during times of crisis. Measures include information exchanges such as launch notifications, constraints on military operations, and provisions for enhanced communications during crises. An excellent article which presents an overview of this subject area with recommendations for further progress is given in Reference 16.

In June 1963, the U.S. and U.S.S.R. representatives to the Eighteen Nation Disarmament Committee negotiated and signed the Hot Line Agreement which established a direct communications link between the two countries. The link showed its value during the Middle East conflicts in 1967 and 1973. Concerns about the vulnerability and survivability of the communications link in the event of war led to an agreement in 1971 to upgrade the Hot Line using the latest U.S. and Soviet satellite communications technology. The 1971 negotiations to upgrade the Hot Line were carried out as part of the SALT I process. In 1984, the U.S. and U.S.S.R. again agreed to improve the Hot Line

by adding a direct facsimile link to allow transmission of figures, charts, and other pictures.

The Accident Measures Agreement was also concluded as part of SALT I. Both countries agreed to take unilateral steps to improve operational and technical measures to prevent the accidental and unauthorized use of nuclear weapons. The agreement also committed each side to make arrangements to notify the other side in case of accidents, unexplained incidents, and unidentified objects picked up by early warning systems. Included in the agreement was a provision to notify the other side of missile test launches that could be interpreted as a threat. In 1985, the U.S. and U.S.S.R. completed a Common Understanding at the S.C.C. to more clearly identify the kind of incidents that are of concern.

The Prevention of Nuclear War Agreement signed in 1973 provides for consultations between the U.S. and U.S.S.R. in the event of situations that might arise in which there is danger of a nuclear confrontation.

These agreements are all aimed at building confidence between the superpowers rather than at reducing or limiting weapons. They have been successful and we continue to make progress in this area. For example, in May of this year, the U.S. and U.S.S.R. negotiated an agreement to establish Risk Reduction Centers in each nation's capitol. The centers will contain modern communication equipment and will be staffed with diplomatic, military, and intelligence personnel. The centers will provide a way to exchange information in support of existing and future such agreements. The new agreement was signed on September 15, 1987 when Foreign Minister Shevardnadze visited Washington.

Considerable emphasis continues to be placed on developing confidence building measures. Negotiations for such measures were an important aspect of SALT II and continue to form an integral part of the current START and INF negotiations in Geneva. In recent years, there has been considerable activity in the U.S. studying how better to manage crises and enhance confidence. For example, there are efforts like the Harvard Avoiding Nuclear War Project (Reference 17) and the Harvard Negotiating Project (Reference 18). Stanford University has also been active in studies of crisis management and nuclear war prevention measures (References 19 and 20).

#### The Conference on Confidence and Security Building Measures in Europe

While so far we have been discussing arms control agreements that have to do with nuclear weapons, I believe it would be worthwhile to mention an arms control agreement dealing with conventional forces that was concluded just a year ago at the 35-nation Conference on Confidence and Security Building Measures in Europe (CDE). The 35 nations were from NATO, the Warsaw Pact, and neutral countries. After three years of negotiations, they agreed to adopt measures that would reduce the risks of military confrontation in Europe and to refrain from the use of force in their relations. The measures include prior notification of military activities involving forces above a certain size and a provision for observers from the parties to the agreement to be at maneuvers above a certain size. The agreement sets time requirements for the

advance reporting of military activities. Two years advance notice is required for a very large troop maneuver to avoid what might otherwise be interpreted as a show of force.

A significant part of the agreement was that a state could request a challenge on-site inspection (OSI) of another state in order to determine compliance with the agreement, with the number of OSIs that a state would have to accept being limited to three. The OSIs could be conducted on the ground or in the air, where the inspected state provides the aircraft and the inspecting state can use its own monitoring equipment. The fact that the Soviets agreed to these OSIs may be a significant indicator of their future willingness to accept effective OSIs for other arms control agreements now under negotiation. The prospects for progress in arms control are enhanced when all the parties see value in the agreed measures rather than viewing the measures as one-sided concessions.

