NUCLEAR WEAPONS IN A CHANGING WORLD: CONSEQUENCES FOR DEVELOPMENT*

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The end of the Cold War and the conduct and termination of the Gulf conflict ushered in the promise of a substantially changed and more stable international environment. With such a promise also came the hope of a substantial diversion of resources away from military expenditure and into human development. Unfortunately, the hope for a peace dividend to be used for the reinvigoration of the world's economy, by fostering unprecedented growth and development, has given way to a more sober view reflecting the high costs inherent in dramatic systemic change.

Focusing on the process of nuclear disarmament and the efforts to control the spread of nuclear weapons technologies, this paper seeks to highlight the shortcomings that have to date prevented the anticipated cost savings and diversion of resources to human development. To summarize, the most important findings of this report include:

- The current export control regime is inadequate and discriminatory over the long-run. Legitimate security concerns must be addressed before lasting reductions can be achieved.

- Adherence to nonproliferation norms can prove a boon, rather than a burden, to national economies.

- Extensive linkages between nuclear and non-nuclear proliferation and disarmament point to the need for a more comprehensive approach in order to effect mutually beneficial and lasting change.

- While unilateral initiatives, and provisions of the INF, START I, and START II treaties call for the reduction of over 20,000 warheads from the arsenals of nuclear weapons states, they make no provision for the ultimate disposition of the fissile materials released as a result of this process.

- Although potentially dramatic, the reductions envisioned in the START I and II treaties have yet to result in the dismantlement of a single warhead.

- Although lessening the immediate threat of nuclear conflagration, these agreements fail to address the long-term environmental and security threats posed by inadequate storage or the potential dispersal of fissile materials to unintended parties.

- Continuing moratoria on the part of the United States, Britain, France, and Russia bode well for a suspension of the nuclear arms race and the eventual conclusion of a Comprehensive Test Ban (CTB) treaty.

- Despite the steep costs associated with dismantling and safe storage of nuclear weapons retired as a result of either unilateral initiatives or bilateral or multilateral disarmament agreements, the long-term savings accrued could be substantial if the materials released by this process are adequately controlled.

- The precarious state of civilian nuclear power worldwide may complicate efforts at controlling the spread of fissile materials.

- Despite the high financial and technical barriers to proliferation, a handful of states continue to harbor clandestine nuclear weapons programs or are widely believed to be actively seeking one. This may bar further reduc-

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tions by the nuclear weapons states and stall disarmament efforts.

- Whatever the exact costs, it is fairly safe to say that an effective nuclear weapon development program is beyond the scope of what most aspiring states can afford to spend given the needs of their civilian population.

- Finally, indefinite extension of the Nuclear Non-Proliferation Treaty (NPT) appears likely as do prospects for a CTB and International Plutonium Storage (IPS) facility. While these may not halt proliferation, they will serve to further isolate non-adherents, highlight deviant activity, and enhance international security in such a way as to open the door towards substantive and lasting development.

Despite an inauspicious start, substantial diversion of resources from the military to civilian sector could be realized if the current consensus favoring further reductions and prohibitions against further acquisitions hold.

ONGOING CONCERNS

A variety of issues confronts the international community faced with alleviating the dangers posed by the spread of nuclear weapons while dealing with the amassed arsenals of the current nuclear weapons states. Among the key issues are: the adequacy of the existing nonproliferation regime based mainly on a system of export controls; the continuing North-South divide and the nonproliferation regime's effect on development; the complex relationship between nuclear and non-nuclear proliferation and disarmament; and the durability of the emerging consensus against the further acquisition or use of weapons of mass destruction.

Adequacy of Export Controls

The current nonproliferation regime relies almost exclusively on export controls to deter the spread of nuclear weapon technology. Such reliance is inadequate in the long-run as it fails to address the underlying motivations for weapons acquisition. Export controls in the nuclear field are designed to limit the spread of key nuclear weapon components and, thus, to make it difficult for a state to achieve a nuclear capability. However, a great deal of coordination among supplier states is required to achieve effective control. Despite the lessons of the Gulf War, full coordination of export control policies is still lacking. To effect lasting change, a determined attempt must be made to assure the security of states at the lowest possible level of armaments by providing them a stable and predictable environment within which to act. This will require concerted effort on the part of developed as well as developing nations.

While export controls cannot, in and of themselves, eliminate the threat of proliferation of nuclear weapons, they can raise the price and time required for a would-be proliferant to develop a nuclear weapons capability. In the wake of the Gulf War, many states unilaterally tightened up their national export control laws, and many multilateral efforts were undertaken to prevent another Iraq. One example of a multilateral effort was the mandate given to the U.N. Special Commission on Iraq (UNSCOM) to dismantle and indefinitely monitor Iraq's weapons of mass destruction capability. Another was the series of discussions initiated in July 1991 among the permanent five members of the U.N. Security Council (P-5 talks) to fashion some form of restraint on destabilizing arms transfers to the Middle East. However, the ambiguity surrounding China's proliferation policy and the economic and political uncertainty in the former Soviet republics leave substantial questions about the adequacy of the current effort. Even in traditionally non-proliferant countries, the ability to enforce export controls, whether they be stringent or lax, cannot always be assumed.

The North-South Question

Closely related to the issue of export controls is the policy option of levying sanctions against perceived proliferant activity. Developing states constantly charge that such sanctions and controls serve to stifle their development by denying them access to technologies vital to their development of a modern economy. Certainly, many technologies, such as advanced computing and machine tool technologies, have both weapon development and peaceful uses.

However, there is a growing consensus among developing countries that, far from being a hindrance to development, cooperation with the nonproliferation regime and adherence to international norms can prove a boost to a country's technological advancement. Most recently Argentina, which had previously considered the 1967 Tlatelolco Treaty discriminatory against developing countries' nuclear programs, ratified the treaty, and plans to join the NPT.[1]

Such a change of heart can be attributed not only to the substantial economic incentives being offered to regime-compliant states, but also to the growing awareness that the major powers are making good faith efforts to reduce their arsenals and provide access to advanced technologies to those states which adhere to basic nonproliferation norms. Additionally, both the industrialized and developing worlds no longer perceive nuclear energy as an economic and safe source of electricity. Thus, the argument that sanctions stifle growth continues to shed adherents.

Nuclear and Non-nuclear Proliferation

Extensive linkages between nuclear and non-nuclear proliferation and disarmament point to the need for a more comprehensive approach in order to effect mutually beneficial and lasting change. Linkages between nuclear and non-nuclear proliferation are substantial. For instance, a country's buildup of conventional forces may prompt another's development of nuclear weapons to counter the perceived threat, or vice-versa. For example, Israel's nuclear monopoly in the Middle East no doubt caused the acquisition of chemical weapons and ballistic missiles by Iraq, Syria, and Egypt. Additionally, many conventional systems, especially ballistic missiles and aircraft, can be reconfigured to deliver nuclear weapons. Also, if a nuclear weapons program already exists, it may be more cost effective for a state to pursue additional weapons production rather than costly conventional weapons imports. This may be particularly true in the case of India. With the Soviet Union no longer a source of conventional arms at bargain prices, India, which has large stocks of plutonium, may pursue a more robust nuclear force rather than divert scarce hard currency to conventional arms purchases if confronted with a greater perceived threat.[2]

Emerging Consensus on Nonproliferation: Will it Last?

