The Soviet Nuclear Weapon Legacy

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Preface

Many issues connected with the Soviet nuclear weapon legacy require rethinking. This task was taken up by Marco De Andreis and Francesco Calogero. Their views and assessments provide not only an informed, sound and professional contribution to the debate on the future of nuclear weapon legacy on the territory of the former Soviet Union (FSU), but are also of practical value.

This SIPRI research report is addressed equally to researchers, negotiators and decision makers. Proper decisions can be taken only if the actual state of affairs is known and rational terms of reasoning are accepted. The difficulty in the preparation of this report stemmed from the fact that the subject of analysis has undergone and is still undergoing substantial changes.

As the findings in this report illustrate, some progress towards resolution of the difficult nuclear weapon legacy of the FSU has been achieved. High-level diplomatic bargaining efforts successfully resulted in the agreement by all parties concerned to consolidate *all* former Soviet nuclear weapons in Russia. With the accession of Ukraine to the Non-Proliferation Treaty in December 1994, the goal of having a single nuclear weapon state successor to the Soviet Union was achieved.

The denuclearization assistance provided by the USA and other countries to the FSU represents only a tiny fraction of their annual defence outlays. Although it is impracticable to attach a monetary value to the security obtained through these assistance programmes, the findings in this research report indicate that the security benefit received through these disbursements far exceeds the cost.

Reduction of nuclear weapons in Russia is part of a transformation process which embraces various dimensions: political, economic, military and ecological. The developments in Russia in recent years could not have been foreseen. Nor is the future certain. In this light, it is difficult to overestimate the importance of one of the key conclusions of this report: that a verified global inventory of nuclear warheads and weapon fissile material should be established as soon as possible.

On behalf of SIPRI, I thank the authors for their competent and comprehensive report and valuable conclusions.

Adam Daniel Rotfeld
Director of SIPRI
June 1995

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Marco De Andreis
Francesco Calogero
June 1995

Abbreviations and acronyms

ALCM	Air-launched cruise missile
ASAT	Anti-satellite
CANDU	Canadian deuterium–uranium (reactor)
CD	Conference on Disarmament
CIA	Central Intelligence Agency (USA)
CISAC	Committee on International Security and Arms Control (of the US Academy of Science)
CIS	Commonwealth of Independent States
COCOM	Coordinating Committee on Multilateral Export Controls
CSCE	Conference on Security and Co-operation in Europe
CTBT	Comprehensive test ban treaty
DOD	Department of Defense (USA)
DOE	Department of Energy (USA)
EAR	Estimated assured resources
ESD	Environmental sensing device
EU	European Union
FBI	Federal Bureau of Investigation (USA)
FSU	Former Soviet Union
G-7	Group of Seven industrialized nations (Canada, France, Germany, Italy, Japan, the UK and the USA)
HEU	Highly enriched uranium
IAEA	International Atomic Energy Agency
ICBM	Intercontinental ballistic missile
JCIC	Joint Compliance and Inspection Commission
KGB	(Soviet) Committee for State Security
LCC	Launch control centre
LEU	Low enriched uranium
MAPI	Ministry of Atomic Power and Industry (USSR)
Minatom	Ministry for Atomic Energy (Russia)
MOX	Mixed oxide
MTCR	Missile Technology Control Regime
NATO	North Atlantic Treaty Organization
NPT	Non-Proliferation Treaty
NSG	Nuclear Suppliers Group
PAL	Permissive action link
RAR	Reasonably assured resources

SSD	Safe and Secure Dismantlement (Talks)
SLBM	Submarine-launched ballistic missile
SLCM	Sea-launched cruise missile
SRAM	Short-range attack missile
SSBN	Nuclear-powered ballistic-missile submarine
START	Strategic Arms Reduction Treaty
UN	United Nations
USEC	United States Enrichment Corporation

1. Introduction*

Writing on the nuclear weapon complex of the former Soviet Union (FSU) is a classic case of trying to shoot at a moving target. An extraordinary amount of domestic and international activity is in fact focused on this complex, changing both its current features and its future prospects by the day. This report reviews this process of change. Its main ambition is to give the reader at least a sense of the moving target's trajectory, describing first its initial conditions and then its progress, or lack thereof, towards a state which will hopefully be more stable and more consonant with peace and international security.

Much is at stake in this transition. It represents the first time mankind has had to cope with the political breakdown of a nuclear weapon state. It is the first unambiguous reversal of the post-war nuclear arms race, and as such it is linked with the parallel downsizing of the US nuclear weapon complex. It coincides with a critical juncture in the history of the nuclear non-proliferation regime, and it can have a decisive influence on this regime's continuing viability. Many key questions are raised—such as how to dispose of excess weapon fissile material—which will also have a substantial impact on the commercial nuclear industry. Last but not least, this transition affects the well-being of the people of the FSU—beginning, of course, with those who formerly made their living from the FSU nuclear weapon complex.

Using open sources, this report assesses what is known of the *modus operandi* of the FSU nuclear weapon complex, how it has been affected by the dissolution of the Union and what it might look like in the coming years. The dynamics of this evolution are viewed through the prism of the central international concerns and hopes, that is, avoiding the proliferation of nuclear hardware and knowledge and promoting the conversion of the huge industrial nuclear weapon complex of the FSU to peaceful enterprises.

* The responsibility for this report rests exclusively with the authors in their personal capacity and the findings do not necessarily represent the views of any institution with which they have been or are associated, including the Pugwash Conferences on Science and World Affairs. An earlier and shorter version of this report was published as 'The conversion of the nuclear weapon complex of the former Soviet Union', eds D. Carlton, M. Elena, K. Gottstein, and P. Ingram, *Controlling the International Transfer of Weaponry and Related Technology* (Dartmouth: Aldershot, 1995).

Chapter 2 reviews the known data concerning the quantitative dimension of the FSU nuclear weapon stockpile and the steps taken to consolidate these weapons within Russia. Chapter 3 examines the technical and procedural arrangements established through the years to control the FSU nuclear arsenal. Chapter 4 discusses some of the issues concerning the disabling of nuclear warheads. Also addressed are the problems associated with transporting, storing and securing the warheads. Chapter 5 outlines the problem of 'brain drain' from the nuclear weapon complex. Chapter 6 discusses the sources of fissile and other nuclear-related material and some of the relevant measures to prevent their transfer. Chapter 7 reviews the key provisions of the major arms control measures and initiatives concerning nuclear weapons. Chapter 8 examines the major sources of assistance to the FSU as it attempts to denuclearize in accordance with its treaty obligations. Chapter 9 summarizes the key findings of the report. A glossary of selected nuclear technical terms and data relevant to nuclear weapon fabrication, dismantlement and disposal can be found in annexe A. Annexe B provides the text of selected treaties and other documents relevant to the analysis in this report. A breakdown of British, Chinese, French and US nuclear forces in 1994 is presented in annexe C.

2. Consolidating the nuclear arsenal

Before the breakup of the Soviet Union in 1991, the possibility that a major nuclear weapon power could disintegrate as a political entity was not a subject of serious speculation. It is now fair to say that such a consideration would have suggested, in Moscow as elsewhere, more prudence in terms of both the number of weapons produced and the geographic scope of their deployment. Other things being equal, the more numerous and dispersed nuclear weapons are, the more difficult keeping control of them becomes—and the same applies to their key components.

With respect to both the number and dispersion of nuclear weapons, the Soviet Union was of much greater concern than, for example, the United Kingdom. Indeed, when the process of Soviet disintegration became apparent in mid-1991, the exact number and location of the weapons were not publicly known. To a considerable extent, this uncertainty still exists.

I. Number and location of the nuclear weapons of the former Soviet Union

Despite official claims of full control of the nuclear arsenal,[1] the exact number of warheads that were produced and deployed in the FSU remains shrouded in secrecy and therefore a matter for estimation. The most reliable estimates, based on data from the US Central Intelligence Agency (CIA) and the Russian Ministry for Atomic Energy (Minatom), credit the FSU with some 32 000 nuclear warheads in mid-1993, of which 15 000 are active, or deployed, and 17 000 are in storage or awaiting disassembly and disposal.[2] War-

[1] For example, Gen. Sergei A. Zelentsov, chief engineer for the 12th Main Directorate of the Soviet Defence Ministry (the unit in charge of nuclear weapons), declared in Dec. 1991 that 'all Soviet warheads and their principal components are stamped with serial numbers, allowing Soviet army inspectors to register each warhead and follow it from production through dismantlement'. Quoted in Paine, C. and Cochran, T. B., 'Kiev conference: verified warhead controls', *Arms Control Today*, vol. 22, no. 1 (Jan./Feb. 1992), p. 16.

[2] 'Nuclear pursuits', *Bulletin of the Atomic Scientists*, vol. 49, no. 4 (May 1993), pp. 48–49; 'Estimated Russian (CIS) nuclear stockpile (July 1993)', *Bulletin of the Atomic Scientists*, vol. 49, no. 6 (July/Aug. 1993), p. 57; and Lockwood, D., 'Report on Soviet arsenal raises questions, eyebrows', *Arms Control Today*, vol. 23, no. 9 (Nov. 1993), p. 23. In Sep. 1994, however, the US DOD estimated that Russia had 'about 25 000 nuclear weapons'. No breakdown between active and reserve stockpiles was available. US DOD, 'Remarks

heads built between 1949 and 1992 total 55 000, the inventory peak year being 1986 when the Soviet active stockpile reportedly contained 45 000 warheads.[3]

In comparison, the in mid-1993 USA retained some 16 500 warheads, 6000 of which were awaiting disassembly. The total number of US warheads built between 1945 and 1992 has been estimated at 70 000, the inventory peak year being 1967 with 32 500 nuclear warheads in the US active stockpile.[4]

Table 2.1 offers a breakdown of the FSU active nuclear stockpile by location of deployment and type of weapon as of early 1991. (Withdrawals of some 2100 warheads for land forces and 900 for air forces, deployed by the FSU in Eastern Europe, were completed in mid-1989 from Hungary, in early 1990 from Poland, in May 1990 from Czechoslovakia and in August 1991 from the territory of the German Democratic Republic.[5])

Tactical nuclear weapons were apparently deployed in all 15 republics of the Soviet Union. In contrast, strategic nuclear weapons were concentrated in three republics (Belarus, Kazakhstan and Ukraine) besides Russia. The sheer dimension of these deployments was clearly a matter of concern: the number of strategic weapons on the territories of Ukraine and Kazakhstan would have made them the third- and fourth-ranked nuclear powers in the world, respectively, each with more nuclear warheads than China, France and the UK combined.[6]

prepared for delivery by Secretary of Defense William J. Perry to the Henry L. Stimson Center, 20 Sep. 1994', News Release, Office of the Assistant Secretary of Defense (Public Affairs), Washington, DC, 20 Sep. 1994.

[3] 'Nuclear pursuits' (note 2); and 'Estimated US and Soviet/Russian Nuclear Stockpiles, 1945–94', *Bulletin of the Atomic Scientists*, vol. 50, no. 6 (Nov./Dec. 1994), pp. 58–59.

[4] 'Nuclear pursuits' (note 2); and 'Estimated US and Soviet/Russian nuclear stockpiles, 1945–94' (note 3). A table outlining the nuclear forces of the USA is presented in annexe C in this volume.

[5] 'Where the weapons are', *Bulletin of the Atomic Scientists*, vol. 47, no. 9 (Nov. 1991), pp. 48–49.

[6] According to the Sep. 1990 Memorandum of Understanding annexed to START I, there were 7327 treaty-accountable strategic warheads in Russia, 1568 in Ukraine, 1360 in Kazakhstan and 54 in Belarus. As explained in chapter 7, however, the treaty's counting rules discount the actual number of nuclear warheads carried by bombers. An additional deployment of 27 single-warhead SS-25s occurred in Belarus after the signing of START I, which brought the total to 81, but between Dec. 1993 and Sep. 1994, 45 SS-25s were withdrawn to Russia, bringing the total down to 36. Similarly, 6 more Tu-160 Blackjack bombers were deployed in Ukraine in the second half of 1991. Tables outlining the nuclear forces of China, France and the UK are included in annexe C in this volume.

Table 2.1. Nuclear weapon deployments in the former Soviet Union, as of early 1991

Figures show the estimated numbers of warheads and may not add up to totals due to rounding. Figures in italics are percentages.

Former Soviet Republic	Strategic offensive	Tactical[a]	Total	Share
Russia	8 750	8 525	17 275	*65.6*
Ukraine	1 750	2 605	4 355	*16.1*
Kazakhstan	1 400	650	2 050	*7.6*
Belarus	100	1 120	1 220	*4.5*
Georgia	–	320	320	*1.0*
Azerbaijan	–	300	300	*1.0*
Armenia	–	200	200	< *1.0*
Turkmenistan	–	125	125	< *1.0*
Uzbekistan	–	105	105	< *1.0*
Moldova	–	90	90	< *1.0*
Kyrgyzstan	–	75	75	< *1.0*
Tajikistan	–	75	75	< *1.0*
Lithuania	–	325	325	*1.0*
Latvia	–	185	185	< *1.0*
Estonia	–	270	270	*1.0*
Total	**12 000**	**15 000**	**27 000**	**100**

[a] Warheads for ground forces, air defence forces, air force and navy.

Sources: 'Where the weapons are', *Bulletin of the Atomic Scientists,* vol. 47, no. 9 (Nov. 1991), pp. 48–49; and Norris, R. S., 'The Soviet nuclear archipelago', *Arms Control Today*, vol. 22, no. 1 (Jan./Feb. 1992), pp. 24–31.

The locations of active FSU strategic nuclear forces—intercontinental ballistic missile (ICBM) fields, strategic submarine ports and bomber bases—are listed in table 2.2. FSU nuclear systems and warheads deployed outside Russia as of autumn 1994 are presented in table 2.3. Nuclear weapon sites and other sites of proliferation concern in Belarus, Kazakhstan, Russia and Ukraine are shown in figures 2.1–2.4.

On the other hand, the various types of tactical nuclear weapon—those carried by delivery vehicles with less than 5500-km range—were scattered in almost every corner of the FSU. In all likelihood, however, they had been removed from Armenia and Azerbaijan

Table 2.2. Locations of active strategic forces in the FSU, as of late 1994

Location	Weapon	Location	Weapon
Belarus		*Russia*	
Lida	SS-25 (ICBM)	Vypolzovo	SS-17 (ICBM)
Mozyr'	SS-25 (ICBM)		SS-25 (ICBM)
		Yoshkar Ola	SS-13 (ICBM)
Kazakhstan[a]			SS-25 (ICBM)
Derzhavinsk	SS-18 (ICBM)	Yur'ya	SS-25 (ICBM)
Zhangiz-Tobe	SS-18 (ICBM)	Mozdok	Bear-G (bomber)
		Ukrainka	Bear-H (bomber)
Russia		Engels	Blackjack (bomber)
Aleysk	SS-18 (ICBM)	Nerpich'ya	Typhoon (submarine)
Bershet'	SS-24 (ICBM)	Yagel'naya	Delta/Yankee (submarine)
Dombarovskiy	SS-18 (ICBM)	Olen'ya	Delta (submarine)
Irkutsk	SS-25 (ICBM)	Ostrovnoy	Delta (submarine)
Kansk	SS-25 (ICBM)	Rybachiy	Delta (submarine)
Kartaly	SS-18 (ICBM)		Yankee (submarine)
Kostroma	SS-24 (ICBM)	Pavloskoye	Delta (submarine)
Kozel'sk	SS-19 (ICBM)		Yankee (submarine)
Krasnoyarsk	SS-24 (ICBM)		
Nizhniy Tagil	SS-25 (ICBM)	*Ukraine*[b]	
Novosibirsk	SS-25 (ICBM)	Khmel'nitski	SS-19 (ICBM)
Tatishchevo	SS-19 (ICBM)	Pervomaysk	SS-19 (ICBM)
	SS-24 (ICBM)		SS-24 (ICBM)
Teykovo	SS-25 (ICBM)	Uzin	Bear-A/B/H (bomber)
Uzhur	SS-18 (ICBM)	Priluki	Blackjack (bomber)

[a] Of the 104 SS-18s deployed at the two bases in Kazakhstan 44 have been deactivated.

[b] All of the 40 SS-19s and 46 SS-24s at Pervomaysk have been deactivated.

Sources: US Department of State, 'START, Treaty Between the USA and the USSR on the Reduction and Limitation of Strategic Offensive Arms', *Dispatch Supplement*, vol. 2, no. 5 (Oct. 1991); 'News brief', *Arms Control Today*, vol. 24, no. 9 (Nov. 1994), p. 33; and Arms Control Association, 'Strategic nuclear forces of the USA and the Commonwealth of Independent States', Fact Sheet, Nov. 1994.

well before the attempted coup in the Soviet Union in August 1991 because of ethnic strife in Nagorno-Karabakh.[7] Nuclear weapon withdrawals from Estonia, Latvia and Lithuania apparently occurred immediately thereafter, when these Baltic states gained their independence.

[7] Fitchett, J., 'Counting those warheads', *International Herald Tribune,* 28 Aug. 1991.

Table 2.3. Strategic nuclear weapons of the former Soviet Union outside Russia, as of late 1994

Country	Delivery vehicles	Designation	Number Weapons	Warheads[a]
Ukraine	ICBM	SS-19	130	(660)
	ICBM	SS-24	46	(280)
	Bomber	Bear-H6	7	42
	Bomber	Bear-H16	14	224
	Bomber	Blackjack	19	228
Total				**1 374**
Kazakhstan	ICBM	SS-18	92	920
Belarus	ICBM	SS-25	36	36
Total				**2 330**

[a] Brackets highlight inconsistencies in the expected ratio of delivery vehicles to warheads. Normally, SS-19s carry 6 warheads, and SS-24s carry 10 warheads. A total of 700 warheads were removed from 40 SS-19s and 46 SS-24s, but in both cases the missiles themselves are still in Ukraine awaiting dismantlement *in loco.* Transferred to Russia by the end of Sep. 1994 were 360 warheads: here it is assumed that they are shared equally between the ICBM systems. Ukraine has also 1 Bear-A bomber and 1 Bear-B bomber at Uzin Air Base, but it is highly doubtful that they are equipped to carry nuclear gravity bombs. As of June 1994 Kazakhstan had moved to Russia its entire fleet of 40 Bear-H strategic bombers, along with 370 AS-15 nuclear-tipped ALCMs, plus 12 SS-18s and the associated 120 warheads. By Sep. 1994, a total of 44 SS-18s were reported to have been deactivated, meaning that warheads, even though still kept in Kazakhstan, had been removed from a further batch of 32 SS-18s. Belarus has shipped to Russia a total of 45 single-warhead SS-25 ICBMs as of late 1994.

Sources: 'Testimony on the Cooperative Threat Reduction Program by Ashton B. Carter, Assistant Secretary of Defense for International Security Policy before the Senate Foreign Relations Committee', 4 Oct. 1994; 'News Brief', *Arms Control Today,* vol. 24, no. 9 (Nov. 1994), p. 33; and Arms Control Association, 'Strategic Nuclear Forces of the USA and the Commonwealth of Independent States', *Fact Sheet,* Nov. 1994.

II. The 1991 Bush and Gorbachev nuclear disarmament initiatives

The withdrawal of tactical nuclear weapons from Estonia, Latvia and Lithuania still left 10 Soviet republics with nuclear weapons on their territory, at the very moment when the process of breakup of the USSR had gained an unstoppable momentum. Such a situation could not be viewed but with profound concern in the West, and it is in that light that the disarmament initiative announced by US President George Bush on 27 September 1991 can best be interpreted.[8]

In addition to various measures concerning strategic weapons, President Bush announced that all US nuclear artillery projectiles and short-range missile warheads would be withdrawn and destroyed. He also stated that all naval tactical nuclear weapons, including sea-launched cruise missiles (SLCMs), would be withdrawn (some of them would also be destroyed). In addition, 900 B-57 nuclear depth bombs were to be removed from land bases worldwide, dismantled and destroyed. While presenting his initiative as a set of unilateral moves, Bush also called on Soviet President Mikhail S. Gorbachev to respond in kind.[9]

Gorbachev answered a few days later, on 5 October, by reciprocating every step taken by Bush, and adding the removal to 'central bases' of all nuclear warheads for surface-to-air missiles and an offer to store nuclear bombs and missiles away from frontline tactical aircraft.

Therefore, as early as October 1991, a framework was established to initiate the process of concentrating in a more manageable and smaller number of more secure locations all tactical nuclear warheads, that is to say, some 15 000 of the 27 000 Soviet active nuclear weapons at that time, as a preliminary step towards the eventual elimination of most of them.

The implementation of these initiatives, however, took a back seat to the political developments of December 1991, when the drama of the dissolution of the USSR unfolded. In a popular vote on 1 December, Ukraine opted overwhelmingly for independence. While recognizing the move as a *fait accompli*, the West quickly made clear

[8] The Bush initiative is reproduced in SIPRI, *SIPRI Yearbook 1992: World Armaments and Disarmament* (Oxford University Press: Oxford, 1992), pp. 85–87. An appeal to the leaders of the 5 nuclear weapon countries (China, France, the USSR, the UK and the USA) 'to begin the elimination of all tactical nuclear weapons and to take all necessary steps to ensure their safe control until destroyed', was privately conveyed on 23 Sep. 1991, by the Pugwash Council from Beijing where the 41st Annual Pugwash Conference was meeting. See 'Letter sent to the Leaders of the Five Nuclear Weapon Countries (USA, USSR, UK, France, China)', Memorandum attached to the letter by F. Calogero and J. Rotblat, 23 Sep. 1991, *Pugwash Newsletter*, Oct. 1991.

[9] The Gorbachev initiative is reproduced in SIPRI (note 8), pp. 87–88.

its stance as to the fate of Soviet nuclear weapons. According to a statement of the North Atlantic Treaty Organization (NATO) Secretary General, issued after a meeting of the Council on 3 December, NATO expected that Ukraine 'will commit itself to a non-nuclear policy and adhere to the nuclear Non-Proliferation Treaty (NPT) [and will commit itself] to abide by and implement all other arms control and disarmament agreements signed by the Soviet Union'.[10]

The following weeks saw the gradual formation of the new political entity intended to replace at least some functions of the Soviet Union: the Commonwealth of Independent States (CIS), first proclaimed by Belarus, Russia and Ukraine at a meeting in Minsk, Belarus, on 8 December and later joined by eight other republics (all those of the FSU, minus the Baltic states and Georgia) at the Almaty (Alma-Ata) summit meeting of 20–21 December 1991.[11]

Throughout these events, the West strove to make its influence felt through all the diplomatic means: in particular the US Secretary of State, James A. Baker, visited the four republics where strategic weapons were deployed—Belarus, Kazakhstan, Russia and Ukraine—from 15 to 20 December 1991.

All this activity was meant to make abundantly clear the key Western expectations in the nuclear field: namely, only one nuclear power was to emerge from the FSU, that is, Russia; credible guarantees had to be given as to the survival of a unified, central control of the FSU nuclear arsenal; all disarmament commitments undertaken by the FSU had to be carried out; and nuclear proliferation outside the borders of the FSU, in the form of both hardware and know-how, had to be prevented. The importance of the first of these points was underlined in January 1992, when Russia was given the FSU seat as a permanent member of the UN Security Council.

III. The withdrawal of tactical nuclear weapons to Russia

From its very beginning, the CIS made specific efforts to meet these Western concerns. At the Almaty meeting, for example, an Agreement on Joint Measures on Nuclear Weapons was signed,

[10] NATO Press Release (91)103, 3 Dec. 1991.
[11] SIPRI (note 8), pp. 558–59.

providing for the withdrawal of tactical nuclear weapons from Belarus, Kazakhstan and Ukraine into Russia for dismantlement by 1 July 1992.[12] Belarus and Ukraine (but not Kazakhstan) pledged the total elimination of nuclear weapons on their territories and to join the NPT as non-nuclear weapon states. At a further CIS summit meeting, held in Minsk on 30 December 1991, Ukraine went as far as committing itself to be nuclear weapon-free by the end of 1994.

Thus, at the beginning of 1992 it appeared clear that tactical nuclear weapons deployed anywhere in the FSU were to be immediately withdrawn for storage and eventual destruction on Russian territory, and a specific deadline (1 July 1992) had been set for the accomplishment of this process.

Strategic weapons outside Russia, on the other hand, were to remain deployed at their respective sites—pending the implementation of the Strategic Arms Reduction Treaty (START) and other additional measures,[13] even though their eventual elimination was already agreed upon in principle. Over the following months, the commitment regarding tactical nuclear weapons was adhered to, albeit with some second thoughts and several attempts at political bickering. The most alarming instance of backtracking occurred in March 1992, when Ukraine suspended the transfer to Russia of tactical nuclear weapons because of an alleged lack of assurances and involvement as to their safe storage and eventual dismantlement.[14] At that time, tactical nuclear weapons had been removed from all the republics except Ukraine, where the withdrawal was halfway through and expected to be completed by the 1 July deadline.[15]

In mid-April, however, Ukraine bowed to strong international pressure, in particular from US Secretary of State James Baker, and decided to resume the shipment of tactical nuclear weapons to Russia.[16] By early May, the transfer was completed, almost two months ahead of schedule.[17] The important goal of concentrating all

[12] The text of this agreement is reproduced in SIPRI (note 8), p. 562.

[13] Some of these measures were taken; some remained under discussion. For more on this aspect, see the section IV in this chapter and chapter 7 in this volume.

[14] 'Ukraine halts nuclear transfers to Russia', *International Herald Tribune,* 13 Mar. 1992.

[15] This information was provided by high-level CIS officials during a Pugwash Workshop on 'The Future of the Soviet Nuclear-Weapon Complex', held in Moscow on 6–7 Mar. 1992.

[16] 'Ukraine declares transfer of atom arms is to resume', *International Herald Tribune,* 15 Apr. 1992.

[17] Shapiro, M., 'Last tactical nuclear arms pulled out of Ukraine', *International Herald Tribune,* 7 May 1992.

the tactical nuclear armory of the FSU on Russian territory was thus achieved. Since then, unfortunately, little progress has been made on another front: consolidating the weapons within Russia itself. While the US nuclear arsenal is now distributed among a dozen of sites, 'Russia's strategic and non-strategic forces are scattered over more than 100 sites'.[18] Russian nuclear weapons are still widely distributed organizationally, since 'each of the Russian armed services continues to retain a nuclear role'.[19] Taking into account that instances of internal turmoil and civil strife abound in Russia, there are clearly grounds for concern.

These risks were vividly illustrated in mid-December 1994, when war broke out in Chechnya—an autonomous republic of the Russian Federation which declared its independence in 1991—between the local, separatist armed forces and several divisions of the Russian Army sent by Moscow to quell the secession. The headquarters for the Russian Army's operations was located in the nearby North Ossetian town of Mozdok, also the site of one base for Russian nuclear strategic bombers.[20]

IV. FSU strategic nuclear weapons outside Russia: the Lisbon Protocol and its implementation

As for strategic weapons, a series of intense bilateral talks between the USA on the one hand and the four republics on the other produced an understanding centred on the 1991 START I Treaty.[21] The heads of state of Belarus, Kazakhstan and Ukraine sent letters to the US Government whereby they pledged to remove nuclear weapons from their territories within seven years after START I's entry into force. Then, at a 23 May 1992 meeting in Lisbon, Portugal, a protocol to the Treaty was signed by the USA and the four ex-Soviet republics with nuclear weapons on their territories. The so-called Lisbon Protocol made all five countries party to START I and committed Belarus,

[18] US DOD (note 2).
[19] US DOD (note 2).
[20] Erlanger S., 'Russian force renews drive on capital in Chechnya', *International Herald Tribune*, 19 Dec. 1994. By a strange coincidence, the leader of the breakaway Chechen republic, Dzhokar M. Dudayev, is a former air force general who commanded 'a division of Soviet Strategic bombers based near Tartu, Estonia, from 1987 to 1990'. See Erlanger S., 'A general at 36, a rebel at 50', *International Herald Tribune*, 16 Dec. 1994.
[21] See also chapter 7, section I.

Kazakhstan and Ukraine to accede to the NPT as non-nuclear weapon states 'in the shortest possible time'.[22]

To enter into force, START I required ratification by all five parties. Moreover, the Russian Parliament's resolution of ratification of 4 November 1992 made it clear that Moscow would not exchange the instruments of ratification until after Belarus, Kazakhstan and Ukraine had acceded to the NPT as non-nuclear weapon states. For its part, the US Senate ratified START I on 1 October 1992, stipulating that the Lisbon Protocol and the letters of the three heads of state carried the same legal obligations as START I itself. As a result of Ukraine's delay in acceding to the NPT, therefore, START I did not enter into force until December 1994, two and a half years after the signing of the Lisbon Protocol.

After a promising start—the five parties signed an agreement in Geneva, on 23 October 1992, on the procedures governing the operation of a body established by the Treaty, the Joint Compliance and Inspection Commission (JCIC)[23]—the road to implementation of the accord's commitments became extremely bumpy. Second thoughts of a political, economic and security nature quickly characterized the attitude of Belarus, Kazakhstan and Ukraine, although to differing degrees.

Belarus

Belarus ratified START I on 4 February 1993 and deposited its instruments of accession to the NPT as a non-nuclear weapon state on 22 July 1993. As of December 1994, it had transferred to Russia 45 road-mobile, single-warhead SS-25s; 36 SS-25s remained on its territory. The government in Minsk has pledged to complete the transfer by the end of 1995.[24] These systems will eventually be incorporated into the Russian strategic nuclear forces. As of mid-1994, no agreement had been reached with Russia on financial compensation for the highly enriched uranium (HEU) contained in the

[22] 'US, four Commonwealth states sign START Protocol in Lisbon', *Arms Control Today,* vol. 22, no. 5 (June 1992), pp. 18, 25.

[23] 'Five parties to START agree on procedures for JCIC', United States Information Service, US Embassy, Rome, 13 Nov. 1992.

[24] Lockwood, D., 'Nuclear weapon developments', SIPRI, *SIPRI Yearbook 1994* (Oxford University Press: Oxford, 1994), p. 291.

Figure 2.1. Sites of proliferation concern in Belarus

Source: Adapted from US Congress, Office of Technology Assessment, *Proliferation and the Former Soviet Union*, OTA-ISS-605 (US Government Printing Office: Washington, DC, Sep. 1994).

nuclear warheads deployed in Belarus.[25] Minsk is asking for $50 million.[26]

The limited number of the nuclear systems involved and their mobility help explain why Belarus' de-nuclearization process has started earlier and has proceeded more smoothly than has been the case with Kazakhstan and Ukraine. However, there are also political factors, the key one being that a significant majority of the parliament and the executive are believed to favour closer ties with Moscow, or even their country joining the Russian Federation. However this attitude may be perceived in the West, there is little doubt that it facilitates the transfer of strategic nuclear weapons to Russia.

[25] See chapter 5, section VII.
[26] Lockwood, D., 'Nuclear arms control', SIPRI (note 24), p. 669.