The successful conclusion of the CDE agreement illustrates what can be accomplished in arms control when the parties realize the advantages to be gained for their national security. Owing to the widely varying views that are possible amongst nations, it is also noteworthy that 35 nations were able to come to closure on the agreement. The CDE agreement should go far in building confidence in Europe and in reducing the risks of an outbreak of war.

#### The Priorities of Arms Control

I have just described the achievements of arms control over the past 25 years. Considering the large nuclear arsenals that the superpowers have amassed in that time, we certainly have a lot more to accomplish. Considering that parity in strategic balance generally exists between the superpowers, I believe that the conditions are now ripe to make major progress in arms reductions at the negotiating table. I am optimistic that the current Geneva negotiations will produce meaningful results. As you know, these negotiations actually consist of three separate negotiations involving strategic arms (START), mid-range weapons (INF), and defense and space weapons. For the past year, the U.S. and the Soviets have also been meeting in the Nuclear Test Experts Meetings discussing a broad range of issues related to nuclear testing. When Foreign Minister Shevardnadze visited Washington just recently, it was agreed to turn these discussions into negotiations.

What should the priorities of arms control be? In an article written by Thomas Schelling in 1985 entitled "What Went Wrong with Arms Control," (Reference 21), he defined the issues very well. Schelling said that we have lost sight of what arms control should be about. He said that arms control should avoid developments which would result in a strategic situation on one side that threatens the other side's ability to retaliate after being attacked. Such a situation would be extremely destabilizing in a crisis. I agree with Schelling. Negotiations should seek to reduce the weapon systems which most threaten the survivability of either side's deterrent. The difficult task is then to find ways where the two sides can work out compromises, where both sides agree to cut back or limit weapons which are at the same time destabilizing to the other side and an important element in the strategic forces of the possessor. For example, the U.S. is particularly

concerned about the Soviet SS18 missiles which pose a first strike threat to our land-based missile forces. And the Soviets are concerned about our SDI program which they view as a threat to their retaliatory capability.

I believe that we are on the verge of major progress in Geneva. Now that it has been decided to negotiate a global zero-zero limit on INF missiles, the problems of verifying an INF agreement have become more tractable. During Foreign Minister Shevardnadze's recent visit to Washington, the U.S. and U.S.S.R. "agreed in principle to conclude a treaty" on eliminating INF missiles with ranges of 300-3400 miles. The goal has been set to sign such a treaty at a summit meeting this fall. The value of such an agreement will lie more in setting the stage for further progress in Geneva on strategic arms than it will in having any major impact on the balance of power in Europe. Nuclear weapons are political weapons, and INF weapons are perhaps the most political of all. There are still other weapons to accomplish the same mission for which the INF missiles were intended. I believe that the biggest gains to be achieved in Geneva will be in the area of strategic arms. These will follow an INF agreement.

There is a fundamental issue that relates to arms control, and it has to do with modernization, new technologies, and research. Some say that new technologies drive the arms race, and sometimes they are correct. Others say that new technologies help make deterrence work better, and sometimes they are correct. The difficulty is to determine which technologies are desirable and then agreeing on this in Geneva. A considerable amount of time is devoted in Geneva to discussions on the control of technology.

A major thrust of the Soviet position in the current Geneva negotiations is to limit research on the Strategic Defense Initiative (SDI). Earlier, I gave my views on SDI and said that SDI research should go on as long as it is consistent with the ABM Treaty. The Soviet position has been to place much more restrictive limits on such research. The U.S. has been unwilling to accept this and the differences became an issue at the presummit meeting in Reykjavik, Iceland last October. The two sides were very near to agreeing on some major changes in nuclear arms, when the Soviet insistence (Reference 22) that the U.S. make major concessions in its SDI research program got in the way of agreements on strategic and INF weapons. There appears to have been a softening of the Soviet position when Foreign Minister Shevardnadze visited Washington. U.S. newspapers report that the Soviets are now willing to allow research pursued within the traditional interpretation of the ABM Treaty.

