U.S. Inventories of Nuclear Weapons and Weapon-Usable Fissile Material

by

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SUMMARY

* The U.S. stockpile as of 1990 was about 21,500 warheads.

* Since then about 30 percent of the U.S. stockpile has been dismantled. The U.S. still has about 15,000 intact warheads.

* The U.S. nuclear weapons stockpile is currently about 11,000 warheads, made up of about 7,800 operational strategic warheads, 1,150 operational non-strategic warheads, about 900 spares and about 1,100 warheads in active and inactive reserve.

* Another 4,400 U.S. warheads have been removed from the operational arsenal and are stored in depots and awaiting dismantlement.

* Since end-FY 1990 the U.S. has dismantled about 7,800 warheads, a rate of about 1,550 per year. Over the next five years the U.S. could dismantle an additional 8,000 warheads.

* The U.S. operational stockpile scheduled for 2003 will be about 5,000 warheads, with another 2,500 warheads kept in reserve for possible redeployment.

* The U.S. Department of Energy (DOE) inventory of plutonium is about 98 metric tons (t). Approximately 84 t is weapon-grade (WGPu) for weapons, and about 15 t is fuel-grade plutonium (FGPu) for civil R&D.

* Of the 84 t WGPu, some 64 t is in weapons or intact pits, and the remaining 19 t is in the form of solutions, scrap and waste material at the Rocky Flats Plant and other DOE sites.

* The U.S. plans to retain a strategic reserve of about 23 t of WGPu in intact pits--roughly 7,800 pits--and has declared that 38 t of WGPu, including 19 t in roughly 6,300 pits, is in excess of weapon requirements and will no longer be available for weapons. The other half of the WGPu that has been declared to be excess is the 19 t of solutions, scrap and waste materials.

* Thus, only 19 t out of 64 t (30%) of the WGPu currently in weapons or intact pits has been declared surplus. Under current plans the remaining 45 t (70%) will be retained under START II as intact warheads or intact strategic reserve pits.

I. Introduction.

This report provides NRDC's latest estimates of U.S. inventories of nuclear weapons, plutonium and highly-enriched uranium (HEU).[1] These data may be helpful in policy discussions related to achieving further reductions in the number of nuclear weapons, both deployed and those kept in reserve, and the disposition of fissile materials removed from weapons. Some of the official inventory data are classified. In these cases NRDC's estimates are pieced together from unclassified sources. The NRDC Nuclear Program staff seeks to refine, update and correct any errors in these estimates, and therefore welcomes comments from the reader.

II. The U.S. Nuclear Weapon Stockpile.

The U.S. nuclear weapons stockpile peaked in 1967 at about 32,500 warheads (Figure 1).[2] The estimated inventory of U.S. nuclear warheads, as of the end of FY 1995 (ending 31 September), is given in Table 1.[3] Today there are about 9,900 warheads in the Department of Defense's (DOD's) operational (deployed) stockpile and another 1,100 warheads in the active and inactive reserve.[4] The total DOD stockpile is about 11,000 warheads. In addition, there are an estimated 4,430 retired warheads in Air Force, Navy and Department of Energy (DOE) depots that are in a queue, awaiting their turn on the Pantex disassembly line (Table 2). We have included in the operational stockpile (Table 1) the sixteenth Trident submarine which is just now entering the force with its 24 Trident-II SLBMs. Even now, the mindless momentum of the arms race continues, as the U.S. operational stockpile will actually *increase* over the next two years as the Navy deploys two additional Trident submarines.

The number of U.S. nuclear warheads dismantled annually by the DOE is given in Table 2. The dismantlement goal for FY 1995 was 2,000 warheads, but by the end of August only 1,316 warheads had been dismantled, and only about 1,400 are expected to be retired by end-FY

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[1] An earlier version of this report, presented at the 24 Pugwash Workshop on Nuclear Forces, London, 22-24 September 1995, has been revised to reflect the recent announcement by President Clinton of the respective amounts of WGPu and HEU making up the fissile material declared to be in excess of military needs. Also, the HEU inventory breakdown (Table 9) has been revised.

[2] Thomas B. Cochran, William M. Arkin, and Milton M. Hoenig, *Nuclear Weapons Databook, Volume I: U.S. Nuclear Forces and Capabilities*, (Cambridge, MA: Ballinger Publ. Co., 1984), p. 15.

[3] This table was compiled by Robert S. Norris with the assistance of other members of NRDC's Nuclear Program staff. Dr. Norris updates this estimate on a regular basis. Dr Norris and William Arkin publish an annual update of the U.S. nuclear weapon stockpile in the "NRDC Nuclear Notebook" section of the *Bulletin of the Atomic Scientists* (see the July/August 1995 issue, pp. 77-79).

[4] The "inactive reserve" is reportedly composed of intact warheads stored without the limited-life components, such as plutonium-238 batteries, neutron generators, and deuterium-tritium boost gas reservoirs.