Recent events have strengthened the pro-Russian trend. In December 1993, Minsk signed the CIS Charter's collective security pact: a move put off for almost a year by the opposition of then Chairman of the Supreme Council Stanislav Shushkevich and widely seen as a *de facto* subordination of the Belarussian armed forces to the Russian high command. At the end of January 1994, Shushkevich, the key government figure in Belarus with a clearly independent, neutralist stance, was toppled by a vote of no confidence of the parliament. Presidential elections held on 10 July brought to power Alexander Lukashenko, a politician described by one Western source has having a populist orientation similar to that of the Russian nationalist, Vladimir Zhirinovsky.[27] Reportedly, 'the question now is not so much whether Belarus, overwhelmingly Russian-speaking, will formally return to the Russian fold, but how and when'.[28]

Kazakhstan

Kazakhstan ratified START I on 2 July 1992 and deposited its instruments of accession to the NPT as a non-nuclear weapon state on 14 February 1994.[29] When the Soviet Union broke up, 104 SS-18s (1040 warheads) and 40 Bear-H strategic bombers (with an estimated 370 warheads) were deployed in Kazakhstan. An agreement reached in Moscow on 28 March 1994 between Russian President Boris Yeltsin and his Kazakh counterpart, Nursultan Nazarbayev, reportedly calls for the withdrawal of all warheads to Russia by mid-1995 and the dismantlement of all SS-18 silos and missiles by mid-1997.[30] As of December 1994, 12 SS-18s with their 120 nuclear warheads had been sent to Russia for dismantlement; all the Bear-H aircraft, with their estimated 370 nuclear-tipped AS-15 ALCMs, had also been transferred to Russia to be incorporated in the Russian strategic forces. An additional 32 SS-18s had been deactivated by removing their warheads prior to their shipment to Russia. No agreement has been reached between Almaty and Moscow on fissile material

[27] 'Going bearish', *The Economist,* 16 July 1994, pp. 24–25.

[28] Note 27.

[29] President Nazarbaev was immediately rewarded by US President Bill Clinton's decision to double the $85 million of safe and secure nuclear dismantlement aid pledged by Washington to that date. See Sullivan, A. M., 'Clinton sees long-term partnership with Kazakhstan', United States Information Service, US Embassy, Rome, 14 Feb. 1994.

[30] Radio Free Europe report of 4 May, quoted in 'News brief', *Arms Control Today,* vol. 24, no. 5 (June 1994), p. 31.

Figure 2.2. Sites of proliferation concern in Kazakhstan

Source: Adapted from US Congress, Office of Technology Assessment, *Proliferation and the Former Soviet Union*, OTA-ISS-605 (US Government Printing Office: Washington, DC, Sep. 1994).

compensation similar to that reached by Ukraine.[31] Almaty is asking for $1 billion.[32]

Although keen on maintaining its independence, Kazakhstan has also managed to keep good security relations with Russia—at least to date.[33] An original signatory of the January 1993 CIS Charter, including its collective security pact, the government in Almaty shares Moscow's concerns with threats from the South (Muslim fundamentalism) and from the East (China). Despite the Chinese nuclear arsenal, however, Kazakhstan decided not to incur the political and economic costs of clinging to the nuclear weapons deployed on its territory.[34] Finally, the need to attract foreign investments, especially US investment in the oil industry, has also contributed to Kazakhstan making good on its non-nuclear pledges.

[31] See chapter 4, section VI.

[32] Lockwood (note 26), pp. 669–70.

[33] A note of caution is in order. Some 36% of the population of Kazakhstan are ethnic Russians and their relations with Kazakhs (43% of the population) are reportedly worsening. See 'Russian rumblings', *The Economist*, 12 Mar. 1994.

[34] 'Yet there is evidence that Kazakhstan's leadership and military command may keep all missile maintenance personnel [from Russia] under [rather close] control'. See Arbatov, A. (ed.), *Implications of the START II Treaty for US–Russian Relations*, Report no. 9 (The Henry L. Stimson Center: Washington, DC), Oct. 1993.

Ukraine

Ukrainian nuclear policy has taken many twists and turns since Ukraine's early pledges, taken in December 1991 at the Almaty and Minsk CIS summit meetings, respectively, to join the NPT as a non-nuclear weapon state and to become nuclear weapon-free by the end of 1994.[35] Also note that the Declaration of State Sovereignty of 16 July 1990 by the Rada (the Ukrainian Parliament) had affirmed the principles of non-alignment, non-membership in military blocs *and* non-nuclear weapon status.

In fact, Ukraine finally ratified START I on 18 November 1993 but attached 13 conditions to its ratification resolution.[36] One of these repudiated the Lisbon Protocol pledge on prompt accession to the NPT as a non-nuclear weapon state. Another condition limited the elimination of launchers and warheads deployed on Ukrainian territory to 36 and 42 per cent, respectively.[37] Finally, the Rada asked the nuclear powers for security guarantees, economic assistance and compensation for fissile material removed from strategic and tactical systems deployed on its soil.

The latter group of conditions was apparently met by a Trilateral Statement issued jointly in Moscow by the Presidents of Ukraine, Russia and the USA on 14 January 1994.[38] This paved the way for approval in the Rada on 3 February 1994 (by a vote of 260 to 3) of a resolution directing the executive to exchange the START I instruments of ratification and reaffirming Ukraine's obligation under the Lisbon Protocol to join the NPT.[39]

According to the terms of the Trilateral Statement Kiev was granted compensation (estimated to be worth $1 billion) for the HEU of the strategic warheads deployed on its territory, most of it in the form of nuclear reactor fuel from Russia.[40] An annex to it stipulated that within 10 months at least 200 nuclear warheads from SS-19s and

[35] SIPRI (note 8), appendix 14A, pp. 558–61.

[36] The resolution is reproduced in SIPRI (note 24), appendix 16A, pp. 675–77.

[37] SIPRI (note 8); note 35; and 'The Ukrainian Parliament's resolution on START-I ratification', *Radio Free Europe/Radio Liberty Research Report*, vol. 3, no. 4 (28 Jan. 1994), p. 9.

[38] See annexe B in this volume.

[39] 'Ukraine deputies agree to remove START conditions', *International Herald Tribune*, 4 Feb. 1994.

[40] In addition, Russia has reportedly agreed to write off some of Ukraine's energy debt as a compensation for the 2000–3000 tactical nuclear warheads previously withdrawn from Ukraine to Russia. See Lockwood, D., 'Nuclear arms control', SIPRI (note 24), p. 642. Note

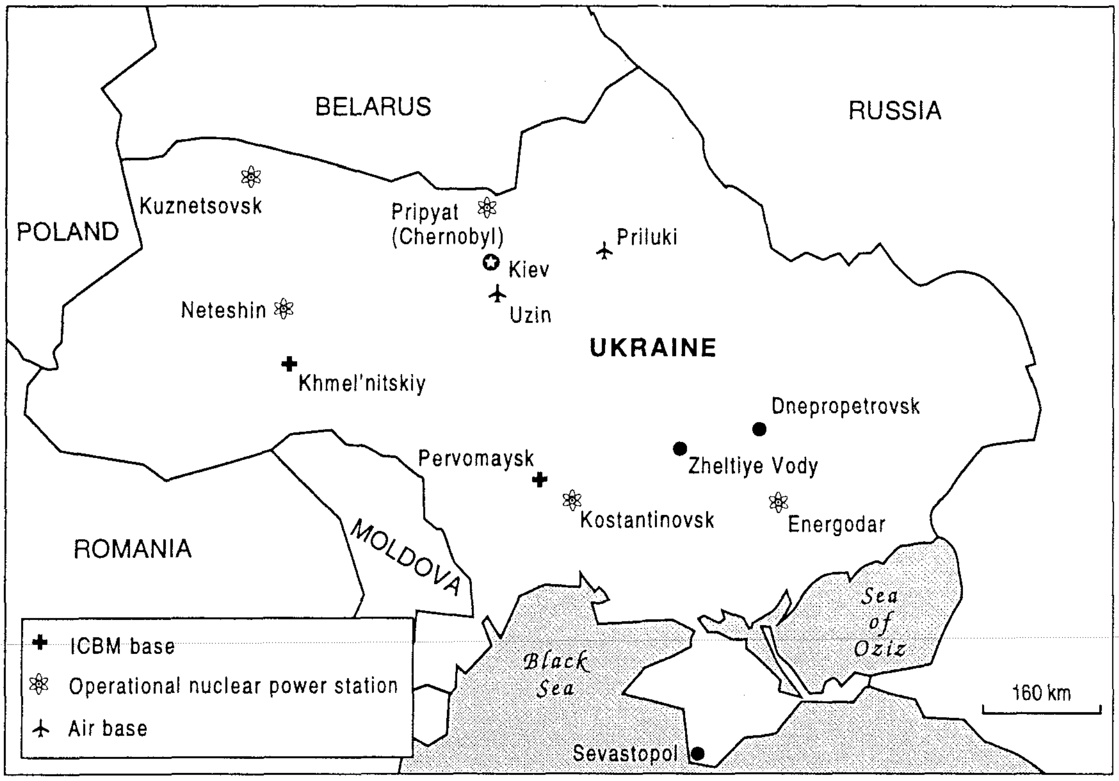

Figure 2.3. Sites of proliferation concern in Ukraine

Source: Adapted from US Congress, Office of Technology Assessment, *Proliferation and the Former Soviet Union*, OTA-ISS-605 (US Government Printing Office: Washington, DC, Sep. 1994).

SS-24s would have to be transferred to Russia for dismantlement under Ukrainian monitoring and all SS-24s on Ukraine's territory have to be deactivated by having their warheads removed. These obligations were met by Ukraine in both a timely and thorough fashion: as of November 1994, 40 SS-19s (with a total of 240 warheads) had been deactivated by removing the missiles from their silos, and 460 warheads on the 46 SS-24s deployed on Ukrainian territory had been removed.[41] According to a US Government source, 360 warheads have been shipped from Ukraine to Russia in four successive trainloads.[42] Since Ukraine insisted on getting its compensation at the same pace as it withdraws warheads to Russia, Moscow has provided Kiev with 100 tonnes of reactor fuel; for this

that the other successor states to the FSU are thus entitled, at least in principle, to receive compensation from Moscow, since all had tactical nuclear weapons deployed on their territories.

[41] Federal News Service (USA), White House Press Briefing, 5 Dec., 1994.

[42] 'Testimony on the Cooperative Threat Reduction Program by Ashton B. Carter, Assistant Secretary of Defense for International Security Policy before the Senate Foreign Relations Committee', 4 Oct., 1994.

fuel Washington has given Moscow $60 million of advance payment under the HEU deal.[43] The stipulations contained in the annex to the Trilateral Statement have thus been satisfied ahead of schedule.

The deadline for complete elimination of strategic nuclear weapons deployed in Ukraine is officially set at the end of the seven-year period of START I implementation, although according to Spurgeon M. Keeny, Jr, President and Executive Director of the Washington-based Arms Control Association, there might be 'a secret agreement between Ukraine and Russia, which reportedly will move all remaining warheads to Russia within less than three years'.[44] Meanwhile, the Ukrainian Ministry of Defence has administrative control over the personnel assigned to strategic weapons on its soil: the troops operating strategic arms were incorporated into the Ukrainian Armed Forces in April 1993; they are paid by, and (many but not all) have sworn allegiance to, Kiev.[45] Operational control, however, remains in Moscow.[46] Russia has lamented that its missile maintenance personnel is often treated in an uncooperative manner by Ukraine's authorities.

Ukraine deposited its instruments of accession to the NPT on 5 December 1994, in Budapest during the CSCE summit meeting. The three depositaries of the treaty—the UK, the USA and Russia—signed an agreement with Ukraine which substantially reiterated the security assurances contained in the January 1994 Trilateral Statement.[47] By a vote of 301 to 8, the Rada had ratified the NPT on 16 November, attaching two declarations—one claiming ownership on the FSU warheads deployed on its territory, and the other making adherence to the NPT conditional to official, written receipt of those

[43] See chapter 4, section VI.

[44] 'Prospects for Ukrainian denuclearization after the Moscow Trilateral Statement', *Arms Control Today,* vol. 24, no. 2 (Mar. 1994), pp. 21–26. On the eve of the signing of the Trilateral Statement, press reports did in fact mention the 3-year time span. See, for example, Smith, R. J., 'Ukraine near to accepting final deal on nuclear arms', *International Herald Tribune*, 10 Jan. 1994. In May 1994, the then Ukrainian Defence Minister, Vitaliy Radetsky, declared that the transfer would take from three to four years at the present rate (60 warheads a month). See 'News briefs', *Arms Control Today,* vol. 24, no. 6 (July/Aug. 1994), p. 26.

[45] 'On 21 January [1994] the commander of the Forty-Third Missile Army, which controls the nuclear missiles based in Ukraine, swore allegiance to Ukraine, as did the commander of the missile division based at Pervomaisk.' Lepingwell, J. W. R., 'Ukrainian Parliament removes START-1 conditions', *RFE/RL Research Report*, vol. 3, no. 8 (25 Feb. 1994), pp. 37–42. Reportedly, two-thirds of the military personnel involved with nuclear weapons in Ukraine have done the same.

[46] Operational control can be essentially understood as synonymous with positive control. See chapter 3 of this study, in particular section II.

[47] See annexe B in this volume; and Clark B., 'Ukraine signs up to treaty on nuclear non-proliferation', *Financial Times,* 6 Dec. 1994, p. 4.

security assurances subsequently granted to Ukraine in Budapest.[48] The Rada had previously supported postponing accession to the NPT until after the 1995 Review and Extension Conference, during which time Kiev would have sought some form of 'transitional status' for Ukraine, as a 'temporary nuclear power'. Ukraine's final decision to confirm an unambiguous non-nuclear weapon status has thus marked a watershed of great political significance: the goal of formally having just one nuclear weapon successor state to the USSR has been achieved. The entry into force of START I, made possible by Ukraine's accession to the NPT, paves the way to the ratification of the 1993 START II Treaty and the implementation of its sweeping disarmament measures.

The long delay in Kiev concerning accession to the NPT had given rise to all sort of speculation about Ukraine's real intentions. Ukraine's security perceptions *vis-à-vis* Russia differ markedly from those of Belarus and Kazakhstan. Indeed, among ethnic Ukrainians (which represent three-quarters of the population) the perception that Russia is bent on either putting into question Ukraine's independence or on threatening Ukrainian territorial integrity is widespread. The disputed (by Russians) status of Crimea as part of Ukraine is a case in point.[49] The unsettled question of how finally to apportion the former Soviet Black Sea Fleet between Russia and Ukraine is another. Then there is the geographical concentration in the eastern part of Ukraine of a sizeable Russian minority (representing more than 20 per cent of the population).[50] Finally, Ukraine's heavy dependence on supplies of oil and nuclear fuel from Russia has also given rise to fears of economic blackmail. Hence the request in the Rada resolutions concerning the ratification of both START I and the NPT ratifications not only for security guarantees in the conventional and nuclear fields, but also for economic guarantees.[51]

[48] Rupert J., 'Ukraine joins treaty curbing nuclear arms', *Washington Post*, 17 Nov. 1994.

[49] In a referendum held on 10 Mar. 1994, some 70% of the predominantly Russian local population supported broader autonomy from Kiev. In Jan. voters had also elected as President Yuri Meshkov, whose campaign platform was basically pro-secessionist.

[50] Both in legislative elections held in Apr. 1994, and in the presidential elections in July, Ukrainian nationalist candidates were defeated by pro-Russian, communist candidates. The latter have their stronghold in the more populous Eastern Ukraine, the former in the Western part of the country. This split along semi-coherent geographic, ethnic and political lines might call into question Ukraine's integrity.

[51] Both the text of the 14 Jan. 1994 US–Russian–Ukrainian Trilateral Statement and [Budapest Declaration Decisions] on 5 Dec. 1994 do not include any particular security guarantees beyond those granted by the NPT to non-nuclear weapon states and those

A worst-case reading of Ukraine's reluctance to join the NPT—despite having accepted ridding itself of the nuclear weapons still on its territory—pointed to some basic facts. Within the FSU, Ukraine is second only to Russia in terms of fissile material (as long as Kiev remained outside of the NPT its reactors were unsafeguarded),[52] know-how and infrastructure[53]—that is to say, the basic elements Ukraine would need in order to build and to control,[54] the nuclear weapons it might deem appropriate to deter Russia: short- to medium-range systems, capable of striking the European part of Russia, where most of the major cities and industrial plants are located.

In fact, the presence of strategic nuclear missiles on its territory posed several dilemmas to a Ukraine hypothetically bent on keeping them to deter Russia. The SS-24s do not have the ability to strike targets at relatively short distances (that is, below about 2000 km); the variable-range SS-19s are able, but Ukraine cannot properly maintain them. Maintenance of SS-24s is made easier by the fact that these missiles use solid fuel. Moreover, they were built in Ukraine. Conversely, the SS-19s were built in Russia and use a highly toxic and volatile liquid fuel.[55] To complicate matters further, targeting programs and blocking devices for the SS-24 are Russian-made; those for the SS-19 are largely Ukrainian-made.[56] The retargeting of ICBMs

contained in the Conference on Security and Co-operation in Europe (CSCE) Final Act. However, the existence of secret or informal understandings cannot be excluded. See Lepingwell, J. W. R., 'Negotiations over nuclear weapons: the past as prologue?', *RFE/RL Research Report*, vol. 3, no. 4 (28 Jan. 1994), pp. 1–11; Lepingwell, J. W. R., 'The Trilateral Agreement on nuclear weapons', *RFE/RL Research Report*, vol. 3, no. 4 (28 Jan. 1994), pp. 12–20; and Clark (note 47).

52 'Apart from fissile material that is still in nuclear warheads, the largest stock of unsafeguarded nuclear material in the CIS outside of Russia is in Ukraine's 15 nuclear power reactors, two research reactors, and large store of highly enriched uranium'. See Fisher, D., 'Nuclear energy and nuclear safeguards in the CIS and East-Central Europe: the case for "Eurasiatom"', *The Nonproliferation Review*, vol. 1, no. 3 (spring–summer 1994), pp. 54–60. However, shortly before acceding to the NPT, Ukraine signed an agreement on 'close-to-full-scope safeguards' with the IAEA.

53 See chapter 6, section II.

54 See chapter 3, section V.

55 Kincade W. H., 'Nuclear weapons in Ukraine: hollow threat, wasting asset', *Arms Control Today*, vol. 23, no. 7 (July/Aug. 1993), pp. 13–18.

56 From this messy situation, a Russian observer saw the possibility that the Ukrainians—while making the cosmestic gesture of sending back to Russia 200-plus strategic warheads as envisaged in the Trilateral Statement—might aim for: keeping as many SS-19 warheads as possible; tampering with the SS-24 warheads (as many as 220) removed from the missiles but not yet shipped to Russia. After having overcome their blocking devices and equipped them with new targeting information, these would be put on top of new missiles built in Ukraine. However, this seemed to be a rather complicated scheme to be put into practice, as well as a weak case for arguing that Kiev was seeking positive control of nuclear weapons. See

is probably impossible without geodetic data from satellites which are not available to Kiev.

Cruise missiles for strategic bombers stored in Ukraine have long been 'disabled in place'.[57] Reportedly, 'Unlike ICBMs, targeting and launching codes released from [national command authorities] are not necessary to launch these weapons. Their blocking devices are certainly less sophisticated than those of ICBMs'.[58] As with ICBMs, however, retargeting them would be impossible for Ukraine, which does not have access to data from geodetic satellites; the same goes for computer maintenance. So, even a suspicious reader of Ukrainian intentions would be left with the hypothesis that cruise and ballistic missile warheads might be eventually used as gravity bombs,[59] a rather convoluted route to exercising the nuclear weapon option for a country that has most of what is needed to build nuclear gravity bombs *ex novo*.[60]

These concerns turned out to be misplaced even though, for the security reasons outlined above, a majority of the Ukrainian body politic in 1992–93 had undoubtedly come to look with favour upon a temporary or permanent retention of the nuclear weapon assets on Ukrainian territory. An eventual turnaround of this pro-nuclear weapon attitude was achieved partly through a substantial change in the Western approach to the problem, particularly on the part of the USA. In the second half of 1993, it became clear to Ukraine's diplomatic counterparts that making the fulfilment of Ukraine's

Pikayev, A. A., 'Post-Soviet Russia and Ukraine: who can push the button?', *Nonproliferation Review*, vol. 1, no. 3 (spring–summer 1994), pp. 31–46.

[57] Blair B., *The Logic of Accidental Nuclear War* (Brookings Institution: Washington, DC, 1993), p. 63. The term 'disabled in place' means that target and guidance information has been removed from the weapon in question.

[58] Pikayev (note 56), p. 43.

[59] Pikayev (note 56).

[60] The risk of Belarus, Kazakhstan or Ukraine gaining custody of nuclear weapons deployed on their territories, or those stemming from a leakage of weapon or weapon-related material, are universally appreciated. Much less attention has been paid to the likelihood that a Soviet successor state could develop an indigenous nuclear weapon programme, as noted by Steven Miller. See Miller, S. E., 'The Former Soviet Union', eds M. Reiss and R. Litwak, *Nuclear Proliferation After the Cold War* (Woodrow Wilson Center Press: Washington DC, 1994), pp. 89–128. This report accepts that the acquisition of a nuclear capability on the part of any non-Russian Soviet successor state is not in anyone's best interest. Still there are authors who have a different opinion and argue for nuclear proliferation in the FSU. See, for example, Mearsheimer J. J., 'The case for a Ukrainian nuclear deterrent', *Foreign Affairs,* vol. 72, no. 3 (summer 1993), pp. 50–66. For counter-arguments, see Miller S. E., 'The case against a Ukrainian nuclear deterrent', *Foreign Affairs,* vol. 72, no. 3 (summer 1993), pp. 67–80.

nuclear disarmament pledges a precondition for the provision of aid was a non-starter. On the contrary, it was realized that allowing aid to begin to flow might function as an inducement to Ukraine to make good on its promises. Hence, in October 1993, the first Nunn–Lugar umbrella agreements with the USA were signed, well in advance of ratification of both START I and the NPT.[61]

Offers of economic assistance to Ukraine multiplied after the signing of the 1994 Trilateral Statement: for example, in March US President Bill Clinton doubled to $350 million each the level of US assistance to Ukraine for economic reform and nuclear weapon disarmament.[62] At a summit meeting in early July in Naples, the Group of Seven (G-7) industrialized nations granted Ukraine $4 billion in assistance for economic reform. These decisions were widely seen at the time as concrete rewards to President Leonid Kravchuk who was facing a tough bid for re-election in the July presidential elections. Thus, when Kravchuk was defeated by his rival and former Prime Minister, Leonid Kuchma, Western observers were generally pessimistic about Kuchma's ability to persuade a communist-dominated Rada to support accession to the NPT and a programme of market-oriented economic reforms.[63] However, this pessimism was rapidly proven wrong on both counts.

V. The Russian nuclear arsenal

Table 2.4 shows the status of the Russian strategic nuclear arsenal as of December 1994. The unilateral disarmament initiatives announced first by Mikhail Gorbachev and then by Boris Yeltsin in 1991–92 have been largely implemented.[64]

As for the future, the implementation of START I and II will imply further and larger reductions. Among ICBMs, the first systems in line for withdrawal are the SS-13s and SS-17s; among submarine-launched ballistic missiles (SLBMs), the SS-N-6s onboard one Yankee-I nuclear-powered ballistic missile submarine (SSBN) and the SS-N-8s onboard 12 Delta-I and 4 Delta-II SSBNs.

[61] See chapter VIII, section 1.

[62] Greenhouse S., 'US to double aid to Ukraine as reward for nuclear accord', *International Herald Tribune*, 5–6 Mar. 1994.

[63] For example, see 'Going bearish' (note 27).

[64] For more on these initiatives, see section II of this chapter and annexe B in this volume.

Table 2.4. Russian operational strategic nuclear forces, as of late 1994

Type of weapon	System	Number	Warheads
ICBMs	SS-13	30	30
	SS-17	25	100
	SS-18	188	1 880
	SS-19	170	1 020
	SS-24	46	460
	SS-25	297	297
Total		*756*	*3 787*
SLBMs	SS-N-6	16	16
	SS-N-8	208	208
	SS-N-18	224	672
	SS-N-20	120	1 200
	SS-N-23	112	448
Total		*680*	*2 544*
Bombers	Bear-G	36	72
	Bear-H16(ALCM)	36	576
	Bear-H6 (ALCM)	27	162
	Blackjack(ALCM)	5	60
Total		*104*	*870*
Total		**1 540**	**7 201**

Note: the figures above include 45 SS-25s transferred from Belarus and 40 Bear-Hs transferred from Kazakhstan.

Sources: 'News brief', *Arms Control Today*, vol. 24, no. 9 (Nov. 1994), p. 33; and Arms Control Association, 'Strategic nuclear forces of the USA and the Commonwealth of Independent States', Fact Sheet, Nov. 1994.

Russia is also left with very little in terms of modernization programmes. The SS-25 is the only ICBM currently under production, the development of a small mobile ICBM similar to the US Midgetman having been abandoned. The development of a single-warhead mobile ICBM based on the SS-25 is still under way. Plans are eventually to deploy at least 200 of these missiles in silos and 300 on mobile launchers. An SS-N-20 follow-on SLBM, to equip the Typhoon Class strategic submarines, is being developed for deployment towards the end of the 1990s. Construction of new SSBNs is

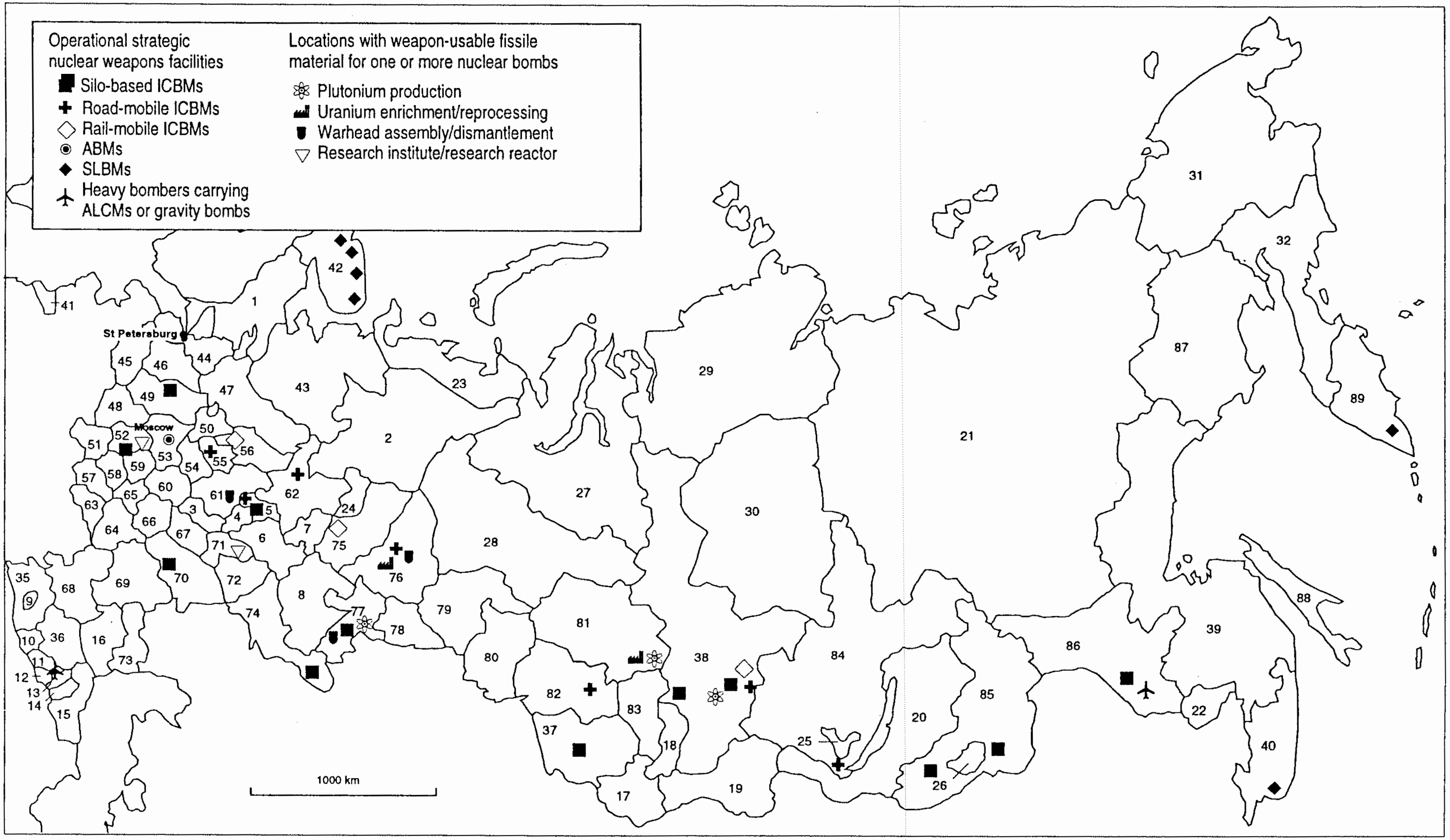

Figure 2.4. Sites of proliferation concern in Russia

Figure 2.4. Sites of proliferation concern in Russia

Entries below refer to territorial sub-divisions of the Russian Federation.

1. Karelia
2. Komi
3. Mordovia
4. Chuvashia
5. Mariy El
6. Tatarstan
7. Udmurtia
8. Bashkortostan
9. Adygueya
10. Karachaevo-Cherkessia
11. Kabardino-Balkaria
12. Northern Ossetia
13. Ingushetia[a]
14. Chechnia[b]
15. Dagestan
16. Kalmykia
17. Gorniy Altay[c]
18. Khakassia[c]
19. Tuva
20. Buryatia
21. Yakut-Sakha
22. Yevreysk
23. Nenets
24. Komi-Permyak
25. Ust-Ordyn Buryat[c]
26. Aguin Buryat[c]
27. Yamalo-Nenets
28. Khanty-Mansi
29. Taymyr
30. Evenki
31. Chukotka
32. Koryaki
33. Moscow
34. St Petersburg
35. Krasnodar
36. Stavropol
37. Altay (Barnaul)
38. Krasnoyarsk
39. Khabarovsk
40. Primorskiy (Vladivostok)
41. Kaliningrad
42. Murmansk
43. Archangelsk
44. Leningrad (St Petersburg) (region)
45. Pskov
46. Novgorod
47. Vologda
48. Smolensk
49. Kalinin
50. Yaroslavl
51. Bryansk
52. Kaluga
53. Moscow (region)
54. Vladimir
55. Ivanovo
56. Kostroma
57. Kursk
58. Orel
59. Tula
60. Ryazan
61. Nizhniy Novgorod
62. Kirov
63. Belgorod
64. Voronezh
65. Lipetsk
66. Tambov
67. Penza
68. Rostov
69. Volgograd
70. Saratov
71. Ulyanovsk
72. Samara
73. Astrakhan
74. Orenburg
75. Perm
76. Sverdlovsk (Yekaterinburg)
77. Chelyabinsk
78. Kurgan
79. Tyumen
80. Omsk
81. Tomsk
82. Novosibirsk
83. Kemerovo
84. Irkutsk
85. Chita
86. Amur (Blagoveshchensk)
87. Magadan
88. Kamchatka (Petropavlovsk)
89. Sakhalin (Yuzhno-Sakhalinsk)

Notes:

[a] The Ingush Republic was restored in 1992 and its territory delimited from that of North Ossetia and Chechnya.