Especially in the wake of the Gulf War and the revelation of just how close Iraq was to a nuclear weapon capability, an international consensus seems to be emerging that further proliferation of weapons of mass destruction should be stopped. In addition, the past few years have seen a substantial rise in signatories to the NPT (from 138 at the end of 1989 to 157 by January 1, 1993).[3] However, it is uncertain whether this consensus will hold, especially if the debate in 1995 on the indefinite extension of the NPT becomes contentious over lingering fears by the developing world that the treaty remains discriminatory.

RECENT NUCLEAR WEAPONS DEVELOPMENTS AND THE STATUS OF DISARMAMENT AGREEMENTS

The end of the Cold War has held out both promise and predicament for the future reduction of nuclear arsenals worldwide and the prevention of additional nuclear weapons states. The signing of the START I and II agreements point towards dramatic reductions in delivery systems but make no allowance for dismantlement of warheads. Furthermore, the failure of Ukraine to ratify START I puts realization of that treaty, as well as START II, in doubt. Examples of the promise of nuclear disarmament include the cancellation of modernization programs and, at least in the case of South Africa, the complete abandonment of a nuclear weapons program. This decline in the urge to modernize nuclear forces has led in turn to a moratorium on nuclear testing and significant momentum towards the realization of a CTB. Countering this trend, however, is the continual, if slow, push towards modernization by the People's Republic of China, resulting in the sole nuclear test of 1993. Furthermore, North Korea's apparent drive towards acquiring a nuclear weapons capability may stall these efforts and drive other states towards nuclear development.

A look at the holdings and recent

U.S. STRATEGIC NUCLEAR FORCES

Type	Deployed	Range(km)x	Warheads x yield	Warheads in stockpile
ICBMs				
Minuteman II	261	11,300	1x 1.2 Mt	261
Minuteman III	507	13,000	3 x 170-335 kt	1,521
MX/Peacekeeper	50	11,000	10x 300 kt	500
SLBMs				
Trident C-4	336	7,400	8 x 100 kt	2,688
Trident D-5	144	7,400	8 x 100-475 kt	1,152
Bombers				
B-52H	94	16,000	20 ALCMs/ACMs	~1,500B
B-1B	94	19,800	16 bombs 5 kt-1 Mt	~1,400

Sources: IISS, The Military Balance 1993-1994 (London: Brassey's, 1993) and SIPRI Yearbook 1993: World Armaments and Disarmament (New York: Oxford University Press, 1993).

nuclear-related developments of the five declared nuclear weapons states, as well as the status of disarmament agreements, will serve to highlight these trends.

United States

In the wake of the Cold War, the United States has continued to retire older inter-continental ballistic missiles (ICBMs) from service and, in early 1992, decided to halt further development of additional systems. In January 1992, then-President George Bush announced the cancellation of the only U.S. ICBM under development, the Midgetman missile, saving an estimated $40 to $50 billion in acquisition costs for the system. The decision was also made in 1992 to cease all submarine-launched ballistic missile (SLBM) warhead production, canceling further production of the W-88 warhead.[4] The U.S. Air Force has decided to retire all nuclear-role B-52G bombers by the end of 1993. President Bush also called for the cancellation of further B-2 bomber production after 20 aircraft are built. Production of the Advanced Cruise Missile (ACM) is also to be discontinued following production of the 460 already funded.

In anticipation of the 1991 START Treaty's entry into force, the United States has continued retiring Minuteman II missiles,[5] all 450 of which are slated for removal from their silos by 1995. As of June 1993, approximately 189 Minuteman IIs had been removed from their silos, but, as yet, no missiles or silos have been destroyed. Additionally, the remaining silo-based Minuteman IIs have been taken off alert. Under terms of the START II Treaty, all MX/Peacekeeper missiles will be removed from service, leaving only the 500 existing Minuteman III missiles remaining. These missiles will have their loadings reduced from three warheads to one, and will be the only U.S. ICBMs deployed beyond the turn of the century. The United States also continues to decommission older Poseidon submarines that are nearing the end of their service lives.

By June 1992, the United States completed the global withdrawal of all its ground and sea-launched tactical nuclear weapons. A total of 1,700 ground-launched warheads were withdrawn from abroad, including some 700 Lance missile warheads and 1,000 artillery shells. These, in addition to 150 Lance warheads and 300 artillery shells stored in the United States, are scheduled for dismantlement.

Also withdrawn were all 500 warheads routinely deployed at sea, including 100 W-80 submarine-launched cruise missiles (SLCMs) and 400 B-57 depth bombs and B-61 gravity bombs. In addition, 350 B-57 depth bombs deployed with land-based naval anti-submarine warfare (ASW) aircraft were removed from service. About half of these 850 naval tactical nuclear weapons are slated for dismantlement.

In January 1992, Chairman of the Joint Chiefs of Staff Colin Powell announced that the United States planned to retain 1,600 tactical nuclear warheads. These would apparently consist of 700 B-61 gravity bombs for tactical air forces in Europe and the United States, 550 B-61s stored in the United States for aircraft carriers, and 350 W-80 Tomahawk SLCM warheads stored in the United States for surface ships and nuclear-powered attack submarines.[6]

U.S. TACTICAL NUCLEAR FORCES

	Withdrawn	Scheduled for Dismantlement*	To be retained
Land-based			
artillery shells	1,000	1,300	-
Lance warheads	700	850	-
Naval			
W-80 SLCMs	100	n.a.	350
B-57 depth/strike bomb	~425	~425	-
B-61 gravity bombs	~325	n.a.	550
Air			
B-61 gravity bombs	~700	~700	700
Totals	~3,250	~3,275	1,600

* including those stored in the United States

Data source: SIPRI Yearbook 1993: World Armaments and Disarmament (New York: Oxford University Press, 1993).