1995. As of May 8, 1995 there were 7,239 pits in storage at Pantex, so we estimate there will be about 7,650 in storage as of end-FY 1995.[5]

While the public perception is that the U.S. and Russian nuclear weapon stockpiles will be reduced to about 3,500 warheads by 2003 under the START II treaty, the truth is the Clinton Administration is planning a stockpile more than twice as large--close to 7,400 warheads (Table 1). In addition to the 3,500 operational strategic warheads in the U.S. arsenal in 2003, the Pentagon plans to retain another 950 warheads for non-strategic forces , i.e., the ''strategic reserve'' and presumably additional spares which we estimate will equal about 10 percent of the active inventory. The strategic reserve, originally created for use after a nuclear war with Russia, now is conceived as a force allowing the U.S. to resist potential coercion by such nations as China, North Korea, and Iran who might attempt to take advantage of the United States following a nuclear war. The reserve force could also be directed towards these or other countries irrespective of the Russian context, should the national command authorities so decide.

Finally, another 2,500 warheads are destined for what the Pentagon calls the ''hedge.'' When fully implemented in 2003, the hedge will be a contingency stockpile made up of warheads removed from active strategic forces, but not dismantled. The purpose of retaining them intact is so that they can be rapidly ''reconstituted,'' to use the Pentagon's word. By redeploying them on bombers and missiles the Pentagon could return to something close to START I force levels if the need should arise. Thus, the real size of the future U.S. stockpile will be approximately 7,400 warheads after START II.

Assuming the U.S. retains 7,400 warheads under START II, by then the number of pits in storage should be about 15,700.[6] Below we estimate that the U.S. has about 64.4 tonnes (t) of plutonium in assembled warheads and pits. This 64.4 t is spread among an estimated 22,730 pits, which works out to just under 2.8 kg per pit. Since a small fraction of the warheads, e.g. the B53, contain no plutonium, those pits containing plutonium would have on average something closer to 3 kg of plutonium per pit.

III. U.S. Fissile Material Declared Excess of Military Needs.

President Clinton announced on 1 March 1995, that ''To further demonstrate our commitment to the goals of the [Non-Proliferation] Treaty, today I have ordered that 200 tons of fissile material--enough for thousands of nuclear weapons--be permanently withdrawn from the United States nuclear stockpile. It will never again be used to build a nuclear weapon.''[7] In a message from President Clinton to the International Atomic Energy Agency (IAEA),

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[5] Pantex Public Affairs Office to Robert S. Norris, private communication, May 1995; there were 7,239 pits in storage as of May 8, therefore there will be an estimated 7,700 pits in storage at end-FY 1995 [7,239-986+1,400=7,653].

[6] From Tables 1 and 2 and footnote 4: 7,653 + (15,430-7,395) = 15,688.

[7] President William Jefferson Clinton, Address to the Nixon Center for Peace and Freedom Policy Conference, Washington, D.C., 1 March 1995.

Secretary of Energy Hazel O'Leary revealed that the 200 tons of excess fissile material amounted to about 20 percent of the total fissile material inventory and consisted of 38 t of weapon-grade plutonium (WGPu) and 165 t of HEU.[8] This 203 t is in addition to the one tonne of fuel-grade plutonium (FGPu) oxide and the 10 t of HEU oxide that were previously declared in excess of military requirements. The one tonne of FGPu-oxide stored in the Z vault at Hanford and the 10 t of HEU stored in Vault 16 at the Y-12 Plant were placed under IAEA safeguards in early-1995 and late-1994, respectively. In his message to the IAEA President Clinton announced that 20 t of the 203 t would be placed under IAEA safeguards in March 1996.[9] The schedule for placing the remaining 183 t under international safeguards has not been revealed.

Of the 38 t WGPu declared to be in excess of weapon requirements, we estimate below that approximately 19 t are in pits. Therefore, using the average mass of 3 kg WGPu per warhead, we estimate that roughly 6,300 of the estimated 7,400 pits in storage today have been declared excess of future military needs.

The Committee on International Security and Arms Control of the National Academy of Sciences recommended in 1994 that "The United States and Russia should make formal commitments that specific quantities of fissile material from dismantled weapons (***representing a very large fraction of those materials***) will be declared excess and committed to non-weapons use or disposal."[10] (emphasis supplied) However, as shown below, only 19 out of 64 t (30%) of the WGPu currently in weapons or intact pits has been declared to be excess of military needs; and only about 125 t out of an estimated 730 t (17%) of the HEU that was in weapons or available for weapons has been declared surplus.

IV. U.S. DOE Plutonium Production and Inventory.

Table 3 summarizes the amount of plutonium that was produced by the DOE at its 14 production reactors--nine at the Hanford Reservation and five at the Savannah River Site--now all shut down. These revised production figures were released on 27 June 1994 by DOE as part of Secretary of Energy Hazel O'Leary's Openness Initiative. The 14 production reactors produced 105.5 t of plutonium, of which 90.9 t was WGPu [<7% Pu-240], and 12.9 t was FGPu [7%≤Pu-240<19%]. In the 1980s the DOE blended 2.2 t of FGPu with supergrade plutonium produced at Savannah River to make an additional 2.2 t of WGPu.