[b] Chechnya declared full independence from Russia in 1991.

[c] In 1991–92 these four former autonomous regions upgraded themselves to the status of republics.

Sources: Adapted from US Congress, Office of Technology Assessment, *Proliferation and the Former Soviet Union*, OTA-ISS-605 (US Government Printing Office, Washington, DC, Sep. 1994); and SIPRI Fact Sheet, 'Crisis in Russia: Facts and Figures, People and Data' (Oct. 1993).

unlikely before the year 2010.[65] Production of strategic bombers has stopped altogether.

As recalled above, all FSU non-strategic nuclear warheads are now in Russia, even though they appear to be still widely distributed, geographically and organizationally, within the vast territory of the Russian Federation. As for their number, in September 1994 US Deputy Secretary of Defense John Deutch estimated it 'to be between 6000 and 13 000'.[66] It is unclear whether this is the result of a generally low rate of warhead dismantlement in Russia or is an indication of Russian interest in retaining a large number of tactical nuclear weapons.

[65] Arbatov (note 34). In Nov. 1992, during an official visit to South Korea, Yeltsin had indeed declared that Russia was cutting by half the production of new submarines and will stop producing them altogether in the next 2–3 years. See 'Yeltsin says Russia will stop making submarines', *International Herald Tribune*, 20 Nov. 1992.

[66] Quoted in Carey B., 'US adopting new nuclear weapons policy', US Information Agency (USIA), *Wireless File*, EURS09, 23 Sep. 1994.

3. Controlling the nuclear arsenal

The continuing effectiveness and viability of the nuclear command and control system put in place during the Soviet era is of crucial importance for a number of reasons. First, strategic stability and the responsible management of the Russian nuclear arsenal depend largely upon it. So does the maintenance of unified, central control—a key international concern, as explained in chapter 2. Finally, the custodial organization subordinated to the nuclear command and control system is the ultimate guarantor against some of the most blatant instances of nuclear proliferation—such as the unauthorized transfer of nuclear warheads, delivery vehicles and fissile material. Thus, an outline of the nuclear command and control system is in order.

I. Negative and positive control of nuclear weapons

Both the USA and the Russia possess extremely elaborate and complex systems established over the years to control the tens of thousands of nuclear weapons that they have deployed. These systems combine an impressive array of hardware—satellites and radars for early warning, tracking and targeting; communication equipment to transmit information and orders; mechanical and electronic locks to activate or deactivate weapons, and so on—and software. The software component basically revolves around a number of standard procedures to prevent the use of nuclear weapons without proper authorization (negative control) and to ensure their use when duly authorized (positive control).

An inherent tension exists between negative and positive control, in the sense that the more effort that is spent in guarding against any improper or hasty use of nuclear weapons, the more difficult and time-consuming it becomes to employ them, should the decision be taken to do so.

To give only one example, the physical separation of a nuclear warhead from its delivery vehicle clearly enhances security against a number of contingencies, such as attempts at unauthorized use or from misinterpretation or miscalculation of enemy intentions. It also increases safety against many types of accident, such as those associated with accidental burning of the fuel of the delivery vehicles. However, the time and distance gained by this kind of safeguard obstruct the quick execution of even legitimate and sanctioned orders.

Resolving these contradictory requirements in favour of negative control may seem logical and uncontroversial today in the wake of the end of the cold war. However, only a few years ago, at the height of the superpower confrontation, it was far less so. Then, it was considered prudent to maintain substantial portions of the strategic nuclear forces in a high state of alert—ready to be used within minutes. Options for so-called 'launch-on-warning' of strategic forces were seriously considered—and indeed inspired the strategic nuclear postures of both sides—while 'use them or lose them' scenarios for tactical nuclear weapons were commonly discussed by security experts. It was at that time and with such contingencies in mind that the nuclear command and control systems of the USA and the FSU were designed and made operational.

In retrospect, it appears that the centralized and over-suspicious character of the leadership of the FSU entailed a definite propensity towards the negative control of nuclear weapons: the command and control system was built to avoid, to the extent possible, instances of devolution of nuclear authority. Individual weapons, with very few exceptions, were replete with technical and procedural obstacles meant to avoid unsanctioned use. Generally speaking, almost all categories of Soviet nuclear forces were kept at a lower level of alert than their US counterparts. All of these measures were reassuring, at least as long as it remained clear who was in charge. In the early 1990s, the spiralling turmoil in the Soviet Union leading to its final dissolution dramatically changed the terms of the nuclear command and control problem.

In November 1991, this problem was highlighted by the authors of an influential report on the fate of the Soviet nuclear arsenal. They wrote:

> Finally and fundamentally, we are concerned . . . about the potential behavior of the Soviet nuclear command and control system under severe stress, not about its normal or prescribed workings. Even a detailed description of how the system is supposed to work only hints at how it *might* work or be manipulated under stress . . . To be sure, the prescribed procedures governing normal actions with nuclear weapons have doubtless been designed with the dangers of insanity, terrorism, civil discord, and perhaps even minor

mutiny in mind. But it stretches credulity to the breaking point to suppose that throughout the half-century development of the Soviet nuclear command and control system, and across the deployment of several tens of different kinds of nuclear weapon systems to five different military services, Soviet military commanders and engineers have assiduously built in specific safeguards against the contingencies of political revolution, republican secession, and widespread civil chaos of the kinds that are distinctly possible in the Soviet Union today. Thus we are forced to contemplate the workings of a socio-technical system outside its range of design parameters and amidst the disintegration of the social system in which it is embedded.[1]

II. Authority to launch

During and after the attempted coup in the Soviet Union of August 1991, much public attention focused on what might have happened to President Mikhail Gorbachev's briefcase containing the nuclear codes—called the 'football' in US jargon. These concerns implicitly assumed that the president, as the supreme political and military authority of the country, was the only individual to be in full control of the nuclear arsenal, and that whoever took his place would also inherit his supposedly exclusive nuclear responsibilities.

As it became clear in the weeks following the coup, two other 'footballs' existed in the FSU: one held by the Defence Minister, then Dmitriy Yazov, and the other held by the Chief of the General Staff, then General Mikhail Moiseyev.[2] The system was supposed to work in the following way:

The separate codes sent by the president and defense minister traveled over a dedicated communications channel to an electronic device with a special algorithm that validated the two codes halves, combined them, and passed them to another device that integrated the permission code input of the [Chief of the General Staff]. Then the composite permission code would

[1] Campbell, K. M. *et al., Soviet Nuclear Fission: Control of the Nuclear Arsenal in a Disintegrating Soviet Union*, CSIA Studies in International Security, no. 1 (Center for Science and International Affairs, John F. Kennedy School of Government, Harvard University: Cambridge, Mass., Nov. 1991), pp. 3–4. Emphasis in the original.

[2] It is possible that, for one or two days during the coup, Moiseyev secured access to all three 'footballs', thus realizing precisely the situation the three-pronged system was meant to avoid: concentration of the authority to launch in the hands of just one person. The existence of 'spare' sets of nuclear keys has also been mentioned. See Pikayev, A. A., 'Post-Soviet Russia and Ukraine: who can push the button?', *Nonproliferation Review,* vol. 1, no. 3 (spring–summer 1994), pp. 31–46.

travel to the [Commanders-in-Chief] of the strategic forces designated for launch.[3]

This three-pronged system, called in Russian *Kazbek*, became operational in the early 1980s and was specifically designed to respond to the threat of a surprise attack. On the other hand, it was assumed that in case of a Soviet first strike, or launch-on-warning during a crisis, the leadership would have already moved to a command post equipped to issue permission codes, thus rendering the three briefcases superfluous.

Once the nuclear commanders had received the order permitting the use of nuclear weapons from the top leadership, they would coordinate with the General Staff to issue a direct command to individual launch crews.[4] The same distinction has been framed by other analysts in terms of authorizing codes on the one hand and enabling codes on the other.[5] In other words, once a given force (for example, the Strategic Rocket Forces in case of a launch of land-based missiles) had received the authorization for use of nuclear weapons, launch crews would still need a set of codes enabling them physically to unlock and then use the weapons.

The Soviet/Russian system also provides the possibility for the top politico-military leadership to bypass lower echelons and fire land-based intercontinental nuclear missiles directly. Similar arrangements exist in the USA and are clearly intended to counter the threat of a severe disruption of the command chain.[6]

Given the fact that strategic nuclear weapons will be deployed in three other republics outside Russia for several years, some form of consultation on nuclear use between President Boris Yeltsin and his

[3] Blair, B., *The Logic of Accidental Nuclear War* (Brookings Institution: Washington, DC, 1993), p. 72.

[4] Blair (note 3), pp. 75–77.

[5] Campbell *et al.* (note 1), pp. 9–10.

[6] Blair calls the Soviet arrangement 'a fully automatic mode of nuclear release'. This total transfer of positive control to the centre, he claims, could even 'occur spontaneously if certain conditions obtained, particularly extensive damage to the chain of command caused by nuclear detonations on Soviet soil'. See Blair (note 3), p. 78. He later went a step further, implying in practice that nuclear retaliation itself would take place automatically if the system had been switched in advance to its 'automatic mode' and a massive nuclear attack against Russia had taken place. See Blair, B., 'Russia's doomsday machine', *New York Times*, 8 Oct. 1993.

counterparts in Belarus, Kazakhstan and Ukraine has probably been considered.[7]

For example, at the CIS summit meeting held in Minsk on 20 December 1991, a 'Combined Strategic Forces Command' was created. On the same occasion, some details were given about new control arrangements for nuclear weapon use, which would be decided by the Russian President 'in agreement with' the leaders of Belarus, Kazakhstan and Ukraine and 'in consultation' with those of the other CIS member states. In all likelihood, the procedures for such consultation would be similar to those in use within NATO: namely, it would take place 'time and circumstances permitting' and it will be limited to the weapons deployed outside Russia, the only ones whose use the leaders of the three republics can veto.[8]

From the aftermath of the attempted coup against Gorbachev in August 1991 until the summer of 1993, the nuclear command structure in the FSU underwent a number of changes and outright experimentation.[9] For example, a Strategic Deterrent Force was created under whose control were put all strategic nuclear weapons; previously ICBMs were under the control of the Strategic Rocket Forces, SLBMs under Navy control, and bombers under a special command (Dal'aviatsia) of the Air Force.

Moreover, the issue became entangled with the military command structure of the CIS, in which some former Soviet republics—notably Ukraine—participated only with many reservations. For some time, the Commander-in-Chief of the CIS Joint Armed Forces and the Commander-in-Chief of the CIS Strategic Deterrent Force had one 'football' each. It was then unclear to whom these (Russian) commanders were subordinated, let alone loyal: to the Russian President or to the Council of CIS Heads of State?

Shortly after Ukraine, in the spring of 1993, put the strategic forces in its territory under its administrative control, the issue of nuclear weapon control finally led to the abolition, on 15 June 1993, of the CIS joint military command itself, effectively ending efforts to maintain a common security system in the FSU. According to Russian

[7] 'A special communications network was installed in the presidential offices in [Almaty, Kiev and Minsk], linking them with Mr Yeltsin's office in Moscow.' See Pikayev (note 2).

[8] The leaders of Belarus, Kazakhstan and Ukraine have sought, but not obtained, a so-called key to the nuclear weapons deployed on their territories. See Blair (note 3), pp. 87–88. However, they have the physical capability to impede launches, if only through such crude means as placing a truck on the roof of a missile silo.

[9] See Pikayev (note 2).

Defence Minister Pavel Grachev, 'the provisions of the draft agreements [approved by Russia's CIS partners] that leave the right to control nuclear weapons to the CIS armed forces main command do not suit Russia. The main command, as well as the CIS, is not a state and cannot have the right to control and use nuclear weapons'.[10]

From that time on, Russia recreated the old nuclear command structure of the Soviet Union: the Strategic Deterrent Forces Command was abolished and the Strategic Rocket Forces Command was resuscitated; after many vagaries and uncertainties the nuclear National Command Authority is once again shared among the President, the Minister of Defence and the Chief of the General Staff, each holding one set of codes or 'football'.[11]

III. Safeguards

While the crux of the nuclear command and control system issue is largely concerns questions of positive control, the other end of the system—negative control—refers to the safeguards against unauthorized seizure, movement, launch or detonation of weapons. From this point of view, the Soviet system, inherited by Russia, is rather strict. In peacetime many nuclear warheads are not mounted on their delivery systems nor are they kept in the custody of the military personnel who would launch them—although the bulk of the strategic systems (ICBMs and SLBMs) and some tactical naval systems are, when deployed on board ships and submarines. Those in the former category are stored separately under the control of the nuclear technical troops of the Ministry of Defence 12th Directorate, who are also in charge of security when warheads are moved: for example, from assembly lines to deployment sites, or from deployment sites to maintenance and overhaul facilities. In the past, the task of ensuring secure communications for the nuclear forces was carried out by the Committee of State Security, better known as the KGB.

As in the US system, several other safeguards exist and every single nuclear weapon is under some, if not necessarily all, of them.[12] First, a

[10] Quoted in Foye, S., 'End of CIS command heralds new Russian defense policy?', *RFE/RL Research Report*, vol. 2, no. 27 (2 July 1993), p. 47.

[11] Pikayev (note 2).

[12] According to one Russian source, however, 'old tactical nuclear warheads are equipped with unreliable mechanical blocking devices, or are not equipped with any devices at all'. See Pikayev (note 2).

'more-than-one-man' rule is strictly followed for every operation (from custody, to movement, to launch) concerning nuclear weapons, that is to say, no single individual can on his own accomplish the relevant procedures. The number of personnel actually involved in launch procedures varies, in the FSU and in Russia, from a minimum of three in the launch control centres of ICBMs to several members of a SSBN crew who are called to execute a sequence of procedures simultaneously. Any individual serviceman involved in the process can therefore effectively veto any use he may deem unlawful or unauthorized, and even though overturning his opposition may be possible in some cases, it would be time-consuming and very difficult to hide from higher echelons.[13]

Second, strong physical security exists at nuclear storage sites, which are normally surrounded by minefields, barbed wire fences (sometimes electrified) and heavily armed special troops. In the US system, warheads are kept in so-called 'igloos' made of heavy concrete and steel, where an intruder would also be confronted with detecting, confounding and immobilizing mechanisms. Soviet nuclear storage sites in the German Democratic Republic were much more low-profile and 'blended into the surroundings', suggesting that the USSR's attitude was roughly the opposite of that of the West: it worried much more about the other side being able to detect and target these sites than about domestic terrorism.[14] It has also been reported that inside these bunkers in the FSU 'each weapon sits atop a sensor that would sound an alarm if the weapon was improperly moved. Moreover, any such unauthorized movement would reportedly send a signal to central command'.[15]

Third, many types of nuclear weapon are equipped with safety features to avoid accidental detonation in case of fire, fall or even explosion in their proximity—that is, in any circumstances except via the arming and fusing circuitry. The obvious implication is that the physical possession of a nuclear warhead does not translate into the ability to detonate it, unless it is coupled with the proper access to its firing circuitry.

[13] Unauthorized attempts at nuclear use in Russian ICBM launch control centres, as well as at army, division and regiment level, are automatically reported to the central command post near Moscow, from where the missiles can be deactivated.

[14] Blair (note 3), p. 102.

[15] Norris, R. S., 'The Soviet nuclear archipelago', *Arms Control Today*, vol. 22, no. 1 (Jan./Feb. 1992), pp. 24–31.

Fourth, nuclear warheads and/or delivery vehicles are equipped with switches that permit arming and fusing only when a given code is entered—these devices are called permissive action links (PALs) in the USA. Launch crews do not have these enabling codes, which are provided by higher commanders prior to actual use. All categories of strategic weapons in the FSU are believed to be covered by PALs, including SLBMs—this is an important difference from the US system, where submarine crews possess the enabling codes, and SLBM launching requires only an authorization code and the execution of the relevant procedure by several members of the crew. Note that PALs are needed to enable crews to launch ballistic missiles, whereas arming and fusing take place only when and if a sensor registers the acceleration typical of the missile's lift-off.

Bruce Blair, a US expert on nuclear command and control matters, has described the role codes play in the launching procedures of a Soviet weapon in the following terms.

> To launch an ICBM, for example, now requires a '12-digit key' inserted via a complex and apparently highly secure system, and originating with the top political and military leadership. The ICBM crews do not normally have access to be able to launch missiles, but must receive a special 'preliminary' command from the top military leadership. Then they must receive additional codes that physically unblock the missiles for which they are responsible. Only when they have received these codes and commands do the crews have the physical ability to fire any of the 10 missiles in their group . . . The crews must correctly insert the codes in three tries, with an allowable time span of several seconds between each try, or else the crews are locked out and unable to perform the launch sequence. After a certain span of time has expired, the blocking system is automatically activated.[16]

A last type of safeguard goes under the name of the environmental sensing device (ESD). The purpose of such devices is to prevent the explosion of a nuclear weapon that has not gone through the environmental pattern of its intended use. 'Thus, a bomb equipped with an ESD will not detonate unless it has experienced free fall, a change in barometric pressure accompanying a change in altitude, and/or deceleration due to impact or deployment of a parachute . . .

[16] Quoted in Garwin, R. L., 'Post-Soviet nuclear command and security', *Arms Control Today*, vol. 22, no. 1 (Jan./Feb. 1992), pp. 18–23.

Soviet spokesmen have indicated that at least some Soviet weapons have ESDs.'[17]

An additional type of safeguard, self-destruction, is peculiar to former Soviet long-range missiles. These are in fact equipped with sensors that determine whether the missile stays on its intended trajectory via a three-star astral reading: deviation beyond a certain threshold would trigger an explosive charge blowing up the missile. 'It was extensively used in the SLBM arsenal and to a lesser but still considerable extent in the ICBM arsenal.'[18]

IV. The Russian abandonment of nuclear 'no-first-use'

On 2 November 1993, it was announced in Moscow that the Russian Government had adopted a new military doctrine. Under discussion for more than a year, the new doctrine and the timing of its adoption had mostly to do with domestic policy—a reward to the military which in the previous October had taken sides with Yeltsin in his show-down with the parliament—and the conduct of international relations—the military dimension of a sharp new assertiveness in Russia's foreign affairs.[19] The document, however, also had an impact on nuclear policy, since it repudiated the no-first-use pledge made by the Soviet Government in 1982.[20]

On this nuclear policy shift opinions diverge. One group of Western strategic experts never took the Soviet no-first-use pledge as anything more than a propaganda gesture, apparently contradicted by operational practices. If true, then the novelty contained in the new military doctrine is of little or no importance. Another school of thought regarded the pledge as having profound operational consequences.

[17] Campbell *et al.* (note 1), p. 14.

[18] Blair (note 3), p. 107.

[19] 'Russia reaches out', *The Economist*, 26 Feb, 1994; Crow, S., 'Why has Russian foreign policy changed?', *RFE/RL Research Report,* vol. 3, no. 18 (6 May 1994), pp. 1–6; and Lepingwell, J. W. R., 'The Soviet legacy and Russian foreign policy', *RFE/RL Research Report*, vol. 3, no. 23 (10 June 1994), pp. 1–8.

[20] Russia eventually opted for a policy on nuclear weapon use similar to that of the USA and expressed in its policy statements issued since the 1970s. The nuclear security assurance that presidents Clinton and Yeltsin jointly gave to Ukraine in the Trilateral Statement reads as follows: '[The USA and Russia] reaffirm, in the case of Ukraine, their commitment not to use nuclear weapons against any non-nuclear-weapon state party to the NPT, except in the case of an attack on themselves, their territories or dependent territories, their armed forces, or their allies, by such a state in association or alliance with a nuclear weapon state.' The Trilateral Statement is reproduced in annexe B.

According to this interpretation, no-first-use, coupled with a policy of launch-on-warning of strategic forces, resulted in a call for higher combat readiness in peacetime and the capability to reach full combat readiness rapidly in a crisis. Blair went so far as to write that: 'The tension between negative and positive control that would emerge in a nuclear crisis is *aggravated* by the commitment of the former Soviet Union never to be the first to use nuclear weapons'.[21] Somewhat paradoxically, and perhaps unintentionally, the abandonment of no-first-use might even end up strengthening the negative control of Russian nuclear forces. On the other hand, the renunciation of a stated policy of no-first-use may be interpreted as an unfortunate step back from the general recognition of the essential unusability of nuclear weapons.

V. Other aspects of nuclear command and control

There are other important aspects of the nuclear command and control issue. Although they do not bear directly on nuclear weapon proliferation, they can help explain why denuclearization is perhaps the most logical course of action for the newly independent republics, besides Russia.

To manage their sizeable nuclear arsenals effectively, in fact, Belarus, Kazakhstan and Ukraine would have to build almost from scratch facilities and equipment as diverse as radars and satellites for strategic and tactical warning, and for attack assessment, fixed and mobile command posts, and secure communications links. Moreover, they should overcome a number of less visible, but none the less crucial, problems. For example, 'ICBMs and SLBMs cannot be targeted without intelligence about the geodetic coordinates of targets and without the assistance of guidance software programmed with gravity maps of the earth (themselves obtained from satellites)'.[22]

If this is true in general terms, it is also true that the three states differ in their potential capacity to manage a nuclear arsenal. Ukraine is undoubtedly the best placed. For example, the SS-24s deployed on its soil have been produced in a Ukrainian plant at Kharkov and it is to be expected that they can be serviced locally with relative ease. Guidance systems for SS-19s were manufactured in Ukraine, even

[21] Blair (note 3), p. 108 (emphasis added).
[22] Campbell *et al.* (note 1), p. 34.

though those for SS-24s are Russian-built.[23] Kharkov also hosts the Krylov Higher Military Command School, one of the four FSU centres to train launch control officers. A factory located in Ukraine and named Monolith used to build the FSU ballistic missile PALs—even though the design centre for these devices is in St Petersburg.[24]

However, it is in Russia that the bulk of command and control assets of the FSU are located—together with the vast majority of the research centres and production facilities for anything even loosely associated with nuclear weapons.[25] This does not mean, of course, that the dissolution of the Soviet Union has left Moscow completely unscathed. In addition to the facilities already recalled, several large radar installations are located outside Russia, namely, in Azerbaijan, Belarus, Kazakhstan, Latvia and Ukraine, a fact that adversely affects Russian early-warning capabilities; the Tyuratam launch site in Kazakhstan was used to put in orbit photo-reconnaissance, electronic intelligence, ocean reconnaissance and Glonass navigation satellites and the Soviet anti-satellite (ASAT) system, and to lift the largest Soviet Proton and Energia boosters.

The fact remains, however, that for the sake of a coherent management of whatever will survive of the FSU nuclear arsenal, Russia was the only plausible successor in the short term—Ukraine was second in line, but only over the longer term. This point was perhaps more quickly appreciated outside the FSU than inside it.[26]

[23] See also chapter 2, section IV.

[24] Coll, S. and Smith, J., 'In fight over warheads, Kiev seeks upper hand', *International Herald Tribune*, 4 June 1993.

[25] For further details, see chapter 6.

[26] As this book went to press, we obtained copies of two very informative Russian papers on the topics covered in this chapter, as well as in chapters 4–6. These sources essentially confirm the gist of our presentation. See Rogov, S. and Konovalov, A. (eds) The Soviet Nuclear Legacy Inside and Outside Russia: Problems of Non-Proliferation, Safety and Security (Institute of the USA and Canada: Moscow, 1993); and Sutiagin, G., 'How Russia ensures the safety of its nuclear weapons', *Military Journal*, no. 7 (1993). The *Military Journal* is published by the Postfactum News Agency in Moscow.

4. Running the dismantlement pipeline

In the year 2003, if the START II Treaty is fully implemented, the USA is expected to have an operational stockpile of some 5000 nuclear warheads, about 1000 of which for non-strategic forces and 500 as 'spares for routine maintenance'.[1] Assuming that Russia will in the near future retain roughly as many tactical warheads as the USA,[2] it is now possible to estimate the quantitative range of nuclear weapons of the FSU to be destroyed over the coming years.

Some assumptions are in order, however. First, the warheads assigned to the strategic delivery vehicles to be eliminated will also be dismantled. Note that neither START I nor START II requires the elimination of strategic nuclear warheads—whereas the leaders of both the USA and the FSU have publicly pledged to destroy the bulk of those tactical nuclear warheads that have been withdrawn from service. Second, no sizeable stockpile will be held in reserve.[3] Third, Belarus, Kazakhstan and Ukraine will eventually make good on their pledges and transfer to Russia for dismantlement the nuclear warheads still deployed on their territories.

I. Targets and rates of warhead dismantlement

Thus, if Russia is to be left at the end of the reduction period with an operational stockpile of 4000–5000 nuclear warheads (3000–3500 strategic, 1000–1500 tactical and including some spares), then 27 000–28 000 warheads will have to be destroyed over the remaining years of the 1990s and possibly beyond. To meet the earliest START II deadline, the year 2000, more than 4000 nuclear warheads will have to be destroyed each year. According to Minatom sources, the combined dismantlement capacity at the four relevant Russian centres (Sverdlosk-45, Zlatoust-36, Penza-19 and, in a more limited way, Arzamas-16) is approximately 5500–6000 warheads per year. The US CIA estimates that the same centres can certainly dismantle more than 1500 warheads per year, and indicates a figure as high as 4000 per

[1] 'US nuclear weapons stockpile, July 1994', *Bulletin of the Atomic Scientists*, vol. 50, no. 4 (July/Aug. 1994), pp. 61–63.

[2] For the reasons recalled in chapter 2, section VI, this is far from being certain.

[3] In the US case, however, '[a]n additional 4000–5000 warheads could be retained in the inactive reserve stockpile'. See note 1.

year as being 'credible'.[4] The current actual yearly dismantlement rate of FSU warheads, however, has been mentioned to be between 2000 and 3000.[5]

II. Disabling warheads

This unprecedented disarmament effort involves a series of successive steps, some of which are fraught with problems and uncertainties.[6] The first step is disabling the nuclear warheads slated for withdrawal, that is, removing their arming, fusing and firing mechanisms. It could be done at their deployment sites, and it is to be expected that this routine precaution was taken by the military prior to any movement of nuclear warheads.

III. Transportation

The second step is secure transportation from deployment sites to depots. This is an area in which much has already been done: some 6000 tactical nuclear warheads were concentrated in Russia in less than six months. The lack of any serious incidents is also a testimony to the high competence of the Russian personnel in charge of this sensitive, massive shipment. According to one account:

Extraordinary precautions were taken during the loading and shipping. Prior to shipment to Russia, each warhead was mechanically disabled to preclude the possibility of a nuclear explosion, and no more than two warheads were carried in each rail car. When trucks were used, each vehicle was loaded with one warhead. A convoy was heavily guarded using air cover and armored personnel carriers between each truck; public roads were closed when more than three warheads were transported.[7]

[4] Cochran, T. B. and Norris, R. S., *Russian/Soviet Nuclear Warhead Production,* Nuclear Weapons Databook Working Paper no. 93–1 (Natural Resources Defense Council: Washington, DC, 8 Sep. 1993).

[5] 'Testimony before the Senate Armed Services Committee by Ashton B. Carter, Assistant Secretary of Defense for International Security Policy', 28 Apr. 1994, p. 10.

[6] The description that follows in the text is largely based on Allison, G. *et al.* (eds), *Co-operative Denuclearization: From Pledges to Deeds,* CSIA Studies in International Security, No. 2 (Center for Science and International Affairs, John F. Kennedy School of Government, Harvard University: Cambridge, Mass., Jan. 1993).

[7] Blair, B., *The Logic of Accidental Nuclear War* (Brookings Institution: Washington, DC, 1993), p. 102.

Transportation has also attracted much of the initial Western aid in the nuclear weapon field.[8] In the opinion of qualified Russian observers, however, this is possibly the weakest link in the nuclear weapon dismantlement chain:

> Assuming that yearly 3–4 thousand [warheads] will have to be sent to the factories and the average load of a train convoy amounts to 50 warheads, this means that 60–80 train convoys will be needed every year. Since it may take a convoy from 3 to 5 days to reach its destination, every day one to two convoys would be moving on the railroads of Russia carrying uniquely dangerous freight. Bearing in mind the increasing accident rate on Russian railroads, the transportation question gives rise to considerable concern about the safety of the nuclear weapons.[9]

IV. Storage

The third step concerns storage. Clearly, both the US and the FSU nuclear management systems were built on the assumption that a large fraction of the warheads would for much of the time be attached, or stored in close proximity, to their intended delivery vehicles. Secure depots existed and still exist, especially for tactical weapons, but many of them were located outside the borders of Russia and have therefore been abandoned. Those still in service were soon filled to capacity, and nuclear weapons 'are temporarily put in storage in depots used previously for conventional munitions'.[10] On the other hand, building new depots makes little long-term sense in light of the coming massive reductions: scarce resources can be better used in accelerating the pace of warhead disassembly and destruction.[11]

V. From warheads to pits

The fourth step is dismantling the weapons beyond the removal of their arming, fusing and firing circuitry which, together with their

[8] See chapter 8, sections I and II.

[9] Arbatov, A. and Pinchukov, Y., 'The elimination of nuclear weapons in Russia', Background document to the 22nd Pugwash Workshop on Nuclear Forces, held in Geneva, Switzerland, 5–6 Mar. 1994. To solve this problem, the authors recommend that the USA transfer to Russia its aerial transportation technology.

[10] Arbatov and Pinchukov (note 8).

[11] If sites capable of storing not only warheads in the short term but also fissile material in the longer term were built, then it would probably make sense to invest in this sector.

tritium reservoir, are placed outside the warhead casing and are more easily accessible. Thus, dismantling means working inside the weapon casing in order to separate the mass of fissile material (held inside a metal container called a pit) from the high explosive around it—whose implosion forces the fissile material to reach its critical mass. Thermonuclear weapons contain a secondary device, whose superheating and explosion (largely via nuclear fusion) are triggered by the first nuclear explosion (mainly via nuclear fission).

Warhead pits can be stored as such. As an additional safety measure against their use in reassembling a workable weapon, the shape of the pits can be altered by crushing their metal plate, which inhibits their re-use in nuclear explosive devices unless a total re-manufacture takes place. According to a study sponsored by the US National Academy of Sciences, 'Deformation of [the] pits . . . should be given serious consideration, and should be undertaken if [it] can be accomplished at relatively low cost and risk to the environment, safety, and health'.[12] Despite having two facilities (at Tomsk-7 and Chelyabinsk-65) to implement such deformation, Russian authorities have reportedly decided to store nuclear weapon components intact.[13]

The last step involves the dismantlement of the pits themselves, that is, the separation of their metal containers from the highly enriched uranium (HEU)[14] and plutonium contained therein. Unfortunately problems do not end here, since the fissile material extracted is, by definition, weapon-grade material, available for reuse in the manufacture of new nuclear explosive devices. However, plutonium is in fact still being produced in Russia.[15]

VI. Fissile material disposition

Highly enriched uranium

Measures can be taken to downgrade both HEU and weapon-grade plutonium, so as to introduce a technological barrier against their

[12] Committee on International Security and Arms Control (CISAC), National Academy of Sciences, *Management and Disposition of Excess Weapons Plutonium—Executive Summary* (National Academy Press: Washington, DC, 1994).

