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The U.S. Nuclear Stockpile

Materials Production and New Weapons Requirements

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Arms control negotiations have benefited the release of information on the number and characteristics of weapons systems. Much of the official data on the nuclear arsenals of the superpowers is now available to the public. Conspicuous in its absence, however, has been information about the size and characteristics of the nuclear stockpiles. William M. Arkin, Thomas B. Cochran and Milton M. Hoenig have pieced together the composition of the U.S. nuclear stockpile from open sources. The final picture they draw is critical in understanding the imperative for and implications of arms control.

The authors are co-editors of the forthcoming Nuclear Weapons Data Book (prepared by the National Resources Defense Council and to be published by Ballinger) from which the information in this article is excerpted.

The size and state of the U.S. nuclear stockpile[1] has remained fairly constant throughout the 1970s. During the 1980s, however, the rate of production and retirements will increase and the complexion of the stockpile will change markedly. Many older weapons are being withdrawn as a new generation of nuclear warheads is produced. The present increase in the rate of warhead production is being accompanied by substantial measures to increase the supply of nuclear materials. Nuclear weapons plans for the late 1980s and early 1990s, however, project further materials shortages in the face of production increases and an accelerated generational turnover of warheads.

Mass production of nuclear wearheads began in 1947 with the B3, the production model of the FAT MAN nuclear bomb dropped on Nagasaki, Japan. Since then there have been 58 nuclear warhead types produced. Many warhead models have been used in a variety of weapons configurations and delivery systems. Over 20 additional warhead designs never progressed past the development stage. As indicated in Figure I, between 1955 and 1965, the number of weapons produced was massive. Over 30,000 warheads entered the stockpile during this period. The stockpile growth rate peaked in the period from 1958 to 1960 when approximately 12,000 warheads were added to the nuclear arsenal. In 1967, the stockpile reached its all time high of some 32,000 warheads. That number dropped to 27,000 by 1970, increased to about 29,000 by 1974 and since then has declined to its current size of some 26,000 nuclear warheads.[2]

While the stockpile was made up predominantly of tactical weapon warheads in the 1960s, the mix is now about evenly split between strategic and tactical weapons. Reductions in the stockpile over the past twenty years represent shifts in the mix or characteristics of the weapons rather than any real decline in military capability.[3] The deployment of thousands of multiple reentry vehicles on missiles in the 1970s, for instance, sharply increased the number of strategic warheads but did not result in a significant change in stockpile size.

Since their introduction, nuclear weapons have acquired a continually increasing importance in all aspects of military nuclear stockpile (see Table I), ranging from man portable nuclear land mines weighing about 150 pounds (W54 Special Atomic Demolition Mine or ADM) to multi-megaton bombs weighing more than 8000 pounds (B53 strategic bomb). Nuclear warheads are fitted to almost every weapons type, and used by the military services for almost all warfare roles.

Six warhead types are in production today, including the air-launched cruise missile warhead (W80), Minuteman III Mark 12A warhead (W78), the B-61 bomb, Trident I warhead (W76), the Lance missile enhanced radiation warhead (W70), and the 8-inch artillery enhanced radiation shell (W79). Sixteen additional types are in research and development (Table III) and three of these (the B-83 bomb, W-84 ground-launched cruise missile, and W-85 Pershing II) are slated to enter production next year.

Continued on page 2

INSIDE

The Nuclear Stockpile

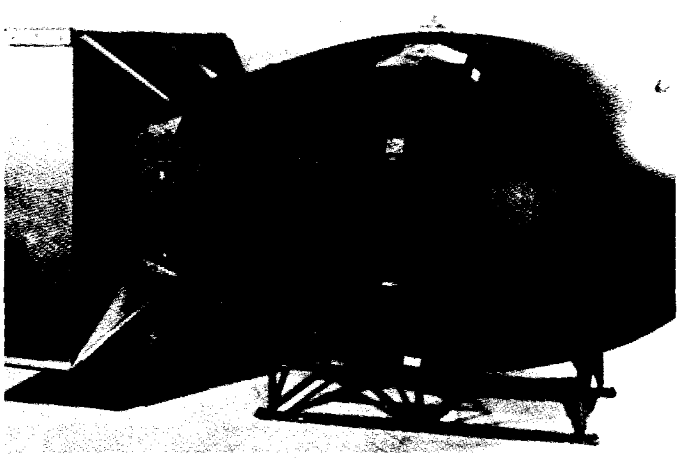
from page 1

The Stockpile Memorandum

The requirements for new warheads are determined by the Departments of Defense and Energy, and then approved by the President in an annual Nuclear Weapons Stockpile Memorandum. Congress, through approval of the budgets of the Departments, confirms both the weapon systems and warhead plans of the Executive. Traditionally, however, little critical oversight of the specifics of warhead production or materials supply has taken place. This is mostly due to the excessive secrecy surrounding nuclear warhead plans.

