Canberra Commission Issue Paper

Practical Interim Steps Toward Nuclear Weapons Elimination and A Fissile Control Regime for Nuclear Weapon States.

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I. Introduction.

Interim steps toward nuclear weapon elimination and fissile material control have as their common purpose increasing the time, resources and technical effort required to restore nuclear forces to war-fighting readiness, and reducing the risks posed by the forces that remain. This paper outlines a dozen interim steps toward nuclear weapon elimination and fissile material control that focus on the readiness of the weapon system for launch, the physical separation and/or destruction of component parts, and the disposition of weapon-usable fissile material and tritium. Not all of these steps are required, and while none are mutually exclusive, some may be redundant or irrelevant depending on the implementation of others. For example, reducing the alert status of operational systems by removing on-board missile guidance hardware becomes irrelevant if the reentry vehicles (RVs) themselves are removed from the missiles and the nuclear weapons in turn removed from the RVs and placed in monitored storage. The twelve suggested steps are:

1) reducing the alert status of strategic weapon systems by eliminating launch-on-warning or launch-under-attack alert readiness postures;

2) in situ deactivation of strategic launch vehicles;

3) "demating" of nuclear reentry vehicles from strategic ballistic missiles in advance of formal agreements on further reductions (possibly followed by removal of the nuclear warhead package from the RV, and storage of both components at locations remote from missile launch sites);

4) further reductions in deployed strategic nuclear delivery vehicles (SNDVs) and in warheads on that may be carried by such systems, e.g. START II/III;

5) removal from active service and monitored storage of all *non-strategic* nuclear warheads, both offensive and defensive;

6) destruction of strategic launchers (i.e. missile silos, submarine launch tubes), top-stage RV "busses," RVs, and destruction/conversion of the rest of the strategic missiles themselves;

7) verified dismantlement of warheads and monitored interim storage of their fissile material components;

8) application in the weapon states of International Atomic Energy Agency (IAEA) or comparable multilateral safeguards to all fissile material inventories not stored in weapon-component form, and to all facilities with the capacity to use, produce, separate, enrich, or otherwise process fissile material;

9) phased implementation of a global, verified cutoff in the production of fissile materials for weapons purposes, beginning with the U.S. and Russia, and including other relevant states as excess U.S.- Russian inventories of fissile material in or reserved for weapons are brought down significantly;

10) draw-down of military and civil stocks of weapon-usable fissile material (HEU and plutonium);

11) permanent disposal of weapon-usable fissile materials, either directly or following chemical conversion and use as nuclear fuel in the civil sector;

12) safeguarding of tritium in excess of declining weapon requirements.

Implementing these interim steps can be achieved through a combination of unilateral, bilateral, or multilateral measures. Bilateral and multilateral actions can be taken with or without formal agreements, or in the absence of treaty ratification. Unilateral actions can be the most expeditious, but also can be more easily reversed, and may not provide a verifiable basis for reciprocal actions by other states leading in the direction of a nuclear-disarmed world. As an enhancement to the entire process each step can be superseded, accompanied, or followed by policy declarations and transparency measures, including

a) exchange of weapon stockpile and fissile material inventory data and other information;

b) cooperative verification measures to confirm data included in declarations and exchanges;

c) informal transparency measures such as site visits, scientific exchanges, and cooperative programs between organizations involved in sensitive nuclear activities;

d) formal joint safeguards and security measures on stored weapons, weapon components, and stocks of weapon-usable nuclear materials;

e) nondeployment and/or non-use declarations, such as Nuclear Free Zones and Negative Security Assurances.

Various possible combinations from the above categories permit a wide range of interim choices. The challenge is to identify realistic steps and accelerate the process of agreement on specific strategies to implement them. Some steps may better be done unilaterally, others bilaterally or multilaterally. The goals are to: i) accelerate the pace of nuclear weapon elimination, ii) insure that the road to the ultimate abolition of nuclear weapons will not be blocked by a failure to take (and credibly document) specific interim steps, and iii) reduce the risk that any given step might later be reversed.

Most analysts believe that progress toward elimination likely will have to proceed in phases, for example as recently recommended by "An Evolving US Nuclear Posture," a report of a committee of U.S. experts chaired by General Andrew J. Goodpaster (USA, ret.).[1] The Goodpaster panel recommended that elimination take place in the following four phases. During Phase I, the U.S. and Russian arsenals would be reduced to about 2000 warheads each. During Phase II, further cuts in force levels to a few hundred weapons each would be accompanied by steps to remove many, if not all nuclear weapons from active alert status, and by the extension of nuclear transparency and safety measures to the smaller nuclear powers.