Former Soviet Union

In terms of force modernization, the SS-25 appears to be the only ICBM still in production in the former Soviet Union; with its follow-on being the only new Russian ICBM under development. Retirement of SS-11 and SS-17 ICBMs continues with approximately 100 SS-11s being withdrawn in the year ending June 1993, and the remaining 40 or so SS-17s being removed from service

FSU STRATEGIC NUCLEAR FORCES

Type	Deployed	Range(km)	Warheads x yield	Warheads in stockpile
ICBMs				
SS-17	40	10,000	4 x 750 kt	160
SS-18	302	11,000	10 x 550-750 kt	3,020
SS-19	290	10,000	6 x 550 kt	1,740
SS-24 rail/silo	36/56	10,000	10 x 550 kt	920
SS-25	340	10,500	1 x 550 kt	340
SLBMs				
SS-N-8	268	9,100	1 x 1.5 Mt	268
SS-N-18	224	6,500	3 x 500 kt	672
SS-N-20	120	8,300	10 x 200 kt	1,200
SS-N-23	112	9,00	4 x 100 kt	448
Bombers				
Tu-95MS6	27	12,800	6 x AS-15A ALCMs, bombs	162
Tu-95MS16	62	12,800	16 x AS-15A ALCMs, bombs	992
Tu-160	20	11,000	12 x AS-15B ALCMs or AS-16 SRAMs, bombs	240

Sources: IISS, The Military Balance 1993-1994 (London: Brassey's, 1993) and SIPRI Yearbook 1993: World Armaments and Disarmament (New York: Oxford University Press, 1993).

within the next two years. Additionally, six SS-18s deployed in Russia have been eliminated.

Apparently for both economic reasons and compliance with coming treaty obligations, Russia has halted, at least temporarily, production of new ballistic missile submarines. One Delta I class and two Yankee I class SSBNs were recently retired as well. However, development of a follow-on to the SS-N-20 SLBM continues and is likely to become operational before the end of the decade.

Russian President Boris Yeltsin announced in January 1992, that Russia would also discontinue production of strategic bombers, including the Blackjack and Bear-H. He later announced a halt in the production of Backfire bombers. However, further production of the AS-15, Russia's long-range air-launched cruise missile (ALCM), has also been announced.

In terms of tactical nuclear weapons, Yeltsin has announced he will uphold former Soviet President Gorbachev's October 5, 1991, commitment to destroy all nuclear warheads associated with tactical ground-launched systems. He also went beyond Gorbachev, stating that no replacement warheads would be generated and that Russia would also destroy one-third of its tactical sea-launched nuclear warheads, half of its tactical air-launched nuclear warheads, and half of the nuclear warheads used for its anti-aircraft missiles. In addition, all tactical nuclear weapons were withdrawn to Russia from all the former Soviet republics by May 1992. Furthermore, Russia announced on February 4, 1993, that all tactical nuclear weapons had been withdrawn from ships and submarines.[7]

Despite the withdrawal of a large number of systems from active service, there is no evidence that any warheads have been dismantled or their component parts safely stored.

France

The French Government canceled development of the mobile S-45 intermediate-range ballistic missile (IRBM), which was slated to replace its 18 silo-based S-3D IRBMs by the end of the decade. As a result, the French may consider replacing the S-3Ds with an ICBM version of the M-5 SLBM which, in the event the START II treaty is implemented, would leave France with the world's only MIRVed ICBM.

Due to financial constraints, France has also decided to build only four new

FRENCH NUCLEAR FORCES

Type	Deployed	Range(km)	Warheads x yield	Warheads in stockpile
Land-based				
S-3D	18	3,500	1 x 1 M	18
Hadès	-	480	1 x 80 k	30
SLBMs				
M-4	64	6,000	6 x 150 kt	384
Aircraft: land-based				
Mirage IVP	18	93	1 x 300 kt ASMP	18
Mirage 2000N	45	690	1 x 300 kt ASMP	42
Aircraft: carrier-based				
Super Etendard	24	650	1 x 300 kt ASMP	20

Sources: IISS, The Military Balance 1993-1994 (London: Brassey's, 1993) and SIPRI Yearbook 1993: World Armaments and Disarmament (New York: Oxford University Press, 1993).

Triomphant class SSBNs instead of the six originally planned. These will replace France's current fleet of five SSBNs.

In terms of tactical systems, the army's Pluton surface-to-surface missile (SSM) has been completely withdrawn from service. Its units are being disbanded, and the missiles dismantled. Also, a decision was made to reduce production of its scheduled replacement, the Hadès SSM, and to store it rather than deploy it in the field.

Lastly, France's development of the air-launched Air-Sol-Longue-Portée (ASLP) to replace currently deployed Air-Sol-Moyenne-Portée (ASMP) has been thrown into doubt due to financial constraints and the withdrawal of Britain from the program. Overall expenditure on nuclear forces has been reduced 17 percent compared to that of 1990.

Britain

The United Kingdom is in the process of replacing its four Polaris submarines with four Trident submarines; this process should be completed by the turn of the century. In May 1992, it decommissioned one Polaris, the HMS Revenge. The first Trident, the HMS Vanguard, is scheduled to become operational in late 1994.

In June 1992, the British Ministry of Defence stated that all (approximately

BRITISH NUCLEAR FORCES

Type	Deployed	Range(km)	Warheads x yield	Warheads in stockpile
SLBMs				
A3-TK Polaris	48	4,700	2 x 40 kt	~100
Aircraft				
Tornado (GR.1)	72	1,300	1-2 x 200-400 kt	
Buccaneer (S2B)	27	1,700	1 x 200-400 kt	~100 (total)

Sources: IISS, The Military Balance 1993-1994 (London: Brassey's, 1993) and SIPRI Yearbook 1993: World Armaments and Disarmament (New York: Oxford University Press, 1993).

25) of the WE-177C nuclear strike/depth bombs carried by ASW helicopters and carrier-based aircraft will be removed from service and destroyed. Additionally, the U.S. withdrawal of B-57 depth bombs from Europe makes them no longer available for the U.K.'s Nimrod ASW planes. As a result, Britain's tactical nuclear force will consist of Tornado and Buccaneer aircraft armed with the WE-177A/B gravity bomb. The remaining Buccaneer squadrons will be retired by 1994, and the Tornado squadrons will be reduced from 11 to eight.

The Ministry of Defence had indicated a need to replace the WE-177 bomb, which is approaching the end of its service life, with a tactical air-to-surface missile (TASM). To this end, the United Kingdom asked the U.S. firm Martin Marietta to carry out preliminary definition studies for the TASM, and considered joint development of the French ASLP. However, the government decided on October 18, 1993, to scrap plans for a new air-launched nuclear missile, canceling a project which would have cost an estimated $4.5 billion. It appears likely, therefore, that after the turn of the century the United Kingdom will rely solely on its Trident nuclear submarines. Cancellation of the project by Britain also places the future of France's development of the ASLP in doubt.[8]

China

Unlike other nuclear weapons states, China continues, albeit slowly, to develop its nuclear- capable forces. Little, however, is known of developments within the PRC. Nonetheless, China is expected to field a new mobile missile in the next few years. This missile, the DF-31, will apparently be a land-based version of the new 8,000 kilometer JL-2 SLBM. China may also be developing another mobile ICBM, the three-stage, solid propellant DF-41, to be deployed after the turn of the century.[19]

The new JL-2 is expected to be deployed aboard the second-generation 09-4 Xia Class nuclear-powered submarine in the mid- to late-1990s. China also recently deployed the 1,700 to 1,800 kilometer DF-21, a mobile, land-based version of the JL-1 SLBM. Also, China apparently has six trucks with TELs to transport and launch the two-stage,