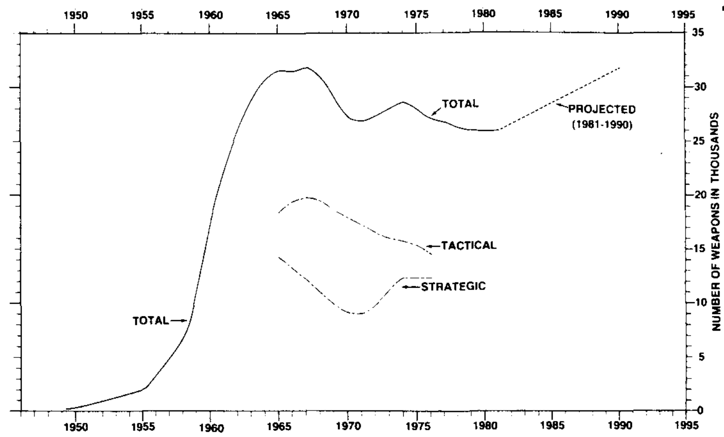
The Stockpile Memorandum determines the rate of warhead production and retirements over a period of fifteen years including materials requirements (prior to the 1982 Memorandum, the period was eight years). In the first five years of the Memorandum schedule, the specific rate of warhead production and retirement is detailed by warhead type and is closely tied to weapon system deployment plans. Beyond this period, only gross projections of retirements and new production are provided. Contingency requirements for rapid production increases are also computed in the out years of the Memorandum. The 1981 Memorandum, signed by President Carter in October 1980, authorized a substantial increase in new warhead production and growth in the size of the stockpile. The 1982 Memorandum, signed by President Reagan in early 1982, approved changes in the mix of warheads but authorized only a slight increase over the 1981 Carter plans. Reportedly, that increase amounts to 380 warheads over a five year period. These plans project a progressively increasing gap between production and retirement rates in the mid and late 1980s.

It is estimated that some 23,000 new nuclear warheads are planned for construction during the next ten years and an additional 14,000 are identified in current research and development programs throughout the mid-1990s (Table 3).[4]



Nagasaki Bomb. Plutonium fission weapon of the FAT MAN type, the kind detonated over Nagasaki, Japan on August 9, 1945. The bomb is 60 inches in diameter and 128 inches long. It weighed about 10,000 pounds and had a 20 kiloton yield.

Figure I



Figures for tactical and strategic breakdown available only from 1965 to 1980.

The U.S. Nuclear Stockpile 1949-1990

During the late 1970s, an average of approximately 1,000 warheads were produced annually, and approximately 1,300 warheads were retired. The new production rates, however, will roughly double the rate of the late 1970s. The 1981 Memorandum called for a "dramatic increase in warhead production."[5] Despite this increase in warhead production the "total magnitude of the stockpile" will not change "in any great consequence."[6] According to DOE, "the stockpile will remain well below the historic highs established in the late sixties."[7] This is due to the concomitant increase in the rate of warhead retirements. Table I identifies those warheads earmarked for retirement in the current Memorandum.

Requirements in the 1980s

The aspect of current nuclear plans which has received considerable attention is the availability of nuclear materials needed to cover the increases. During the Carter Administration, a number of special studies on future nuclear materials requirements were conducted and concluded that there would be a shortage of materials in the 1980s. Until the early 1960s, an important determining factor in overall stockpile size was the amount of nuclear materials available. Today, this factor continues to strongly affect planning on the character and mix, if not the overall size, of the stockpile.