Also occurring during Phase II would be a radical reduction in the political role of nuclear weapons requiring changes in defense policy, military strategy and force posture. During Phase III all nuclear weapons states would reduce their arsenals to tens of weapons each. Achievement of the goals of this phase would require the widespread embrace of new principles and mechanisms for national security and further marginalization of nuclear weapons in interstate relations. During Phase IV, all nuclear weapons would be "eliminated" from all countries, except that "in the event of nuclear disarmament, it is presumed that the United States and other currently nuclear-armed states would preserve components of their nuclear arsenals under international safeguards." The Goodpaster Panel, like all previous panels on the subject, did not attempt to specify either the technical safeguards or international arrangements for implementing multilateral deep reductions (Phase III) or final elimination (Phase IV). This is a task that remains to be accomplished by the Canberra Commission.

To enhance the process and minimize the likelihood of future roadblocks, an early essential step is for all parties to know what other states have produced and currently possess

in the way of nuclear weapons and weapon-usable fissile material, and to provide the data necessary for cooperative monitoring of the disarmament process. The declared weapon states should make comprehensive *public* declarations of their inventories of weapons and materials in the form of official submissions to a United Nations registry, and announce that these declarations will be updated periodically. The United States and Russia agreed in 1994 to initiate an exchange of nuclear weapon and fissile material inventory data, but this effort has been stalled pending completion of a formal "Agreement for Cooperation" (required under the U.S. Atomic Energy Act) to exchange "Restricted Data" involving nuclear weapons with a foreign government. The delay could have been avoided had the two countries simply declassified unilaterally those data that could be made public without risk of revealing sensitive nuclear warhead design data -- probably constituting 90% or more of the data to be exchanged. There is nothing that can be deduced from the declassification of such aggregate data that is not already known to modestly competent proliferant states, so the only audience being kept in the dark by the continuing secrecy are the U.S. and Russian publics, and the rest of the international community.

The declarations would be followed by bilateral (in the case of the United States and Russia) and multilaterally (in the case of the declared weapon states) safeguards or transparency measures to confirm the declarations and provide for continuous monitoring of stocks of warheads and weapon-usable fissile materials and facilities for their production.

II. Specific Interim Steps.

A. Reducing the Alert Status of Strategic Weapon Systems.

In *Global Zero Alert for Nuclear Forces*, Brookings analyst Bruce G. Blair has analyzed various options for achieving maximum safety by taking all nuclear weapons off alert, thereby insuring no weapons are poised for immediate launch.[2] These include:

- de-targeting land-based missiles,

- providing additional measures for ICBMs, e.g., "safing"* the missiles in their unmanned silos as was done to the 450 Minuteman II missiles in October 1991,
- de-targeting submarine-launched missiles,
- providing additional measures for SLBMs, e.g., reducing strategic submarines to single crews and eliminate operational patrols,
- maintaining for heavy bombers only a low level of combat readiness bereft of nuclear payloads, and
- providing additional steps to de-alert strategic bombers, e.g., by relocating payloads away from the bomber bases.

These reductions in alert status could be adopted by all nuclear states unilaterally, with public declarations of the specific steps taken. This would be followed by multilateral negotiations over transparency and binding agreement restricting reversibility.

B. In Situ Deactivation of Launch Vehicles.

Numerous options are available for increasing the time required to prepare a strategic nuclear delivery vehicle for launch, or for preventing preparations for launch without incurring visible signs of reactivation activity. These include:

- Removing guidance sets from ICBMs and SLBMs,
- Removing missile warhead shrouds,
- Removing rocket engines, and
- removing critical aircraft components, e.g. wheels, pylons for cruise missile carriage, etc.

These reductions in alert status would have to be adopted following bilateral or multilateral negotiations over feasibility, timing and transparency measures.

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* Missile "safing" was accomplished by inserting a special pin in the motor ignition mechanism, physically blocking ignition.

In light of extended times required to remove warheads and dismantle launch vehicles from large numbers of missiles, particular consideration should be given to measures that render the systems permanently inoperable, e.g., driving a spike through solid rocket propellant.