CHINESE NUCLEAR FORCES

Type	Deployed	Range(km)	Warheads x yield	Warheads in stockpile
Land-based missiles				
DF-3A (CSS-2)	50	2,800	1 x 3.3 Mt	50
DF-4 (CSS-3)	20	4,750	1 x 3.3 Mt	20
DF-5A (CSS-4)	4	13,000	1 x 4-5 Mt	4
DF-21 (CSS-6)	36	1,800	1 x 200-300 kt	36
DF-31	in devel.	8,000	1 x 200-300 kt	-
DF-41	in devel.	12,000	MIRV	-
SLBMs				
JL-1 (CSS-N-3)	24	1,700	1 x 200-300 kt	24
JL-2 (CSS-N-4)	-	8,000	1 x 200-300 kt	-
Bombers				
H-5	30	1,200	1 x bomb	
H-6	120	3,100	1 x bomb	150 (total)
Q-5	30	400	1 x bomb	
H-7	0	n.a.	1 x bomb	

Sources: IISS, The Military Balance 1993-1994 (London: Brassey's, 1993) and SIPRI Yearbook 1993: World Armaments and Disarmament (New York: Oxford University Press, 1993).

solid-propellant IRBM.

The Chinese Air Force continues work on the H-7, possibly a strategic bomber designed to replace the aging Q-5C. The H-7 is reportedly entering series production at the Xian Aircraft Factory.

Nuclear Testing

Current moratoria on the testing of nuclear weapons bode well for the end of the nuclear arms race and the prospect of a CTB. In concert with the decline in new weapon development outlined above, annual nuclear weapon testing has also declined substantially in the past seven years. In fact, of the five declared nuclear weapon states, only China has conducted a test this year. The United States, Britain, France, and Russia continue to uphold moratoria on testing announced over the past two years.

The former Soviet Union was the first to halt testing when on October 5, 1991, then-President Mikhail Gorbachev announced a one-year moratorium. A year later, on October 2, 1992, then-President George Bush signed a bill halting U.S. tests for nine months, limiting tests for the next three years to a maximum of five per year and committing to no further tests after September 30, 1996, unless another state conducts a test after that date.[10] This in turn prompted Boris Yeltsin on October 19, 1992, to extend the Russian moratorium until July 1, 1993. In July 1993, the U.S. moratorium was further extended for at least another 15 months, provided other nations do not conduct tests during that period.

INF REDUCTIONS

Type	Eliminated
U.S.	
Pershing II	234
GLCM	443
Pershing IA	169
Total	**846**
U.S.S.R.	
SS-20	654
SS-23	239
SS-4	149
SS-5	6
SS-12	718
SSC-X-4	80
Total	**1,846**

Data source: SIPRI Yearbook 1991: World Armaments and Disarmament (New York: Oxford University Press, 1991), p. 404.

This condition was challenged on October 5, 1993, when China tested a 20 to 40 kiloton device at the Lop Nor test site in Xinjiang province.[11] However, as this was only China's 39th test compared to about 1,900 tests for the other four states combined, it is unlikely to spur the United States to resume testing. Further Chinese testing, or even a test by a heretofore nuclear-weapon-free state, however, would most likely result in additional U.S., U.K. and French testing. China, for its part, has expressed support for negotiation of a CTB treaty by 1996.

The United Kingdom, which conducts its testing in conjunction with the United States at the Nevada test site, currently has no choice but to follow the U.S. moratorium. This situation may have influenced the United Kingdom's decision to forego development of an air-launched nuclear missile, which would eventually require testing, and to rely solely on the soon to be deployed U.S.-supplied Trident missile with a fully tested U.K. warhead.

In April 1992, France also announced a moratorium until the end of 1992. In January 1993, President François Mitterrand further stated that France would forego additional testing as long as the United States and Russia refrained.[12]

In spite of the Chinese test, the current moratora by the other four declared nuclear weapon states bode well for the negotiations on a CTB, which will begin in January 1994 in Geneva.[13]

Status of Disarmament Agreements

INF

The Intermediate-range Nuclear Forces (INF) treaty, signed in December 1987 by the United States and the Soviet Union, called for the elimination by June 1, 1991, of all nuclear-capable missiles with a range between 500 and 5,500 kilometers, launchers, support structures, and equipment. Both states met this obligation within

START I: BASIC PROVISIONS

Both sides are limited to 6,000 ac countable warheads deployed on no more than 1,600 strategic nuclear delivery vehicles (SNDVs: includes ICBMs, SLBMs and heavy bombers).

Of these 6,000 warheads, no more than 4,900 may be carried on ballistic missiles and no more than 1,100 on mobile ICBMs.

No more than 1,540 warheads may be carried on heavy ICBMs. This provision applies solely to reductions in Soviet SS-18s from 308 to 154. Increases in throw-weight, launch weight, and the number of warheads on existing heavy missiles are also prohibited.

Limits are also placed on non-deployed mobile missiles and launchers.

Design, testing, and deployment of new systems with more than 10 re-entry vehicles and flight testing of existing systems with more than their current number of re-entry vehicles are also prohibited.

Several means of treaty verification are provided for, including transfer of missile test flight data, on-site inspection, and monitoring of mobile ICBM production facilities.

the required time.[14]

However, neither the INF treaty nor the later START I and II treaties specify that nuclear warheads themselves be dismantled. The INF specifies only that the warhead be removed from its delivery system and that the system be destroyed. Thus, theoretically at least, the 2,692 warheads freed up as a result of this agreement could be rebuilt in their entirety, or refashioned, using their component parts, into new weapons. The treaty did greatlyreduce the immediate threat of an accidental or intentional nuclear exchange in Europe; however, it failed to account for the long-term threat posed by the resulting materials.

START I

The U.S.-Soviet Treaty on the Reduction and Limitation of Strategic Offensive Arms (START I), concluded on July 31, 1991, seeks to reduce the total numbers of strategic warheads possessed by the two states, the total number of delivery vehicles, and also specific types of delivery systems. Its provisions are to be met over a period of seven years after the treaty enters into force. Below is a summary of its basic provisions.

The dissolution of the former Soviet Union posed a host of problems for the implementation of the START I treaty. Though signed in July 1991, it has yet to enter into force. The creation of four states with strategic nuclear weapons on their territories, where one had previously stood, severely complicated treaty implementation. The issue was seemingly resolved with the signing of a protocol to the START I treaty (the Lisbon Protocol) by the United States, Russia, Ukraine, Belarus, and Kazakhstan. In the protocol, the four former Soviet republics agreed to assume the obligations of the U.S.S.R. under the treaty. Additionally, Ukraine, Belarus, and Kazakhstan agreed to join the NPT as non-nuclear states "in the shortest possible time."[15]

Kazakhstan was the first to ratify the treaty on July 2, 1992. Ratification by the U.S. Senate followed on October 1, 1992, by Russia on November 4, 1992, and by Belarus on February 4, 1993. Russia's ratification was accompaniedby a stipulation that actual exchange of instruments of ratification (thus bringing the treaty into force) would not occur until the other former Soviet republics acceded to the NPT as non-nuclear weapons states and agreed to START I implementation measures. Only Belarus has joined the NPT. The major concern at this point is Ukraine's failure to ratify the treaty, which is delaying not only entry into force of the START I treaty but also ratification of START II.