The other additions to the DOE plutonium inventory in Table 3 are estimated by NRDC from historical records. There is some uncertainty in these estimates because the historical

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[8] Secretary of Energy Hazel O'Leary, "Message from the President of the United States of America, William J. Clinton, to the 39th Session of the General Conference, International Atomic Energy Agency, September 18-22, 1995.

[9] Ibid.

[10] Committee on International Security and Arms Control, National Academy of Sciences, *Management and Disposition of Excess Weapons Plutonium*, (Washington, D.C.: National Academy Press, 1994), p. 108.

records are incomplete. Also, the amount of plutonium obtained from the U.K. is still classified at the request of the British government, despite efforts by DOE to obtain their release.

The plutonium expended are all taken from DOE references. The 3.4 t of WGPu expended in nuclear tests and the material unaccounted for (MUF) were declassified on 27 June 1994 as part of the DOE's Openness Initiative. After making all the corrections for plutonium added to and subtracted from the original production in Table 3, we have been able to estimate the total amount of plutonium in the current inventory, 98.3 t, of which 83.5 t is WGPu and 14.86 t is FGPu. By subtracting unclassified WGPu inventory identified in subsequent tables from the 83.5 t of WGPu, we derive the amount of WGPu in weapons and reserved for weapons.

The location and composition of the DOE separated plutonium inventory, exclusive of that in weapons and stored at Pantex as pits, is given in Table 4 for both WGPu and FGPu. In Table 4, the classified inventory at ANL-West is plutonium that was obtained from the U.K. and made into fuel elements for the Zero Power Plutonium Reactor (ZPPR), a plutonium criticality assembly to mock up reactor cores. There is very little reactor-grade plutonium--separated from high burnup civil reactor fuel--in DOE stocks and in our tables it is counted as fuel-grade.

Table 5 gives the plutonium content in irradiated (''spent'') and unirradiated (''fresh'') reactor fuel. This plutonium is included in the DOE plutonium inventory since it is either in irradiated production reactor fuel of targets, or it is in fuel that was manufactured from plutonium produced by DOE in its production reactors, e.g., Fast Flux Test Facility (FFTF) fuel.

The DOE plutonium inventory is given by location and grade in Table 6. In order to estimate the classified inventory of plutonium in weapons and stored pits, from the total WGPu inventory in Table 3 we have subtracted inventory of WGPu at other sites. Here we estimate that there are 64.4 t of WGPu in weapons and weapon pits in storage. Assuming there are about 7,650 pits in storage and that some 15,175 of the 15,230 assembles weapons have plutonium pits (all but the B53 warhead), we estimate that roughly 43 t of the WGPu are still in weapons and roughly 21 t are in pits stored at Pantex.

In 1995 DOE had in storage 2,659 tonnes heavy metal (tHM) of spent fuel (Table 7), much of it from sources that are not weapon related. Some of this is production reactor and FFTF spent fuel at Hanford and Savannah River Site. But this inventory also includes commercial power reactor, naval reactor and foreign and domestic research and test reactor spent fuel. The plutonium in these latter categories of spent fuel is not counted as part of the DOE plutonium inventory.

In Table 8, we summarize the data from the previous tables and include our estimate of the amount of plutonium that the U.S. Government has declared excess of military requirements. Only 19 t of the 38 t (50%) of the WGPu declared to be in excess of military needs are from retired weapons, and it is being stored as intact pits. The other 19 t (50%) are the solutions, scrap and waste materials. Under current plans 45 t of the 64 t (70%) of the WGPu now in

weapons or pits will be retained under START II as intact warheads or intact strategic reserve pits.

V. U.S. DOE HEU Production and Inventory.

In Table 9 we present our accounting of DOE's HEU inventory. The uncertainties associated with some of our HEU inventory estimates are considerably greater than the uncertainties associated with our plutonium estimates. We have assumed that in recent years the U.S. had about 500 t of oralloy (~93.5% U-235) in weapons or assigned for weapon use.[11] We believe this estimate is accurate to within ± 10 t. In addition, some thermonuclear secondaries contain uranium that has been enriched to something between 20% and 90% U-235, as evidenced by the fact that the DOE recently transferred to the U.S. Enrichment Corporation (USEC) 50 t of weapons HEU, of which 5 t was 70%-enriched and 45 t of 37.5%-enriched.[12] Although technically this is HEU because it is enriched to ≥20% U-235, we will refer to it as medium-enriched uranium (MEU), to distinguish it from oralloy (~93.5% U-235).