C. Removal of Warheads From Strategic Launch Vehicles.

A form of "de-alerting," the physical separation of warheads from ICBMs, SLBMs and bombers provides a straightforward means of increasing the time to launch that focuses on the objects of greatest concern from the nuclear disarmament standpoint -- the warheads and bombs themselves. After all, dedicated nuclear strategic nuclear delivery systems could be "deactivated," or even eliminated, and the United States would still retain an enormous potential for long-range delivery of nuclear weapons through redeployment on "conventional" strategic bombers and on inherently dual-capable attack submarines and surface ships with vertical or torpedo-tube launch systems for nuclear armed sea-launched cruise missiles. SLBM warheads could be stored in secure land-based depots a given distance away from submarines in port. Bomber payloads could be relocated away from bomber bases, preferably in storage areas distant from airfields capable of handling strategic bombers. A possible drawback of separating warheads from delivery vehicles, when undertaken as a part of a de-alerting rather than destruction program, is the limited capacity of the support infrastructures to remove, transport, and safeguard operational warheads. Another weakness is that weapon states bent on preserving their nuclear arsenals might tend to adopt easily reversed "demating" of warheads as a substitute for more extensive (but still reversible) "warhead dismantlement" or effectively non-reversible (at reasonable cost) destruction of the warhead components.

D. Further Reductions in Deployed Strategic Arsenals.

1. START II Ratification. To clear the way for more dramatic reductions before the end of the century the timetable for completing START II reductions could be moved up from 2003 to 1997.[3] However, neither the U.S Senate, nor the Russian Duma, have yet ratified START II. Instead of negotiating further reductions, Pentagon plans, as set forth in the Nuclear Posture Review, call for retention of a "hedge" arsenal of some 2500 strategic warheads

and 1000 non-strategic warheads in addition to the 3500 accountable strategic warheads allowed under START II. Russia has been silent with regard to the number of warheads it plans to retain.

2. START III Negotiations. Under current policy the United States will not negotiate further reductions until START II has been ratified by the Duma and Senate and entered into force.

The START treaties place limits on the number of delivery vehicles and warheads on operational systems, but are silent with respect to the destruction of warheads and the total number of nuclear weapons each side is allowed to retain in its stockpile. The United States and Russia should agree to: dismantle all strategic warheads associated with delivery systems withdrawn from deployment under the START treaties and subsequently, as well as tactical warheads withdrawn unilaterally; not reuse the fissile material components removed from weapons in new weapons; and store this material under bilateral monitoring until it can be converted to a form suitable for IAEA safeguards. Warhead and fissile material disposition issues are addressed more fully below.

3. U.K., France and China. These three declared weapon states could take unilateral, and at this stage, reversible steps to reduce the sizes and alert status of their deployed nuclear forces. For example, it is far from clear that the at-sea deterrent patrols of French and British missile submarines now play any role in their national defense or world politics, other than to deprive their publics of needed expenditures in other areas. Deterrent patrols could be ended entirely, and replaced with occasional training cruises with missile systems equipped with disarmed dummy warheads. Much the same, of course, might be said about similar U.S. Navy patrols.

E. Removal of All Non-Strategic Nuclear Warheads from Active Service to Monitored Storage.

All declared nuclear weapon states should declare that they will unilaterally remove all non-strategic nuclear weapons from deployed sites to a limited number of in-country land-based

secure storage facilities. This would be a logical follow-on to the 1991 unilateral declarations of the United States and the Soviet Union, whereby each pledged to remove all non-strategic nuclear weapons from ships and submarines and store them on shore.

All U.S. warheads based in NATO countries would be returned to the United States for secure storage.