Despite the failure of Ukraine to ratify the treaty, reduction of U.S. strategic forces, which began in October 1991, is on-going. Approximately 189 Minuteman II ICBMs have been removed from their silos, and the remaining silo-

START II: BASIC PROVISIONS

By the year 2003, both states must reduce the number of deployed strategic warheads to between 3,000 and 3,500 each.

Both parties are required to eliminate their MIRVed ICBMs.

SLBM warheads are limited to 1,700 to 1,750 each.

The counting practice for bombers is changed to include the number of nuclear weapons that they are actually equipped to carry, although up to 100 strategic bombers are exempted for re-orientation to conventional role.

All SS-18 missiles, both deployed and non-deployed, must be eliminated either through destruction or use as space-launch vehicles.

based Minuteman IIs have been taken off alert. However, no missiles or silos have been destroyed yet.

START II

The U.S.-Russian Treaty on Further Reduction and Limitation of Strategic Offensive Arms (START II), signed in Moscow on January 3, 1993, if implemented will be the most sweeping nuclear arms reduction treaty in history. The treaty, however, does not enter into force until ratification of the START I treaty by all parties; Ukraine has yet to ratify it. The limitations and reductions to be carried out under the treaty are dramatic and indicative of a changed world. Its most important provisions are listed below.

What these reductions mean in terms of the overall holdings of the two parties is insightful. Full treaty compliance will require the United States to reduce its deployed strategic nuclear warheads by more than 70 percent of its September 1990 level and nearly 60 percent from planned deployments under the START I treaty. Included in this reduction is the downloading of all Minuteman IIIs from three warheads to one, the elimination of all MX/Peacekeeper missiles, and the reduction of deployed SLBM warheads to no more than 1,750.[16] Russia will be required to reduce its strategic forces also by about 70 percent of its September 1990 deployments and by about 50 percent of deployments under START I.[17]

Effects of Reductions on Non-Treaty Parties

The effects of these treaties on the security of non-parties is difficult to quantify. Certainly the INF treaty, which removed an entire category of nuclear weapons from Europe, contributes to the stability of the European theater and decreases the danger to European states of becoming embroiled in a nuclear exchange. European and other states also benefit from the relaxation of tensions resulting from the conclusion of the START I and II treaties because of the ranges of the systems being limited and reduced. The extensive reductions to be undertaken by the United States and Russia also signal to the international community that both countries are finally making progress on their NPT obligation to "pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race" (art. VI of the NPT).[19] Also, non-party states may begin to incur indirect savings in the form of reduced military expenditures as a result of the reduced need to counter a Russian or U.S. threat.

Unfortunately, these reductions may also have a negative effect. As noted above, neither the INF, START I, nor START II treaty specifies that warheads be dismantled; merely that the warheads be removed from their delivery system and, in some cases, the delivery system destroyed. Given, as a recent U.S. Office of Technology Assessment report suggests, that "neither the United States nor Russia has developed a technically and politically feasible plan to dismantle warheads and dispose of the nuclear materials from them,"[19] the long-term control (or lack thereof) of retired warheads or their component parts may pose both security and environmental threats not only to the United States and Russia, but also to surrounding states.

Nuclear Disarmament: Short-term costs, long-term benefits

While the initiatives of the United States and Russia to remove tactical nuclear weapons from service and the dramatic reductions embodied in the START treaties concerning strategic systems are encouraging, the burden of the actual dismantlement of the warheads may prove prohibitive. The process of warhead dismantlement involves three basic stages: 1) gathering together and storing warheads at dismantling sites, 2) dismantling the warheads and storing the components, and 3) processing of fissile components, which involves bringing the plutonium and highly-enriched uranium (HEU) to a form that is suitable for long-term storage, recycling, or disposal.[20]

Current U.S. Department of Energy (DOE) plans call for the dismantlement of approximately 2,000 warheads per year, yet only cover the first two phases of the dismantlement process as defined above. These plans appear to be overly optimistic, however. The DOE's Pantex Plant near Amarillo, Texas (where almost all weapons are currently dismantled) dismantled only 1,274 warheads in FY 1992 and will dismantle approximately 1,430 during the current FY 1993.[21] Plutonium "pits" from the dismantlement process are stored at Pantex, while the HEU is shipped to the Y-12 facility in Oak Ridge, Tennessee for storage. While no decision has been made concerning the long-term disposition of these materials, some of the HEU can and will most probably be used as naval reactor fuel.[22] While little information is available on the total yearly costs of this dismantlement process, the U.S. Office of Technology Assessment puts the DOE budget allocated to warhead dismantlement and materials disposition in the range of $500 million to $1 billion for FY 1993.[23]

Little is known about Russia's dismantlement plans or even its total stockpile of nuclear warheads. If taken at face value, recent statements by Viktor N. Mikhailov, the head of Russia's Ministry of Atomic Energy, reveal that Russia's inventory of HEU may be twice the amount originally estimated by the West -- some 1,200 metric tons.[24] Mikhailov has also recently indicated

that approximately 10,000 warheads have been dismantled in the former Soviet Union. The U.S. Department of Defense estimates that 2,000 warheads, at best, are being dismantled annually. However, a great deal of skepticism still surrounds Russia's dismantlement efforts as no means of verification are currently available. The United States has provisionally agreed to purchase 500 metric tons of excess Soviet HEU for about $11.9 billion,[25] although it may consider additional purchases if the revised stockpile figures prove accurate.

Despite the steep costs associated with dismantling and safe storage of nuclear weapons retired as a result of either unilateral initiatives or bilateral or multilateral disarmament agreements, the long term savings accrued could be substantial. Again using the U.S. example, the U.S. Congressional Budget Office has estimated that the United States could save more than $50 billion over the next 15 years in the improved political climate fostered by the START II treaty. Russian officials have also acknowledged that, while dismantlement costs may be substantial, they will be exceeded in the long term by savings from reduced operations and support costs.[26]

The Status of Civilian Nuclear Power

The future of the civilian nuclear power industry was dealt a severe blow by the Chernobyl accident in 1986, and public concern over the safety of nuclear power continues to be significant. Additionally, assessments of the feasibility of new projects are increasingly taking into account a number of hidden costs, such as the disposal of radioactive waste and the decommissioning of older plants. Unless significant strides can be made over the next few years regarding plant safety and materials disposal, the nuclear power industry is likely to decline or, at best, hold steady through the end of the decade. Reflecting this more cautious approach, Spain and Switzerland have placed prohibitions on further reactor construction; the United States has placed no new nuclear plant orders since 1975; and Italy has abandoned nuclear power altogether.[27] Since 1989, a total of 37 commercial reactors have been shut down worldwide. As of June 1993, there were 415 commercial nuclear reactors in operation globally with a total capacity of 328,308 MWe,[28] an increase in capacity of only 2 percent over the previous year. As the industry downsizes in the coming years, the threat of a "brain drain" of skilled scientists or the leaking of sensitive materials will become all the more acute and will require extreme vigilance. This is especially true in the former Soviet Union where the distribution of both military and civilian nuclear facilities across 15 successor states poses real problems for effective technical and material control.[29]

The precarious balance between safety and economic necessity will be a great concern during the coming decade. Nowhere is this tension more evident than in former Eastern bloc countries where decisions are being made to continue operation of plants despite serious safety concerns.