Nuclear warheads contain one or more of the materials plutonium or highly enriched uranium and tritium. The type and mix of materials used has changed over time due to new warhead designs. Most modern warheads utilize plutonium, predominantly for the fissile primary component, rather than the highly enriched uranium used in many older weapons. Plutonium is used to obtain a high yield-to-weight ratio and small size. The new neutron yield warheads are also creating significant new requirements for tritium, traditionally used to obtain yield selection and boosting. Over 1,000 neutron yield artillery and missile warheads are scheduled for construction and future plans call for an enhanced radiation anti-ballistic missile warhead. Thus while the projected size of the stockpile in the 1980s will not exceed the record level

Continued on page 6

Table I
THE UNITED STATES NUCLEAR STOCKPILE

Warhead/Weapon	Year First Deployed	Yield (Kilotons)	User	Number in Stockpile*	Status
W25/GENIE	1957	1-5	AF	400	*To be replaced by new air-to-air missile*
B28/BOMB†	1958	1,100	AF,MC,N	1,200	*To be replaced by B-83*
W31/NIKE HERCULES†	1958	1-20	A,NATO	750	*Being withdrawn*
/HONEST JOHN†	1958	1-20	NATO	200	*Only left in Greek and Turkish armies*
W33/8" ARTILLERY	1956	sub-12	A,MC,NATO	2,000	*To be replaced by W79*
B43/BOMB	1961	500-1,000	AF,MC,N,NATO	2,220	*To be replaced by B83*
W44/ASROC	1961	1	N	850	*To be replaced by ASW warhead/standoff weapon*
W45/TERRIER†	1956	1	N	310	*To be replaced by W81*
/MEDIUM ADM†	1964	1-15	A,MC,NATO	300	*To be withdrawn*
W48/155mm ARTILLERY	1963	sub-2	A,MC,NATO	3,500	*To be replaced by W82*
W50/PERSHING 1A	1962	60-400	A,NATO	410	*To be replaced by W85*
B53/STRATEGIC BOMB†	1962	9,000	AF	150	*To be withdrawn*
W53/TITAN II†	1963	9,000	AF	65	*To be withdrawn starting late 1982*
W54/SPECIAL ADM	1964	.01-1	A,MC,NATO	300	*No planned replacement*
W55/SUBROC†	1965	1-5	N	400	*To be replaced by ASW warhead/standoff weapon*
W56/MM II	1966	1,000-2,000	AF	540	*To be partially replaced with Minuteman III/MX*
B57/DEPTH BOMB	1964	sub-20	AF,MC,N,NATO	1,000	
B61/BOMB	1968	100-500	AF,MC,N,NATO	3,000	*In production*
W62/MK-12 MM III	1970	170	AF	1,200	*Being partially replaced by W78*
W68/POSEIDON	1971	40-50	N	3,480	*Being partially replaced by W76*
W69/SRAM	1972	170	AF	1,140	*To be replaced by Lethal Neutralization System*
W70/LANCE	1972	1-100	A,NATO	565	*In production, circa 380 neutron types planned*
W76/TRIDENT I	1979	100	N	1,300	*In production, circa 3600 planned*
W78/MK-12A MM III	1979	335	AF	540	*In production, 1,083 planned*
W79/8" ARTILLERY	1981	1	A,MC,NATO	120	*In production, circa 800 planned*
W80/AIR-LAUNCHED CRUISE MISSILE	1981	200	AF	80	*In production, 4,348 planned*

Sources: Derived from the *Nuclear Weapons Data Book* (prepared by the Natural Resources Defense Council and published by Ballinger)

*Authors' estimates of stockpile breakdown of 26,000 weapons as of January, 1982.
†Weapons planned for retirement in 1982-1987, as called for in present plans. Other weapons will begin retirement or partial removal in the mid-1980s but are not indicated.
Users include the Air Force,
Marine Corps, Navy, Army and the North Atlantic Treaty organization.

The Nuclear Stockpile

from page 2

Table II

Projected Nuclear Warhead Production, 1982 - mid 1990s

	Number planned*
In Production (1982)	
B61 bomb	1,000
W70 Lance (neutron bomb)	280
W76 Trident I	2,300
W78 Mk-12A reentry vehicle	543
W79 8" artillery shell (neutron bomb)	680
W80 Air-launched cruise missile	4,268
sub total	9,071†
Planned (1982-1987)	
W80 Sea-launched cruise missile	460
W81 Standard 2ER	350
W82 155mm artillery shell	3,500
B83 bomb	2,500
W84 Ground-launched cruise missile	560
W85 Pershing II	300
W87 MX Warhead	2,400
sub total	10,070†
Future Systems (late 1980s-1990s)	
Anti-submarine warfare warhead	1,250
Low-altitude air defense system	500
Lethal neutralization system	1,200
Corps Support Weapon System	500
Advanced tactical air delivered weapon	2,500
Tactical air-to-surface munition	1,500
Advanced cruise missile technology	3,000
sub total	10,450
Alternate Systems**	
MARV	7,500
Submarine-launched ballistic missile	
sub total	7,500
Total warhead production	**37,091**

*Information derived from Nuclear Weapons Data Book (forthcoming) and authors' estimates. Number planned is in addition to those weapons already in the stockpile.
†Not all of these warheads will be produced in the 1980s.
**Competing warhead programs for Trident SLBM upgrade and Trident II.

of 32,000 set in 1967, current nuclear warhead designs demand unprecedented amounts of plutonium and tritium.