F. Dismantlement and Destruction of Strategic Nuclear Delivery Vehicles.

By agreement all strategic delivery vehicles, i.e., missiles and bombers, withdrawn from field deployment to comply with reduction agreements could be destroyed (or the missiles converted into space launch vehicles) and production of these vehicles could be ended. The importance of the latter proposal is often underestimated. Unfortunately, the dynamics of the nuclear deterrence dilemma do not lend themselves to a "steady state." If the arms race is not put into reverse by mutual agreement, it will continue to sputter ahead. Today, for example, production of strategic submarine-launched ballistic missiles (D-5), bombers (Stealth), and attack submarines is continuing in the Untied States largely on the strength of the circular argument that continued production is needed to "maintain a strategic industrial base" in the event the arms race with Russia is resumed at some point in the future. This points up the dilemma of proposals for deterrent stability at some lower but still substantial level of operational nuclear forces, such as the 2000 deployed weapons often mentioned as the objective for START III. Such forces will require the maintenance of a warm nuclear-industrial complex, if only to maintain the warheads and delivery systems and replicate their component systems when they are replaced. But the parallel existence of several such complexes will lead to inevitable cross pressures for improvements in delivery systems and warheads, and an "arms race" of some sort will continue, if only to incorporate the latest improvements in technology arising in the civilian sector. The only way out of this box is to preempt the warm-industrial-base "hedge requirement" by definitively altering perceptions of the future through mutual agreement, such as a ban on further production of new or additional strategic nuclear delivery vehicles, and major alterations to these systems, such as replacement of the warhead bus or upper stage.

G. Dismantlement of Warheads.

Independent of the above option, the United States and Russia should agree to specific warhead disassembly rates. Russia is believed to have several thousand more intact warheads than the United States. To reduce this imbalance the two could agree to dismantlement rates by individual warhead type or mission category.

Current dismantlement schedules are probably geared to dismantling the obsolescent and less threatening warheads (e.g., artillery shells) first. By agreement the more threatening modern strategic warheads recently removed from missile systems could be moved to the head of the queue. Reserve ("hedge") warheads, retained for possible "uploading" to pre-START II force levels, should be eliminated.

H. Monitored Bilateral/Multilateral Interim Storage of All Plutonium and HEU Components Withdrawn from Weapons.

Plutonium, HEU, and composite (HEU-Pu) pits, thermonuclear secondaries, and fissile components removed from secondaries should be stored, initially under bilateral monitoring arrangements. After further U.S.-Russian reductions have been implemented, it may become more likely that the U.K., France, and China can be induced to join the U.S. and Russia in a five-power monitoring system. Thermonuclear secondaries removed from dismantled warheads should be promptly disassembled, and their medium-enriched uranium metal components converted to uranium oxide and blended down for eventual sale as LEU in the commercial marketplace. Arrangements for conversion of weapon plutonium to forms suitable for safeguarded fuel fabrication or disposal as vitrified waste, are likely to require storage as metal pits for a longer period.

The United States has declared that about 39 t of government-owned plutonium and 175 t of government-owned HEU are in excess of weapon needs. A tiny fraction of these inventories -- 10 t of HEU and 1 t of plutonium -- has been placed under IAEA safeguards, but the United States has announced its intention to eventually place all of its "excess" fissile material inventories under IAEA safeguards. Russia has made no similar declaration, but has agreed to

blend-down up to 500 t of HEU from its weapon stockpile and sell it to the U.S. as low-enriched uranium for fabrication into fuel for nuclear power plants. The Clinton Administration's announced intention decision to place any fissile material declared excess under IAEA safeguards regrettably resulted in the Pentagon preemptively limiting the amount of fissile material that could be considered excess to military needs. Huge amounts of weapon-grade plutonium and HEU, amounting to some 38 t and 600 t, respectively, have been sequestered indefinitely for future military use.

I. Application in the Weapon States of IAEA or comparable Multilateral Safeguards to All Fissile Material Inventories Not Stored in Weapon-Component Form, and to All Facilities With the Capacity to Use, Produce, Separate, Enrich, or Otherwise Process Fissile Material.

As long as the nuclear arms race continued at full tilt, there was little thought given to safeguards implementation in nuclear weapon states, as the risk of state-sponsored diversion was seen as being essentially irrelevant in a nuclear weapon state. Possible losses due to terrorism and theft were treated as the concern of each individual weapon state's physical security systems, which were generally viewed as being capable and well-maintained. The unprecedented political disintegration of the USSR -- a nuclear weapons state -- in 1991, the subsequent confirmed reports of losses of weapon-usable fissile material from former Soviet nuclear installations, and the decrepit state of physical security and material accounting systems throughout the former Soviet bloc, have exploded the mistaken notion that weapon states need not be held to strict international standards of nuclear accountability and security.