[13] Cochran and Norris (note 3).

[14] Uranium is considered to be highly enriched when the content of its radioactive isotope uranium-235 is 90–95%—natural uranium contains only 0.7% of the uranium-235 isotope, the rest being mainly made of the isotope uranium-238.

[15] See chapter 6, section I.

eventual re-use in nuclear explosive devices. The former can be diluted by mixing it with the isotope ^{238}U down to a level of 3–6 per cent enrichment; the latter can be converted into mixed oxides (MOX) of plutonium and uranium. The products are then usable as nuclear reactor fuel, which suggest this to be a suitable method by which to dispose of weapon-grade fissile material.

The technological barrier preventing the re-use for weapons of uranium enriched to 3–6 per cent in the isotope ^{235}U is indeed very robust: isotopic enrichment of uranium is a very difficult and special technique; and to be usable as weapon material uranium has to be enriched to over 90 per cent in the isotope ^{235}U. Unfortunately, it is not the same with the technological barrier that prevents the transformation of MOX back into metallic plutonium, which is less arduous to master. In fact, as is also the case with plutonium separation from spent reactor fuel, it only requires a chemical process—although one to be conducted with special precautions, given the highly toxic and radioactive nature of plutonium and the other fission products.

On 31 August 1992, President Bush announced that an agreement in principle had been reached with Moscow for the purchase and conversion of Russian HEU. The agreement was signed in Moscow on 18 February 1993. Under the terms, over the next 20 years Russia will convert 500 tonnes of HEU extracted from nuclear weapons into low-enriched uranium (LEU) and sell it to the United States Enrichment Corporation (USEC), a quasi-governmental organization. Reportedly, USEC will use the LEU to fulfil contracts to supply fuel for nuclear power stations in the USA and abroad, so that there will be no net cost to the US Government.[16] The proceeds from this operation are estimated to be worth around $12 billion at current market prices for nuclear reactor fuel. They are to be partly shared by Russia with Belarus, Kazakhstan and Ukraine as a compensation for the value of HEU contained in the nuclear weapons deployed on their territories.[17]

[16] For more details about the HEU agreement, see Bukharin, O., 'Weapons to fuel', *Science and Global Security*, vol. 4, no. 2 (1994), pp. 189–212; and Lockwood, D., 'Nuclear arms control', *SIPRI Yearbook 1994* (Oxford University Press: Oxford, 1994), pp. 673–75.

[17] See chapter 2, section IV.

Plutonium

Disposing of plutonium raises different problems than those of HEU, especially in light of the relative ease with which it could be re-used for weapons, as indicated above. First, the use of MOX in most current (light water and Canadian deuterium–uranium, or CANDU) reactors would be technically feasible but uneconomical, that is, doing so would cost more than the purchase and use of ordinary LEU, even if the plutonium recovered from the warheads were provided at zero cost. Second, in order to get MOX fuel from weapon plutonium in a relatively short time, commercial facilities in Europe and Japan would have to be used. Renegotiation of existing contracts for plutonium reprocessing from spent fuel would not be easy on either technical or economic grounds. Moreover, a plutonium fuel cycle with substantial movements of weapon-grade materials would thus be established around the world—a predictably controversial outcome for safety, security and non-proliferation reasons.

Note that even though reactor-grade plutonium has a different isotopic composition from weapon-grade plutonium, it can nevertheless be used, if somewhat less efficiently, to make nuclear explosive devices.[18] In 1962, the USA successfully conducted a test of a nuclear device of 'less than 20 kilotons' yield which used reactor-grade plutonium.[19] The real threshold then is between separated material of any grade and unseparated material in spent fuel, where it is mixed with highly radioactive elements, so that its extraction is dangerous unless done with quite sophisticated and costly technology.[20]

Stocks of plutonium for civilian use are growing at a rate of some 60–70 tonnes per year; some 130 tonnes of reactor plutonium have been separated from spent fuel, 80–90 tonnes of which are in storage.[21] Comparing these figures with the 100–200 tonnes likely to be extracted from US and FSU nuclear weapons makes clear that the real question is thus the future role of plutonium in the nuclear

[18] For a brief comparison, see table 4.1.

[19] Verification Technology Information Centre (VERTIC), *Trust and Verify*, no. 50 (Sep. 1994).

[20] It should, however, also be taken into account that the difficulty of plutonium reprocessing declines over time as the radioactivity of the nuclear waste in which it is mixed decays. A few decades may thus make a substantial difference.

[21] CISAC (note 12); and annexe A in this volume. For a comprehensive survey of world stocks of plutonium and HEU, see Albright, D., Berkhout, F. and Walker, W., SIPRI, *Plutonium and Highly Enriched Uranium 1995: World Inventories, Capabilities and Policies* (Oxford University Press: Oxford, forthcoming, 1995).

Table 4.1. Weapon-grade and reactor-grade plutonium

Figures in italics are percentages.

	Plutonium	
	Weapon-grade	Reactor-grade
^{239}Pu	*94*	*60*
^{240}Pu	*6*	*24*
^{241}Pu	*0.13*	*5.6*
^{241}Am	*0.22*	*3.5*
Spontaneous fission neutrons, (gm-sec)-1	52	340
Decay heat, W/kg	2.5	14
Kg for an effective nuclear bomb	c. 4	c. 5

Source: Data provided by John P. Holdren during the 22nd Pugwash Workshop on Nuclear Forces, held in Geneva, 5–6 Mar. 1994.

industry—a question that is better answered on its own economic, safety, environmental and non-proliferation grounds, rather than only from the point of view of weapon-grade plutonium recycling.

The use of LEU and MOX as commercial reactor fuel, however, generates plutonium—although combined with the other radioactive products of fission. Plutonium is inevitably produced in a nuclear reactor in whose core the isotope ^{238}U (which constitutes 99.3 per cent of natural uranium) is present. Theoretically, some solutions that do not do this are available. 'One can imagine a fast neutron reactor the core of which would contain only plutonium and no uranium at all. Such a reactor would be operated as a true plutonium incinerator. As a mere indication, a 1000 MWe fast reactor specifically designed for that purpose would burn about 700 kg of plutonium per year.'[22] Also, slow neutron reactors can apparently be designed to be 'almost exclusively fed with plutonium and devoted to its burning'.[23]

[22] Vendryes, G., 'Plutonium burning in fast reactors and as MOX fuel', Paper presented at the International Symposium on Conversion of Nuclear Warheads for Peaceful Purposes, Rome, 15–17 June 1992.

[23] Lombardi, C. and Cerrai, E., 'Burning weapon-grade in ad hoc designed reactors?', Paper presented at the International Symposium on Conversion of Nuclear Warheads for Peaceful Purposes, Rome, 15–17 June 1992. The use of terms as 'burning' or 'incinerating', when applied to plutonium, is controversial. The CISAC (note 12) study, for example, notes that: 'the use of advanced reactors and fuels to achieve high plutonium consumption without reprocessing is not worthwhile, because the consumption fractions that can be achieved—

In practice, however, these suggestions seem difficult and controversial. The few fast neutron reactor prototypes in the world are plagued by seemingly endless problems, ranging from unsatisfactory safety to ever-increasing costs.[24] Building from scratch tens of plutonium-dedicated slow neutron reactors does not appear to be any easier than building ordinary reactors at a time when orders for new commercial nuclear facilities are grinding to a halt. Finally, both alternatives raise long-term nuclear proliferation problems associated with introducing and promoting a plutonium fuel cycle which would eventually spread worldwide.[25]

Other authoritative options are now circulating. Following a request put forward by the Bush Administration and then confirmed by President Clinton, in early 1994 the Committee on International Security and Arms Control (CISAC) of the US National Academy of Sciences made public a report on *Management and Disposition of Excess Weapons Plutonium*.[26] The committee recommended, first, to set standards of accountability, transparency and security for the storage and disposition of fissile materials from dismantled weapons as stringent as those applied to stored nuclear weapons. Mutual declarations of total military and civilian inventories of fissile materials should be exchanged between the USA and Russia, while monitoring agreements should allow the two parties to confirm the amounts declared throughout the warhead dismantlement process, as well as a cut-off of the production of HEU and plutonium for weapons.[27]

Second, the CISAC report recommended that the intermediate storage of weapon-grade plutonium take place in the form of warhead pits and under IAEA monitoring;[28] steps should thus be taken to

between 50 and 80%—are not sufficient to greatly alter the security risks posed by the material remaining in the spent fuel'.

[24] On 22 Feb. 1994, the French Government decided to allow the re-start of the Superphénix breeder reactor at Creys-Malville, but only as a 'research and demonstration' reactor—not as a power plant, as originally intended. The re-start took place in early Aug. 1994. Construction on the Superphénix began in 1972 and costs so far have totalled FFr 51 billion, or some $8 billion. See Benhamou, G., 'Le Gouvernement enterre la rentabilité de Superphénix', *Libération*, 24 Feb. 1994.

[25] Japan—the country that since the 1960s has invested the most on reprocessing plutonium from its own nuclear power plants—is seriously reconsidering its commercial nuclear policy, due partly to international criticism and partly to cost considerations. See Sanger, D. E., '20-year delay in nuclear plan', *International Herald Tribune*, 23 Feb. 1994.

[26] CISAC (note 12).

[27] Moscow and Washington subsequently agreed on reciprocal visits of each other's plutonium storage facilities. See chapter 7, section X.

[28] On nuclear warheads and pits see section V.

strengthen the IAEA financially and otherwise. The USA is also urged to continue to provide assistance for the construction of a Russian storage facility (see the next section). Third, as for excess weapon plutonium disposition, after a thorough investigation of many possibilities, the panel recommended as 'most promising' two alternatives: the spent-fuel option and the vitrification option, neither of which, however, can be implemented immediately, given the time and resources required for construction or modification of the required facilities. The former option, which is favoured by the Russian Government, entails the use of the plutonium in existing and future commercial nuclear reactors.[29] With the latter option, the plutonium would be mixed with radioactive high-level wastes and the resulting material would be melted into glass logs. This would make reprocessing for weapon use about as difficult as it is with spent fuel. A third option, burial of the plutonium in deep boreholes, is described by the CISAC report as deserving of additional study.

[29] This alternative presents a number of technical and commercial problems, some of which have been touched upon in the preceding sections of this study. The CISAC report emphasizes that proliferation risks are raised by all kinds of plutonium stocks, military and civilian, separated and unseparated. Thus, any spent fuel option 'can only realistically be considered in the broader context of the future of nuclear electricity generation'. CISAC (note 12).

5. Preventing a 'brain drain' from the nuclear weapon complex[1]

Stemming nuclear weapon proliferation implies keeping under strict control not only existing weapons, the fissile materials and the other non-nuclear components needed to build new ones, but also the know-how—preventing the so called 'brain drain' phenomenon. Preventing 'brain drain' from such a far-flung and elaborate nuclear weapon complex as that of the FSU is as difficult as it is important.

I. The people

Overall responsibility for the nuclear weapon complex in the Soviet Union fell under the Ministry of Atomic Power and Industry (MAPI), an agency created in 1989 from the Ministry of Medium Machine-Building. MAPI was charged with the supervision of all nuclear programmes, both civilian and military, in all their aspects. On 28 January 1992, after the breakup of the Soviet Union, MAPI was liquidated. Its legal successor under the jurisdiction of the Russian Federation is the Ministry for Atomic Energy (Minatom), headed by former MAPI Minister Viktor Mikhailov. Minatom has at its disposal over 151 enterprises with over one million personnel, '47.2 per cent [of whom are] engaged in the manufacture process, 16.5 per cent in science, 19.4 per cent in construction and 16.9 per cent in other nuclear related branches'.[2]

While it is plausible to assume that once a nuclear warhead is assembled and made ready to function Minatom transfers jurisdiction over to the military, very little is known about the relationship between the two, including whether this is normally smooth or whether they observe the same standards of custodianship.

According to a US CIA estimate, some 900 000 people in the FSU, civilian as well as military, had clearances to work with nuclear

[1] The primary source for this section of the study is Cochran, T. B. and Norris, R. S., *Russian/Soviet Nuclear Warhead Production,* Nuclear Weapons Databook Working Paper no. 93–1 (Natural Resources Defense Council: Washington, DC, 8 Sep. 1993).

[2] Mikhailov, V. N., 'Conversion of nuclear complex of the Russian Federation and nuclear disarmament', Paper presented at the International Symposium on Conversion of Nuclear Warheads for Peaceful Purposes, Rome, 15–17 June 1992.

weapons. Of these, 2000 had detailed knowledge of weapon design and 3000–5000 worked at a high know-how level in the production of fissile material.[3]

Somewhat different numbers were offered in 1992 by Robert L. Gallucci, then US Assistant Secretary of State for politico-military affairs. According to Gallucci:

If one was concerned with the scientists and engineers who actually have the full range of knowledge about how to design, develop, manufacture, and field nuclear weapons, who can direct programmes, and who can build the whole span, there probably are not more than 100–200 such individuals. If one wanted to identify and count the number of people who are directly involved in the manufacture of nuclear weapons—those who could design and develop the high-explosive device that compresses these things, or who know everything about the electrical components, or everything about the shaping of the fissile material, or some aspect of the actual weapon itself, and who would be extremely helpful to a country that was wishing to build one of these weapons—there are probably some thousands of those. If you want to talk about the number of people involved in fissile material production . . . you would be talking about expanding that to tens of thousands of people. If you're talking about support people, we're pushing up against 100 000 people, just in the nuclear area.[4]

II. The laboratories

As in the United States, where nuclear warheads and bombs are designed in two national laboratories—Los Alamos and Livermore—there are also two such complexes in the FSU: the Scientific Research Institute of Experimental Physics, also known as Arzamas-16; and the Scientific Research Institute of Technical Physics, also called Chelyabinsk-70. The division of labour between these two centres is not publicly known. In the USA it takes place on a competitive basis for each new weapon, and the winning laboratory is charged with following the entire life-cycle of the weapons it designs.

A third US laboratory, Sandia, is responsible for the non-nuclear parts of a nuclear weapon. The Pantex plant is where final assembly takes place. In the FSU it appears that Arzamas-16 and

[3] Norris, R. S., 'The Soviet nuclear archipelago', *Arms Control Today*, vol. 22, no. 1 (Jan./Feb. 1992), pp. 24–31.

[4] 'Ambassador Robert L. Gallucci: redirecting the Soviet weapons establishment', *Arms Control Today*, vol. 22, no. 5 (June 1992), pp. 5–6.

Chelyabinsk-70 deal with weapon development up to the stage of prototype creation. Warhead assembly and disassembly work is carried out at Arzamas-16 in a limited way and at three other sites: Sverdlovsk-45 at Nizhnyaya Tura, on the eastern edge of the Urals (the main such centre), Zlatoust-36 in Yuryuzan, and Penza-19 in Kuznetsk. According to Minatom sources, the combined warhead fabrication capacity of these four centres is about 7000 devices per year.

There has been contradictory information concerning nuclear weapon manufacturing in Russia. In September 1994, a written statement by Mikhailov seemed to imply that nuclear weapon production was still taking place. The minister noted: 'One of the important activities [of Minatom] today is the utilisation of outdated nuclear ammunitions under the nuclear weapon reduction programme. Today the amount of this work is more than twice as large as that of batch production of nuclear ammunition'.[5]

Presumably many other plants and production facilities are involved in the nuclear weapon fabrication process. 'The US B-61 bomb, for example, contains approximately 1800 discrete parts supplied by nearly 570 different contractors. These parts are combined into 120 sub-assemblies at nine different sites before the bomb is finally assembled at the Department of Energy's Pantex facility near Amarillo, Texas'.[6]

III. The problem of closed cities and the spectre of a 'brain drain'

In November 1991, the Japanese newspaper *Yomiuri Shimbun* published a list of 10 closed Russian cities where nuclear weapons are designed and manufactured. All these centres were previously unknown and none appeared on any map of the FSU. The list, presented as a classified Soviet document, has since been confirmed as authentic and is reproduced here as table 5.1. It includes all the

[5] Mikhailov (note 2).

[6] Campbell, K. M. *et al.*, *Soviet Nuclear Fission: Control of the Nuclear Arsenal in a Disintegrating Soviet Union*, CSIA Studies in International Security, No. 1 (Center for Science and International Affairs, John F. Kennedy School of Government, Harvard University: Cambridge, Mass., Nov. 1991), p. 24. See also Mikhailov, V., 'A general description of the RF Ministry for Nuclear Power', *International Affairs*, no. 9 (1994), p. 16.

Table 5.1. Closed cities in the Soviet nuclear complex

Post box names	Real names	Population
Arzamas-16	Kremlev	80 300
Chelyabinsk-70	Snezhinsk	46 300
Chelyabinsk-65	Ozersk	83 500
Krasnoyarsk-26	Zhelenogorsk	90 300
Krasnoyarsk-45	Zelnogorsk	63 300
Penza-19	Zarechnoye	61 400
Sverdlovsk-44	Novouralsk	88 500
Sverdlovsk-45	Rusnoy	54 700
Tomsk-7	Seversk	107 700
Zlatoust-36	Torifugornuy	29 800

Source: *Yomiuri Shimbun,* 17 Nov. 1991.

facilities mentioned above. The 10 cities reportedly had a combined population of 705 800.

The population in these remote, self-contained places was totally dependent on generous subsidies from the central government. The dire financial situation of Russia, coupled with the fact that the research, design and manufacture of nuclear weapons are no longer a state priority, has turned living standards in the centres upside down: from above-average, privileged status to substantial neglect. In Arzamas and Chelyabinsk, failure to pay staff for two months in late spring 1993 triggered protest rallies. Moreover, salaries in these laboratories have been growing much slower than in the rest of the economy.[7] Obviously, this feeds into the brain drain problem. It also increases the likelihood that people from the Russian nuclear weapon complex might be tempted to obtain and smuggle weapon-grade fissile materials. Since the material control and accountancy in most of the Russian facilities leave much to be desired,[8] the outlook for nonproliferation is not particularly bright—which calls for an intensification of all those Western efforts intended to improve the working and living conditions of former nuclear weapon scientists in Russia.[9]

[7] US Congress, Office of Technology Assessment, *Proliferation and the Former Soviet Union*, OTA-ISS-605 (US Government Printing Office: Washington DC, Sep. 1994), p. 63.
[8] For more on material control and accountancy, see chapter 6, section V.
[9] For more on these efforts, see chapter 8, section IV.

Of great importance is the fate of the immense reservoir of FSU scientists and technicians with advanced, military-applicable know-how. The economic crisis in the FSU makes their current monthly salaries worth a few tens of dollars at the current rate of exchange of the rouble, while there is presumably plenty of demand for their skills in the world, with monthly salaries reaching several thousand US dollars. To expect this demand to be limited to peaceful nuclear applications would amount to wishful thinking.

It must also be taken into account that the opening up of the former Soviet society is bound to imply a larger freedom of international movement for its citizens. In fact, a rather liberal Law on the Procedures of Exit from the Union of Soviet Socialist Republics (USSR) and Entry to the USSR for Citizens of the USSR had been approved on 20 May 1991, after two years of discussion. This law was later adopted by the Russian Federation and took effect on 1 January 1993. While little is know about the legislation on emigration in the other former Soviet republics, in Russia there are legal restrictions. 'People with access to information constituting a state secret, for example, may be prohibited from leaving the country for up to five years from the time of last contact with such information. The five-year term can then be extended on an individual basis by the appropriate government committee'.[10]

[10] Helmstadter, S., 'The Russian brain drain in perspective', *RFE/RL Research Report*, vol. 1, no. 42 (23 Oct. 1992), pp. 57–60.

6. Preventing leakage of fissile materials and other weapon components

I. Fissile material production

There are two main areas in which uranium ore can be extracted in Russia, two in Ukraine, three in Kazakhstan and two in Uzbekistan. Taken together, these sites represented in 1991 some 26 per cent of the world's known uranium resources in the categories Reasonably Assured Resources (RAR) and Estimated Assured Resources, Category I (EAR-1). Production of uranium from conventionally mined ore was in the FSU heavily concentrated in the central Asian republics (Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan) with one facility each in Ukraine and Russia.[1]

Although in October 1989 the Soviet Government announced the cessation of the production of weapon-grade HEU, four plants for uranium enrichment are still operational for the civilian nuclear industry and for naval reactors. All these facilities use gas centrifuges and are located in Russia. They are: the Ural Electrochemistry Combine (Sverdlovsk-44) at Verkh-Neyvinsk (49 per cent of production); the Electrochemistry Combine (Krasnoyarsk-45), on the Kan River, in Siberia (29 per cent of production); the Siberian Chemical Combine (Tomsk-7) (14 per cent of production); and the Electrolyzing Chemical Combine at Angarsk, near Lake Baikal (8 per cent of production).[2] The plants which convert the material into uranium hexafluoride prior to enrichment are also located at Verkh-Neyvinsk and Angarsk. A plutonium production reactor site is also located at Tomsk.[3]

[1] Bukharin, O., 'Nuclear fuel cycle activities in Russia', in eds T. B. Cochran and R. S. Norris, *Russian/Soviet Nuclear Warhead Production,* Nuclear Weapons Databook Working Paper no. 93–1 (Natural Resources Defense Council: Washington, DC, 8 Sep. 1993). Another source reports two more active uranium production facilities in the FSU, one in Ukraine and one in Estonia. See Potter, W. C., 'Nuclear exports from the former Soviet Union: what's new, what's true', *Arms Control Today*, vol. 23, no. 1 (Jan./Feb. 1993), pp. 3–10.

[2] Arbatov, A. and Pinchukov, Y., 'The elimination of nuclear weapons in Russia', Background document to the 22nd Pugwash Workshop on Nuclear Forces, held in Geneva, 5–6 Mar. 1994; and 'Denuclearization in the FSU proceeding', *Arms Control Today,* vol. 24, no. 5 (June 1994), pp. 31.

[3] Bukharin (note 1). According to Potter (note 1), plants for the conversion of uranium concentrate into uranium hexafluoride are located also in Kyrgyzstan, Tajikistan and Ukraine.

At least five other gaseous diffusion plants existed in the FSU, and together with the other four it is estimated that they have produced 700–1000 tonnes of HEU over the years.[4] Some 50 kg of HEU are needed to make a gun-type fission bomb, and some 15 kg to make an implosion fission bomb. Smaller quantities might suffice with more sophisticated designs.

Plutonium and tritium production in the FSU has taken place at three sites, all in Russia: Chelyabinsk-65 (formerly Chelyabinsk-40), Tomsk-7, and Krasnoyarsk-26. Some 170 tonnes of weapon-grade plutonium have been produced over the years. The civilian stockpile of plutonium for the FSU breeder reactor programme—which is very unlikely to be pursued any further, given its financial and technical problems—had reached in 1990 the level of some 25 tonnes.[5] Some 4 kg of plutonium are needed to make an implosion fission bomb. The precise quantity depends on the details of a specific device: a smaller quantity might suffice with more sophisticated designs.[6]

Between 1987 and September 1992, 10 reactors were shut down, leaving only two graphite-moderated reactors at Tomsk-7 and one at Krasnoyarsk-26 for the production of weapon-grade plutonium. Two operational light water reactors at Chelyabinsk-65 are used for the production of special isotopes, including (if it is still produced at all) tritium, a relatively short-lived radioactive hydrogen isotope (12 years of half-life—as opposed to 713 million for uranium-235 and 24 400

[4] See annexe A.

[5] According to data released by the Department of Energy in an Openness Press Conference held in Washington on 7 Dec. 1993, the current level of the US plutonium stockpile is 33.5 tonnes; between 1945 and 1988 total production of weapon-grade plutonium was 89 tonnes, plus 13 tonnes of reactor-grade plutonium. See Lockwood, D., 'Nuclear arms control', SIPRI, *SIPRI Yearbook 1994* (Oxford University Press: Oxford, 1994), p. 661; and Horvitz, P., 'US tells of secret A-tests and its plutonium stockpile', *International Herald Tribune*, 8 Dec. 1993. These data may underestimate the real quantities involved; Secretary of Energy, Hazel O'Leary has ordered a comprehensive study of the question. See Programme for Promoting Nuclear Non-Proliferation, *PPNN Newsbrief* (second quarter 1994).

[6] See table 4.1. Recently it has been suggested that 3 kg of plutonium or 8 kg of HEU would be sufficient to manufacture a nuclear explosive device with a yield of at least 1 kt (i.e., 1 million kg of equivalent conventional high explosive). This would be possible using a 'low technical capability'; with a 'medium technical capability' the estimates shrink to 1.5 kg and 4 kg respectively, and with a 'high technical capability' to 1 kg and 2.5 kg, respectively. On the basis of these estimates it is argued that the 'quantities of safeguards significance' of the IAEA should be reduced by a factor of 8, from the present values of 8 kg of plutonium, 8 kg of uranium-233 and 25 kg of HEU to 1 kg of plutonium, 1 kg of uranium-233 and 3 kg of HEU. See Cochran, T. B. and Paine, C. E., *The amount of plutonium and highly-enriched uranium needed for pure fission nuclear weapons* (Natural Resources Defense Council: Washington, DC, 22 Aug. 1994).

for plutonium-239) used as a 'booster' in nuclear bombs.[7] The Russian tritium inventory may have peaked at around 90 kg in 1986, when the number of warheads in the FSU nuclear weapon arsenal also peaked, and is currently estimated at about 66 kg.[8] Plutonium production continues at an estimated yearly rate of 1.5 tonnes for weapon-grade plutonium and 1.0 tonne for reactor-grade plutonium.[9] Moscow has now agreed to halt this production soon.[10]

II. Other nuclear weapon-related production

Production of some other materials used in nuclear weapons was, and possibly still is, also taking place outside Russia. For instance, there are sites for the production of heavy water in Armenia and Ukraine and possibly in Tajikistan; zirconium and beryllium are produced at the Ulbinskiy Metallurgy Plant at Ust-Kamenogorsk in eastern Kazakhstan.

Indirectly linked with the nuclear weapon complex is the more widespread and far-reaching military–industrial complex that designs, develops and produces nuclear delivery vehicles and platforms. Outside Russia, the main such facilities are in Riga, Latvia (missile production); Minsk, Belarus (design bureau); Kiev (design bureau, aircraft production, missile production, naval production), Kharkov (design bureau, aircraft production, missile production), Nikolayev (naval production), Pavlograd (aircraft production), Zaporozhye (design bureau, aircraft production), Dnepropetrovsk (design bureau, missile production), Kerch (design bureau, naval production), all in Ukraine; Tbilisi, Georgia (aircraft production); and Tashkent, Uzbekistan (aircraft production).

[7] The nucleus of tritium is composed of one proton and two neutrons; its 2:1 ratio of neutrons to protons is higher than for any other reasonably long-lived atomic nucleus. Thus the presence of tritium constitutes an abundant source of neutrons, which facilitate the development of the nuclear chain reaction, based on nuclear fission caused by neutrons and yielding neutrons ('neutron multiplication'). Fission is the basic phenomenon underlying the explosive release of nuclear energy in 'atom bombs', which also serve as triggers to initiate the thermonuclear reactions which characterize 'hydrogen bombs'. Tritium and Lithium 6 are also the main fuels for the fusion reactions which are the basic phenomena underlying the explosive release of nuclear energy in thermonuclear weapons ('hydrogen bombs'). See also annexe A.

[8] International Network of Engineers and Scientists Against Proliferation, *INESAP Information Bulletin*, no. 3 (Oct. 1994), p. 17.

[9] Bukharin (note 1).

[10] See chapter 7, section III.

Table 6.1. Soviet military design bureaus, 1989

Specialization	Number of plants
Strategic missiles and space boosters	7
Tactical missiles	9
Aircraft	9
Ships	6
Satellites	6
Tracked vehicles and artillery	7
Radar	8
Total	**52**

Source: Cochran, T. B. *et al.*, *Nuclear Weapons Databook, Vol. IV: Soviet Nuclear Weapons* (Ballinger: Cambridge, Mass., 1989).

Table 6.2. Soviet military production plants, 1989

Specialization	Number of plants
Missile and components	49
Aircraft and components	37
Ground force materiel	24
Naval shipyards	24
Ministry of Medium Machine Building[a]	47
Total	**181**

[a] Includes facilities producing nuclear weapons and now under MAPI administration. Probably not all are involved exclusively in defence production.

Source: Cochran, T. B. *et al.*, *Nuclear Weapons Databook, Vol. IV: Soviet Nuclear Weapons* (Ballinger: Cambridge, Mass., 1989).

Particularly noteworthy among these is the Dnepropetrovsk Missile Development and Production Centre, 'the largest missile-producing plant in the world—two million square feet of floor space—where ICBMs designed by the Yangel [design bureau] are built'.[11] All in all, there were 52 military design bureaus and 181 major military production plants in the FSU, as shown in tables 6.1 and 6.2.

[11] Cochran, T. B. *et al.*, *Nuclear Weapons Databook, Vol. IV: Soviet Nuclear Weapons* (Ballinger: Cambridge, Mass, 1989), p. 77.

III. Naval nuclear reactors

There is a naval dimension to the Soviet nuclear weapon and military complex which is often overlooked. In 1992, Russia had the largest nuclear-powered fleet in the world with more than 320 nuclear reactors in operation—a figure that does not include nuclear-powered ships with a civilian crew, such as some ice-breakers. The vast majority of these reactors powered both strategic and attack submarines. They all use HEU, hence their spent fuel contains much less plutonium than that of ordinary nuclear reactors for electricity generation.[12]

The safety record of FSU naval nuclear operations is dismal: 'With at least eight nuclear submarines permanently lost due to sinking or reactor meltdown, Soviet nuclear submarines were at times as much a threat to Soviet sailors and to the environment as they were to western navies'.[13] Some 60–80 nuclear submarines are docked awaiting final disposition in Russia; it is not known how many of these still have spent fuel on board. The entire reactors have been removed from only three vessels.

Is there, therefore, a good case to be made for channelling some Western aid to help in FSU nuclear submarine decommissioning? Here opinions diverge. According to the environmental organization Greenpeace, both the Pacific Fleet and the Northern Fleet of the Russian Navy lack the capacity and the resources to scrap the decommissioned submarines.[14] According to at least one US author, Moscow has consciously decided to employ its naval industrial capacity to build additional nuclear submarines rather than to decommission old ones. Thus, 'financial assistance might provide a cross-subsidy for the construction of new warships'.[15]

Another question is nuclear waste dumping at sea, which is still practised by the Russian Navy. A recent episode in the Sea of Japan concerning 900 tonnes of radioactive waste from nuclear submarines led to protests by Japan and other countries. Russia eventually bowed

[12] George, G. R., 'Naval nuclear aspects of cooperative denuclearization', eds Allison, G. *et al., Cooperative Denuclearization: From Pledges to Deeds,* CSIA Studies in International Security, No. 2 (Center for Science and International Affairs, John F. Kennedy School of Government, Harvard University: Cambridge, Mass., Jan. 1993).

[13] Handler, J., 'Russian Navy nuclear submarine safety, construction, defense conversion, decommissioning, and nuclear waste disposal problems', Greenpeace, Nuclear Free Seas Campaign, 15 Feb. 1993.

[14] Handler (note 13).