The amount of MEU produced for weapons is not known by us. We have assumed it was on the order of 100 t of oralloy equivalent, and further assumed that 10% was at 70%-enriched and 90% was 37.5%-enriched, similar to the material turned over to USEC. Thus, we assume that there were about 23 t of 70%-enriched uranium and 206 t of 37.5%-enriched uranium. These estimates appear reasonable in that DOE has announced that through 1992 it produced 994 t of HEU for all purposes. We have identified from unclassified DOE sources about 50 t of HEU--exclusive of HEU for weapons and naval fuel--that were in storage prior to the transfer of the 50 t to USEC. Subtracting this 50 t and the 730 t we have allocated to weapons from the 994 t total leaves about 220 t of HEU to fuel naval reactors, civil reactor and test reactors and makeup fuel for the Savannah River production reactors over the 1945-1992 period. This seems reasonable in light of what we know about these reactor requirements.[13]

The 50 t of HEU in storage noted above includes 24.4 t of HEU, containing about 50% U-235 and about 35% U-234. This HEU started as fresh 97.3%-enriched naval reactor fuel, was subsequently recovered from spent naval fuel, then used to make fresh Savannah River production reactor fuel, and then recovered again, which accounts for the high concentration of U-234. Also in storage is some very highly-enriched uranium that was intended to be naval fuel but which did not meet Navy specifications. In this category are 13.2 t in the chemical form UF_6, and a few tonnes (we have assumed 3 t) of metal. Also, there are the 10 t of oxide in Vault 16 at Y-12 under IAEA safeguards. There may be other stocks that we have missed.

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[11] Thomas B. Cochran, William M. Arkin, Robert S. Norris and Milton M. Hoenig, *Nuclear Weapons Databook, Volume II: U.S. Nuclear Warhead Production*, (Cambridge, MA: Ballinger Publ. Co., 1987), p. 191.

[12] William Broad, "Quietly, U.S. Converts Uranium into Fuel for Civilian Reactors," *New York Times*, 19 June 1995, p. A10.

[13] *Nuclear Weapons Databook, Volume II: U.S. Nuclear Warhead Production*, Appendix D.

In Table 9, the 175 t that has been declared excess consists of the 165 t associated with Clinton's 1 March 1995 declaration and the 10 t already in Vault 16 at Y-12. We are told that the Navy has refused to permit any oralloy metal from being included in the 175 t excess, in order to retain it for future use as naval reactor fuel. Under these assumptions we estimate that of the 175 t of HEU declared excess, about 125 t is from weapons, and it is all MEU. Of these 125 t of MEU, 50 t has already been turned over to USEC and is being blended down to make low-enriched uranium (LEU) fuel for future use in commercial power reactors. About 40 t of the 175 t declared excess was never meant for weapons. This 40 t includes the 16 or so tonnes of scrap naval fuel and the 24 t of high U-234 content uranium at the Savannah River site.