The nuclear weapon states have failed to date to fund the implementation of full IAEA safeguards on anything but a few of their civil reactors. Nor have they conducted studies and in-plant demonstrations of how international safeguards might be applied to their own sensitive facilities for plutonium separation and uranium enrichment with a degree of risk that they and the rest of the world would find acceptable if *they* were the ones without nuclear weapons. Such studies and demonstrations are urgently needed to lay the groundwork for a comprehensive safeguards regime in the civil sector to complement a bilateral/five power monitoring regime for

military nuclear facilities and stocks. Such studies are likely to find that from a technical material accounting and control perspective, the present level of safeguards techniques now in use by the IAEA are not adequate to detect the loss or diversion of a "significant (i.e. weapon) quantity" of plutonium from "bulk-handling" facilities, such as a spent fuel reprocessing or plutonium fuel fabrication plant.**

J. A Global, Verified Cutoff in the Production of Fissile Materials for Weapons Purposes.

Negotiations of a global multilateral fissile material cutoff in the CD are going nowhere, primarily due to the opposition (e.g. Pakistan) or non-participation (e.g. Israel) of some threshold states, and an obvious lack of enthusiasm by such important states as India, China, and France. A more productive approach would be to implement a global cutoff in stages, beginning with the two states with far and away the largest stockpiles of weapon-usable fissile material -- the U.S. and Russia -- the states for whom the cutoff proposal was originally intended. From the perspective of implementing the so-called "irreversible" reductions in U.S.-Russian nuclear weapons agreed to at the 1995 Moscow Summit joint statement, a de-facto verified cutoff is required in any case to create a stable backdrop for measuring future reductions and assuring that they are indeed "irreversible." Other nuclear weapon states, and threshold states, will be more susceptible to international political pressures to join the formal cutoff regime when their basic equity requirements have been met by much deeper reductions in U.S. and Russian nuclear stockpiles.

** The IAEA's definition of a "significant quantity" and the adequacy of IAEA safeguards are discussed in detail in another issue paper we have prepared for the Commission, "Preventing the Weapons Use of Nuclear Energy - I: Technical Realities Confronting the Transition to a Nuclear Weapons Free World."

K. Drawing Down the World Inventories of Weapon-Usable Fissile Materials, Including a Moratorium on Programs for the Civil Production of HEU and Separation of Plutonium.

There is a huge surplus of HEU from retired weapons, and no bona-fide technical requirement for any country to produce HEU for military or civil reactor use. There is now also a world glut of separated plutonium composed of material that was originally separated for both civil and nuclear explosive purposes. The U.K., France, Japan, and Russia all continue to separate weapon-usable plutonium faster than it can be absorbed in the commercial fuel market. These countries should defer further separation of plutonium from civil reactor spent fuel until the global stocks of separated plutonium, both military and civil, are substantially reduced. This would enable the excess stocks of weapon-grade plutonium to be drawn down more quickly. Moreover, the existence of large stocks of separated plutonium in the civil sector represent a likely barrier to the deep reduction and eventual elimination of stocks of warheads, warhead components, and fissile material from warheads.

L. Final Disposition of Weapon-Usable Fissile Material.

1. Plutonium. The U.S. has chosen the "spent fuel standard" as the criterion for the safe disposition of its excess plutonium, meaning that plutonium from weapons should be made as difficult to retrieve as the plutonium currently stored as spent civil reactor fuel. To meet this standard the United States may fabricate some of the excess plutonium into Mixed-Oxide (MOX) fuel and burn it in reactors on a once-through basis. The remainder of the excess plutonium likely will be mixed with fission product waste and vitrified. Russia's Ministry of Atomic Energy (MINATOM) would like to use its excess plutonium to fuel new breeder reactors, but lacks the financial means to implement this proposal. Meanwhile, Russian weapon-usable fissile materials are stored under inadequate physical security and material control and accounting. The British, French and Japanese nuclear establishments are playing a counterproductive role. While the United States is studying the conversion of plutonium into spent fuel, the U.K., France and Japan are busily removing plutonium from spent fuel much faster than the separated plutonium can be burned as MOX fuel.

2. Highly-Enriched Uranium (HEU). All parties agree that excess highly-enriched uranium (HEU) from weapons should be "blended-down" into low-enriched uranium (LEU) and used as commercial power reactor fuel. Russia has agreed to dilute up to 500 t of HEU from weapons and sell the LEU to the United States for use in commercial reactors. Implementation of this agreement was slowed for two years by both domestic and international negotiations related to: a) price, b) Department of Commerce restrictions on the import of uranium into the U.S. market from Russia and other C.I.S. countries that were imposed after a Commerce determination that the Soviet Union had been dumping uranium on the U.S. market at below producer cost; c) transparency arrangements for insuring that the uranium comes from weapons; and (d) a complex plan to "privatize" the U.S. Enrichment Corporation with the most attractive balance sheet possible while maintaining its current monopoly on the importation of Russian LEU derived from weapons. Further disagreements over price are likely to slow the pace of future deliveries under this agreement.