There were other concepts introduced at Reykjavik that in my mind would have established some dangerous steps in nuclear policy. The notion that we could completely eliminate ballistic missiles in a decade was particularly disturbing to many policy experts, such as Brent Scowcroft, John Deutch, and R. James Woolsey who said in all seriousness in a New York Times Article (Reference 23).

"SDI has already protected the United States by preventing an agreement at Reykjavik that would have destroyed the American ballistic-missile deterrent within a decade."

Similar words were said by James Schlesinger (Reference 24). Christoph Bertram presented a cautious European point of view on Reykjavik in an interview in Arms Control Today (Reference 25), where he said,

"There was a very real and justified concern in Europe over what I would call the Utopian objectives of Reykjavik."

An interesting perspective on the elimination of ballistic missiles was recently discussed by Thomas Schelling (Reference 26) who sees merits in eliminating land-based missiles because of their destabilizing vulnerability to preemptive attack but sees "no comparably strong case for eliminating or reducing the number of missile-carrying submarines."

I believe that the complete elimination of ballistic missiles in the near future, in the absence of carefully thought-out and well-planned arms control progress in other nuclear and conventional areas, could seriously impact the deterrent capabilities of the Western World.

Another area where there has always been pressure to restrict technology is nuclear testing. In the 1950s and early 1960s, a nuclear test ban was the primary focus of arms control. One of my colleagues, Warren Heckrotte, has referred to the early test ban negotiations as "the SALT of their day" (Reference 27). The problems of verification stood in the way of agreement on a CTB. The LTBT was concluded in 1963 as a compromise, readily verifiable step toward a CTB. The LTBT was followed by the NPT, an agreement which most nonnuclear nations were willing to accept so long as the superpowers continued progress toward a CTB. Then came the TTBT and PNET which I have already discussed and which have posed their own set of verification concerns. During 1977-1980, the Carter administration reopened full scale CTB negotiations. Considerable progress was made in achieving agreement on in-country seismic networks and on procedures for voluntary on-site inspections. President Carter temporarily put aside consideration of a CTB in order to pursue SALT II, and the Reagan administration in 1982 withdrew consideration of a CTB indefinitely, saying that a CTB was a long term goal.

Recently, there have been increasing pressures on the U.S. to undertake more restrictive test limitations. The Soviet unilateral moratorium from August 1985 to January 1987 focused world attention on the issue. Other developments have occurred. There is the joint effort between the Soviet Academy of Sciences and the National Resources Defense Council in the U.S. which sets up seismic stations around Soviet and U.S. test sites. There was also a proposal (Reference 28) by a group of six nations (Mexico, Greece, Tanzania, India, Argentina, and Sweden) called the Delhi-6 for a global seismic monitoring capability.

The U.S. Congress has also considered test limitations. Last year and this year, the House of Representatives passed amendments (References 29 and 30) that would eliminate funding for nuclear tests greater than 1 kt as long as the Soviets agree both to abide by the same limit and to acceptive effective verification measures. The House has passed arms control legislation in a number of other areas, including SDI, SALT II, chemical weapons, and antisatellite weapons. Last October, when President Reagan and

Secretary General Gorbachev went to Reykjavik, the House agreed to withdraw its arms control legislation so as to give the President negotiating flexibility. The legislation has been introduced again. The Senate has also considered legislation on test limitations. The Senate legislation is less restrictive than that considered by the House. In the past three years, the Senate has passed two nonbinding "sense of the Senate" resolutions (Reference 31) asking the President to submit the TTBT and PNET for ratification, as well as to resume CTBT negotiations. Currently, there is Senate legislation (Reference 32) pending for a two-year 1 kt moratorium with one 15 kt test per year. The legislation calls for bilateral verification provisions. Our Laboratory has analyzed these provisions and finds that they fall short of what is required for effective verification.