Figure 1. U.S. Nuclear Weapon Stockpile

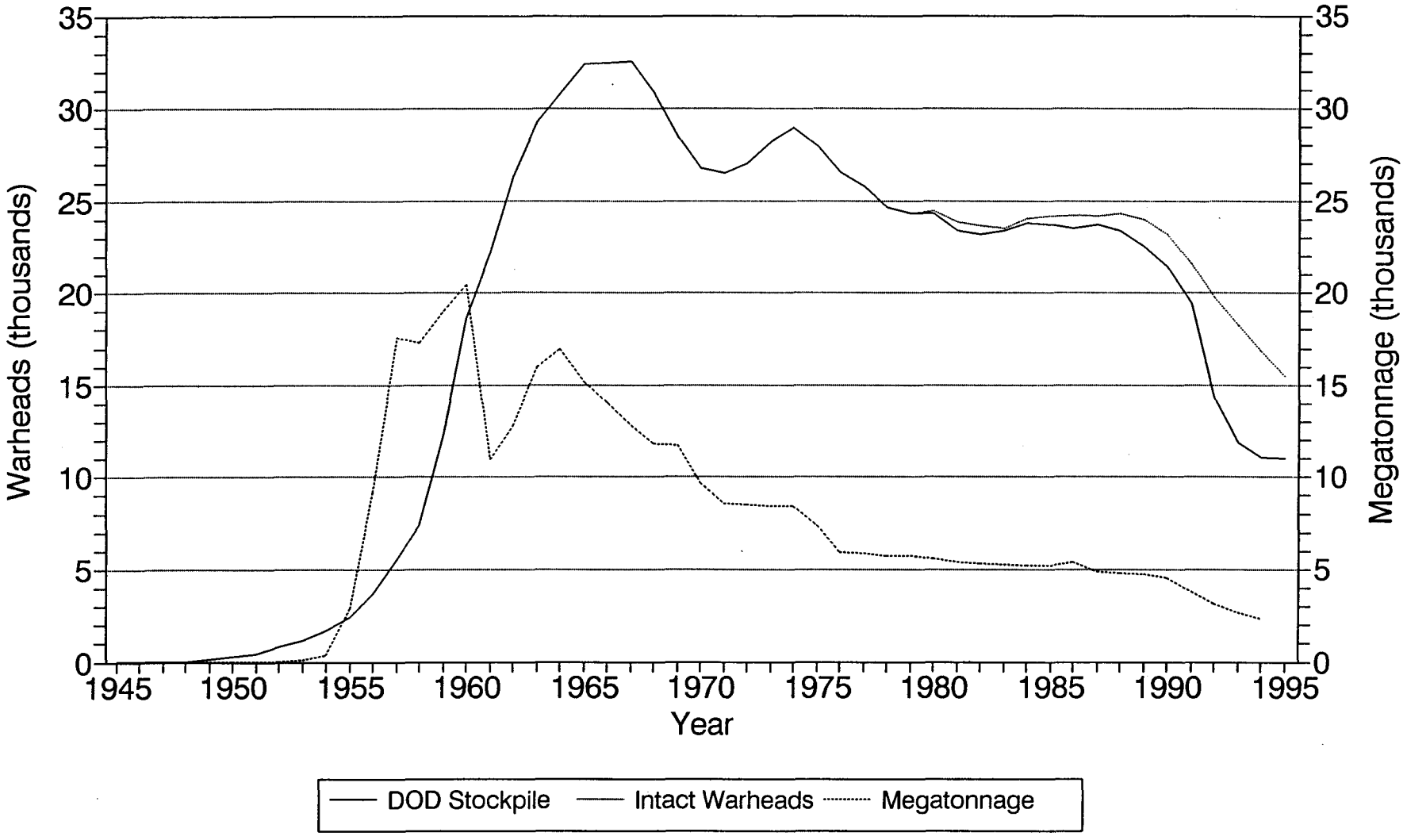

Table 1. U.S. Nuclear Weapons Stockpile.

(NRDC Estimates--Revised 15 September 1995)

Weapon System Category	1995 SNDVs	1995 Warhead	1995 Active	1995 Reserve	1995 Total	2003 SNDVs	2003 Warhead	2003 Active	2003 Reserve	2003 Total
STRATEGIC:										
Minuteman III	300	W78	900		900	500	W87	500		500
	230	W62	690		690		W78		900	900
MX	50	W87	500		500					
Subtotal - ICBM	**580**		**2,090**		**1,590**	**500**		**500**	**900**	**1,400**
Trident I C4	336	W76	2,688	384	3,072					
Trident II D5	48	W88	384		384	259	W76	1,295	450	1,745
						77	W88	385		385
Subtotal - SLBM	**384**		**3,072**	**384**	**3,456**	**336**		**1,680**	**450**	**2,130**
B52H (up to 20 ALCM/ACM/bombs)	93	W80-1/B53/B61-7/B83				66	W80-1/B53/B61-7/B83			
B1B (up to 24 gravity bombs)	82	B61-7/B83				0				
B2 (up to 16 gravity bombs)	6	B61-7/B83				20	B61-7/B83			
Subtotal - Bombers	**181**					**86**				
ALCM		W80-1	800	400	1,200					
ACM		W80-1	400		400		W80-1	400	400	800
Gravity Bombs		B53	50		50		B53	0		
		B83	650		650		B83	420	300	720
		B61-7	750		750		B61-7	500	100	600
Subtotal - Bomber Weapons			**2,650**	**400**	**3,050**			**1,320**	**800**	**2,120**
Subtotal - Strategic			**7,812**	**784**	**8,596**			**3,500**	**2,150**	**5,650**
NON-STRATEGIC:										
Gravity Bombs		B61-3/4/10	800		800		B61-3/4/10	600		600
SLCM		W80-0	350		350		W80-0	350		350
Cruise Missile		W84		350	350		W84		350	350
Subtotal - Non-Strategic			**1,150**	**350**	**1,500**			**950**	**350**	**1,300**
STRATEGIC + NON-STRATEGIC			**8,962**	**1,134**	**10,096**			**4,450**	**2,500**	**6,950**
Spares (10% of Active Inventory)			896		896			445		445
TOTAL			**9,858**	**1,134**	**10,992**			**4,895**	**2,500**	**7,395**

Table 2. U.S Nuclear Weapons Stockpile.

(NRDC Revised: 18 September 1995)