[15] George (note 12).

to the objections, cancelling plans for further dumping, but noting at the same time that construction of a plant to process the waste on land would cost $8.5 million. On the same occasion, Japanese officials said that they were ready to discuss the possibility of using for this purpose some of the $100 million Japan has allocated to the dismantlement of FSU nuclear weapons.[16]

Finally, there is the question of assessing the radiological hazards posed by nuclear reactors lying on the seabed, particularly in the Arctic Ocean: $18.6 million of US Nunn–Lugar programme funds have already been obligated,[17] out of a total sum of $20 million allocated for this purpose.[18] In the case of the *Komsomolets*, a Soviet nuclear submarine that sank off the coast of Norway in 1989, preliminary reports indicate that the hazards are limited, owing mainly to the relatively weak underwater current around the hulk.[19]

IV. The role of the Russian nuclear industry

The fate of the fissile material to be extracted from the FSU nuclear weapons is linked with the debate on the future of the nuclear industry in Russia: different opinions exist within the Russian leadership itself. For example, on the eve of the July 1992 G-7 meeting, an organization called Socio-Ecological Union urged that the FSU nuclear reactors be shut down altogether and replaced with gas-turbine power modules at an estimated cost one-tenth of that of replacing nuclear reactors with new, safer designs.[20] Yeltsin's adviser on ecological problems, Alexey Yablokov, supported this proposal.

Critics point not only to the unsatisfactory safety record of Soviet nuclear plants, but also to the relatively low importance of nuclear energy in the FSU (3.4 per cent of primary energy sources, 13 per cent of electricity in 1988). Doing away with it, they suggest, appears feasible if one considers the abundance, especially in Russia, of alternative sources (oil, coal, natural gas) and the large scope for improving energy efficiency in the CIS.

[16] Whitney, C. R., 'Russia seeks aid as it suspends N-waste disposal off Japan', *International Herald Tribune*, 22 Oct. 1994.

[17] See chapter 8, section I.

[18] See table 8.1.

[19] Broad, W. J., 'Russia submarine's hulk "not that bad"', *International Herald Tribune*, 6 Sep. 1993.

[20] The proposed modules would use aviation engines of the Su-27 fighter aircraft, thus providing a good opportunity of conversion from military to civilian production.

On the other hand, it is clear that a powerful pro-nuclear lobby exists in Russia, as underlined by the creation of a separate Ministry for Atomic Energy (Minatom). In Western countries, for example, nuclear affairs normally fall under the jurisdiction of a department of energy. The fact that Viktor Mikhailov, the current chief of Minatom, formerly played a leading role in the Soviet nuclear weapon programme is another indication of a persistent linkage between the military and civilian aspects of the Russian nuclear establishment. Minatom's insistence on the eventual use of weapon-grade plutonium as nuclear fuel is probably intended to justify (while aiding the disarmament process) the construction of new nuclear power plants—construction which otherwise would be made all but impossible by Russia's dire financial predicament.[21]

There also seems to be an ideological strain in the notion, certainly prevalent among the present leaders of the Russian nuclear complex, that since plutonium was very costly to produce it is a very valuable material, to be used rather than disposed of. Mikhailov is on record as saying: 'We have spent too much money making this material to just mix it with radioactive wastes and bury it'.[22] In the United States, perhaps because of a more natural empathy with a market-oriented view of the economy, the fact that using plutonium—even if made available at zero cost—is more expensive than purchasing and using an alternative fuel (LEU) is perceived as a strong argument to suggest that plutonium should be disposed of rather than utilized—of course the cost of disposal must also be factored into the economic evaluation. It is for these reasons that the CISAC study seems to favour disposal rather than re-use,[23] in any case emphasizing that the decision about what to do with the weapon-grade plutonium made available from nuclear disarmament must be made primarily on the

[21] As Minatom plans have it, after at least a decade of storage the plutonium from the FSU nuclear weapons would be used to fuel three BN-800 liquid-metal fast breeder reactors to be built at Chelyabinsk-65. However, it is difficult to see where Minatom can find the financial resources necessary to build these three plants, as well as a MOX fabrication facility to provide fuel for them. See Lockwood (note 5) p. 663. A useful overview of the FSU nuclear industry's status and plans is Marples, D. R., 'Nuclear power in the CIS: a reappraisal', *RFE/RL Research Report*, vol. 3, no. 22 (3 June 1994), pp. 21–26.

[22] Quoted in Wald, M. L. and Gordon, M. R., 'Plutonium: world peril or cornucopia?', *International Herald Tribune*, 20–21 Aug. 1994.

[23] See chapter 5.

basis of security considerations.[24] On the other hand, from the point of view of long-term ecological considerations there may be a case for not forsaking the utilization of the energy potential stored in plutonium nuclei.

Finally, it might also be noted that to the extent nuclear deterrence helped to preserve peace during the cold war, the resources used to produce Soviet weapon-grade plutonium have already provided a substantial return on the investment—which is perhaps an argument to help overcome the psychological barrier entertained by some of the leaders of the nuclear complex in the FSU against 'throwing away' the plutonium whose production has required such tremendous financial and human sacrifice.

V. The problem of interim storage

While a satisfactory solution to the problem of final disposal of the weapon-grade fissile material extracted from excess nuclear weapons will take years to enter its operational phase,[25] especially in the case of plutonium, interim storage is a case for immediate concern. Indications abound, in fact, that in the FSU all the current relevant practices—from physical security to material control and accountancy—are in urgent need of amendment.

In November 1994 it became known that the USA, in agreement with local authorities, had conducted a secret operation in Kazakhstan to purchase and transport 600 kg of HEU to the USA. In this case it was not so much the operation itself, which was successful, that gave rise to concern. Rather it was the fact that the HEU had been found stored in an unguarded warehouse in the middle of a factory employing more than 14 000 people—in Ulba, a city 1300 km north-east of Almaty. Reportedly, 'no chemical essays or radiation sensors were used to account for or safeguard the material. Instead, its presence or absence was simply noted by hand in record books'.[26]

A US visitor to a facility in Russia containing about 600 kg of weapon-grade plutonium found out that although it lay inside a large

[24] Committee on International Security and Arms Control (CISAC), National Academy of Sciences, *Management and Disposition of Excess Weapons Plutonium—Executive Summary* (National Academy Press: Washington, DC, 1994).

[25] See chapter 4, section VI.

[26] Smith R. J., 'Kazakh uranium had few safeguards, US experts found', *International Herald Tribune*, 25 Nov. 1994.

fenced and guarded area protecting against an overt external threat, there were no portal monitors or metal detectors at the facility. No measure was in place, in other words, to detect or deter an insider from covertly stealing plutonium fuel pills which, being about half an inch thick and about an inch and a half in diameter, could easily be concealed in a pocket.[27]

It appears also that accounting for all Russian nuclear material is done in paper form, through a so-called passport which describes the amount and type of material, 'a copy of which goes with the material and a record is kept from where it is sent'. Russian nuclear officials told their US colleagues that in the FSU, 'Book inventories were done once a year and based on the value (or cost) of the material, but no actual measurements were made, and there was no estimate of uncertainty or errors. Every manager kept his stock of extra material, made up from allowed book losses to make up for actual or apparent losses'. As for the present, they said that 'The Russian nuclear regulatory organization, Gosatomnadzor (GAN), is still under development, has many vacancies and no professionals available'.[28]

Other observers confirm this bleak picture. In testimony before the Foreign Affairs Committee of the US House of Representatives on 27 June 1994, William C. Potter noted that almost all nuclear facilities in Russia that control HEU and plutonium suffer from past inadequate accounting practices, making the distinction between 'stolen' and 'unaccounted for' largely impossible. Potter added that:

> The most dangerous and immediate problem involving inadequate physical security concerns the large stockpile of HEU in the form of fuel for Russia's nuclear propulsion reactors. This fresh fuel, much of it enriched to between 70 and 90 percent, is concentrated at shipbuilding plants that in 1993 supported over 200 nuclear-powered ships in the Russian Navy's Northern and Pacific Fleets, as well as seven civilian nuclear ice-breakers. These ships contained nearly 400 nuclear reactors. An associated, but subordinate physical security problem relates to the storage of spent fuel from the reactors of 113 nuclear-powered submarines that recently have been decommissioned.[29]

[27] Sutcliffe W. G., personal communication, 20 Dec. 1994.

[28] Sutcliffe (note 27).

[29] Potter is Director of the Program for Nonproliferation Studies at the Monterey Institute of International Studies. His testimony is reproduced in 'Nuclear insecurity in the post-Soviet states', *Nonproliferation Review*, vol. 1, no. 3 (spring–summer 1994), pp. 31–46. On naval nuclear reactors, see section III.

VI. Export controls in the former Soviet Union[30]

There is little doubt that nuclear proliferation concerns will continue for several years to loom large in the relations between Russia and the rest of the world. Both the nuclear hardware and 'software', that is, materials and knowledge, accumulated by the vast FSU nuclear system described above will have to be monitored lest they end up helping unwanted programmes throughout the world.

Accountability and final disposal of nuclear warheads and their fissile materials are only a part, although a very important one, of the hardware problem. A host of other technologies useful in nuclear-related programmes (enrichment and reprocessing techniques, warhead design, arming and fusing, to name only a few) as well as the transfer of delivery vehicles (especially cruise and ballistic missiles, and combat aircraft) and the technology to build them will all have to be held in check.

Russia is an NPT depositary state and a member of the Nuclear Suppliers Group (NSG). It signed with the USA in November 1993 an agreement to abide by the standards of the Missile Technology Control Regime (MTCR), which limits the transfer of ballistic missiles of more than 300-km range and related components and technology. Export control lists conforming to the NSG and MTCR lists were approved via Presidential Orders, Government Regulations and Decrees in 1992–93.

Ukraine, while not a member of the NSG, is now a party to the NPT. In May 1994 this country, which has a substantial missile production capacity, signed a Memorandum of Understanding with the USA in which it agreed to conform to the criteria and standards of the MTCR, and it is drafting the relevant export control list. Three decrees issued in 1992–93 form the legal basis of nuclear export controls.

Belarus and Kazakhstan are both members of the NPT, but neither adheres formally or informally to NSG or MTCR restrictions. While Belarus has in 1991–93 issued several decrees concerning nuclear export controls, and is also drafting an overarching export control law, Kazakhstan has an export control structure still in its formative stage. Belarus, Kazakhstan and Russia, but not Ukraine, are parties to

[30] Information in this section is based on that contained in *Nuclear Successor States of the Soviet Union*, no. 1 (May 1994).

the 26 June 1992 Minsk accord on CIS Export Control Coordination. On 9 February 1993 they also reached an agreement with five other CIS states to co-operate in the control of exports which could be used to manufacture weapons of mass destruction. This was an important first step, as several other FSU states have the potential to engage in nuclear commerce and should be drawn into the relevant regime.

Before the states parties to the Coordinating Committee on Multilateral Export Controls (COCOM) (all NATO members, except Iceland, plus Australia and Japan) decided to end COCOM's activities on 31 March 1994, they had agreed to establish on 1 June 1992, a COCOM Cooperation Forum on Export Controls, in which the former Soviet republics were invited to participate. It remains to be seen what role these states will play in any organization that will succeed COCOM. Meanwhile Western nations have made export controls one of their priority areas in nuclear disarmament assistance to the FSU.[31]

Even with the best set of applicable laws, the implementation of export controls is an entirely different matter. According to a report of the Office of Technology Assessment of the US Congress:

> Under the Soviet Union, the flow of goods had been controlled by highly intrusive and restrictive border police actions, and more directly by the fact that foreign trade was a state monopoly and that all major vendors were state owned. Customs services, as they are known in Western countries, did not really exist. Since the dissolution of the Soviet empire, the role of the border police in controlling flows of commodities and people has become considerably less draconian. At the same time, corruption has increased in all segments of society, including border control personnel. It is therefore essential for Russia to establish, train, motivate, and equip an effective customs service that is both competent and resistant to corruptibility. This latter requirement is difficult, given the current parlous state of economic affairs.[32]

[31] See chapter 8, sections I and II.

[32] US Congress, Office of Technology Assessment, *Proliferation and the Former Soviet Union*, OTA-IIS-605 (US Government Printing Office: Washington DC, Sep. 1994), p. 29.

7. Arms control and nuclear weapons in the FSU

I. START I and II

The Strategic Arms Reduction Treaty (START I) was signed in Moscow on 31 July 1991 by Presidents George Bush and Mikhail Gorbachev. START I entered into force on 5 December 1994 when the Presidents of Belarus, Kazakhstan, Russia, Ukraine and the USA, the five states signatories of the Lisbon Protocol, exchanged the instruments of ratification in Budapest.

The main provisions of START I include a reduction, to be accomplished over a seven-year period, from the existing forces down to 6000 'accountable' warheads deployed on no more than 1600 strategic nuclear delivery vehicles for each side.

Under START I, heavy bombers are accorded special counting rules. They count as only one warhead when equipped with gravity bombs and short-range attack missiles (SRAMs) although they generally carry several bombs and SRAMs. They count as 8 (in the Soviet case) or 10 (in the US case) warheads when carrying ALCMs—although Soviet and US bombers can actually be loaded with twice as many ALCMs. This 'discounting' of bomber loadings means that the actual number of strategic warheads permitted after the START I reductions is about 7000 for the FSU and about 9500 for the USA.

The Bush and Gorbachev initiatives of September–October 1991, although mainly focusing on tactical nuclear weapons, also included measures affecting their respective strategic forces. On the Soviet side, it was announced that all bombers and 503 ICBMs were removed from alert; six Yankee Class SSBNs were taken out of operation; existing rail-based missiles were to be kept at their main bases and the production of additional ones were frozen, as well as the development of new modified SRAMs for strategic bombers and new mobile small ICBMs.

In his State of the Union address on 28 January 1992, President Bush gave the nuclear disarmament process further impetus by announcing a number of unilateral cuts in US strategic programmes and by calling for an agreement with Russia to eliminate all land-based missiles with multiple warheads.[1] Since these systems represent the bulk of Russian strategic forces as opposed to some 10 per cent of post-START I US forces, Bush offered as a sort of compensation to cut US submarine-based warheads by about one-third. A few hours after Bush's address, President Boris Yeltsin announced that all production of heavy bombers, as well as of nuclear SLCMs and ALCMs, would be stopped.[2] He also proposed cuts leaving 2000–2500 strategic nuclear warheads on each side.

After almost five months of informal negotiations—mainly through a series of meetings between the US Secretary of State James Baker and Russian Foreign Minister Andrey Kozyrev—an agreement was signed by Presidents Bush and Yeltsin on 17 June 1992 spelling out the provisions of a 'tight and simple' follow-on treaty on strategic weapons—START II—which was to be concluded over three months.

As was to be expected, the main feature of the accord placed it almost halfway between the two sides' initial proposals: the ceiling agreed upon for strategic warheads was, in fact, 3000–3500; Russia agreed to eventually get rid of all ICBMs with multiple warheads; and the USA accepted a 50 per cent cut in its SLBM force.[3]

The reductions are to be accomplished in two phases. In the first phase, up to the year 2000, coinciding with the reduction period covered by START I, the number of warheads deployed will be reduced to 3800–4250, with sub-ceilings of 1200 warheads on ICBMs (no more than 650 of which on heavy ICBMs), and 2160 warheads on SLBMs. In the second phase, up to the year 2003, the number of warheads deployed will fall to 3000–3500, with a sub-ceiling of 1750 warheads on SLBMs, and the remainder available to be mixed between warheads carried by bombers and single-warhead ICBMs (all multiple-warhead ICBMs will be eliminated). It was envisaged that the deadline of 1 January 2003 will be moved back to 31 December 2000 if the United States can help (financially and otherwise) to expedite the destruction of strategic nuclear weapons in Russia.

[1] An excerpt from the address is reproduced in SIPRI, *SIPRI Yearbook 1993: World Armaments and Disarmament* (Oxford University Press: Oxford, 1993), p. 574.

[2] Production of heavy bombers was suspended in 1992 and there are currently no plans to reopen production lines. See Arbatov, A. (ed.), *Implications of the START II Treaty for US–Russian Relations*, Report no. 9 (The Henry L. Stimson Center: Washington, DC, Oct. 1993).

[3] Reportedly, the 3000 ceiling will apply to Russia and the 3500 one to the USA. See, for example, 'Partners with Russia', *International Herald Tribune*, 19 June 1992. However, since this asymmetry was not codified in treaty language, it must be the result of an informal understanding between the 2 parties.

Note that the numbers represent in this case actual warheads. Thus START I and START II—which will be in force simultaneously and will be independent of each other, even though the latter will enter into force 'not prior to the entry into force' of the former—will have different counting rules for the same weapon systems: for example, the special counting rules for strategic bombers and their nuclear loads valid under START I will not apply under START II; US Trident SLBMs, which will actually carry four warheads, will be counted as such under START II, but as carrying eight under START I. This choice was made in order to avoid the long and complex negotiations that would presumably have occurred in case START II had to amend or replace START I.[4]

The three–month deadline to complete START II was too optimistic, as it turned out. The Russian delegation engaged in tough bargaining and eventually succeeded in obtaining agreement that five warheads from 105 SS-19s could be removed (the maximum allowable downloading under START I is four warheads) and 90 SS-18 silos could be converted for use by SS-25 missiles. The Treaty on Further Reduction and Limitation of Strategic Offensive Arms was finally signed by Presidents Bush and Yeltsin in Moscow on 3 January 1993, basically codifying the June 1992 Bush–Yeltsin 'Joint Understanding' described above.

A few days after the signing ceremony, the Treaty was submitted to the US Senate for ratification. The Foreign Affairs Committee ran four hearings on the subject but then, in agreement with the Clinton Administration, decided to suspend the process until START I was ratified by all five states and political stability in Russia improved. Debate in the Russian Parliament also began in early 1993 and was characterized by strong opposition to START II. As for the merits of the treaty, critics charged that Russia had sacrificed the main component of its strategic forces (ICBMs), while the USA had kept the main component of its forces (SLBMs) largely intact. As for the politics of the ratification process, it had to do with the growing confrontation between the executive and the legislature which finally led to the violent dissolution of the latter in early October 1993. The Russian Parliament elected in December 1993 has been no less vocal

[4] Lockwood, D., 'New details emerge on START follow-on treaty', *Arms Control Today*, July/Aug. 1992. Potential conflict between the provisions of the treaties is addressed in the preamble of START II, according to which what is not regulated by the terms of START II is to be regulated by the provisions of START I.

in opposing START II, given the presence among its ranks of a substantial number of far-right, nationalist members.

On 26 September 1994, in an address to the UN General Assembly, President Yeltsin proposed a new treaty to cut the strategic nuclear arsenals beyond the levels of START II. As seen by Moscow, this new round of nuclear disarmament should also involve the other three nuclear weapon powers, China, France and the UK.[5]

Two days after his address to the UN, President Yeltsin signed with President Bill Clinton a Joint Statement on Strategic Stability and Nuclear Security. The two presidents 'confirmed their intention to seek early ratification of the START II Treaty, once the START I Treaty enters into force'—which it did on 5 December 1994. They also pledged to deactivate, once START II is ratified, all strategic delivery systems subject to reduction by removing their nuclear warheads or 'taking other steps to remove them from alert status'. As for future disarmament undertakings, the two presidents explicitly envisaged 'the possibility, after ratification of START II, of further reductions of, and limitations on, remaining nuclear forces'.[6]

A few days earlier, on 22 September 1994, the Pentagon had made public the results of its Nuclear Posture Review. It contained no major policy shift: no-first-use was rejected, extended deterrence confirmed, as well as the continuing viability of the nuclear triad (ICBMs, SLBMs, bombers). As in the US–Russian Joint Statement, new agreements further reducing nuclear weapons were foreseen only after the entry into force and initial implementation of START I and START II.[7]

II. The agreement on de-targeting

Safeguards are built-in features of the nuclear command and control system.[8] Additional security measures of an *ad hoc* character can be taken and actually do appear to have been taken in the FSU. For example, 'the 176 missiles in Ukraine are described by Russian offi-

[5] 'At UN, Yeltsin calls for new reductions in nuclear arsenals', *International Herald Tribune*, 27 Sep. 1994.

[6] The White House, Office of the Press Secretary, 'Joint statement on strategic stability and nuclear security by the Presidents of the United States of America and the Russian Federation', 28 Sep. 1994.

[7] Smith, J., 'US keeps nuclear guard against Russia', *International Herald Tribune*, 13 Sep. 1994.

[8] For a discussion of nuclear weapon safeguards, see chapter 3, section III.

cials as being "in the deep freeze", and the 104 SS-18 missiles in Kazakhstan are also off alert (as are the US Minuteman II ICBMs); they would reportedly require 24–48 hours to be fired'.[9]

This information was basically confirmed by Russian Defence Minister Pavel Grachev, reportedly stating that missiles in Belarus, Kazakhstan and Ukraine had been taken off combat alert.[10] He also claimed that missiles on alert have no specific targets, an assertion previously made by Yeltsin but subsequently contradicted by the then CIS Commander-in-Chief, Marshal Yevgeniy Shaposhnikov, who stated that they were targeted as before on the West.

On 14 January 1994, the de-targeting arrangement was made both bilateral and into a public pledge: it was announced in Moscow that the US and Russian strategic nuclear forces will target no country—meaning in fact that their strategic missiles will contain no targeting information, or will be set to ocean area targets, in peacetime.[11] The agreement, which cannot be verified and which would take very little time to reverse, became effective on 30 May 1994. Britain entered a similar agreement with Russia in February 1994, while China followed suit at the beginning of September 1994, during the visit to Moscow of President Jiang Zemin.[12]

III. The fissile material cut-off[13]

In October 1989, the Soviet Government declared that it planned to halt plutonium production by the year 2000. After the break-up of the Soviet Union, in January 1992, Russian President Boris Yeltsin turned this intention into a public pledge. Given the fact that the United States has discontinued all production of fissile materials for weapons, and that the nuclear disarmament process is creating an oversupply of such material, one wonders why Russia does not immediately cease its plutonium production.[14] Russian authorities

[9] Garwin, R. L., 'Post-Soviet nuclear command and security', *Arms Control Today*, vol. 22, no. 1 (Jan./Feb. 1992), pp. 18–23.

[10] *Izvestia*, 5 Oct. 1992.

[11] 'US, Russia will de-target strategic nuclear missiles', United States Information Service, US Embassy, Rome, 14 Jan. 1994.

[12] On the Chinese–Russian de-targeting agreement, see 'La visite de Jiang Zemin consacre les retrouvailles de Pékin et Moscou', *Le Monde*, 3 Sep. 1994.

[13] For a definition of fissile material, see annexe A in this volume.

[14] In the USA, plutonium production for weapons ceased in 1988, while HEU for weapons was last produced in 1964. On 13 July 1992, President Bush formalized the end to weapon-

reply that the reactors at Tomsk and Krasnoyarsk are also used for generating electricity, on which local populations depend. It is of course possible to keep running the reactors, while at the same time suspending the chemical separation of plutonium from the reactors' spent fuel, but according to Minatom officials the aluminium-clad fuel corrodes rapidly in storage pools and the plutonium must be separated essentially for safety reasons.

On 23 June 1994, at the end of the third meeting of the US–Russian Joint Commission on Economic and Technological Cooperation, US Vice-President Albert Gore and Russian Prime Minister Viktor S. Chernomyrdin signed an agreement that commits their two countries to end the operation of plutonium production reactors by the year 2000 and forbids the restart of any of the same plants already shut down. The plutonium produced in the meantime by the three Russian reactors (two at Tomsk and one at Krasnoyarsk) will be placed under a monitoring regime to be developed by the end of 1994. US and Russian experts will also work together to identify and establish a replacement capacity for the three Russian facilities.[15] Both gas and coal power plants are under consideration for such replacement. In March 1994, the two sides had reached an agreement on reciprocal visits to storage sites for plutonium extracted from dismantled nuclear weapons (Pantex and Tomsk-7) to be held by the end of the year.

On 27 September 1993, the White House had also unveiled its new Non-Proliferation and Export Control Policy which, among other things, stated the intention to 'propose a multilateral convention prohibiting the production of highly-enriched uranium or plutonium for

grade fissile materials production in the USA. Tritium production was also discontinued in the USA in 1988, when the nuclear reactors at the Savannah River Plant in South Carolina were halted. It is still undecided whether new facilities will be built to resume tritium production at some point in the future. It is unclear whether or not Russia is still producing tritium. However, the reactors associated with such production are still operational (see chapter 4, section VI). Some authors have argued that any agreement to ban the production of weapon-grade fissile material should also include a ban on tritium production, because the latter could also be used to cover up plutonium production. See Kalinowski, M., 'No mention of tritium in Gore–Chernomyrdin Agreement', International Network of Engineers and Scientists Against Proliferation, *INESAP Information Bulletin,* no. 3 (Oct. 1994), pp. 16–17. Moreover, such a cut-off implies the appealing possibility of a nuclear disarmament process whose overall pace cannot be slower than what is mandated by the physical law of the radioactive decay of tritium—implying a halving of the nuclear arsenals every 12 years. This pace is considerably slower than that envisaged by START II, but—to the extent all present nuclear weapons contain tritium as an essential component—it implies a continual exponential decrease towards a nuclear weapon-free asymptomatic outcome.

[15] White House Office of the Vice-President, 'United States and Russia agree to halt plutonium production', 23 June 1994.

nuclear explosive purposes or outside of international safeguards'. The proposal was endorsed in December by the UN General Assembly. However, the 1994 session of the Conference on Disarmament (CD) in Geneva adjourned on 7 September 1994 without having reached a mandate to establish a committee to negotiate a fissile material production cut-off. The impasse was brought about by the demands of some non-aligned countries to go beyond the letter of the General Assembly's resolution, so that the prohibition on the future production of weapon-usable fissile materials would be supplemented by a ban on using the existing stockpiles of such materials for manufacturing nuclear weapons.[16] For Russia and the USA, in fact, a cut-off which does not affect existing stocks is easy to contemplate in the light of the huge plutonium glut they are facing.

To encourage international support for a cut-off, the new US Non-Proliferation and Export Control Policy pledges to 'submit US fissile material no longer needed for our deterrent to inspection by the International Atomic Energy Agency (IAEA)'. Ten tonnes of US HEU were put under IAEA safeguards in September 1994—a symbolic gesture, since this probably represents only about 0.1 per cent of the total US HEU stockpile. Regarding plutonium, the policy states that 'the United States does not encourage the civil use of plutonium and, accordingly, does not itself engage in plutonium reprocessing for either nuclear power or nuclear explosive purposes'.[17]

The decision to renounce a plutonium-based nuclear fuel cycle was taken by the Carter Administration in the 1970s. Japan and many countries in Europe, however, continued to keep the plutonium option open. The Clinton policy is careful to state that the USA 'will maintain its existing commitments regarding the use of plutonium in civil nuclear programs in Western Europe and Japan'.

In a joint statement of 14 January 1994, Presidents Clinton and Yeltsin noted that 'an important contribution to the goal of non-proliferation of nuclear weapons would be made by a verifiable ban on the production of fissile materials for nuclear weapons'. They agreed to establish a joint working group to consider the role of IAEA safeguards for verification of both non-production of fissile materials

[16] Institute for Science and International Security, *ISIS Report*, vol. 2, no. 1 (Sep. 94), p. 5.

[17] 'White House fact sheet on non-proliferation and export control policy', *Arms Control Today*, Nov. 1993.

and dismantlement of existing nuclear weapons and to study options for the long-term disposition of plutonium.[18] A few weeks later, the US National Academy of Sciences released a report outlining precisely such options.[19]

IV. Banning nuclear testing

The policy change between the two successive US administrations is also evident with respect to two other important issues, both previously stalled by the approach adopted by the Bush Administration of avoiding, to any possible extent, to enter into additional formal agreements in the nuclear field. The first was mentioned above: the September 1993 US proposal for a multilateral convention banning the production of weapon-grade fissile material.

The second issue is the comprehensive test ban treaty (CTBT), which President Bush steadfastly refused to negotiate despite strong international pressure, despite the closure of Semipalatinsk in Kazakhstan (one of the two FSU nuclear test sites),[20] despite the Russian declared readiness to enter a CTBT as substantiated among other things by their continuing testing moratorium, and despite the new French approach towards the issue and their testing moratorium declared on 8 April 1992. Indeed, in June 1992, only a few days after the Bush–Yeltsin agreement on strategic arms was signed, the Bush Administration made a point of strongly reaffirming its support of reliance on nuclear testing for 'safety, security, and reliability'.[21]

In September 1992, however, Congress enacted a nine-month moratorium on nuclear tests, to begin on 1 October, at the same time asking the Administration to negotiate a CTBT. That legislation, better known as the Hatfield Amendment, allowed five nuclear tests for each of the three following years (one per year was allotted to British testing) for safety, security and reliability only, to be followed after 30 September 1996 by a cessation of testing 'unless a foreign state conducts a nuclear test after this date'. While calling the bill

[18] The text of the joint statement is reproduced in *Wireless File* (United States Information Service, US Embassy: Rome, 14 Jan. 1994).

[19] See chapter 4, section VI.

[20] The other one, on the island of Novaya Zemlya in the Arctic Circle, is far less convenient, indeed unusable for most of the year because of the cold climate, and also internationally less acceptable because of its location relatively close to Scandinavian countries.

[21] 'US opposes any A-test ban', *International Herald Tribune*, 27–28 June 1992.

'highly objectionable', Bush did not veto it: that same bill contained authorization for the construction of the 'supercollider' particle accelerator, to be located in Texas, Bush's political home state.

President Clinton first committed the USA to negotiate a multilateral nuclear test ban in April 1993 at the Vancouver summit meeting with President Yeltsin. On 3 July he announced the extension of the moratorium on US nuclear testing at least through September 1994, 'as long as no other nation tests'. Although China conducted a test on 5 October, the USA did not resume testing citing, among other items, the linkage with nuclear non-proliferation policy. On 14 March 1994, Clinton extended the US moratorium through September 1995, reiterating the importance of an indefinite extension of the NPT.

The Chinese test did not affect the Russian nuclear moratorium either; President Yeltsin decided to continue it in support of nuclear non-proliferation, despite pressure from Minatom and the military. The lack of economic resources and the problems surrounding both FSU testing sites make a resumption even more unlikely. The French moratorium appears to depend on the favourable attitude of President François Mitterrand to a CTBT. The President, who according to the French Constitution is also the Commander-in-Chief of the armed forces, has exclusive jurisdiction on the matter. However, Mitterrand's term expires in May 1995, and the conservative cabinet, in power since the spring of 1993, is on record as being in favour of a resumption of testing. The British attitude to a CTBT is at best lukewarm, but the dependence on the US Nevada Test Site has left the UK with little or no flexibility.

In August 1993, the CD agreed to mandate an *ad hoc* committee to hold consultations on the organization and mandate for CTBT negotiations—a step supported by a resolution adopted by the UN General Assembly on 16 December. On 25 January 1994, the CD re-established the *ad hoc* committee on CTBT negotiations, naming as chairman Mexican Ambassador Miguel Marin Bosch. Working groups on verification and on legal and institutional issues were established. The 1994 CD session adjourned on 7 September 1994: several proposals for a CTBT were on the table but an official draft treaty text was at that date still in the making.