Clearly, there is increased interest at many levels for further test limitations. I emphasize that the process of arms control in the U.S. is quite complex owing to a considerable amount of interplay between and within the Executive and Legislative branches of the Government. Proposed arms control agreements must have technical, military, and political merits that will stand the test of time with varying opinions in dominance. These prerequisites must be met in order to pave the way for general acceptance of an international agreement.

The Reagan administration has formally responded to all these concerns at an international level. In 1986, the U.S. and U.S.S.R. started a series of technical meetings in Geneva which have been called the Nuclear Test Experts Meetings. I was the Department of Energy Delegate to the first three sessions of NTEM in July, September, and November of 1986. The NTEM has had three sessions this year. The first U.S. goal at NTEM has been to negotiate improved verification measures for the TTBT and PNET. In Reykjavik, President Reagan made the following proposal:

"The U.S. and Soviet Union will begin negotiations on nuclear testing. The agenda for these negotiations will first be to resolve remaining verification issues associated with existing treaties. With this resolved, the U.S. and U.S.S.R. will immediately proceed, in parallel with the reduction and elimination of nuclear weapons, to address further step-by-step limitations on testing, leading ultimately to the elimination of nuclear testing."

The main Soviet goal regarding nuclear testing is to achieve a CTB. They appear to be willing to agree to intermediate steps along the way to a CTB, perhaps even along the lines of President Reagan's proposal in Iceland. At Reykjavik, Secretary General Gorbachev said in a press conference:

"We submitted the following proposal to the U.S. President: Let us agree to start talks on banning nuclear explosions immediately after the conclusion of our meeting in Reykjavik. At the meeting we proposed that this be a process over the course of which we could examine at some stage, perhaps even on a top-priority basis, also the question of thresholds, the nuclear blast yield, the number of nuclear explosions per year, and the fate of the 1974 and 1976 treaties, and that we would move further toward the elaboration of a comprehensive treaty banning all nuclear explosions."

Just before President Reagan went to Reykjavik, as a condition to get the U.S. Congress to withdraw its legislation on nuclear test limits, the President agreed to submit the TTBT and PNET to the Senate for advice and consent to ratify the treaties, whether or not Gorbachev agreed to the U.S. proposal for improved verification of the two treaties. If Gorbachev refused the proposal, the President agreed to submit the treaties with a reservation that they would not go into effect until the verification provisions were acceptable.

Gorbachev did not accept the proposal and the President submitted the two treaties, with the above-mentioned reservation, in January 1987 to the Senate to seek their advice and consent for ratification. A complicated debate (Reference 33) developed in the Senate, as to whether to provide that advice and consent. Considerable concern was expressed about the reservation. Some Senators asked if the President would return to the Senate for a second vote of approval on the acceptability of improved verification measures yet to be negotiated with the Soviets. Other Senators suggested that advice and consent be given without conditions; they suggested that the President should certify on his own the acceptability of any improved verification measures agreed to by the Soviets and that he should decide on that basis when the treaties would go into effect. Still other Senators suggested that the President defer his request for advice and consent until he had successfully negotiated the desired verification improvements with the Soviets. The Senate was unable to decide the issue, and in effect, the last suggestion was essentially chosen by default.

At a meeting in Moscow in April, which included Secretary of State Shultz and Foreign Minister Shevardnadze, the Soviets suggested performing joint verification experiments at each other's test sites. The nature of these experiments was discussed at NTEM. At the most recent session in July 1987, the Soviets table a proposal for the conduct of "joint experiments designed to improve verification measures of the TTBT and PNET" (Reference 34). The Soviet proposal has received extensive review by the U.S. Government.