End-FY	New Builds	DOD Retired	DOD Stockpile	Yield (Mt)	DOE Disassem-blies	Awaiting Disas-sembly	Intact Warheads
1945	2	0	2	0	0		2
1946	7	0	9	0	0		9
1947	4	0	13	0	0		13
1948	43	6	50	1	6		50
1949	123	3	170	4	3		170
1950	264	135	299	10	135		299
1951	284	145	438	35	145		438
1952	644	241	841	50	241		841
1953	345	17	1,169	73	17		1,169
1954	535	1	1,703	339	1		1,703
1955	806	87	2,422	2,880	87		2,422
1956	1,379	109	3,692	9,189	109		3,692
1957	2,232	381	5,543	17,546	381		5,543
1958	2,619	817	7,345	17,304	817		7,345
1959	7,088	2,135	12,298	19,055	2,135		12,298
1960	7,178	838	18,638	20,491	838		18,638
1961	5,162	1,571	22,229	10,948	1,571		22,229
1962	4,854	766	26,317	12,825	766		26,317
1963	3,813	830	29,300	15,977	830		29,300
1964	4,051	2,534	30,817	16,944	2,534		30,817
1965	3,519	1,936	32,400	15,153	1,936		32,400
1966	2,429	2,357	32,472	14,037	2,357		32,472
1967	1,693	1,649	32,516	12,786	1,649		32,516
1968	536	2,194	30,858	11,838	2,194		30,858
1969	684	3,045	28,497	11,714	3,045		28,497
1970	219	1,936	26,780	9,695	1,936		26,780
1971	1,073	1,347	26,506	8,584	1,347		26,506
1972	2,035	1,541	27,000	8,532	1,541		27,000
1973	1,794	544	28,250	8,452	544		28,250
1974	1,507	807	28,950	8,425	807		28,950
1975	1,240	2,240	27,950	7,368	2,240		27,950
1976	783	2,181	26,552	5,936	2,181		26,552
1977	221	998	25,775	5,845	998		25,775
1978	50	1,148	24,677	5,721	1,148		24,677
1979	353	730	24,300	5,696	730		24,300
1980	904	904	24,300	5,619	732	172	24,472
1981	987	1,887	23,400	5,383	1,577	482	23,882
1982	1,337	1,537	23,200	5,359	1,535	484	23,684
1983	949	749	23,400	5,232	1,120	113	23,513
1984	1,543	1,143	23,800	5,192	994	262	24,062
1985	1,222	1,322	23,700	5,217	1,075	509	24,209
1986	1,024	1,224	23,500	5,415	1,015	718	24,218
1987	1,158	958	23,700	4,882	1,189	487	24,187
1988	723	1,023	23,400	4,790	581	929	24,329
1989	894	1,794	22,500	4,743	1,208	1,515	24,015
1990	345	1,400	21,445	4,519	1,154	1,761	23,206
1991	0	2,000	19,445	3,796	1,595	2,166	21,611
1992	0	5,145	14,300	3,168	1,856	5,455	19,755
1993	0	2,400	11,900	2,647	1,556	6,299	18,199
1994	0	800	11,100	2,375	1,369	5,730	16,830
1995	0	100	11,000		1,400	4,430	15,430
Total:	70,655	59,655			55,225		

Data Sources:

The DOD stockpile for 1945-1961; DOE, Openess Press Conference, 27 June 1994.

The DOD stockpile for 1961-1994 are fitted to DOD/Sandia laboratories graphs, May 1994.

Annual new builds of warhead types now fully retired are from DOE, Openess Press Conference, 27 June 1994.

Annual new builds of warhead types now in the stockpile were estimated by NRDC.

Dismantlement data were obtained from DOE, Openess Press Conference, 27 June 1994 and by private communication with Pantex officials.

Table 3. U.S. DOE Plutonium Production and Inventory.

(NRDC Estimates--Revised 13 September 1995)

	WGPu (t)	FGPu (t)	TotalPu (t)
Production:			
Hanford	54.5	12.9	67.4
SRS	36.1	0	36.1
Subtotal (Production)	90.6	12.9	103.5
Blending	2.2	-2.2	0
Total Production	**92.8**	**10.7**	**103.5**
Additions (Barter/Purchased):			
U.K.	0.3	3.8	4.1
NFS-West Valley	0	0.204	0.204
AEC buy-back		0.839	0.839
Other	0	0.61	0.61
Total Additions	**0.3**	**5.5**	**5.8**
Expended:			
Testing	3.4		3.4
MUF	2.5025	0.2513	2.7358
Pu-recycle		0.12	0.12
FFTF		0.33096	0.33096
Shipped oversees		0.2321	0.2321
HLW (SRP+Hanford)	1.1777		1.1777
TRU Waste	2.553	0.363	2.916
Total Expended	**9.63**	**1.30**	**10.91**
Remaining Inventory:	**83.5**	**14.86**	**98.3**

Sources:

The Hanford and SRS production data: DOE, September 1994 Revision.
Blending FGPu into WGPu: DOE Office of Classification, Private communication to Thoms B. Cochran, 1995.
UK Additions: Thomas B. Cochran, "Nuclear Weapons Databook," Vol. II, p. 76.
Additions from NFS-West Valley: ERDA correspondence 17 June 1975; 1.2904 t Pu recovered at West Valley.
We assume 0.204 t of Pu recovered at West Valley was separated from N Reactor spent fuel.
AEC buyback: ERDA correspondence, 17 June 1975.
Other Additions: This amount is needed to balance with current inventory.
Expended through testing: DOE, Openess Press Conference Fact Sheets, 27 June 1994.
Total MUF: DOE, Openess Press Conference Fact Sheets, 27 June 1994; prorated by NRDC between WGPu and FGPu
FFTF Expended: DOE, letter from Almquist to Thomas B. Cochran, 7 March 1995.
High Level Waste: DOE, Pu Working Group, App. B, Pt. 4, App. F, p. 11
TRU Waste: DOE, letter fron Matthew Zenkowich to Thomas B. Cochran, 27 March 1995.