Over the past ten years, most of the materials going into new warheads came out of the materials from retired weapons. In the future, however, the plutonium and tritium supply from old weapons will be insufficient and new plutonium and tritium will have to be produced in government reactors.[8]

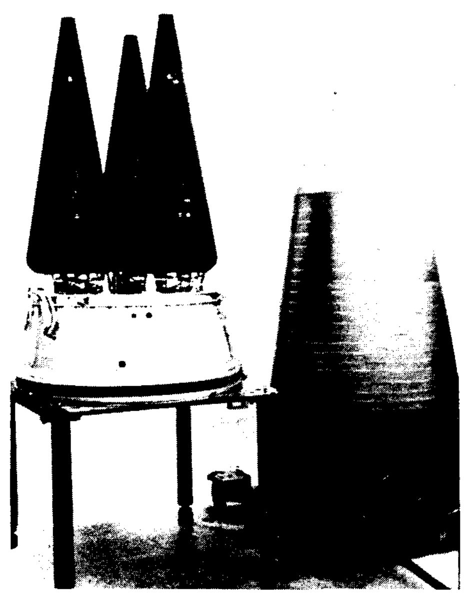
The initiatives already undertaken by the Department of Energy to increase the supply of plutonium and tritium are acknowledged to be sufficient for the specific, near term warhead requirements of the present Stockpile Memorandum. These initiatives will, in fact, more than double the rate of plutonium production. (See page 7 for a detailed description of DOE programs.) But the increases in the capacity of the production complex that have been taken to accommodate nuclear weapons planners are still claimed as insufficient. As a result, DOE is considering a number of options to expand materials production even further. The additional options to increase the supply of nuclear materials are designed to accommodate long-range[9] warhead production contingencies and to build a reserve of nuclear materials. These options are supported by the belief that future requirements should not be constrained by the technological capacity of the materials and production complex.

Materials Gap

Long-range production and materials requirements, based upon gross projections, have created a materials "gap" in the 1990s. This gap is a vivid reminder of the fact that among the impulses behind a never ending arms race are the "shortages" which can always be manufactured by the planning process.

The plans of the late 1980s and early 1990s which project such a gap are for an accelerated generational replacement of strategic systems, including the MX missile, Trident II, and a new cruise missile. In addition, new warhead designs and innovations are deemed to be necessary and their development and deployment are assumed. It can be argued that some of the new warheads do not represent additional military capabilities. The military requirements for neutron bombs over fission weapons, for higher yield small MX warheads, or for enhanced radiation and directed energy antiballistic missile warheads have been questioned both technically and politically, and they are only "exotic" new ways of doing old things.

continued on page 8



Minuteman III nosecone with warheads exposed

Fueling the Arms Race

Department of Energy Programs for the 1980s and Beyond

Planned Programs

To meet the requirements for increased warhead production, the Department of Energy (DOE) has initiated a number of programs to increase the supply of plutonium and tritium. Together these programs will almost triple the recent production rate of about 1400 kilograms of plutonium (equivalent)[1] per year to some 4000 kilograms by the mid-1980s.

The programs now underway include:

(1) restoring the three currently operating production reactors[2] at the Savannah River Plant in South Carolina to full reliability and converting them to the production of "supergrade" plutonium (containing 3% of the isotope Pu-240) from weapon-grade plutonium (6% Pu-240).

(2) upgrading and restarting the deactivated L Reactor at Savannah River to produce plutonium and tritium starting in October 1983, thereby increasing to four the number of operating reactors at the Savannah River.

(3) blending small amounts of supergrade plutonium from Savannah River with existing stocks of fuel-grade plutonium (12% Pu-240) stored at Richland, Washington, a principal source of materials for the breeder reactor program. In the mid-1980s an estimated 500 kilograms of fuel-grade materials will be blended to weapon-grade annually, depending on the fraction of capacity at Savannah River that is used for tritium production.