NUCLEAR POWER REACTORS IN COMMERCIAL OPERATION

Country	Units	NetMWe
Argentina	2	935
Belgium	7	5,484
Brazil	1	626
Bulgaria	6	3,666
Canada	22	15,442
Czech Republic	4	1,632
Finland	4	2,310
France	55	56,488
Germany	21	22,508
Hungary	4	1,729
India	9	1,834
Japan	43	33,171
Kazakhstan	1	135
Korea	9	7,220
Lithuania	2	2,760
Mexico	1	654
Netherlands	2	507
Pakistan	1	125
Russia	25	19,799
Slovakia	4	1,632
Slovenia	1	620
South Africa	2	1,840
Spain	9	7,110
Sweden	12	10,002
Switzerland	5	2,936
Taiwan	6	4,884
Ukraine	14	12,095
United Kingdom	35	11,950
United States	108	98,214
Total	**415**	**328,308**

Source: "World List of Nuclear Power Plants," Nuclear News (September 1993), pp. 43-62.

THRESHOLD AND ASPIRING STATES

Region	Country	Comment
Middle East/	Algeria	Possibly interested in weapons development, but currently lacks facilities; has agreed to IAEA inspection of formerly secret, Chinese supplied nuclear reactor; not party to the NPT.
	Iran	Reportedly pursuing nuclear weapons, but little public evidence of progress; CIA testimony estimated production unlikely before the end of the decade without foreign assistance.
	Iraq	Massive program uncovered after Gulf War; U.N. has required destruction of most infrastructure, but knowledgeable personnel still in country.
	Israel	Widely believed to have a clandestine nuclear arsenal of approximately 100 weapons; ample delivery capability (both ballistic missile and aircraft).
South Asia	India	Exploded nuclear device in 1974; probably has sufficient materials for several weapons.
	Pakistan	Undoubtedly has nuclear weapons program, probably successful; U.S. President no longer certifies to Congress that Pakistan does not possess a nuclear device, suggest ing high likelihood that it does.
Korean	North Korea	Suspicious reactor and reprocessing laboratory; submitted to some IAEA inspections in 1992 and 1993, but refused others; on March 12, 1993, denied IAEA access to suspected reprocessing waste sites and declared its intention to withdraw from NPT (since rescinded).
Latin America	Argentina	In agreement with Brazil, seems to have ceased weapons program; no disclosure of progress towards weapons, but suspected of having developed clandestine enrichment plant.
	Brazil	In agreement with Argentina, has apparently ceased weapons program; in 1987, re vealed it had developed the ability to enrich uranium. (Brazil has also had a nuclear power submarine program requiring highly enriched uranium fuel.)
Africa	South Africa	Widely suspected to be very near nuclear-weapons capability, South Africa declared in March 1993 that it had in fact constructed six nuclear weapons, but dismantled them in 1990. The South African president promised that South Africa would cooper ate fully with the IAEA to assure the world that it was complying with the NPT, which it joined in 1991, placing declared weapons-grade uranium under IAEA inspection and presumably dropping nuclear weapon ambitions.

Source: U.S. Congress, Office of Technology Assessment, Proliferation of Weapons of Mass Destruction: Assessing the Risks, OTA-ISC-559 (Washington, D.C.: U.S. Government Printing Office, August 1993), p. 64 (with some changes made by the authors).

An example of this is the continued operation of the Ignalina nuclear power plant in Lithuania. Consisting of two RBMK, or "Chernobyl-type," reactors the plant supplies 85 percent of the country's electricity needs in addition to exporting half of its output to neighboring Latvia, Belarus, and Russia's Kaliningrad region. Shutting down the plant is impossible. Yet, continued operation, absent even the most basic Western safety provisions, and with serious structural deficiencies, is all the more unthinkable. Fortunately, Sweden has heeded the concerns of the plant's management and its own citizens and has paid SKr70 million ($8.4 million) to date, and will contribute another SKr53.2 million ($6.4 million) in 1994, to improve reactor safety and train workers. The Swedes, however, anticipate a shutdown of the plant in eight to 10 years and consider such measures only a stopgap. Security is another problem at Ignalina. In the summer of 1993, a seven-meter-long spent fuel shell, full of radioactive material, disappeared from the plant. Yet, in spite of all these concerns, plant director Viktor Shevaldin asserts that the plant will remain open another 30 years.[30]

Even in relatively economically stable countries, the growing environmental costs and safety concerns associated with reactor operation are fueling a battle over nuclear energy's future. In England, the dispute centers on the Thorp reprocessing plant whose future, and that of additional new reactors in the United Kingdom, is currently under government review. The trouble with Thorp is that it is planned to produce about 60 metric tons of plutonium for customers in Switzerland and Japan over the next decade at a time when there is a glut of plutonium on the world market and growing concern over diversion to terrorists or rogue governments. A decision to go ahead with the plant may also go against U.S. interests. In a recent letter to members of Congress, U.S. President Bill Clinton characterized continued production of plutonium, even for civilian purposes, as "not justified on either economic or national security grounds, and its accumulation creates serious proliferation and security dangers."[31] Germany is also in the throes of a serious debate concerning the future of its nuclear power program.

The Problem of Aspiring and Threshold States

Despite the consensus of major powers on the need to curtail the spread of weapons of mass destruction, including acknowledgement by the U.N. Security Council that "the proliferation of all weapons of mass destruction constitutes a threat to international peace and security,"[32] several states continue to harbor undeclared nuclear weapons programs or aspire to such a capability.