Table 4. Location of DOE Separated Plutonium Inventory, Exclusive of Plutonium in Weapons and Separated Pits (1994).

	Soln. (kg)	Metal (>50%) (kg)	Oxide (>50%) (kg)	Oxide Residues (<50%) (kg)	Total (kg)
Separated Weapon-Grade Plutonium:					
Hanford	367	0	0	0	367
SRP(*)	190	800	800	10	1,800
ANL-East		0.45	0.48	0.5	1.43
LANL		1,133	721	1,400	3,254
LLNL		20	102	35	157
Mound		0.855	28.132	3	31.987
LBL			0.014	0.5	0.514
Oak Ridge		0.3013	1.706	0.1	2.1073
Sandia		6.7	1.4		8.1
Rocky Flats	143	6,600	3,200	3,000	12,943
Subtotal - Separated WGPu	**700**	**8,561**	**4,855**	**4,449**	**18,565**
Separated Fuel-Grade Plutonium:					
Hanford	0	700	1,500	1,500	3,700
ANL-West (*)		3,900			3,900
Subtotal - Separated FGPu	**0**	**4,600**	**1,500**	**1,500**	**7,600**
Total Separated Plutonium (WGPu+FGPu):					
Hanford	367	700	1,500	1,500	4,067
SRP(*)	190	800	800	10	1,800
ANL-West (*)	0	3,900	0	0	3,900
ANL-East	0	0.45	0.48	0.5	1.43
LANL	0	1,133	721	1,400	3,254
LLNL	0	20	102	35	157
Mound	0	0.855	28.132	3	31.987
LBL	0	0	0.014	0.5	0.514
Oak Ridge	0	0.3013	1.706	0.1	2.1073
Sandia	0	6.7	1.4	0	8.1
Rocky Flats	143	6,600	3,200	3,000	12,943
Total - Separated Pu	**700**	**13,161**	**6,355**	**5,949**	**26,165**

Sources:

The classified inventories indicated by an asterick (*) are estimated by NRDC.

All other data are taken from DNFSB Recommendation Plan 94-1 Implementation Plan, 28 February 1995, and other DOE reports.

Table 5. Location of DOE Unseparated Plutonium Inventory (1994).

	WGPu (kg)	FGPu (kg)	Total (kg)	
Plutonium in Fuel Elements:				
Unirradiated Fuel:				
INEL		500	500	
Hanford (FFTF)		497.08	497.08	
Subtotal - Unirradiated	**0**	**997**	**997**	
Irradiated Fuel:				
SRP	300	0	300	4.4 %
ANL-West	0	100	100	1.5 %
Hanford:				
K-East	200	1,950	2,150	31.7 %
K-West	20	1,830	1,850	27.3 %
Subtotal - K-East + K-West	220	3,780	4,000	59.0 %
FFTF	0	2,383	2,383	35.1 %
Subtotals:				
Hanford - Irradiated	220	6,163	6,383	94.1 %
All Locations - Irradiated	**520**	**6,263**	**6,783**	100.0 %
Totals:				
Hanford - Fresh+Irradiated	220	6,660	6,880	
All locations - Fresh+Irradiated	**520**	**7,260**	**7,780**	

Sources: DNFSB Recommendation Plan 94-1 Implementation Plan, 28 February 1995, and other DOE Reports.

Table 6. Location of DOE Plutonium Inventory (Pu Separated and in Spent Fuel)

(NRDC Estimates--Revised 18 September 1995)

	WGPu (kg)	FGPu (kg)	Total (kg)
Total Inventory:			
Hanford	587	10,360	10,947
SRP(*)	2,100	0	2,100
INEL	0	500	500
ANL-East	1	0	1
ANL-West	0	4,000	4,000
LANL	3,254	0	3,254
LLNL	157	0	157
Mound	32	0	32
LBL	1	0	1
Oak Ridge	2	0	2
Sandia	8	0	8
Rocky Flats	12,943	0	12,943
DOE-EM Stocks	**19,085**	**14,860**	**33,945**
In Pits at Pantex (*)	21,391		21,391
In Weapons (*)	42,991		42,991
Total	**83,467**	**14,860**	**98,327**

Assumes:		
	7,650	Pits
	15,375	Weapons
	23,025	Weapons + Pits

Source:

All data are from Tables 4 and 5 with the exception of the plutonium in weapons and in pits in storage

Plutonium in weapons plus pits is estimates by substracting the WGPu in Tables 4 and 5 from the total WGPu inventory in Table 3.

The (*) denotes classified inventories.