V. Verification

The reduction and verification provisions in START I and START II apply only to nuclear delivery vehicles, not to nuclear warheads and fissile materials. Some of the CISAC recommendations recalled above were intended to address this problem. As things stand, the release of information on which warheads will be destroyed, how many will remain and how the fissile material will be handled will depend on the good will of the Russian Government, with little chance to have the data confirmed by outside controls.

The START I ratification resolution passed by the US Senate Foreign Relations Committee in October 1992 included a condition, introduced by Senator Joseph Biden, requiring the US Administration to seek, in any further agreement reducing strategic arms, an arrangement to monitor nuclear stockpiles and production facilities. The Bush Administration had rejected any interpretation of the condition that would imply negotiating verification provisions on the grounds that it would be inconsistent 'with US security interests and [the] statutory requirements under the Atomic Energy Act of 1954 for the protection of nuclear weapons design information'.[22] START II, negotiated and signed by the Bush Administration, does not cover nuclear stockpiles and production facilities. In this regard, the Clinton Administration has been more flexible. In Senate testimony in May 1993, Secretary of State Warren Christopher informed Senator Biden that the Administration intends 'responsively and conscientiously to see if there are ways to achieve' the aims of the Biden condition.[23] Further, the US–Russian agreements of January and March 1994 consider the role of the IAEA in verifying the dismantlement of nuclear weapons and fissile material non-production, and conducting reciprocal visits to plutonium storage facilities. In September 1994, Russia and the USA agreed to 'Exchange detailed information . . . on aggregate stockpiles of nuclear warheads, on stocks of fissile materials and on their safety and security. The sides will develop a process for exchanging this information on a regular basis'.[24]

[22] Statement by Robert L. Gallucci before the US Senate Armed Services Committee, 4 Aug. 1992; and 'US goal: safe disposition of nuclear weapons in CIS', United States Information Service, US Embassy, Rome, 13 Aug. 1992.

[23] Lockwood, D., 'Christopher outlines START II benefits to Senate Committee', *Arms Control Today*, vol. 23, no. 5 (June 1993), p. 26.

[24] See note 18. See also note 5 and section III of this chapter.

8. International denuclearization assistance to the FSU

I. US Nunn–Lugar assistance

With the reciprocal initiatives of September–October 1991, Presidents Bush and Gorbachev agreed to open US–Soviet discussions on how to improve the physical security and safety of nuclear weapons and cooperation on their 'safe and environmentally responsible storage, transportation, dismantling and destruction'. In November 1991, the US Congress passed the Soviet Threat Reduction Act, known as the Nunn–Lugar legislation after the members who sponsored it, Senators Sam Nunn and Senator Richard Lugar. The US Department of Defense (DOD) received the authority to transfer up to $400 million to facilitate 'the transportation, storage, safeguarding, and destruction of nuclear and other weapons in the Soviet Union'.

In October 1992, Congress authorized the transfer of $400 million under the Former Soviet Union Demilitarization Act, which expanded the programme to include aspects of defence industry conversion and military-to-military contacts. In November 1993 the Co-operative Threat Reduction Act added another $400 million, broadening the scope of assistance to include environment restoration of former military sites and housing for former military personnel. However, out of a total amount authorized of $1.2 billion in 1992–94, $330 million expired, leaving $870 million available for obligation. The 1995 Defense Appropriations bill, approved in September 1994, contained additional Nunn–Lugar funding of $400 million—which brings the total amount authorized under the programme to $1.27 billion.

The Nunn–Lugar legislation requires that aid 'to the extent feasible draw upon US technology and expertise'. Weapon dismantlement assistance flows basically under two forms: 'supplies of equipment purchased in the United States, or from US stockpile, to be shipped to appropriate [FSU] agencies; and US technical or advisory teams to supply technical services or data to appropriate agencies'.[1] Other donors seem to have taken the same approach.

[1] US Congress, Office of Technology Assessment, *Dismantling the Bomb and Managing the Nuclear Materials,* OTA-0-572 (US Government Printing Office: Washington, DC, Sep. 1993), p. 134.

Projects to be funded by Nunn–Lugar assistance are discussed in the Safe and Secure Dismantlement (SSD) Talks, which take place on a bilateral basis with the four former Soviet republics with nuclear weapons on their territories. Prior to specific programmes, so-called umbrella agreements (covering diplomatic immunity and exemptions from tax and customs for foreign contractors) had to be concluded. The USA signed such agreements with Russia (in June 1992), with Belarus (in October 1992), with Ukraine (in October 1993) and with Kazakhstan (in December 1993).

Concrete progress, however, was extremely slow until mid-1993, when the DOD notified Congress of proposed obligations of $468 million—meaning that an agreement existed or had been signed with the recipients—but only $31 million had been obligated—meaning that money had been actually disbursed. At the end of March 1994, proposed obligations had reached $961 million, while actual obligations stood at $177 million. Over the following six months, the pace at which the Nunn–Lugar programme is being implemented was stepped up dramatically, as shown by a fourfold increase in actual obligations, worth $434 million as of 30 September 1994.

Table 8.1 details the funds, recipients and programmes associated with Nunn–Lugar assistance. While the bulk of obligations in the first two years was applied to improve the safety and security of warhead transportation, the emphasis has now shifted to other programmes, such as storage facilities for Russian plutonium,[2] destruction of Russian chemical weapons, and strategic nuclear weapon elimination (destruction of missiles and their silos). Taken together, these programmes are worth $530 million—more than half of the Nunn–Lugar total proposed obligations.

According to the agreement signed in August 1993 and concerning US assistance in dismantling Russian strategic weapons, Washington is providing Moscow with an estimated $130 million worth of equipment, including mobile cranes, plasma cutters and bulldozers for ICBM destruction; shears to cut up SLBM tubes; and guillotines, dump trucks, forklifts and tractors for heavy bomber dismantlement.[3] Strategic nuclear weapon elimination is also scheduled to absorb $70 million and $185 million of Nunn–Lugar assistance in Kazakhstan

[2] See section III.

[3] Lockwood, D., 'US, Russia sign new agreements on nuclear dismantlement assistance', *Arms Control Today*, vol. 23, no. 8 (Oct. 1993), p. 21.

and Ukraine, respectively. In December 1994, US defence contractors were working at the Yuzhmash plant in Dnepropetrovsk, Ukraine, to help build a facility for cutting up SS-19 ICBMs and incinerating their highly toxic liquid fuel.[4]

Criticism of the US aid programme for denuclearization in the FSU has often focused on two points. First, too few resources have been made available. Second, assistance has been slow in coming—to the point of allowing more than $300 million of spending authority to expire. The aid efforts of other donors can also be criticized on the same grounds. Still, it should be kept in mind that a number of political obstacles in the FSU have delayed prompt implementation of the programmes. Ukraine and Kazakhstan signed their umbrella agreements with the USA when the Nunn–Lugar programme was entering its third year. Their reluctance to accede to the NPT—neither country did so until 1994—certainly did not help in establishing a climate of mutual trust with prospective donors.

Additional political obstacles to implementation of FSU denuclearization assistance were mentioned in an October 1994 Pentagon report. For example, 'negotiations defining assistance requirements for several projects such as military Material Control and Accountability activities and Export Control activities with Russia have been particularly difficult and slow'; also, 'defining [Cooperative Threat Reduction] assistance requirements for the dismantlement of SS-18 silos in Kazakhstan has been delayed until Kazakhstan and Russia resolve several questions of control and responsibility for the elimination of the silos'.[5]

In sum, at the end of 1994 it was still too early to evaluate the adequacy and success of denuclearization aid programmes for the FSU, most of which are far from completion. However, Ukraine's accession to the NPT and entry into force of the START I Treaty have finally removed the major political stumbling-blocks to both increasing and accelerating the nuclear disarmament aid to the FSU.

[4] Perlez, J., 'New partners jointly end Ukraine's nuclear era', *International Herald Tribune,* 10–11 Dec. 1994.

[5] US Department of Defense, *Second FY 1994 Semi-Annual Report on Program Activities to Facilitate Weapons Destruction and Nonproliferation in the Former Soviet Union*, 30 Oct. 1994.

Table 8.1. US security assistance to the former Soviet Union, as of 30 September 1994

Figures are in current US$.

Purpose	Proposed	Obligated
To Russia		
Armoured blankets	5 000 000	3 244 000
Railcar security	21 500 000	21 500 000
Emergency response	15 000 000	11 888 000
Material controls	30 000 000	1 176 000
Fissile material containers	50 000 000	48 658 000
Storage facility design	15 000 000	14 969 000
Storage facility equipment	75 000 000	26 493 000
Export controls	2 260 000	0
Science centre	25 000 000	22 507 000
Chemical weapon destruction	55 000 000	15 113 000
Strategic arms elimination	130 000 000	67 172 000
Arctic nuclear waste assessment	20 000 000	18 561 000
Defence conversion	40 000 000	17 122 000
Research and development foundation	10 000 000	0
Sub-total	**493 760 000**	**268 403 000**
To Ukraine		
Emergency response	5 000 000	2 002 000
Communications link	2 400 000	282 000
Export controls	7 260 000	2 543 000
Material controls	12 500 000	1 960 000
Science centre	10 000 000	16 000
Strategic arms elimination	185 000 000	75 034 000
Nuclear reactor safety	11 000 000	0
Defence conversion	40 000 000	34 981 000
Sub-total	**273 160 000**	**116 818 000**
To Belarus		
Emergency response	5 000 000	4 293 000
Communications link	2 300 000	692 000
Export controls	16 260 000	1 604 000
Environmental restoration	25 000 000	6 000 000
Defence conversion	10 000 000	9 880 000
Propellant elimination	6 000 000	0
Sub-total	**67 560 000**	**22 469 000**

Purpose	Proposed	Obligated
To Kazakhstan		
Emergency response	5 000 000	2 006 000
Communications link	2 300 000	301 000
Export controls	2 260 000	160 000
Material controls	5 000 000	524 000
Defence conversion	15 000 000	141 000
Strategic arms elimination	70 000 000	0
Sub-total	**99 560 000**	**3 132 000**
Other		
Defence and military contacts	15 000 000	6 532 000
Defence enterprise fund	7 670 000	7 670 000
Other assessments	15 000 000	9 176 000
Sub-total	**37 670 000**	**23 378 000**
Total	**968 710 000**	**434 198 000**

Source: US DOD, *Second FY 1994 Semi-Annual Report on Program Activities to Facilitate Weapons Destruction and Nonproliferation in the Former Soviet Union*, 30 Oct. 1994.

II. Other international assistance

Aside from the USA, other countries are also involved in denuclearization aid programmes.[6] The UK has signed agreements to provide Russia with 250 'super-containers for weapons' (railcars) and 20 vehicles for road transport of weapons and fissile material (the latter programme is worth some $60 million). In 1994, the UK also discussed with Russia the transfer of emergency response equipment and training and of assistance in materials control and accounting and in export control; and with Ukraine assistance in strategic offensive arms dismantlement and in liquid fuel disposal. It also discussed with Kazakhstan assistance in export control and in materials control and accounting.

[6] NATO established in Mar. 1992 an *Ad Hoc* Group to discuss and coordinate among members assistance in the safety, security and dismantlement of FSU nuclear weapons.

France has signed $98 million worth of agreements with Moscow whereby it will help in the conversion of fissile material, and it will provide emergency response equipment and training, super-containers for weapons and tooling for weapon dismantlement. It also held discussions with Russia on the construction of a storage facility for hydrogenous products and at the end of 1994 was considering aid in the field of materials control and accounting. Germany has agreed to provide Russia with emergency response equipment and training ($5.1 million), to help in chemical weapon destruction ($6.1 million), conversion of fissile material, radiation monitoring and protection, and export control. Germany is also aiding Ukraine on defence conversion ($400 000) and export control.

Italy has signed an agreement with Russia for the transfer of emergency response (radiation monitoring and protection) equipment and training ($7.5 million) and is considering help in chemical weapon destruction. Italy has held discussions with Ukraine on defence conversion, and is considering providing aid in the field of export control. Canada has agreed to help both Russia and Ukraine in materials control and accounting and in defence conversion. Japan has signed framework agreements under which disarmament would be provided to Russia ($80 million), Ukraine ($17 million), Kazakhstan ($11 million) and Belarus ($8 million). Some of the money may go to help processing Russian nuclear waste from naval reactors.

The countries mentioned above also provide aid to the four former Soviet republics in fields that, although not directly related to the dismantlement of weapons of mass destruction, have an indirect impact on this problem—such as officer resettlement and retraining, housing for military personnel, nuclear reactor safety and environmental protection, energy conservation and production.

III. A storage facility for Russian plutonium

A specific issue concerning fissile material production in Russia is the construction of a storage facility for the plutonium recovered from nuclear weapons with Nunn–Lugar assistance programme funds. The USA agreed in September 1993 to provide $15 million for design assistance and $75 million for equipment and training assistance, for Russian construction of the facility. By September 1994, one-third of the latter amount, and almost all of the former, had been spent.

Construction was scheduled to start in the spring of 1994, but was delayed because of local opposition in Tomsk, the site originally chosen and where a tank of nuclear waste exploded in April 1993. In March 1994, Russia officially notified the USA that the facility would be located at the Mayak site in Chelyabinsk, but lack of funds has delayed the start of construction until sometime during the first half of 1995. The availability of a highly secure storage site is considered by Russia as a prerequisite to step up its warhead dismantlement rate.

In late 1993, the US Congress stipulated that 'no funds may be obligated for the purpose of assisting [Minatom] of Russia to construct a storage facility for surplus plutonium from dismantled weapons' until the President certifies to Congress that Russia is 'committed to halting the chemical separation of weapon-grade plutonium from spent nuclear fuel and is taking all practical steps to halt such separation at the earliest possible date'. The US–Russian agreement to stop plutonium production paved the way for such certification to Congress, which took place in April 1994.

IV. The Science and Technology Centres

Two Science and Technology Centres were established in 1992, one in Moscow and the other in Kiev. The former is intended for all CIS members, the latter only for Ukraine. The Moscow Centre is funded by the European Union ($29 million), the USA ($25 million), Japan ($17 million), Canada ($2.5 million) and other smaller contributors. The Kiev centre is funded by the USA ($10 million), Canada ($2 million) and Sweden.

Both centres are expected to act as clearing-houses to engage former defence establishment scientists in peaceful research in basic science, applied science or in commercial applications. Priority will be given to nuclear, chemical, biological and ballistic missile scientists and technicians: in Russia the majority of projects are expected to employ weapon designers and engineers from the nuclear laboratories; in Ukraine most projects will involve the ballistic missile scientists and engineers from the Dnepropetrovsk plant. Collaboration with Western scientists will be actively sought.[7]

[7] 'Ambassador Robert L. Gallucci: redirecting the Soviet weapons establishment', *Arms Control Today*, June 1992; and 'US goal: safe disposition of nuclear weapons in CIS', United States Information Service, US Embassy, Rome, 13 Aug. 1992.

Implementation of this initiative has been painfully slow: the agreement with Ukraine, for example, was not signed until October 1993 and has yet to be implemented. As for the Moscow Centre, grants for 54 projects, representing a funding commitment of about $26 million, were approved in two successive meetings of its governing board, in March and June 1994. These projects will involve more than 3000 scientists and engineers for a three-year period in the areas of environmental monitoring, telecommunications, nuclear reactor safety, computer modelling of ecological and meteorological phenomena, medical imaging methods, stable isotope production safeguards and radioactive waste disposal research.

In addition to the Science and Technology Centres, other initiatives have been taken in the USA. Section 511 of the Freedom for Russia and Emerging Eurasian Democracies and Open Markets Support Act of 1992 (Public Law 102-511) authorized the establishment of a non-governmental foundation for joint research projects between civilian scientists from the USA and the FSU. The Fiscal Year 1994 Foreign Operations Appropriations Act (Public Law 103-87) appropriated $35 million for partnerships among US industry, universities, US national laboratories and major FSU institutes, a programme known as the Laboratory–Industry Partnership Program (LIPP) and whose main aim is the commercialization of products in collaboration with the private sector. Direct laboratory-to-laboratory contacts have been established involving mainly the Los Alamos, Livermore and Sandia national laboratories on the US side and Chelyabinsk, Arzamas and Tomsk facilities on the Russian side.[8] The Moscow-based International Science Foundation has been active since 1992 thanks to $100 million of funds provided by the US financier George Soros. Its main goal is to support civilian basic research in the FSU. The funds are expected to expire by the end of 1995. Soros has offered an additional $20 million for 1996–97 if the US and Russian Governments each pledge the same.[9] Russia seemed to be well disposed to respond favourably to this offer, less so the USA where the new Congress appears less sympathetic than its predecessor to disburse funds to help Russia.

[8] US Congress, Office of Technology Assessment, *Proliferation and the Former Soviet Union*, OTA-IIS-605 (US Government Printing Office: Washington DC, Sep. 1994), pp. 27–28, 65.

[9] Hockstader L., 'Financier's aid for Russian science is endangered', *International Herald Tribune*, 30 Nov. 1994.

9. Conclusions

I. Assessing the safety of the FSU nuclear custodial system

In conclusion, what can be said about the safety of the former Soviet nuclear weapon complex or, perhaps more precisely, about the FSU nuclear custodial system? Has it worked? Is it working? Is it dependable? Is it safe?

The only possible answer to these questions seems to be a qualified yes. No major accident has taken place, not even during the political upheavals before and after the dissolution of the Soviet Union. The withdrawal of some 5000–7000 tactical nuclear warheads to Russia in barely four months—almost two months ahead of schedule—was a remarkable success for the nuclear custodial system.

Officials of the FSU have repeatedly claimed that all the weapons are accounted for and no signal of unauthorized warhead movement has ever been received by the central command.[1] By the end of 1994, the goal of having only one nuclear weapon power, that is, Russia, succeed the Soviet Union has been achieved. All other former Soviet Republics have acceded as non-nuclear weapon state parties to the NPT. Finally, a substantial build-down of the strategic arsenals of Russia and the USA is under way and is scheduled to continue for several years after the entry into force of START I in December 1994. In turn, one major legal obstacle for the entry into force of START II has been cleared—the others being the ratification of START II by the US Congress and the Russian Parliament.

On the other hand, the sheer magnitude of the task of keeping physical track of several tens of thousands of objects defies the imagination. Military organizations sometimes have difficulties in keeping track of much larger items, such as tanks or aircraft, as they move from factories to operational units and then back to repair and maintenance facilities.[2] Thus, reassuring statements on the part of CIS officials, although very important, must be taken with a grain of salt.

[1] Norris, R. S., 'The Soviet nuclear archipelago', *Arms Control Today*, vol. 22, no. 1 (Jan./Feb. 1992), pp. 24–31.

[2] For example, in 1994 an audit by the US General Accounting Office found that US DOD inventory records of certain categories of non-nuclear missiles were in extremely poor shape. There were '7732 more Stinger missiles in stockpiles than listed in military records, 5230

Early rumours of three tactical nuclear warheads being lost from the Soviet inventory and possibly ending up in Iran[3] were never substantiated and now appear to have been false.[4] However, even if someone actually managed to sell and transfer abroad a single warhead, the safety features likely to be associated with it make any direct use next to impossible without the parallel transfer of substantial know-how and technical skills. This is not to say, for example, that the warheads' fissile material could not be recycled. The process is not a simple one, however, and in order to fabricate a new nuclear weapon, it calls for the availability of experienced personnel and a host of non-nuclear techniques and devices.

The illicit traffic in fissile material is of course an entirely different matter. From the breakup of the Soviet Union in December 1991 until the summer of 1994, the issue remained largely moot. In 1992, the most serious instance of attempted deals with smuggled fissile material from Russia involved 2.2 kg of 'enriched uranium' seized by the German police in Munich on 13 October[5] —but it did not turn out to be weapon-grade uranium. The known cases of attempted illicit exports of nuclear materials from Belarus, Kazakhstan, Russia and Ukraine did not provide any concrete evidence of serious breaches of counter-proliferation policies in 1993.[6]

In early 1994, a cautiously optimistic view of the problem on the part of well-placed Western observers was thus justified. Former US Secretary of Defense Les Aspin declared in January that 'There is reason to believe that no nuclear weapons have been lost or sold from

more Redeye missiles, and 9744 fewer Dragons'. See Barr, S., 'Inventory chaos uncovered at Pentagon', *International Herald Tribune*, 27 Oct. 1994.

[3] 'When nukes spread', *The Economist*, 18 Jan. 1992.

[4] During a conference held in Rome, 15–16 June 1992, on 'Disarmament, Armed Dictatorships and Human Rights', Olzhas Sulejmenov, leader of the Nevada–Semipalatinsk Association (the organization that emerged out of the popular movement that brought about the closure of the Semipalatinsk nuclear test range in Kazakhstan) declared that the 3 missing warheads were buried deep underground in the former test range at the bottom of a deep shaft filled with concrete. Apparently, they were there, ready to be detonated, when the decision to close the facility was finally taken in Aug. 1991. The existence of at least 1 unexploded FSU nuclear warhead at the Semipalatinsk test site has been confirmed by other sources as well: see, for example, Carnegie Endowment for International Peace and the Monterey Institute for International Studies, *The Nuclear Successor States of the Soviet Union: Nuclear Weapons and Sensitive Export Status Report*, no. 1 (May 1994).

[5] Foye, S. and Reisch, A. A. (eds), 'Military and security notes', *RFE/RL Research Report*, vol. 1, no. 43 (30 Oct. 1992), p. 61.

[6] Monterey Institute of International Studies, *CIS Nuclear Database—Quarterly Nuclear-Weapon and Sensitive Export Status Report*, 27 Jan. 1994.

the former Soviet arsenal to other nations or groups'.[7] The then US CIA Director R. James Woolsey, stated: 'We investigate every report or claim of the illegal transfer of weapons or weapons-grade material. To date, reports of illegal transfer of weapons do not appear credible. As for weapons-grade material, we are not aware of any illegal transfers in quantities sufficient to produce a nuclear weapon'.[8] Investigative journalists tried to verify the extent to which Russian black marketeers of nuclear material were able to deliver the goods they were peddling, finding, in fact, little or no substance.[9]

In May 1994, however, the Director of the US Federal Bureau of Investigation, Louis Freeh, declared in the US Senate that Russian organized crime groups could obtain and sell nuclear weapon material or even a nuclear bomb. He also mentioned an ongoing international investigation into an alleged theft of 2 kg of HEU from the St Petersburg area.[10] It later turned out that in March 1994 three men had been arrested in St Petersburg who were in possession of 3 kg of 90 per cent enriched uranium originating from the Machine Building Plant Production Association at Elektrostal, near Moscow, and intended for use in the manufacture of fuel elements for research or fast breeder reactors.[11] Also, in November 1993, three fuel rods containing around 4.5 kg of HEU had been stolen from a nuclear submarine base at Murmansk. Subsequent investigation led to the arrest of three naval officers.[12]

Then in mid-July 1994 the German police disclosed that two months earlier they had seized 6 grams of plutonium-239 inside the garage of a businessman's house near Stuttgart. Reportedly, the German authorities were convinced that the plutonium originated

[7] US Department of Defense, *Annual Report of the Secretary of Defense to the President and the Congress* (US Government Printing Office: Washington, DC, Jan. 1994), p. 60. We are grateful to Dunbar Lockwood who brought to our attention this quotation and the one that follows in the text.

[8] Prepared Statement Submitted to the US Senate Select Committee on Intelligence, 25 Jan. 1994, p. 12.

[9] Belyaninov, K., 'Nuclear nonsense, black-market bombs, and fissile flim-flam', *Bulletin of the Atomic Scientists*, Mar./Apr. 1994.

[10] Smith, R. J., 'Russian crime gangs threaten US, FBI chief says', *International Herald Tribune*, 27 May 1994.

[11] 'Theft and smuggling of Russian nuclear materials', *Russia and Republics Nuclear Industry*, no. 2 (30 June 1994), p. 40.

[12] See note 11; and US Congress, Office of Technology Assessment, *Proliferation and the Former Soviet Union*, OTA-ISS-605 (US Government Printing Office: Washington DC, Sep. 1994), note 5, p. 60.

'from a Russian nuclear arms plant'.[13] Russian officials first denied this vigorously,[14] then seemed to accept that a possibility at least existed.[15] This, however, was the first proven case of smuggling involving nuclear weapon-grade fissile material, albeit in a very limited quantity, detected outside the FSU. It was also the first such news in what quickly became a real crescendo, lasting roughly one month. On 10 August some 350 grams of a nuclear material with a plutonium-239 content of 87 per cent were seized at Munich airport. The material was inside a suitcase that was on board a Lufthansa flight from Moscow. A Colombian and two Spaniards were arrested.[16] Other subsequent instances were essentially the product of overheated media attention, as for example the case of a man arrested on 12 August in Bremen trying to sell a negligible amount of plutonium extracted from an old smoke detector. Questions also arose as to whether so many smugglers were the effect, rather than the cause, of a demand on intelligence agents to intercept the traffic.

The German Government took a high-profile stance *vis-à-vis* these cases. On 27 August Chancellor Helmut Kohl sent his intelligence co-ordinator, Bernd Schmidbauer, to Moscow to talk with the Russian Government on how to tighten controls over nuclear materials.[17] For his part, Schmidbauer declared that personnel of the former East German secret police might be involved in the nuclear trade. He also told parliament that it could not be excluded that there were buyers acting on behalf of foreign governments.[18]

These allegations, however, were met not only with concern, but also with scepticism. The foreign editor of the daily *Süddeutsche Zeitung*, Josef Joffe, while noting that the quality and quantity of intercepted fissile material were a long way from those necessary to manufacture of a nuclear explosive device, wrote that 'the police and the secret service are creating a climate of doom in the name of law

[13] Vogel, S., 'Illicit nuclear cache called a "harbinger"', *International Herald Tribune*, 21 July 1994.

[14] 'Russia sees no link to plutonium in Germany', *International Herald Tribune*, 18 Aug. 1994.

[15] 'Weak points exist in nuclear security, Russians concede', *International Herald Tribune*, 24 Aug. 1994.

[16] 'Formula for terror', *Time*, 29 Aug. 1994; 'Nukes for sale', *Newsweek*, 29 Aug. 1994; and Aktinson , R., 'Theft of nuclear materials: did Germans overstate danger?', *International Herald Tribune*, 29 Aug. 1994.

[17] 'Formula for terror' (note 16).

[18] Aktinson (note 16).

enforcement'.[19] Senior politicians from the opposition Social Democratic Party went even further, implying that the seizures of nuclear materials were no more than a campaign ploy staged by Kohl as general elections, due for October, approached.[20]

Even if one does not regard the instances of transit of fissile material uncovered in Germany with undue alarm, the fact remains that weapon-grade fissile material was actually found. While the cases in St Petersburg and Murmansk remain a matter for justified apprehension, another episode occurred—this time in Prague, where nearly 3 kg of suspected HEU were seized and three people, including a nuclear physicist, arrested on 14 December 1994. According to press reports, the material carried a Russian certificate.[21] Finally, despite the fact that no case of FSU fissile material smuggling has so far been reported from the Middle East or Central Asia, there is reason to believe that the borders of the former Soviet Union with these regions might be substantially more porous than those with Central Europe.

In sum there are ample reasons to step up the international alert—not only to intercept any attempted smuggling of weapon-usable fissile material, but also to address the root causes of the growing leakage: unsatisfactory physical security and sloppy practices of material control and accounting at storage sites; inadequate export and border controls, the development of which is still in the formative stage; and hard living conditions for personnel employed at nuclear facilities.

II. Looking ahead

Converting the nuclear weapon complex of the former Soviet Union is no easy task. On the contrary, it requires, and will require for several years, an extraordinary amount of patience, prudence, ingenuity and dedication—which is not surprising if one considers that it took four decades, and great human and material resources, to build such a sprawling complex organization.

[19] Joffe, J., 'Nuclear black market: much ado about not much', *International Herald Tribune*, 26 Aug. 1994.

[20] Kinzer, S., 'Foes suspect a Kohl ploy in nuclear-smuggling affair', *International Herald Tribune*, 26 Aug. 1994.

[21] 'Czechs seize 3 and suspected Uranium-235', *International Herald Tribune*, 20 Dec. 1994.

On the one hand, as the process of nuclear conversion gains momentum, the world begins to step back from folly—the accumulation, on both sids of the former iron curtain, of tens of thousands of nuclear weapons capable of destroying life on earth several times over. This can certainly be hailed as the first and foremost achievement so far.

Although the nuclear conversion process is just beginning, other feats have been accomplished: the vast majority of tactical nuclear weapons have been withdrawn from service and are being dismantled; agreements exist, and are already being implemented, to slash the major strategic nuclear arsenals; START I has entered into force, and the leaders of Russia and the USA have pledged to seek early ratification of START II;[22] and multilateral negotiations are under way to halt the production of fissile materials for weapons and to arrive at a comprehensive ban on nuclear weapon testing. Tactical nuclear weapons—previously scattered throughout 15 different Soviet republics and across the territory of the former Warsaw Pact—have been concentrated in Russia. Belarus, Kazakhstan and Ukraine have all ratified START I, the treaty whose protocol commits them to get rid of the strategic nuclear weapons still on their territory. The process of shipping to Russia the relevant warheads has begun, and Belarus, Kazakhstan and Ukraine all acceded to the NPT as non-nuclear weapon state parties in 1993–94.

On the other hand, the nuclear disarmament process is taking place in a political framework which is far from stable. The process of change in the FSU has not yet reached its turning-point: the economic and political outlook remains clouded and tensions are high within the FSU republics and between them. Second thoughts on nuclear disarmament are still discernible among Ukrainian and Russian legislators. Hence the urgency to speed up the process: even the nearest START II deadline, the year 2000, looks far in the future in the light of the current political volatility in the FSU. Moreover, speeding up the nuclear disarmament process is certainly well within the technological and economic capabilities of the industrialized

[22] At the 2nd Pugwash Workshop on the 'Future of the Nuclear Weapon Complexes of Russia and the USA', held in Moscow, 20–23 Feb. 1995, several Russian experts emphasized that START II is unlikely to be ratified by Russia. However, several key legislators of the Russian Duma indicated a more flexible attitude. Some US participants noted that in the wake of the US congressional elections of Nov. 1994 the ratification of START II will meet strong opposition in the Senate.

world. Finally, the pressing questions of the final disposition of the fissile materials, particularly plutonium, extracted from nuclear weapons must be answered.

It is therefore quite natural to note that the absolute level of rich countries' resources devoted to the conversion of the Soviet nuclear weapon complex could be increased. For example, the $400 million per year authorized for Nunn-Lugar programmes for nuclear threat reduction represent less than 0.2 per cent of the US defence budget. The sums so far committed by members of the European Union and Japan are about as small relative to military expenditure. This is clearly in sharp contrast to the incommensurable amount of security these donors are buying through the reduction of both the former Soviet nuclear threat and the risks of nuclear proliferation outside the FSU borders.

In practical terms, money is needed in the FSU to build more secure storage sites for nuclear weapons and fissile materials, to raise the level of security at existing sites via, among other things, the rapid adoption of more sophisticated methods for material control and accountancy, to improve export and border controls, to improve the living conditions of nuclear custodians, technicians and scientists, and to double or triple the dismantlement rate of nuclear warheads—to give only some examples.