The process of acquiring a nuclear weapon capability, and of ensuring its safety, security, and survivability is no small task -- even for those states with the requisite financial, technical, and material resources. It is generally acknowledged that designing a nuclear weapon is well within the capabilities of most states. However, it is the process of acquiring the nuclear material for the weapon's core that poses the greatest challenge. Acquisition of either HEU or plutonium requires the construction and operation of expensive and highly complex facilities. To produce HEU for example, natural uranium must be mined, milled, and enriched to a concentration of 90 percent or more U^{235} (natural uranium contains less than one percent U^{235}).[33] Plutonium acquisition requires the existence of a nuclear reactor, through which natural or low-enriched uranium can be burned and partially transformed into plutonium. The spent fuel rods must then be reprocessed to extract plutonium through a series of chemical processing steps. Despite the declassification of information about both these procedures in the United States and France as early as the 1950s, they are still complex procedures that few nations have been able to undertake without external assistance.[34]

The cost of developing a nuclear weapons capability, choosing either the HEU or plutonium route, can be prohibitive. The cost of an enrichment plant (for HEU production) can vary widely depending on the separation method chosen and the size and extent of separation work undertaken. As an example, by the end of 1984, the total investment in plant and capital for all three U.S. gaseous diffusion plants was $3.86 billion (an average of $1.28 billion each).[35] Plutonium production includes the cost of reactor construction and maintenance, as well as construction and maintenance of a reprocessing facility. At a bare minimum, production of enough plutonium for two weapons annually (10 kilograms), would require between $75 and $100 million in capital costs alone. To obtain enough for 10 to 20 weapons annually would require up to $1 billion and some 50 to 75 engineers and 150 to 200 skilled technicians.[36] Moreover, if such a program were developed in secret, the costs would skyrocket. Iraq, for example, spent about $10 billion for the construction of complex and redundant facilities in pursuit of multiple uranium enrichment technologies, before its efforts were interrupted.[37]

The costs, however, do not stop there. Unless a state is merely trying to develop a one-shot, very crude terror weapon, provision must be made for the safety, security, survivability and command and control of a state's nuclear

force in order to render it an effective deterrent. Add to this the development of an advanced, dedicated delivery system, and the costs far exceed most countries' capacity for investment. Whatever the exact costs, it is fairly safe to say that an effective nuclear weapons development program is beyond the scope of what most aspiring states can afford to spend given the needs of their civilian population. In addition to the material costs of nuclear weapons, a country would have to devote its best human and technical assets, which oftentimes can scarcely be afforded.

Despite the high financial and technical barriers to proliferation, a handful of states continue to harbor a clandestine nuclear weapons program or are widely believed to be actively seeking one. Concern about states' acquiring nuclear weapons is focused on three regions: the Middle East and North Africa, South Asia, and the Korean Peninsula. Aside from the five acknowledged nuclear powers (the United States, Russia, France, Britain and China) and the three non-Russian former Soviet republics that still have nuclear weapons on their territory (Belarus, Kazakhstan, and Ukraine), only three states are believed to either possess nuclear weapons or have the ability to deploy them on short notice (Israel, India, and Pakistan). At least four countries are suspected of aspiring to nuclear weapons status (Algeria, Iran, Iraq, and North Korea). Three other states appear to have halted or reversed an earlier decision to pursue weapons development (Argentina, Brazil, and South Africa). Two other states, Syria and Libya, are feared to have nuclear ambitions but lack the resources to mount a credible threat.

ALTERNATIVE FUTURES: WHERE DO WE GO FROM HERE?

Given the foregoing problems and prospects concerning the state of nuclear disarmament and the production of civilian nuclear power, a host of policy choices must be made to channel concerns into positive developments. The following constitutes a partial list of potential policy choices and outcomes to be faced by the international community in the decades ahead.

A World of Many Nuclear Powers

While no state, not even a potential proliferant, has argued for the unimpeded spread of nuclear weapons, some have argued forcibly for "managed proliferation" of nuclear weapons in the hopes of stabilizing certain regions of conflict.[38] However, the acceptance of a nuclear weapons capability in Germany, Japan, and Ukraine (to name but a few suggestions) is not likely to be welcomed by all relevant parties and could erode the growing, but fragile, consensus towards nonproliferation norms and adherence to the NPT.

The 1995 NPT Review Conference and Indefinite Extension

Of the three different options available for extension of the NPT treaty in 1995 -- a single fixed period, additional fixed periods, or an indefinite period (art. X.2 of the NPT) -- the latter is most likely to occur given the current balance of opinion. However, if significant debate and disruption of the process are to be avoided, a package of concessions may be necessary to allay the concerns of many non-nuclear weapons states. Such a package might include security assurances to non-nuclear weapon states, revamping of the safeguards system, and further disarmament commitments on the part of nuclear weapon states.

Transparency in Armaments

The suggestion has been put forward that the current U.N. Register of Conventional Arms be expanded to include weapons of mass destruction, or at the very least that a parallel register be established to track the status of such weapons. Such an approach is consistent with the goal of the Register to prevent "excessive and destabilizing accumulations" of arms. However, such an approach, within the context of the current Register, is likely to meet with substantial resistance from nuclear weapons states, and it could jeopardize the gains made to date in making the trade in conventional weapons more transparent.

The Argentinean delegation to the Conference on Disarmament (CD) in Geneva proposed a more likely approach, the development of a "nuclear

ESTIMATES OF CIVIL AND MILITARY INVENTORIES OF PLUTONIUM AND HEU

end of 1990 (in metric tons)

	Civil inventory	Military inventory	Total
Plutonium	654	257	911
HEU	20	1,310	1,330

Source: David Albright, Frans Berkhout and William Walker, World Inventory of Plutonium and Highly Enriched Uranium 1992 (New York: Oxford University Press, 1993), p. 197.

logbook" to track nuclear weapons holdings and the pace of reductions. The proposal has earned a great deal of support from influential members of the developing world represented at the CD.

A Comprehensive Test Ban Treaty

Despite the recent test by China, progress towards a CTB treaty appears more likely in light of the continuing moratoria by the United States, the United Kingdom, France, and Russia. Negotiations are scheduled to begin in January 1994 at the CD in Geneva. Given the support (however reluctant) of the five acknowledged nuclear weapon states for a CTB treaty, the treaty is likely to garner even greater support in the developing world. Despite the great political significance of such an agreement, it will likely have little or no effect upon actual arms control and disarmament efforts. Those aspiring to nuclear status are unlikely to sign, and those who have conducted substantial testing can effect significant modernization or development short of a large-scale test.

International Plutonium Storage

Discussions regarding the establishment of an international plutonium storage capability began in the 1970s and have recently gained renewed vigor given fears over the long-term security of fissile material stockpiles created as a result of the disarmament process in the former Soviet Union. Storage of materials would be the first step in the process of a verified cut-off of production of fissile materials[39] and their transfer from military to non-military applications. Materials would be stored either in internationally or nationally monitored sites under strict scrutiny.[40] Such a facility would also serve to allay fears regarding the ultimate intentions of, for example, Japan's breeder reactor program.

Integrated and Comprehensive Arms Control and Disarmament Regime

Though undeniably the most desirable outcome, an all-inclusive regime may not be entirely practicable. Although states may pursue nuclear weapons in response to not only accumulations of other types of weapons of mass destruction, but also accumulations of conventional weapons by an adversary, agreement to control acquisition of the entire spectrum of weapons of mass destruction and conventional arms may prove divisive. While a general consensus exists against the further acquisition of nuclear, chemical, and biological weapons, no such consensus holds regarding conventional weapons, which are seen (within limits) as the inherent right of states to acquire in ensuring their own security.