(4) converting by March 1983 the N Reactor at the Hanford Reservation from its current output of fuel-grade plutonium for the breeder reactor program to weapon-grade plutonium, adding as much as 750 kilograms of plutonium yearly to the weapons program. By October 1983, a further change in the production of plutonium containing 5% Pu-240 will allow blending with material of higher Pu-240 content to produce weapon-grade plutonium in addition to the blending at Savannah River.

(5) restarting the deactivated PUREX processing plant at Hanford by October 1983 to allow separation of fuel-grade and weapon-grade plutonium from fuel irradiated in the N reactor. There are now about 4500 kilograms of unseparated fuel-grade plutonium in storage at Hanford.

(6) increasing plutonium production at Savannah River by 25% by first changing the highly enriched uranium fuel used to a homogeneous core of 1.1% enriched uranium fuel and then increasing the reactor operating power. This change will be implemented by October 1984 and will increase plutonium (equivalent) production at Savannah River to over 2800 kilograms annually.

Options

In addition to these programs, DOE has a number of options under investigation as additional sources of nuclear materials to meet future contingencies:

(1) transfer the entire DOE inventory of approximately 17 metric tons of fuel-grade plutonium from unallocated stocks and non-defense research and development (primarily the breeder program) to the weapons program. This material could be converted to weapon-grade in any of the following ways:

a) blending supergrade plutonium from Savannah River in quantities greater than presently planned or underway. The amount of fuel-grade plutonium blended would be limited by tritium production requirements but could reach as high as 1000 kilograms annually.

b) construct a plutonium laser isotope separation facility, now planned for 1989, at a capacity of perhaps one or more tons per year and operate it to purify the fuel grade plutonium to weapon-grade.

Requirements for the breeder program would then be satisfied by purchasing fuel-grade plutonium from the United Kingdom. According to current plans about 1700 kilograms of plutonium will be required for the first core of the Clinch River Breeder Reactor in 1989. Under the most favorable conditions there appears to be a shortfall of plutonium for the breeder and other non-defense programs after 1990 unless material is obtained from the U.K. or recovered from commercial spent fuel.

(2) use plutonium recovered from the spent fuel of commercial power reactors. The plutonium once obtained would be purified to weapon-grade quality using the laser isotope separation facility now planned or it could be used in the breeder program to displace reactor-grade material transferred to the weapons program. Acquisition of plutonium from commercial spent fuel could be achieved in two ways:

a) purchase from the still uncompleted reprocessing plant in Barnwell, South Carolina at an output of some 10 tons per year when and if it is operated by commercial interests.

b) construction of a head-end shear/leach facility at the Savannah River complex in order to recover plutonium from commercial spent fuel at a rate of several tons per year.[3]

These options together with laser isotope separation would set in place the technology needed to recover and enrich the plutonium in spent fuel that is accumulated in reactor storage ponds. Storage ponds in the U.S. now hold approximately 45 metric tons of weapon-grade plutonium.[4]

(3) increase plutonium production at the N reactor by increasing operating power.

(4) build one or more production reactors (currently being designed) for operation by the early 1990s, with a capacity comparable to the N Reactor.

The annual increases in materials production resulting from these options could substantially increase plutonium supply in the late 1980s and 1990s.

—W.A., T.C., M.H.

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[1]Plutonium (equivalent) measures the amount of a material produced in reactor targets in terms of the plutonium production that is displaced. Thus 1 kg of tritium is equal to 72 kg plutonium (equivalent).

[2]These three reactors are the P, K, and C heavy water moderated production reactors used primarily for the production of plutonium and tritium. The N Reactor of Hanford is a water-cooled graphite moderated reactor used for the dual purpose of producing plutonium and electricity. The fourth reactor at Savannah River, the L Reactor, is essentiall identical to the P, K and C Reactors.

[3]This facility would shear stainless steel and zirconium-clad spent fuel elements int pieces and dissolve the oxide fuel thus allowing the nuclear materials to be further pr cessed in one of the two chemical processing plants at Savannah River.

[4]This supply of plutonium could grow to 250 metric tons by the mid-1990s.