At an increased level of aid a division of labour could be imagined whereby rich non-nuclear weapon states concentrate their efforts outside the sensitive areas of warhead dismantlement and fissile material handling, leaving these to France, the UK and the USA. Environmental restoration (the cleanup of nuclear and chemical waste), Science and Technology Centres and other research opportunities for FSU scientists, the establishment of effective export controls (from law drafting to training of personnel), conversion of the military industry, energy conservation—these are all areas where the EU as a whole, and its non-nuclear weapon state members in particular, could and should raise the profile of their commitment to a peaceful and smooth conversion of the FSU nuclear complex.

Also, no effort should be spared to make the fissile materials extracted from nuclear warheads as impervious as possible to recycling into the manufacture of new explosive devices. One of the options discussed above for plutonium disposition should thus be quickly agreed upon, so as to begin its implementation without delay.

As for HEU, 'it would be good to blend [it] as rapidly as possible to below-explosive concentrations, say, to 20 per cent uranium-235. Once this has been done, the material would be much better protected against illicit use for bombs.'[23] While offering a strong protection against illicit diversion, such a step would in no way compromise, nor make more costly, further diluting down to the 3–4 per cent uranium-235 concentration which characterizes nuclear reactor fuel (LEU).

In any case, the establishment of a verified global inventory of warheads and weapon fissile material should be agreed upon and implemented as soon as possible.

Finally, if the nuclear weapon states—in the first instance Russia and the USA—agreed to involve the IAEA in monitoring and safeguarding such an inventory, then the EU, Japan and other rich countries could contribute beyond their fixed allocations to a fund specifically created for this purpose.[24]

[23] Gilinsky, V., 'Demobilizing and disarming formerly Soviet nuclear warheads', Paper presented at the 7th Winter Course of the International School on Disarmament and Research on Conflict (ISODARCO), Folgaria, Italy, Jan. 1994.

[24] The CISAC study made this suggestion with respect to monitoring and safeguarding weapon-grade plutonium. See Committee on International Security and Arms Control (CISAC), National Academy of Sciences, *Management and Disposition of Excess Weapons Plutonium—Executive Summary* (National Academy Press: Washington, DC, 1994).

Annexe A. Selected technical terms and relevant quantities concerning nuclear explosive materials*

An *atom* consists of a nucleus of protons and neutrons, surrounded by electrons.

An *element* refers to a class of atoms characterized by the number of protons in the nucleus (atomic number). Uranium (U) and Plutonium (Pu) are elements with atomic numbers 92 and 94, respectively.

An *isotope* is a subclass of an element, characterized by the number of protons plus neutrons in the nucleus. ^{235}U and ^{238}U are isotopes of uranium containing, respectively, 235–92 = 143 neutrons and 238–92 = 146 neutrons.

Fission is division of a heavy nucleus into two lighter nuclei plus a small number of energetic neutrons, either spontaneously or as a result of absorbing a neutron.

A *fission chain reaction* is the circumstance in which a neutron released by the fission of one nucleus induces another nucleus to fission, and so on.

Fissile isotopes are those capable of sustaining a fission chain reaction propagated by thermal (slow) neutrons. The most important examples are ^{235}U, ^{239}Pu, and ^{233}U.

Fissionable isotopes are those capable of being fissioned if struck by a sufficiently energetic neutron. All fissile isotopes are fissionable, but not all fissionable isotopes are fissile. (^{238}U, for example, is fissionable but not fissile.)

Natural uranium refers to the mixture of uranium isotopes found in nature, consisting of about 0.7 per cent ^{235}U and about 99.3 per cent ^{238}U.

Uranium enrichment is the use of technical means to divide a quantity of uranium into an 'enriched' fraction containing a higher percentage of ^{235}U than the input and a 'tails' fraction containing a lower percentage of ^{235}U than the input.

Nuclear explosive materials are isotope mixtures capable of sustaining a fission chain reaction propagated by fast neutrons (giving the possibility of growth of the reaction rate to explosive levels before expansion of the

* Originally prepared by John P. Holdren for distribution as an introduction to the briefing given by him and Richard L. Garwin at the Palais des Nations in Geneva on 7 Mar. 1994, to ambassadors and other diplomatic staff involved in the negotiations at the Conference on Disarmament on an international agreement to cut off the production of fissile material for weapons use; reprinted in *Pugwash Newsletter*, Jan./Apr. 1994.

material by heating terminates the reaction). All mixtures of plutonium isotopes are nuclear explosives (although nuclear weapon designers prefer to work with *weapon-grade plutonium* containing more than 90 per cent ^{239}Pu). Strictly speaking, mixtures of uranium isotopes are nuclear explosives if they contain more than about 20 per cent ^{235}U or more than about 12 per cent ^{233}U, but practical weapons require concentrations of ^{235}U and/or ^{233}U above about 50 per cent and weapon designers prefer to work with concentrations of these isotopes above 90 per cent (*highly enriched uranium* or *HEU*).

Plutonium production occurs in nuclear reactors when excess neutrons (those not needed to sustain the chain reaction) are absorbed by ^{238}U, initiating a series of two nuclear transformations that results in ^{239}Pu. ^{240}Pu results from the absorption of another neutron by ^{239}Pu, ^{241}Pu from the absorption of another neutron by ^{240}Pu, and so on.

In fuel reprocessing, nuclear fuel that has sustained a chain reaction for some time—accumulating fission products and plutonium as a result—is removed from the reactor, melted or dissolved, and processed chemically to separate the plutonium from the fission products and residual uranium.

For fission explosives: c. 4 kg of weapon-grade plutonium or c. 15 kg of HEU are sufficient to make a fission bomb which, with the simplest types of design, might yield 10–20 kt of high-explosive equivalent.

For thermonuclear explosives: thermonuclear warheads use a fission-explosive 'primary' as a trigger to ignite a fusion-explosive 'secondary'; a typical such warhead contains c. 4 kg of weapon-grade plutonium and c. 15 kg of HEU.

For nuclear-power reactors: a large nuclear-power reactor (1.25 million kw maximum electrical output) of the pressurized-water variety which dominates world nuclear electricity generation today, operating at a year-around average of 75 per cent of capacity, takes in about one tonne (1000 kg) of ^{235}U per year in fresh fuel (typically at an enrichment of 3.3 to 4.5 per cent) and discharges 250–300 kg of plutonium per year in its spent fuel. (This plutonium contains about 60 per cent ^{239}Pu and 40 per cent higher plutonium isotopes.) If fuelled with plutonium instead of ^{235}U, such a reactor would take in about a tonne of plutonium per year and would discharge 550–600 kg of plutonium per year in its spent fuel. Current world nuclear electricity generation is equivalent to the output of about 250 such reactors (nearly all of it fuelled with ^{235}U rather than with plutonium), hence takes in about 250 tonnes per year of ^{235}U in fresh fuel and discharges about 70 tonnes per year of plutonium in spent fuel.

Global inventories of nuclear-explosive materials:

– c. 300 tonnes of plutonium in nuclear weapons and military reserves;

– c. 1500 tonnes of HEU in nuclear weapons and military reserves;

– c. 1000 tonnes of plutonium in the civilian nuclear energy system (some 80 per cent of it in spent nuclear fuel).

Annexe B. Documentation on nuclear arms control

TREATY ON THE NON-PROLIFERATION OF NUCLEAR WEAPONS (NON-PROLIFERATION TREATY, NPT)

Signed at London, Moscow and Washington, DC, on 1 July 1968
Entered into force on 5 March 1970
Depositaries: UK, US and Russian governments

The States concluding this Treaty, hereinafter referred to as the 'Parties to the Treaty',

Considering the devastation that would be visited upon all mankind by a nuclear war and the consequent need to make every effort to avert the danger of such a war and to take measures to safeguard the security of peoples,

Believing that the proliferation of nuclear weapons would seriously enhance the danger of nuclear war,

In conformity with resolutions of the United Nations General Assembly calling for the conclusion of an agreement on the prevention of wider dissemination of nuclear weapons,

Undertaking to co-operate in facilitating the application of International Atomic Energy Agency safeguards on peaceful nuclear activities,

Expressing their support for research, development and other efforts to further the application, within the framework of the International Atomic Energy Agency safeguards system, of the principle of safeguarding effectively the flow of source and special fissionable materials by use of instruments and other techniques at certain strategic points,

Affirming the principle that the benefits of peaceful applications of nuclear technology, including any technological by-products which may be derived by nuclear-weapon States from the development of nuclear explosive devices, should be available for peaceful purposes to all Parties to the Treaty, whether nuclear-weapon or non-nuclear-weapon States,

Convinced that, in furtherance of this principle, all Parties to the Treaty are entitled to participate in the fullest possible exchange of scientific information for, and to contribute alone or in co-operation with other States to, the further development of the applications of atomic energy for peaceful purposes,

Declaring their intention to achieve at the earliest possible date the cessation of the nuclear arms race and to undertake effective measures in the direction of nuclear disarmament,

Urging the co-operation of all States in the attainment of this objective,

Recalling the determination expressed by the Parties to the 1963 Treaty banning nuclear weapon tests in the atmosphere, in outer space and under water in its Preamble to seek to achieve the discontinuance of all test explosions of nuclear weapons for all time and to continue negotiations to this end,

Desiring to further the easing of international tension and the strengthening of trust between States in order to facilitate the cessation of the manufacture of nuclear weapons, the liquidation, and the elimination from national arsenals of nuclear weapons and the means of their delivery pursuant to a Treaty on general and complete disarmament under strict and effective international control,

Recalling that, in accordance with the Charter of the United Nations, States must refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any State, or in any other manner inconsistent with the Purposes of the United Nations, and that the establishment and maintenance of international peace and security are to be promoted with the least diversion for armaments of the world's human and economic resources,

Have agreed as follows:

Article I

Each nuclear-weapon State Party to the Treaty undertakes not to transfer to any recipient whatsoever nuclear weapons or other nuclear explosive devices or control over such weapons or explosive devices directly, or indirectly; and not in any way to assist, encourage, or induce any non-nuclear-weapon State to manufacture or otherwise acquire nuclear weapons or other nuclear explosive devices, or control over such weapons or explosive devices.

Article II

Each non-nuclear-weapon State Party to the Treaty undertakes not to receive the transfer from any transferor whatsoever of nuclear weapons or other nuclear explosive devices or of control over such weapons or explosive devices directly, or indirectly; not to manufacture or otherwise acquire nuclear weapons or other nuclear explosive devices and not to seek or receive any assistance in the manufacture of nuclear weapons or other nuclear explosive devices.

Article III

1. Each non-nuclear-weapon State Party to the Treaty undertakes to accept safeguards, as set forth in an agreement to be negotiated and concluded with the International Atomic Energy Agency in accordance with the Statute of the International Atomic Energy Agency and the Agency's safeguards system, for the exclusive purpose of verification of the fulfilment of its obligations assumed under this Treaty with a view to preventing diversion of nuclear energy from peaceful uses to nuclear weapons or other nuclear explosive devices. Procedures for the safeguards required by this Article shall be followed with respect to source or special fissionable material whether it is being produced, processed or used in any principal nuclear facility or is outside any such facility. The safeguards required by this Article shall be applied on all source or special fissionable material in all peaceful nuclear activities within the territory of such State, under its jurisdiction, or carried out under its control anywhere.

2. Each State Party to the Treaty undertakes not to provide: (*a*) source or special fissionable material, or (*b*) equipment or material especially designed or prepared for the processing, use or production of special fissionable material, to any non-nuclear-weapon State for peaceful purposes, unless the source or special fissionable material shall be subject to the safeguards required by this Article.

3. The safeguards required by this Article shall be implemented in a manner designed to comply with Article IV of this Treaty, and to avoid hampering the economic or technological development of the Parties or international co-operation in the field of peaceful nuclear activities, including the international exchange of nuclear material and equipment for the processing, use or production of nuclear material for peaceful purposes in accordance with the provisions of this Article and the principle of safeguarding set forth in the Preamble of the Treaty.

4. Non-nuclear-weapon States Party to the Treaty shall conclude agreements with the International Atomic Energy Agency to meet the requirements of this Article either individually or together with other States in accordance with the Statute of the International Atomic Energy Agency. Negotiation of such

agreements shall commence within 180 days from the original entry into force of this Treaty. For States depositing their instruments of ratification or accession after the 180-day period, negotiation of such agreements shall commence not later than the date of such deposit. Such agreements shall enter into force not later than eighteen months after the date of initiation of negotiations.

Article IV

1. Nothing in this Treaty shall be interpreted as affecting the inalienable right of all the Parties to the Treaty to develop research, production and use of nuclear energy for peaceful purposes without discrimination and in conformity with Articles I and II of this Treaty.

2. All the Parties to the Treaty undertake to facilitate, and have the right to participate in, the fullest possible exchange of equipment, materials and scientific and technological information for the peaceful uses of nuclear energy. Parties to the Treaty in a position to do so shall also co-operate in contributing alone or together with other States or international organizations to the further development of the applications of nuclear energy for peaceful purposes, especially in the territories of non-nuclear-weapon States Party to the Treaty, with due consideration for the needs of the developing areas of the world.

Article V

Each Party to the Treaty undertakes to take appropriate measures to ensure that, in accordance with this Treaty, under appropriate international observation and through appropriate international procedures, potential benefits from any peaceful applications of nuclear explosions will be made available to non-nuclear-weapon States Party to the Treaty on a non-discriminatory basis and that the charge to such Parties for the explosive devices used will be as low as possible and exclude any charge for research and development. Non-nuclear-weapon States Party to the Treaty shall be able to obtain such benefits, pursuant to a special international agreement or agreements, through an appropriate international body with adequate representation of non-nuclear-weapon States. Negotiations on this subject shall commence as soon as possible after the Treaty enters into force. Non-nuclear-weapon States Party to the Treaty so desiring may also obtain such benefits pursuant to bilateral agreements.

Article VI

Each of the Parties to the Treaty undertakes to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control.

Article VII

Nothing in this Treaty affects the right of any group of States to conclude regional treaties in order to assure the total absence of nuclear weapons in their respective territories.

Article VIII

1. Any Party to the Treaty may propose amendments to this Treaty. The text of any proposed amendment shall be submitted to the Depositary Governments which shall circulate it to all Parties to the Treaty. Thereupon, if requested to do so by one-third or more of the Parties to the Treaty, the Depositary Governments shall convene a conference, to which they shall invite all the Parties to the Treaty, to consider such an amendment.

2. Any amendment to this Treaty must be approved by a majority of the votes of all the Parties to the Treaty, including the votes of all nuclear-weapon States Party to the Treaty and all other Parties

which, on the date the amendment is circulated, are members of the Board of Governors of the International Atomic Energy Agency. The amendment shall enter into force for each Party that deposits its instrument of ratification of the amendment upon the deposit of such instruments of ratification by a majority of all the Parties, including the instruments of ratification of all nuclear-weapon States Party to the Treaty and all other Parties which, on the date the amendment is circulated, are members of the Board of Governors of the International Atomic Energy Agency. Thereafter, it shall enter into force for any other Party upon the deposit of its instrument of ratification of the amendment.

3. Five years after the entry into force of this Treaty a conference of Parties to the Treaty shall be held in Geneva, Switzerland, in order to review the operation of this Treaty with a view to assuring that the purposes of the Preamble and the provisions of the Treaty are being realised. At intervals of five years thereafter, a majority of the Parties to the Treaty may obtain, by submitting a proposal to this effect to the Depositary Governments, the convening of further conferences with the same objective of reviewing the operation of the Treaty.

Article IX

1. This Treaty shall be open to all States for signature. Any State which does not sign the Treaty before its entry into force in accordance with paragraph 3 of this Article may accede to it at any time.

2. This Treaty shall be subject to ratification by signatory States. Instruments of ratification and instruments of accession shall be deposited with the Governments of the United Kingdom of Great Britain and Northern Ireland, the Union of Soviet Socialist Republics and the United States of America, which are hereby designated the Depositary Governments.

3. This Treaty shall enter into force after its ratification by the States, the Governments of which are designated Depositaries of the Treaty, and forty other States signatory to this Treaty and the deposit of their instruments of ratification. For the purposes of this Treaty, a nuclear-weapon State is one which has manufactured and exploded a nuclear weapon or other nuclear explosive device prior to 1 January, 1967.

4. For States whose instruments of ratification or accession are deposited subsequent to the entry into force of this Treaty, it shall enter into force on the date of the deposit of their instruments of ratification or accession.

5. The Depositary Governments shall promptly inform all signatory and acceding States of the date of each signature, the date of deposit of each instrument of ratification or of accession, the date of the entry into force of this Treaty, and the date of receipt of any requests for convening a conference or other notices.

6. This Treaty shall be registered by the Depositary Governments pursuant to Article 102 of the Charter of the United Nations.

Article X

1. Each Party shall in exercising its national sovereignty have the right to withdraw from the Treaty if it decides that extraordinary events, related to the subject matter of this Treaty, have jeopardized the supreme interests of its country. It shall give notice of such withdrawal to all other Parties to the Treaty and to the United Nations Security Council three months in advance. Such notice shall include a statement of the extraordinary events it regards as having jeopardized its supreme interests.

2. Twenty-five years after the entry into force of the Treaty, a conference

shall be convened to decide whether the Treaty shall continue in force indefinitely, or shall be extended for an additional fixed period or periods. This decision shall be taken by a majority of the Parties to the Treaty.

Article XI

This Treaty, the English, Russian, French, Spanish and Chinese texts of which are equally authentic, shall be deposited in the archives of the Depositary Governments. Duly certified copies of this Treaty shall be transmitted by the Depositary Governments to the Governments of the signatory and acceding States.

Source: *Treaty Series,* Vol. 729 (United Nations, New York).

PROTOCOL TO FACILITATE THE START TREATY (LISBON PROTOCOL)

Signed on 23 May 1992
Excerpt

The Republic of Byelarus, the Republic of Kazakhstan, the Russian Federation, Ukraine, and the United States of America, hereinafter referred to as the Parties,

Reaffirming their support for the Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms of July 31, 1991, hereinafter referred to as the Treaty,

Recognizing the altered political situation resulting from the replacement of the former Union of Soviet Socialist Republics with a number of independent states,

Recalling the commitment of the member states of the Commonwealth of Independent States that the nuclear weapons of the former Union of Soviet Socialist Republics will be maintained under the safe, secure, and reliable control of a single unified authority,

Desiring to facilitate implementation of the Treaty in this altered situation,

Have agreed as follows:

Article I

The Republic of Byelarus, the Republic of Kazakhstan, the Russian Federation, and Ukraine, as successor states of the former Union of Soviet Socialist Republics in connection with the Treaty, shall assume the obligations of the former Union of Soviet Socialist Republics under the Treaty.

Article II

The Republic of Byelarus, the Republic of Kazakhstan, the Russian Federation, and Ukraine shall make such arrangements among themselves as are required to implement the Treaty's limits and restrictions; to allow functioning of the verification provisions of the Treaty equally and consistently throughout the territory of the Republic of Byelarus, the Republic of Kazakhstan, the Russian Federation, and Ukraine; and to allocate costs.

Article III

1. For purposes of Treaty implementation, the phrase "Union of Soviet Socialist Republics" shall be interpreted to mean the Republic of Byelarus, the Republic of Kazakhstan, the Russian Federation, and Ukraine.

2. For purposes of Treaty implementation, the phrase "national territory", when used in the Treaty to refer to the Union of Soviet Socialist Republics, shall be interpreted to mean the combined national territories of the Republic of Byelarus, the Republic of Kazakhstan, the Russian Federation, and Ukraine.

3. For inspections and continuous monitoring activities on the territory of the Republic of Byelarus, the Republic of Kazakhstan, the Russian Federation

or Ukraine, that state shall provide communications from the inspection site or continuous monitoring site to the Embassy of the United States in the respective capital.

4. For purposes of Treaty implementation, the embassy of the Inspecting Party referred to in Section XVI of the Protocol on Inspections and Continuous Monitoring Activities Relating to the Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms shall be construed to be the embassy of the respective state in Washington or the embassy of the United States of America in the respective capital.

5. The working languages for Treaty activities shall be English and Russian.

Article IV

Representatives of the Republic of Byelarus, the Republic of Kazakhstan, the Russian Federation, and Ukraine will participate in the Joint Compliance and Inspection Commission on a basis to be worked out consistent with Article I of this Protocol.

Article V

The Republic of Byelarus, the Republic of Kazakhstan, and Ukraine shall adhere to the Treaty on the Non-Proliferation of Nuclear Weapons of July 1, 1968 as non-nuclear weapons states in the shortest possible time, and shall begin immediately to take all necessary actions to this end in accordance with their constitutional practices.

Article VI

1. Each Party shall ratify the Treaty together with this Protocol in accordance with its own constitutional procedures. The Republic of Byelarus, the Republic of Kazakhstan, the Russian Federation, and Ukraine shall exchange instruments of ratification with the United State of America. The Treaty shall enter into force on the date of the final exchange of instruments of ratification.

2. This Protocol shall be an integral part of the Treaty and shall remain in force throughout the duration of the Treaty.

. . .

Source: US Arms Control and Disarmament Agency (ACDA), ACDA document (mimeo).

TREATY BETWEEN THE UNITED STATES OF AMERICA AND THE RUSSIAN FEDERATION ON FURTHER REDUCTION OF STRATEGIC OFFENSIVE ARMS (START II TREATY)

Signed on 3 January 1993

The United States of America and the Russian Federation, hereinafter referred to as the Parties,

Reaffirming their obligations under the Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms of July 31, 1991, hereinafter referred to as the START Treaty,

Stressing their firm commitment to the Treaty on the Non-Proliferation of Nuclear Weapons of July 1, 1968, and their desire to contribute to its strengthening,

Taking into account the commitment by the Republic of Belarus, the Republic of Kazakhstan, and Ukraine to accede to the Treaty on the Non-Proliferation of Nuclear Weapons of July 1, 1968, as non-nuclear-weapon States Parties,

Mindful of their undertakings with respect to strategic offensive arms under Article VI of the Treaty on the Non-Proliferation of Nuclear Weapons of July 1, 1968, and under the Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems of May 26, 1972, as well as the provisions of the Joint Understanding signed by the Presidents of the United States of America and the Russian Federation on June 17, 1992, and of the Joint Statement on a Global Protection System signed by the Presidents of the United States of America and the Russian Federation on June 17, 1992,

Desiring to enhance strategic stability and predictability, and, in doing so, to reduce further strategic offensive arms, in addition to the reductions and limitations provided for in the START Treaty,

Considering that further progress toward that end will help lay a solid foundation for a world order built on democratic values that would preclude the risk of outbreak of war,

Recognizing their special responsibility as permanent members of the United Nations Security Council for maintaining international peace and security,

Taking note of United Nations General Assembly Resolution 47/52K of December 9, 1992,

Conscious of the new realities that have transformed the political and strategic relations between the Parties, and the relations of partnership that have been established between them,

Have agreed as follows:

Article I

1. Each Party shall reduce and limit its intercontinental ballistic missiles (ICBMs) and ICBM launchers, submarine-launched ballistic missiles (SLBMs) and SLBM launchers, heavy bombers, ICBM warheads, SLBM warheads, and heavy bomber armaments, so that seven years after entry into force of the START Treaty and thereafter, the aggregate number for each Party, as counted in accordance with Articles III and IV of this Treaty, does not exceed, for warheads attributed to deployed ICBMs, deployed SLBMs, and deployed heavy bombers, a number between 3800 and 4250 or such lower number as each Party shall decide for itself, but in no case shall such number exceed 4250.

2. Within the limitations provided for in paragraph 1 of this Article, the aggregate numbers for each Party shall not exceed:

(a) 2160, for warheads attributed to deployed SLBMs;

(b) 1200, for warheads attributed to deployed ICBMs of types to which more than one warhead is attributed; and

(c) 650, for warheads attributed to deployed heavy ICBMs.

3. Upon fulfillment of the obligations provided for in paragraph 1 of this Article, each Party shall further reduce and limit its ICBMs and ICBM launchers, SLBMs and SLBM launchers, heavy bombers, ICBM warheads, SLBM warheads, and heavy bomber armaments, so that no later than January 1, 2003, and thereafter, the aggregate number for each Party, as counted in accordance with Articles III and IV of this Treaty, does not exceed, for warheads attributed to deployed ICBMs, deployed SLBMs, and deployed heavy bombers, a number between 3000 and 3500 or such lower number as each Party shall decide for itself, but in no case shall such number exceed 3500.

4. Within the limitations provided for in paragraph 3 of this Article, the aggregate numbers for each Party shall not exceed:

(a) a number between 1700 and 1750, for warheads attributed to deployed SLBMs or such lower number as each Party shall decide for itself, but in no case shall such number exceed 1750;

(b) zero, for warheads attributed to deployed ICBMs of types to which more than one warhead is attributed; and

(c) zero, for warheads attributed to deployed heavy ICBMs.

5. The process of reductions provided

for in paragraphs 1 and 2 of this Article shall begin upon entry into force of this Treaty, shall be sustained throughout the reductions period provided for in paragraph 1 of this Article, and shall be completed no later than seven years after entry into force of the START Treaty. Upon completion of these reductions, the Parties shall begin further reductions provided for in paragraphs 3 and 4 of this Article, which shall also be sustained throughout the reductions period defined in accordance with paragraphs 3 and 6 of this Article.

6. Provided that the Parties conclude, within one year after entry into force of this Treaty, an agreement on a program of assistance to promote the fulfillment of the provisions of this Article, the obligations provided for in paragraphs 3 and 4 of this Article and in Article II of this Treaty shall be fulfilled by each Party no later than December 31, 2000.

Article II

1. No later than January 1, 2003, each Party undertakes to have eliminated or to have converted to launchers of ICBMs to which one warhead is attributed all its deployed and non-deployed launchers of ICBMs to which more than one warhead is attributed under Article III of this Treaty (including test launchers and training launchers), with the exception of those launchers of ICBMs other than heavy ICBMs at space launch facilities allowed under the START Treaty, and not to have thereafter launchers of ICBMs to which more than one warhead is attributed. ICBM launchers that have been converted to launch an ICBM of a different type shall not be capable of launching an ICBM of the former type. Each Party shall carry out such elimination or conversion using the procedures provided for in the START Treaty, except as otherwise provided for in paragraph 3 of this Article.

2. The obligations provided for in paragraph 1 of this Article shall not apply to silo launchers of ICBMson which the number of warheads has been reduced to one pursuant to paragraph 2 of Article III of this Treaty.

3. Elimination of silo launchers of heavy ICBMs, including test launchers and training launchers, shall be implemented by means of either:

(a) elimination in accordance with the procedures provided for in Section II of the Protocol on Procedures Governing the Conversion or Elimination of the Items Subject to the START Treaty; or

(b) conversion to silo launchers of ICBMs other than heavy ICBMs in accordance with the procedures provided for in the Protocol on Procedures Governing Elimination of Heavy ICBMs and on Procedures Governing Conversion of Silo Launchers of Heavy ICBMs Relating to the Treaty Between the United States of America and the Russian Federation on Further Reduction and Limitation of Strategic Offensive Arms, hereinafter referred to as the Elimination and Conversion Protocol. No more than 90 silo launchers of heavy ICBMs may be so converted.

4. Each Party undertakes not to emplace an ICBM, the launch canister of which has a diameter greater than 2.5 meters, in any silo launcher of heavy ICBMs converted in accordance with subparagraph 3(b) of this Article.

5. Elimination of launchers of heavy ICBMs at space launch facilities shall only be carried out in accordance with subparagraph 3(a) of this Article.

6. No later than January 1, 2003, each Party undertakes to have eliminated all of its deployed and non-deployed heavy ICBMs and their launch canisters in accordance with the procedures provided for in the Elimination and Conversion Protocol or by using such missiles for delivering objects into the upper atmosphere or space, and not to havesuch missiles or launch canisters thereafter.

7. Each Party shall have the right to

conduct inspections in connection with the elimination of heavy ICBMs and their launch canisters, as well as inspections in connection with the conversion of silo launchers of heavy ICBMs. Except as otherwise provided for in the Elimination and Conversion Protocol, such inspections shall be conducted subject to the applicable provisions of the START Treaty.

8. Each Party undertakes not to transfer heavy ICBMs to any recipient whatsoever, including any other Party to the START Treaty.

9. Beginning on January 1, 2003, and thereafter, each Party undertakes not to produce, acquire, flight-test (except for flight tests from space launch facilities conducted in accordance with the provisions of the START Treaty), or deploy ICBMs to which more than one warhead is attributed under Article III of this Treaty.

Article III

1. For the purposes of attributing warheads to deployed ICBMs and deployed SLBMs under this Treaty, the Parties shall use the provisions provided for in Article III of the START Treaty, except as otherwise provided for in paragraph 2 of this Article.

2. Each Party shall have the right to reduce the number of warheads attributed to deployed ICBMs or deployed SLBMs only of existing types, except for heavy ICBMs. Reduction in the number of warheads attributed to deployed ICBMs and deployed SLBMs of existing types that are not heavy ICBMs shall be carried out in accordance with the provisions of paragraph 5 of Article III of the START Treaty, except that:

(a) the aggregate number by which warheads are reduced may exceed the 1250 limit provided for in paragraph 5 of Article III of the START Treaty;

(b) the number by which warheads are reduced on ICBMs and SLBMs, other than the Minuteman III ICBM for the United States of America and the SS-N-18 SLBM for the Russian Federation, may at any one time exceed the limit of 500 warheads for each Party provided for in subparagraph 5(c)(i) of Article III of the START Treaty;

(c) each Party shall have the right to reduce by more than four warheads, but not by more than five warheads, the number of warheads attributed to each ICBM out of no more than 105 ICBMs of one existing type of ICBM. An ICBM to which the number of warheads attributed has been reduced in accordance with this paragraph shall only be deployed in an ICBM launcher in which an ICBM of that type was deployed as of the date of signature of the START Treaty; and

(d) the reentry vehicle platform for an ICBM or SLBM to which a reduced number of warheads is attributed is not required to be destroyed and replaced with a new reentry vehicle platform.

3. Notwithstanding the number of warheads attributed to a type of ICBM or SLBM in accordance with the START Treaty, each Party undertakes not to:

(a) produce, flight-test, or deploy an ICBM or SLBM with a number of reentry vehicles greater than the number of warheads attributed to it under this Treaty; and

(b) increase the number of warheads attributed to an ICBM or SLBM that has had the number of warheads attributed to it reduced in accordance with the provisions of this Article.

Article IV

1. For the purposes of this Treaty, the number of warheads attributed to each deployed heavy bomber shall be equal to the number of nuclear weapons for which any heavy bomber of the same type or variant of a type is actually equipped, with the exception of heavy bombers reoriented to a conventional

role as provided for in paragraph 7 of this Article. Each nuclear weapon for which a heavy bomber is actually equipped shall count as one warhead toward the limitations provided for in Article I of this Treaty. For the purpose of such counting, nuclear weapons include long-range nuclear air-launched cruise missiles (ALCMs), nuclear air-to-surface missiles with a range of less than 600 kilometers, and nuclear bombs.

2. For the purposes of this Treaty, the number of nuclear weapons for which a heavy bomber is actually equipped shall be the number specified for heavy bombers of that type and variant of a type in the Memorandum of Understanding on Warhead Attribution and Heavy Bomber Data Relating to the Treaty Between the United States of America and the Russian Federation on Further Reduction and Limitation of Strategic Offensive Arms, hereinafter referred to as the Memorandum on Attribution.