In the euphoria following the end of the Cold War, what was expected to appear was a comprehensive *collective* security regime based on the United Nations. Confronted with the reality of divergent national interests, however, such a regime has failed to emerge. What is more likely to develop is a *cooperative* security regime premised on five principle elements: a strong normative base, inclusiveness and nondiscrimination, transparency, regime management, and well-defined sanctions or other coercive measures.[41] Such a regime would foster increased reductions in armaments and curtail the incentives to acquire them through reassurance of participants' security. While this paper has shown that certain of these elements are well-developed in the case of nuclear weapons (e.g. a strong normative base), others such as nondiscrimination, transparency, and sanctions will need further development for a truly cooperative security regime to evolve.

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[1] John Barham, "Argentina to sign N-treaty," Financial Times, November 12, 1993, p. 5.

[2] See Lewis A. Dunn, "New Nuclear Threats to U.S. Security," in Robert D. Blackwill and Albert Carnesale, eds., New Nuclear Nations: Consequences for U.S. Policy (New York: Council on Foreign Relations Press, 1993), p. 25.

[3] U.S. Congress, Office of Technology Assessment, Proliferation of Weapons of Mass Destruction: Assessing the Risks, OTA-ISC-559 (Washington, D.C.: U.S. Government Printing Office, August 1993), p. 17. Hereafter referred to as "OTA, Proliferation of Weapons."

[4] About 400 W-88 warheads have been produced. See Dunbar Lockwood and Jon B. Wolfsthal, "Nuclear weapon developments and proliferation," in SIPRI Yearbook 1993: World Armaments and Disarmament (Oxford: Oxford University Press, 1993), p. 223.

[5] A process which started in October 1991.

[6] SIPRI Yearbook 1993: World Armaments and Disarmament (New York: Oxford University Press, 1993), p. 225.

[7] Lockwood and Wolfsthal, op. cit., p. 228.

[8] David White, "Britain to drop project for new £3bn N-missile," Financial Times, October 16, 1993.

[9] John W. Lewis and Hua Di, "China's Ballistic Missile Programs: Technologies, Strategies, Goals," International Security, 17 (Fall 1992), p. 29.

[10] IISS, The Military Balance 1993-1994 (London: Brassey's, 1993), p. 15.

[11] David White, "China defies Clinton with underground nuclear test," Financial Times, October 6, 1993.

[12] Mitterrand reinforced this statement in the wake of the Chinese test in saying that, if "countries other than China" resumed testing, France would have to follow suit. See David Buchan, "Mitterrand risks Paris split on N-weapons tests," Financial Times, October 7, 1993.

[13] The Conference on Disarmament, at its 659th plenary meeting of August 10, 1992, gave its Ad Hoc Committee on a Nuclear Test Ban a mandate to negotiate a comprehensive nuclear test ban treaty. See Report of the Conference on Disarmament, U.N. General Assembly document A/48/27, September 23, 1993.

[14] Some questions continue to surround actual Soviet compliance, however, which were buttressed by the Czech government's discovery of a cache of 24 SS-23 missiles in mid-1992. Soviet troops apparently left them behind (after removing the nuclear warheads) when they withdrew from Czechoslovakia. See "Missing the Missiles," U.S. News & World Report, July 6, 1992, p. 26.

[15] See the Protocol to Facilitate the

Implementation of the START Treaty (Lisbon Protocol), May 23, 1993, art. V.

[16] For a complete listing of both U.S. and FSU reductions under the terms of the START I and II treaties, see IISS, The Military Balance 1993-1994 (London: Brassey's, 1993), pp. 235-236.

[17] See Dunbar Lockwood, "Nuclear arms control," in SIPRI Yearbook 1993: World Armaments and Disarmament (Oxford: Oxford University Press, 1993), p. 555.

[18] OTA, Proliferation of Weapons, p. 17.

[19] U.S. Congress, Office of Technology Assessment, Dismantling the Bomb and Managing the Nuclear Materials, OTA-O-572 (Washington, D.C.: U.S. Government Printing Office, September 1993), p. 2. Hereafter referred to as "OTA, Dismantling the Bomb."

[20] David Albright, Frans Berkhout and William Walker, World Inventory of Plutonium and Highly Enriched Uranium 1992 (New York: Oxford University Press, 1993), p. 207.

[21] OTA, Dismantling the Bomb, p. 23.

[22] Matthew Bunn of the National Academy of Sciences, conversation with author, November 4, 1993.

[23] OTA, Dismantling the Bomb, p. 45.

[24] William J. Broad, "Russia Says Soviet Atom Arsenal Was Larger Than West Estimated," New York Times, September 26, 1993, pp. 1, 7.

[25] Bunn conversation, loc. cit.

[26] Lockwood, op. cit., p. 560.

[27] Darryl Howlett, "The Current Status of Nuclear Power," in Darryl Howlett and John Simpson, eds., Nuclear Non-Proliferation: A Reference Handbook, (Essex: Longman Group, 1992), p. 79.

[28] "World List of Nuclear Power Plants," Nuclear News (September 1993), pp. 43-62.

[29] For a complete list of these facilities, see William C. Potter, Nuclear Profiles of the Soviet Successor States (Monterey, Calif.: Monterey Institute of International Studies, 1993).

[30] Matthew Kaminski, "Lithuania's pressure cooker," Financial Times, November 10, 1993, p. 12.

[31] George Graham, "Clinton stiffens stance on plutonium," Financial Times, November 10, 1993, pp. 1, 16.

[32] From the statement adopted by the Security Council at its first ever summit meeting at the level of heads of state or government, held January 31, 1992. U.N. Security Council document S/23500.

[33] A variety of methods exist for enriching uranium, including the use of gas centrifuge technology, laser isotope separation, and aerodynamic separation techniques. See OTA, Proliferation of Weapons, pp. 35-36.

[34] Leonard S. Spector, The Undeclared Bomb (Cambridge, MA: Ballinger, 1988), p. 450.

[35] Comprehensive study on nuclear weapons, Report of the Secretary-General, U.N. General Assembly document A/45/373, July 6, 1990, para. 246.

[36] Ibid., para. 244.

[37] OTA, Proliferation of Weapons, pp. 33, 72.

[38] See especially Kenneth N. Waltz, The Spread of Nuclear Weapons: More May Be Better, Adelphi Paper No. 171 (London: International Institute for Strategic Studies, Autumn 1981) and John J. Mearsheimer, "Back to the Future: Instability in Europe after the Cold War," International Security 15 (Summer 1991).

[39] The United States ceased production of plutonium in 1988 and HEU for nuclear weapons in 1964.

[40] Helen Leigh-Phippard, "The Physical Protection of Nuclear Material," in Darryl Howlett and John Simpson, eds. Nuclear Non-Proliferation: A Reference Handbook (Essex: Longman Group, 1992), p. 61.

[41] Antonia Handler Chayes and Abram Chayes, "Cooperative Security Regime Architecture -- Elements and Principles," unpublished paper, July 30, 1992.