I believe that a step-by-step approach to further nuclear test limitations in parallel with major arms reductions is the correct approach. A major breakthrough occurred during Foreign Minister Shevardnadze's visit to Washington, when the U.S. and U.S.S.R. agreed to begin full-scale negotiations on nuclear testing. The two sides issued a joint statement on September 17, 1987 which states:

"U.S. and Soviet sides have agreed to begin before December 1 full-scale stage-by-stage negotiations which will be conducted in a single forum. In these negotiations, the sides as the first step will agree upon effective verification measures which will make it possible to ratify the U.S.-U.S.S.R. treaties of 1974 and 1976, and proceed to negotiating further intermediate limits on nuclear testing leading to the ultimate objective of the complete cessation of nuclear testing as part of an effective disarmament process. This process, among other things, would pursue as the first priority, the goal of the reduction of nuclear weapons and ultimately their elimination. For the purpose of the elaboration of improved verification measures, for the U.S.-U.S.S.R. treaties of 1974 and 1976, the sides intend to design and



conduct joint verification experiments at each other's test site. These verification measures will, to the extent appropriate, be used in future test limitation agreements which may subsequently be reached."

My own view on nuclear test limitations is that they are more an effort to control technology rather than to control arms. Test limitations will not make nuclear weapons go away. The only thing that will make nuclear weapons unnecessary is vastly improved relations in the world and alternatives to war for resolving conflicts. As long as we rely upon nuclear weapons for a deterrent, then I believe that nuclear testing is necessary to keep that deterrent viable.

An important view on the role of nuclear testing in arms control was expressed by Andrei Sakharov at the Forum for a Nuclear Free World in Moscow in February 1987. Time magazine printed Sakharov's statement (Reference 35) in which he said:

"Thus the question of nuclear testing is not critical for the restraint of the arms race. The issue of nuclear testing, in my opinion, is of minor, secondary importance in comparison with the other military, technical, political and diplomatic problems involved in preventing thermonuclear calamity.... As long as nuclear weapons exist and are not banned, the decision regarding underground testing is the internal sovereign affair of each nuclear power.

"I believe that eliminating the issue of a comprehensive nuclear test ban will facilitate negotiations on more urgent problems of disarmament. I have deliberately omitted any discussion of the propaganda and psychological aspects of the test-ban issue."

The global strategic balance is constantly changing. The deterrent relationship among nations is a dynamic one. Military systems age and become obsolete, and new technologies present alternatives which make for a safer, more secure, more survivable, and more effective deterrent. With or without restrictive test limitations, nations will continue to respond with new developments. Even with test restrictions, there will be new developments in nuclear weapons. These developments will lack the system optimization that now occurs and uncertainties will increase. In fact, we experienced a de facto CTB during the nuclear test Moratorium of 1958-1961. Changes indeed were made to the U.S. stockpile during that time, and later nuclear testing showed that some of these changes involved errors in scientific judgment (Reference 36).

Nuclear weapon technology is empirically based. Assessment of existing weapons and of the impact of new technologies developed by either side rests on scientific judgment, and that judgment is based on nuclear test experience. New technologies can be those which we deem beneficial to enhance the safety and survivability of our own weapons, and they can also be technologies which our adversaries might use that could threaten the viability of our weapons. I believe that the most significant impact of a CTB would be to diminish, asymmetrically vis-a-vis the Soviets, the skills of the relatively few weapon scientists capable of making these judgments.

Science and technology thrive on the relationship between theory and experiment. Take away the experiments, and you remove the credibility of the theory. I have developed computer programs to simulate the physical processes in nuclear weapons. My programs frequently made incorrect predictions, and it took experiments to make the necessary corrections.

Take away the experiments, and you reduce the soundness of scientific judgment. There are many who believe that this would be a good thing to do in the case of nuclear weapon technology. I believe that it would be a dangerous thing to do. The end result would be to introduce uncertainty and instability into our political and military relationships.

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