A limited amount of HEU -- 175 t out of an estimated 780 t in the U.S. stockpile -- has been declared excess of military needs by the United States. About 112 t of the 175 t is from weapons. As part of the evolving privatization plan for its enrichment enterprise, the U.S. Department of Energy has promised to turn over 50 t of the excess HEU to the U.S. Enrichment Corporation for blending into commercial reactor fuel.

M. Safeguarding of Tritium in Excess of Weapon Requirements.

If warheads are withdrawn from active deployment faster than the rate of radioactive decay of tritium--5.5% per year--weapon states will have tritium inventories in excess of their warhead maintenance requirements. The weapon states could agree on a simple formula, based on maintaining an average inventory of 4 grams per warhead, for example, that would establish permitted tritium inventories for weapon purposes. By agreement excess tritium would be placed under multilateral or IAEA safeguards. This would provide greater assurance that weapon states were not retaining excess inventories of modern warheads in an "active reserve" status, with filled tritium reservoirs ready for "uploading" on strategic missiles and bombers.

Conclusion

If the steps outline in this paper are truly to be "interim" steps on the path toward a nuclear weapon free world -- and not merely rules of the road for a scaled-down version of nuclear deterrence -- attention must be paid today to implementing these measures in a manner that protects and even enhances future opportunities to take further steps. For example, before decontaminating and dismantling old fissile material production facilities, it would be desirable to allow mutual inspections of such facilities and take measurements of the concentrations of long-lived radionuclides in permanent components of the reactor core. These measurements can be used to estimate the neutron fluence in various regions of the core, and thereby verify declarations of plutonium produced in the reactor.

Likewise, rather than tossing the old contemporaneous production records at each facility into the dumpster, these records can be examined, and former operators interviewed, to piece together a mosaic of information that can help to authenticate or cast doubt on the accuracy of a state's official declarations. In many cases, such errors may not represent deliberate attempts at concealment but rather honest errors arising from mistakes in compiling data from many different sources and time periods, and from the inherent limitations on the accuracy of the data itself.

Likewise, by reconciling fissile material component and warhead final assembly facility records with returns of intact warheads to monitored storage and dismantlement facilities, it should be possible to reduce mutual suspicions that a substantial number of nuclear weapons or fissile material components had slipped from view to constitute a "secret stockpile" in an otherwise nuclear-weapons-free world. While considerable uncertainties will persist even after such investigations are carried, these uncertainties are likely to be far less than if such cooperative efforts at "nuclear archaeology" were never attempted, and the very act of such sustained and intensive technical collaboration may itself provide additional intangible yardsticks for authenticating declared data that could not be obtained in any other way.

These declaration and cooperative inspection measures should be undertaken as soon as possible. Otherwise the cumulative uncertainties regarding the disposition of U.S.-Russian

stockpiles -- totaling, at their peaks, some 77,000 nuclear weapons and 1500 tons of weapon-usable-fissile material -- may overwhelm the process of nuclear arms elimination.

Notes

1. "An Evolving US Nuclear Posture." Second Report of the Steering Committee Project on Eliminating Weapons of Mass Destruction, chaired by General Andrew J. Goodpaster (USA. ret.), The Henry L. Stimson Center, Report No. 19, December 1995. See also, Richard Garwin, "Nuclear Weapons for the United Nations," Chapter 11 in *Nuclear-Weapon-Free World: Desirable? Feasible?*, edited by Joseph Rotblat, Jack Steinberger, and Bhalchandra Udgaonkar, A Pugwash Monograph, (Boulder, CO: Westview Press, 1993).

2. Bruce G. Blair, *Global Zero Alert for Nuclear Weapons*, (Washington, D.C.: The Brookings Institution, 1995), pp. 78-107.

3. "Toward A Nuclear Peace," Report of the CSIS Nuclear Strategy Study Group, Center for Strategic and International Studies, Washington, D.C., June 1993.