Table III

NUCLEAR WEAPONS RESEARCH AND DEVELOPMENT PROGRAMS

Warhead Program	Status*	First Deployment	Number Planned	Weapon Application
W80 Sea-Launched Cruise Missile	Phase 3	1984	460	*New Weapon*
W81 Standard Missile 2 (Extended Range)	Phase 3	1984	350	*Replacing W45 and for AEGIS Shipboard Air Defense Systems*
W82 155 mm Artillery Projectile	Phase 3	1984	3,500	*Replacing W48*
B83 Modern Strategic Bomb	Phase 3/4	1983	2,500	*Replacing B28 and B43*
W84 Ground-Launched Cruise Missile	Phase 3/4	1983	560	*New Weapon*
W85 Pershing II Missile	Phase 3/4	1983	300	*Replacing W50*
W87 MX Warhead	Phase 3	1986	2,400	*Warhead for MX/Advanced Ballistic Reentry Vehicle (ABRV)*
Anti-Submarine Warfare Warhead	Phase 2	late 1980s	1,250	*Replacing W55 and W44 in new ASW standoff weapon*
Maneuvering Reentry Vehicle (MARV)	Phase 2	late 1980s	(7,500)†	*for MK-500 Navy "Evader" Warhead, Option to replace W68 and W76*
Low-Altitude Air Defense System (Loads)	Phase 2	1985	500	*New Weapon*
Lethal Neutralization System	Phase 2	late 1980s	1,200	*Air-to-Air Missile Warhead, formerly called ASLAM, replacing W69*
Corps Support Weapons System	Phase 1	1988	500	*Replacing W70*
Advanced Tactical Air Delivered Weapon	Phase 1	1990	2,500	*New Multi-Purpose Guided Tactical Bomb*
Submarine Launched Ballistic Missile Warhead	Phase 1	1989	(7,500)†	*Replacing W76 or for Trident III Advanced Ballistic Reentry Vehicle*
Tactical Air-To-Surface Munition Warhead (TASM)	Phase 1	early 1990s	1,500	*New Weapon*
Advanced Cruise Missile Technology Warhead	Phase 1	early 1990s	3,000	*Replacing W80*

Source: Derived from the *Nuclear Weapons Data Book* (forthcoming).
*status in FY 1982 Phases refer to stage development: Phase 1, weapons conception; Phase 2, program study and feasibility; Phase 3, development engineering and full scale development; Phase 4, initial production.
†alternative warhead programs competing for SLBM programs

From page 6

The supposed materials gap prior to when a new production reactor comes on-line is thus, for the most part, falsely manufactured. The projection of a shortfall of materials is based upon a set of inflated contingencies and exaggerated requirements. Beyond the current planning period, the projected acceleration in new weapons production could indeed create an artificial shortage of nuclear materials. But after an expensive and extensive undertaking to upgrade the materials production complex, the argument that there is still a pressing need for further expansion should be closely examined. The planning gap provides the impetus to justify a further $6-10 billion factory upgrade, even though the capabilities for warhead production are already adequate for any but the wildest dreams of nuclear weapons planners.

The bottom line is that the need for nuclear materials and weapons should not be determined by the weapons designers. The "plans" for new weapons should be inextricably linked to overall military policy and plans. If a huge nuclear build-up is thus the plan for the next decade, it should be the subject of an intense public assessment and debate.

Footnotes from *The U.S. Nuclear Stockpile:*

[1] *The stockpile commonly refers to all nuclear warheads within Department of Defense and Energy custody, although it officially excludes warheads under development or in production, or those awaiting to be dismantled.*

[2] *These numbers are based upon estimates derived from various graphs of stockpile size as averaged in Figure I.*

[3] *As indicated by Megatonnage, the stockpile has actually decreased to one-third of its explosive size over the last two decades.*

[4] *This figure is derived from an estimate of those warheads which will actually be produced in the 1980s, and includes some warheads listed under "Future Systems" in Table II.*

[5] *Robert L. Morgan, Acting Assistant Secretary for Defense Programs, Department of Energy, in testimony before the House Appropriations Subcommittee on Energy and Water Development, March 3, 1981* (Energy and Water Development Appropriations Hearings for Fiscal Year 1982, Part 7, *p. 100).*

[6] *Robert L. Morgan, op. cit., p. 160.*

[7] *Major General W. W. Hoover, Director, Office of Military Applications, DOE, in testimony before the House Armed Services Subcommittee on Procurement and Military Systems, March 4, 1981 (Hearings on Military Posture, Fiscal Year 1982, HASC No. 97-2, p. 55).*

[8] *The current supply of materials is estimated to be 90 ±15 metric tons of plutonium, 500-700 metric tons of highly-enriched uranium, and 60 ±10 kilograms of tritium.*

[9] *The long-range requirements are projected to 15 years in the Stockpile Memorandum and through the year 2000 in special studies conducted on future materials needs.*

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