Table 7. Irradiated Fuel Stored by DOE. (1995)

(Some of the Contained Plutonium Is Not Counted as Part of the DOE Plutonium Inventory)

Location:	Spent Fuel (tHM)	%	Pu (t)	Puf (t)
Hanford	2,132	80.2		
INEL:				
TMI	83			
Navada Power & Virginia Power	38			
Fermi I	34			
Naval	10			
Fort St. Vrain (1/3 total)	8			
Foreign TRIGA	1			
Other	96			
Subtotal - INEL	270	10.2		
SRS	201	7.6		
West Valley	27	1.0		
Fort St. Vrain (2/3 total)	16	0.6		
Oak Ridge	3	0.1		
Other (LANL/BNL/ANL/SNL)	10	0.4		
Total:	**2,659**	100	7.584	7.487
			% fissile:	98.7

tHM = metric tons of heavy metal.

Sources:

Dave Huizenga, "Foreign Spent Fuels Management Alternatives," Viewgraphs, 15 May 1995.

DOE, "DOE-Owned Spent Nuclear Fuel Strategic Plan," Rev. 0, December 1994.

Table 8. U.S. Plutonium Inventory, Reserved for Weapons, Declared Excess, and Available for Disposal or MOX Fuel (1995).
(NRDC Estimates--Revised 26 September 1995)

	1995 Inventory (t)	2003 Weapon Reserve (t)	1995 Declared Excess (t)	Available for MOX/Disp. (t)
Weapon-Grade Plutonium (WGPu):				
In Weapons (Active and Reserve)	43.0	22.2	0.0	0.0
In Separated Pits	21.4	23.3	18.9	18.9
Subtotal - Weapons + Pits	**64.4**	**45.5**	**18.9**	**18.9**
Solutions, Scrap, Residues	19.1	0.0	19.1	19.1
Subtotal - WGPu	**83.5**	**45.5**	**38.0**	**38.0**
Fuel-Grade Plutonium (FGPu):				
Pu Oxide (Z Vault at Hanford) under IAEA	1.0		1.0	1.0
Other	13.9			13.9
Subtotal - WGPu	**14.9**	**0.0**	**1.0**	**14.9**
Total Plutonium	**98.3**	**45.5**	**39.0**	**52.8**

Assumes (2003):		7,400	weapons
3	kg/pit	7,761	in reserve
		15,161	weapons + pits in reserve

Table 9. U.S. DOE Highly-Enriched Uranium Inventory, Reserved for Weapons, Declared Excess, and Available for Civil Reactor Fuel.

(NRDC Estimates--Revised 26 September 1995)

	Average Enrichment (% U-235)	1995 Inventory (t)	Reserved for Weapons (t)	Reserved for Navy (t)	Declared Excess (t)	Available for Civil Fuel (t)	Given to USEC (t)
In Weapons:	93.5	231	111				
	70.0	11	5				
	37.5	95	46				
Removed from Weapons:							
Stored Primaries,	93.5	269	116	273			
Secondaries and Metal	70.0	12	5		12	12	5
	37.5	111	48		112	112	45
Subtotals - Weapons	**93.5**	**500**	**227**	**273**			
	70.0	**23**	**10**		**12**	**12**	**5**
	37.5	**206**	**94**		**112**	**112**	**45**
Navy Fuel to spec	97.3	?		?	0	0	
UF6 (not to Navy specs)	97.3	13			13	13	
Metal (not to Navy specs)	97.3	3			3	3	
Oxide at Y-12 under IAEA	93.5	10			10	10	
Spent SR ReactorFuel (35% U-234)	50.0	24			24	24	
Totals (excluding naval fuel to spec)	97.3	16			16	16	
	93.5	510	227	273	10	10	
	70.0	23	10		12	12	5
	37.5	206	94		112	112	45
35% U-234	50.0	24			24	24	
TOTAL HEU (excluding naval fuel to spec)	**All**	**780**	**332**	**273**	**175**	**175**	**50**

Assumptions:

The U.S. total production of HEU from 1945 to 1992 was 994 t; DOE, Openess Press Conference, 27 June 1994.

50 t produced for civil and SRP production reactors and about 165 t produced for naval reactors; NRDC estimate.

500 t of oralloy (93.5% U-355) were reserved for weapons; "Nuclear Weapons Databook, Vol. II, p. 191.

230 t MEU (37.5% and 70% U-235) were reserved for weapons; NRDC estimate having large uncertainty.

Thermonuclear warheads contain on average about 15 kg of oralloy; NRDC estimate.

80 t of oralloy were recovered from dismantlement of 1200 W33 gun-type artillery shells; NRDC estimate.

All oralloy recovered from weapons is reserved for naval reactor fuel.

24.4 t @ SRS; from DOE Fact Sheet, 1995 Press Release.

5 t 70% U-235 and 45 t 70% U-235 transferred from DOE to USEC; William Broad, New York Times, 19 June 1995, p. A10.