3. Each Party undertakes not to equip any heavy bomber with a greater number of nuclear weapons than the number specified for heavy bombers of that type or variant of a type in the Memorandum on Attribution.

4. No later than 180 days after entry into force of this Treaty, each Party shall exhibit one heavy bomber of each type and variant of a type specified in the Memorandum on Attribution.

The purpose of the exhibition shall be to demonstrate to the other Party the number of nuclear weapons for which a heavy bomber of a given type or variant of a type is actually equipped.

5. If either Party intends to change the number of nuclear weapons specified in the Memorandum on Attribution, for which a heavy bomber of a type or variant of a type is actually equipped, it shall provide a 90-day advance notification of such intention to the other Party. Ninety days after providing such a notification, or at a later date agreed by the Parties, the Party changing the number of nuclear weapons for which a heavy bomber is actually equipped shall exhibit one heavy bomber of each such type or variant of a type. The purpose of the exhibition shall be to demonstrate to the other Party the revised number of nuclear weapons for which heavy bombers of the specified type or variant of a type are actually equipped. The number of nuclear weapons attributed to the specified type and variant of a type of heavy bomber shall change on the ninetieth day after the notification of such intent. On that day, the Party changing the number of nuclear weapons for which a heavy bomber is actually equipped shall provide to the other Party a notification of each change in data according to categories of data contained in the Memorandum on Attribution.

6. The exhibitions and inspections conducted pursuant to paragraphs 4 and 5 of this Article shall be carried out in accordance with the procedures provided for in the Protocol on Exhibitions and Inspections of Heavy Bombers Relating to the Treaty Between the United States of America and the Russian Federation on Further Reduction and Limitation of Strategic Offensive Arms, hereinafter referred to as the Protocol on Exhibitions and Inspections.

7. Each Party shall have the right to reorient to a conventional role heavy bombers equipped for nuclear armaments other than long-range nuclear ALCMs. For the purposes of this Treaty, heavy bombers reoriented to a conventional role are those heavy bombers specified by a Party from among its heavy bombers equipped for nuclear armaments other than long-range nuclear ALCMs that have never been accountable under the START Treaty as heavy bombers equipped for long-range nuclear ALCMs. The reorienting Party shall provide to the other Party a notification of its intent to reorient a heavy

bomber to a conventional role no less than 90 days in advance of such reorientation. No conversion procedures shall be required for such a heavy bomber to be specified as a heavy bomber reoriented to a conventional role.

8. Heavy bombers reoriented to a conventional role shall be subject to the following requirements:

(a) the number of such heavy bombers shall not exceed 100 at any one time;

(b) such heavy bombers shall be based separately from heavy bombers with nuclear roles;

(c) such heavy bombers shall be used only for non-nuclear missions. Such heavy bombers shall not be used in exercises for nuclear missions, and their aircrews shall not train or exercise for such missions; and

(d) heavy bombers reoriented to a conventional role shall have differences from other heavy bombers of that type or variant of a type that are observable by national technical means of verification and visible during inspection.

9. Each Party shall have the right to return to a nuclear role heavy bombers that have been reoriented in accordance with paragraph 7 of this Article to a conventional role. The Party carrying out such action shall provide to the other Party through diplomatic channels notification of its intent to return a heavy bomber to a nuclear role no less than 90 days in advance of taking such action. Such a heavy bomber returned to a nuclear role shall not subsequently be reoriented to a conventional role.

Heavy bombers reoriented to a conventional role that are subsequently returned to a nuclear role shall have differences observable by national technical means of verification and visible during inspection from other heavy bombers of that type and variant of a type that have not been reoriented to a conventional role, as well as from heavy bombers of that type and variant of a type that are still reoriented to a conventional role.

10. Each Party shall locate storage areas for heavy bomber nuclear armaments no less than 100 kilometers from any air base where heavy bombers reoriented to a conventional role are based.

11. Except as otherwise provided for in this Treaty, heavy bombers reoriented to a conventional role shall remain subject to the provisions of the START Treaty, including the inspection provisions.

12. If not all heavy bombers of a given type or variant of a type are reoriented to a conventional role, one heavy bomber of each type or variant of a type of heavy bomber reoriented to a conventional role shall be exhibited in the open for the purpose of demonstrating to the other Party the differences referred to in subparagraph 8(d) of this Article. Such differences shall be subject to inspection by the other Party.

13. If not all heavy bombers of a given type or variant of a type reoriented to a conventional role are returned to a nuclear role, one heavy bomber of each type and variant of a type of heavy bomber returned to a nuclear role shall be exhibited in the open for the purpose of demonstrating to the other Party the differences referred to in paragraph 9 of this Article. Such differences shall be subject to inspection by the other Party.

14. The exhibitions and inspections provided for in paragraphs 12 and 13 of this Article shall be carried out in accordance with the procedures provided for in the Protocol on Exhibitions and Inspections.

Article V

1. Except as provided for in this Treaty, the provisions of the START Treaty, including the verification provisions, shall be used for implementation of this Treaty.

2. To promote the objectives and

implementation of the provisions of this Treaty, the Parties hereby establish the Bilateral Implementation Commission. The Parties agree that, if either Party so requests, they shall meet within the framework of the Bilateral Implementation Commission to:

(a) resolve questions relating to compliance with the obligations assumed; and

(b) agree upon such additional measures as may be necessary to improve the viability and effectiveness of this Treaty.

Article VI

1. This Treaty, including its Memorandum on Attribution, Elimination and Conversion Protocol, and Protocol on Exhibitions and Inspections, all of which are integral parts thereof, shall be subject to ratification in accordance with the constitutional procedures of each Party. This Treaty shall enter into force on the date of the exchange of instruments of ratification, but not prior to the entry into force of the START Treaty.

2. The provisions of paragraph 8 of Article II of this Treaty shall be applied provisionally by the Parties from the date of its signature.

3. This Treaty shall remain in force so long as the START Treaty remains in force.

4. Each Party shall, in exercising its national sovereignty, have the right to withdraw from this Treaty if it decides that extraordinary events related to the subject matter of this Treaty have jeopardized its supreme interests. It shall give notice of its decision to the other Party six months prior to withdrawal from this Treaty. Such notice shall include a statement of the extraordinary events the notifying Party regards as having jeopardized its supreme interests.

Article VII

Each Party may propose amendments to this Treaty. Agreed amendments shall enter into force in accordance with the procedures governing entry into force of this Treaty.

Article VIII

This Treaty shall be registered pursuant to Article 102 of the Charter of the United Nations. Done at Moscow on January 3, 1993, in two copies, each in the English and Russian languages, both texts being equally authentic.

Protocol on Procedures Governing Elimination of Heavy ICBMs and on Procedures Governing Conversion of Silo Launchers of Heavy ICBMs Relating to the Treaty of the United States of America and the Russian Federation on Further Reduction and Limitation of Strategic Offensive Arms

Pursuant to and in implementation of the Treaty Between the United States of America and the Russian Federation on Further Reduction and Limitation of Strategic Offensive Arms, hereinafter referred to as the Treaty, the Parties hereby agree upon procedures governing the elimination of heavy ICBMs and upon procedures governing the conversion of silo launchers of such ICBMs.

I. Procedures for Elimination of Heavy ICBMs and Their Launch Canisters

1. Elimination of heavy ICBMs shall be carried out in accordance with the procedures provided for in this Section at elimination facilities for ICBMs specified in the START Treaty or shall be carried out by using such missiles for delivering objects into the upper atmosphere or space. Notification thereof shall be provided through the Nuclear Risk Reduction Centers (NRRCs) 30 days in advance of the initiation of elimination at conversion or elimination facilities, or, in the event of launch, in

accordance with the provisions of the Agreement Between the United States of America and the Union of Soviet Socialist Republics on Notifications of Launches of Intercontinental Ballistic Missiles and Submarine-Launched Ballistic Missiles of May 31, 1988.

2. Prior to the confirmatory inspection pursuant to paragraph 3 of this Section, the inspected Party:

(a) shall remove the missile's reentry vehicles;

(b) may remove the electronic and electromechanical devices of the missile's guidance and control system from the missile and its launch canister, and other elements that shall not be subject to elimination pursuant to paragraph 4 of this Section;

(c) shall remove the missile from its launch canister and disassemble the missile into stages;

(d) shall remove liquid propellant from the missile;

(e) may remove or actuate auxiliary pyrotechnic devices installed on the missile and its launch canister;

(f) may remove penetration aids, including devices for their attachment and release; and

(g) may remove propulsion units from the self-contained dispensing mechanism.

These actions may be carried out in any order.

3. After arrival of the inspection team and prior to the initiation of the elimination process, inspectors shall confirm the type and number of the missiles to be eliminated by making the observations and measurements necessary for such confirmation. After the procedures provided for in this paragraph have been carried out, the process of the elimination of the missiles and their launch canisters may begin. Inspectors shall observe the elimination process.

4. Elimination process for heavy ICBMs:

(a) missile stages, nozzles, and missile interstage skirts shall each be cut into two pieces of approximately equal size; and

(b) the self-contained dispensing mechanism as well as the front section, including the reentry vehicle platform and the front section shroud, shall be cut into two pieces of approximately equal size and crushed.

5. During the elimination process for launch canisters of heavy ICBMs, the launch canister shall be cut into two pieces of approximately equal size or into three pieces in such a manner that pieces no less than 1.5 meters long are cut from the ends of the body of such a launch canister.

6. Upon completion of the above requirements, the inspection team leader and a member of the in-country escort shall confirm in a factual, written report containing the results of the inspection team's observation of the elimination process that the inspection team has completed its inspection.

7. Heavy ICBMs shall cease to be subject to the limitations provided for in the Treaty after completion of the procedures provided for in this Section. Notification thereof shall be provided in accordance with paragraph 3 of Section I of the Notification Protocol Relating to the START Treaty.

II. Procedures for Conversion of Silo Launchers of Heavy ICBMs, Silo Training Launchers for Heavy ICBMs, and Silo Test Launchers for Heavy ICBMs

1. Conversion of silo launchers of heavy ICBMs, silo training launchers for heavy ICBMs, and silo test launchers for heavy ICBMs shall be carried out *in situ* and shall be subject to inspection.

2. Prior to the initiation of the conversion process for such launchers, the missile and launch canister shall be removed from the silo launcher.

3. A Party shall be considered to have initiated the conversion process for silo

launchers of heavy ICBMs, silo training launchers for heavy ICBMs, and silo test launchers for heavy ICBMs as soon as the silo launcher door has been opened and a missile and its launch canister have been removed from the silo launcher. Notification thereof shall be provided in accordance with paragraphs 1 and 2 of Section IV of the Notification Protocol Relating to the START Treaty.

4. Conversion process for silo launchers of heavy ICBMs, silo training launchers for heavy ICBMs, and silo test launchers for heavy ICBMs shall include the following steps:

(a) the silo launcher door shall be opened, the missile and the launch canister shall be removed from the silo launcher;

(b) concrete shall be poured into the base of the silo launcher up to the height of five meters from the bottom of the silo launcher; and

(c) a restrictive ring with a diameter of no more than 2.9 meters shall be installed into the upper portion of the silo launcher. The method of installation of the restrictive ring shall rule out its removal without destruction of the ring and its attachment to the silo launcher.

5. Each Party shall have the right to confirm that the procedures provided for in paragraph 4 of this Section have been carried out. For the purpose of confirming that these procedures have been carried out:

(a) the converting Party shall notify the other Party through the NRRCs:

(i) no less than 30 days in advance of the date when the process of pouring concrete will commence; and

(ii) upon completion of all of the procedures provided for in paragraph 4 of this Section; and

(b) the inspecting Party shall have the right to implement the procedures provided for in either paragraph 6 or paragraph 7, but not both, of this Section for each silo launcher of heavy ICBMs, silo training launcher for heavy ICBMs, and silo test launcher for heavy ICBMs that is to be converted.

6. Subject to the provisions of paragraph 5 of this Section, each Party shall have the right to observe the entire process of pouring concrete into each silo launcher of heavy ICBMs, silo training launcher for heavy ICBMs, and silo test launcher for heavy ICBMs that is to be converted, and to measure the diameter of the restrictive ring. For this purpose:

(a) the inspecting Party shall inform the Party converting the silo launcher no less than seven days in advance of the commencement of the pouring that it will observe the filling of the silo in question;

(b) immediately prior to the commencement of the process of pouring concrete, the converting Party shall take such steps as are necessary to ensure that the base of the silo launcher is visible, and that the depth of the silo can be measured;

(c) the inspecting Party shall have the right to observe the entire process of pouring concrete from a location providing an unobstructed view of the base of the silo launcher, and to confirm by measurement that concrete has been poured into the base of the silo launcher up to the height of five meters from the bottom of the silo launcher. The measurements shall be taken from the level of the lower edge of the closed silo launcher door to the base of the silo launcher, prior to the pouring of the concrete, and from the level of the lower edge of the closed silo launcher door to the top of the concrete fill, after the concrete has hardened;

(d) following notification of completion of the procedures provided for in paragraph 4 of this Section, the inspecting Party shall be permitted to measure the diameter of the restrictive ring. The restrictive ring shall not be shrouded during such inspections. The Parties shall agree on the date for such inspections;

(e) the results of measurements conducted pursuant to subparagraphs (c) and (d) of this paragraph shall be recorded in written, factual inspection reports and signed by the inspection team leader and a member of the in-country escort;

(f) inspection teams shall each consist of no more than 10 inspectors, all of whom shall be drawn from the list of inspectors under the START Treaty; and

(g) such inspections shall not count against any inspection quota established by the START Treaty.

7. Subject to the provisions of paragraph 5 of this Section, each Party shall have the right to measure the depth of each silo launcher of heavy ICBMs, silo training launcher for heavy ICBMs, and silo test launcher for heavy ICBMs that is to be converted both before the commencement and after the completion of the process of pouring concrete, and to measure the diameter of the restrictive ring. For this purpose:

(a) the inspecting Party shall inform the Party converting the silo launcher no less than seven days in advance of the commencement of the pouring that it will measure the depth of the silo launcher in question both before the commencement and after the completion of the process of pouring concrete;

(b) immediately prior to the commencement of the process of pouring concrete, the converting Party shall take such steps as are necessary to ensure that the base of the silo launcher is visible, and that the depth of the silo launcher can be measured;

(c) the inspecting Party shall measure the depth of the silo launcher prior to the commencement of the process of pouring concrete;

(d) following notification of completion of the procedures provided for in paragraph 4 of this Section, the inspecting Party shall be permitted to measure the diameter of the restrictive ring, and to remeasure the depth of the silo launcher. The restrictive ring shall not be shrouded during such inspections. The Parties shall agree on the date for such inspections;

(e) for the purpose of measuring the depth of the concrete in the silo launcher, measurements shall be taken from the level of the lower edge of the closed silo launcher door to the base of the silo launcher, prior to the pouring of the concrete, and from the level of the lower edge of the closed silo launcher door to the top of the concrete fill, after the concrete has hardened;

(f) the results of measurements conducted pursuant to subparagraphs (c), (d), and (e) of this paragraph shall be recorded in written, factual inspection reports and signed by the inspection team leader and a member of the in-country escort;

(g) inspection teams shall each consist of no more than 10 inspectors, all of whom shall be drawn from the list of inspectors under the START Treaty; and

(h) such inspections shall not count against any inspection quota established by the START Treaty.

8. The converting Party shall have the right to carry out further conversion measures after the completion of the procedures provided for in paragraph 6 or paragraph 7 of this Section or, if such procedures are not conducted, upon expiration of 30 days after notification of completion of the procedures provided for in paragraph 4 of this Section.

9. In addition to the reentry vehicle inspections conducted under the START Treaty, each Party shall have the right to conduct, using the procedures provided for in Annex 3 to the Inspection Protocol Relating to the START Treaty, four additional reentry vehicle inspections each year of ICBMs that are deployed in silo launchers of heavy ICBMs that have been converted in accordance with the provisions of this Section. During such inspections, the inspectors also shall have the right to confirm by visual

observation the presence of the restrictive ring and that the observable portions of the launch canister do not differ externally from the observable portions of the launch canister that was exhibited pursuant to paragraph 11 of Article XI of the START Treaty. Any shrouding of the upper portion of the silo launcher shall not obstruct visual observation of the upper portion of the launch canister and shall not obstruct visual observation of the edge of the restricted ring. If requested by the inspecting Party, the converting Party shall partially remove any shrouding, except for shrouding of instruments installed on the restrictive ring, to permit confirmation of the presence of the restrictive ring.

10. Upon completion of the procedures provided for in paragraph 6 or paragraph 7 of this Section or, if such procedures are not conducted, upon expiration of 30 days after notification of completion of the procedures provided for in paragraph 4 of this Section, the silo launcher of heavy ICBMs being converted shall, for the purposes of the Treaty, be considered to contain a deployed ICBM to which one warhead is attributed.

III. Equipment; Costs

1. To carry out inspections provided for in this Protocol, the inspecting Party shall have the right to use agreed equipment, including equipment that will confirm that the silo launcher has been completely filled up to the height of five meters from the bottom of the silo launcher with concrete. The Parties shall agree in the Bilateral Implementation Commission on such equipment.

2. For inspections conducted pursuant to this Protocol, costs shall be handled pursuant to paragraph 19 of Section V of the Inspection Protocol Relating to the START Treaty.

This Protocol is an integral part of the Treaty and shall enter into force on the date of entry into force of the Treaty and shall remain in force as long as the Treaty remains in force. As provided for in subparagraph 2(b) of Article V of the Treaty, the Parties may agree upon such additional measures as may be necessary to improve the viability and effectiveness of the Treaty. The Parties agree that, if it becomes necessary to make changes in this Protocol that do not affect substantive rights or obligations under the Treaty, they shall use the Bilateral Implementation Commission to reach agreement on such changes, without resorting to the procedure for making amendments set forth in Article VII of the Treaty.

Done at Moscow on January 3, 1993, in two copies, each in the English and Russian languages, both texts being equally authentic.

Protocol on Exhibitions and Inspections of Heavy Bombers Relating to the Treaty Between the United States of America and the Russian Federation on Further Reduction and Limitation of Strategic Offensive Arms

Pursuant to and in implementation of the Treaty Between the United States of America and the Russian Federation on Further Reduction and Limitation of Strategic Offensive Arms, hereinafter referred to as the Treaty, the Parties hereby agree to conduct exhibitions and inspections of heavy bombers pursuant to paragraphs 4, 5, 12, and 13 of Article IV of the Treaty.

I. Exhibitions of Heavy Bombers

1. For the purpose of helping to ensure verification of compliance with the provisions of the Treaty, and as required by paragraphs 4, 5, 12, and 13 of Article IV of the Treaty, each Party shall conduct exhibitions of heavy bombers equipped for nuclear armaments, heavy bombers reoriented to a conventional role, and heavy bombers that were reoriented to a conventional role and subsequently

returned to a nuclear role.

2. The exhibitions of heavy bombers shall be conducted subject to the following provisions:

(a) the location for such an exhibition shall be at the discretion of the exhibiting Party;

(b) the date for such an exhibition shall be agreed upon between the Parties through diplomatic channels, and the exhibiting Party shall communicate the location of the exhibition;

(c) during such an exhibition, each heavy bomber exhibited shall be subject to inspection for a period not to exceed two hours;

(d) the inspection team conducting an inspection during an exhibition shall consist of no more than 10 inspectors, all of whom shall be drawn from the list of inspectors under the START Treaty;

(e) prior to the beginning of the exhibition, the inspected Party shall provide a photograph or photographs of one of the heavy bombers of a type or variant of a type reoriented to a conventional role and of one of the heavy bombers of the same type and variant of a type that were reoriented to a conventional role and subsequently returned to a nuclear role, so as to show all of their differences that are observable by national technical means of verification and visible during inspection; and

(f) such inspections during exhibitions shall not count against any inspection quota established by the START Treaty.

II. Inspections of Heavy Bombers

1. During exhibitions of heavy bombers, each Party shall have the right to perform the following procedures on the exhibited heavy bombers; and each Party, beginning 180 days after entry into force of the Treaty and thereafter, shall have the right, in addition to its rights under the START Treaty, to perform, during data update and new facility inspections conducted under the START Treaty at air bases of the other Party, the following procedures on all heavy bombers based at such air bases and present there at the time of the inspection:

(a) to conduct inspections of heavy bombers equipped for long-range nuclear ALCMs and heavy bombers equipped for nuclear armaments other than long-range nuclear ALCMs, in order to confirm that the number of nuclear weapons for which a heavy bomber is actually equipped does not exceed the number specified in the Memorandum on Attribution. The inspection team shall have the right to visually inspect those portions of the exterior of the inspected heavy bomber where the inspected heavy bomber is equipped for weapons, as well as to visually inspect the weapons bay of such a heavy bomber, but not to inspect other portions of the exterior or interior;

(b) to conduct inspections of heavy bombers reoriented to a conventional role, in order to confirm the differences of such heavy bombers from other heavy bombers of that type or variant of a type that are observable by national technical means of verification and visible during inspection. The inspection team shall have the right to visually inspect those portions of the exterior of the inspected heavy bomber having the differences observable by national technical means of verification and visible during inspection, but not to inspect other portions of the exterior or interior; and

(c) to conduct inspections of heavy bombers that were reoriented to a conventional role and subsequently returned to a nuclear role, in order to confirm the differences of such heavy bombers from other heavy bombers of that type or variant of a type that are observable by national technical means of verification and visible during inspection, and to confirm that the number of nuclear weapons for which a heavy bomber is actually equipped does not exceed the number specified in the Memorandum on Attribution. The inspection team shall have the right to visually inspect those portions of the exterior of the inspected heavy bomber where the inspected heavy bomber is equipped for weapons, as well as to visually inspect the weapons bay of such a heavy bomber, and to visually inspect those portions of the exterior of the inspected heavy bomber having the differences observable by national technical means of verification and visible to inspection, but not to inspect other portions of the exterior or interior.

2. At the discretion of the inspected Party, those portions of the heavy bomber that are not subject to inspection may be shrouded. The period of time required to carry out the shrouding process shall not count against the period allocated for inspection.

3. In the course of an inspection conducted during an exhibition, a member of the in-country escort shall provide, during inspections conducted pursuant to subparagraph 1(a) or subparagraph 1(c) of this Section, explanations to the inspection team concerning the number of nuclear weapons for which the heavy bomber is actually equipped, and shall provide, during inspections conducted pursuant to subparagraph 1(b) or subparagraph 1(c) of this Section, explanations to the inspection team concerning the differences that are observable by national technical means of verification and visible during inspection.

This Protocol is an integral part of the Treaty and shall enter into force on the date of entry into force of the Treaty and shall remain in force so long as the Treaty remains in force. As provided for in subparagraph 2(b) of Article V of the Treaty, the Parties may agree upon such additional measures as may be necessary to improve the viability and effectiveness of the Treaty. The Parties agree that, if it becomes necessary to make changes in this Protocol that do not affect substantive rights or obligations under the Treaty, they shall use the Bilateral Implementation Commission to reach agreement on such changes, without resorting to the procedure for making amendments set forth in Article VII of the Treaty.

Done at Moscow on January 3, 1993, in two copies, each in the English and Russian languages, both texts being equally authentic.

Memorandum of Understanding on Warhead Attribution and Heavy Bomber Data Relating to the Treaty Between the United States of America and the Russian Federation on Further Reduction and Limitation of Strategic Offensive Arms

Pursuant to and in implementation of the Treaty Between the United States of America and the Russian Federation on Further Reduction and Limitation of Strategic Offensive Arms, hereinafter referred to as the Treaty, the Parties have exchanged data current as of January 3, 1993, on the number of nuclear weapons for which each heavy bomber of a type and a variant of a type equipped for nuclear weapons is actually equipped. No later than 30 days after the date of entry into force of the Treaty, the Parties shall additionally exchange data, current as of the date of entry into force of the Treaty, according to the categories of data contained in this Memorandum, on heavy bombers equipped for nuclear weapons; on heavy bombers specified as reoriented to a conventional role, and on heavy bombers reoriented to a conventional role that are subsequently returned to a nuclear role; on ICBMs and SLBMs to which a reduced number of warheads is attributed; and on data on the elimination of heavy ICBMs and on conversion of silo launchers of heavy ICBMs.

Only those data used for purposes of implementing the Treaty that differ from the data in the Memorandum of Understanding on the Establishment of the Data Base Relating to the START

Treaty are included in this Memorandum.

I. Number of Warheads Attributed to Deployed Heavy Bombers Other than Heavy Bombers Reoriented to a Conventional Role

1. Pursuant to paragraph 3 of Article IV of the Treaty each Party undertakes not to have more nuclear weapons deployed on heavy bombers of any type or variant of a type than the number specified in this paragraph. Additionally, pursuant to paragraph 2 of Article IV of the Treaty, for each Party the numbers of warheads attributed to deployed heavy bombers not reoriented to a conventional role as of the date of signature of the Treaty or to heavy bombers subsequently deployed are listed below. Such numbers shall only be changed in accordance with paragraph 5 of Article IV of the Treaty. The Party making a change shall provide a notification to the other Party 90 days prior to making such a change. An exhibition shall be conducted to demonstrate the changed number of nuclear weapons for which heavy bombers of the listed type or variant of a type are actually equipped:

(a) United States of America

Heavy Bomber Type and Variant of a Type*	Number of Warheads
B-52G	12
B-52H	20
B-1B	16
B-2	16

Aggregate Number of Warheads Attributed to Deployed Heavy Bombers, Except for Heavy Bombers Reoriented to a Conventional Role —

(b) Russian Federation

Heavy Bomber Type and Variant of a Type	Number of Warheads
Bear B	1
Bear G	2
Bear H6	6
Bear H16	16
Blackjack	12

Aggregate Number of Warheads Attributed to Deployed Heavy Bombers, Except for Heavy Bombers Reoriented to a Conventional Role —

II. Data on Heavy Bombers Reoriented to a Conventional Role and Heavy Bombers Reoriented to a Conventional Role that Have Subsequently Been Returned to a Nuclear Role

1. For each Party, the numbers of heavy bombers reoriented to a conventional role are as follows:

(a) United States of America

Heavy Bomber Type and Variant of a Type	Number
—	—
—	—

(b) Russian Federation

Heavy Bomber Type and Variant of a Type	Number
—	—
—	—

2. For each Party, the numbers of heavy bombers reoriented to a conventional role as well as data on related air bases are as follows:

(a) United States of America

Air Bases:

Name/Location	Bomber Type and Variant of a Type
—	—

Heavy Bombers Reoriented to a Conventional Role   Number —

(b) Russian Federation

Air Bases:

Name/Location	Bomber Type and Variant of a Type
—	—

3. For each Party, the differences

* Heavy bombers of the type and variant of a type designated B-52C, B-52D, B-52E, and B-52F, located at the Davis-Monthan conversion or elimination facility as of September 1, 1990, as specified in the Memorandum of Understanding to the START Treaty, will be eliminated, under the provisions of the START Treaty, before the expiration of the seven-year reductions period.

observable by technical means of verification for heavy bombers reoriented to a conventional role are as follows:

(a) United States of America

Heavy Bomber Type and Variant of a Type	Difference
—	—

(b) Russian Federation

Heavy Bomber Type and Variant of a Type	Difference
—	—

4. For each Party, the differences observable by national technical means of verification for heavy bombers reoriented to a conventional role that have subsequently been returned to a nuclear role are as follows:

(a) United States of America

Heavy Bomber Type and Variant of a Type	Difference
—	—

(b) Russian Federation

Heavy Bomber Type and Variant of a Type	Difference
—	—

III. Data on Deployed ICBMs and Deployed SLBMs to Which a Reduced Number of Warheads is Attributed

For each Party, the data on ICBM bases or submarine bases, and on ICBMs or SLBMs of existing types deployed at those bases, on which the number of warheads attributed to them is reduced pursuant to Article III of the Treaty are as follows:

(a) United States of America

	Type of ICBM or SLBM
	—
Deployed ICBMs or Deployed SLBMs, on Which the Number of Warheads Is Reduced	—
Warheads Attributed to Each Deployed ICBM or Deployed SLBM After Reduction in the Number of Warheads on It	—
Number of Warheads by Which the Original Attribution of Warheads for Each ICBM or SLBM Was Reduced	—
Aggregate Reduction in the Number of Warheads Attributed to Deployed ICBMs or Deployed SLBMs of that Type	—

ICBM Bases at Which the Number of Warheads on Deployed ICBMs Is Reduced:

Name/Location	ICBM Type on Which the Number of Warheads Is Reduced
—	—
Deployed ICBMs on Which the Number of Warheads Is Reduced	—
Warheads Attributed to Each Deployed ICBM After Reduction in the Number of Warheads on It	—
Number of Warheads by Which the Original Attribution of War heads for Each ICBM Was Reduced	—
Aggregate Reduction in the Number of Warheads Attributed to Deployed ICBMs of that Type	—

SLBM Bases at Which the Number of Warheads on Deployed SLBMs Is Reduced:

Name/Location	SLBM Type on Which the Number of Warheads Is Reduced
—	—
Deployed SLBMs on Which the Number of Warheads Is Reduced	—
Warheads Attributed to Each Deployed SLBM After Reduction in the Number of Warheads on It	—

Number of Warheads by Which

the Original Attribution of Warheads for Each SLBM Was Reduced —

Aggregate Reduction in the Number of Warheads Attributed to Deployed SLBMs of that Type —

(b) Russian Federation

Type of ICBM or SLBM

—

Deployed ICBMs or Deployed SLBMs, on Which the Number of Warheads Is Reduced —

Warheads Attributed to Each Deployed ICBM or Deployed SLBM After Reduction in the Number of Warheads on It —

Number of Warheads by Which the Original Attribution of Warheads for Each ICBM or SLBM Was Reduced —

Aggregate Reduction in the Number of Warheads Attributed to Deployed ICBMs or Deployed SLBMs of that Type —

ICBM Bases at Which the Number of Warheads on Deployed ICBMs Is Reduced:

Name/Location	ICBM Type on Which the Number of Warheads Is Reduced
—	—

Deployed ICBMs on Which the Number of Warheads Is Reduced —

Warheads Attributed to Each Deployed ICBM After Reduction in the Number of Warheads on It —

Number of Warheads by Which the Original Attribution of Warheads for Each ICBM Was Reduced —

Aggregate Reduction in the Number of Warheads Attributed to Deployed ICBMs of that Type —

SLBM Bases at Which the Number of Warheads on Deployed SLBMs Is Reduced:

Name/Location	SLBM Type on Which the Number of Warheads Is Reduced
—	—

Deployed SLBMs on Which the Number of Warheads Is Reduced —

Warheads Attributed to Each Deployed SLBM After Reduction in the Number of Warheads on It —

Number of Warheads by Which the Original Attribution of Warheads for Each SLBM Was Reduced —

Aggregate Reduction in the Number of Warheads Attributed to Deployed SLBMs of that Type —

IV. Data on Eliminated Heavy ICBMs and Converted Silo Launchers of Heavy ICBMs

1. For each Party, the numbers of silo launchers of heavy ICBMs converted to silo launchers of ICBMs other than heavy ICBMs are as follows:

(a) United States of America

Aggregate Number of Converted Silo Launchers —

ICBM Base for Silo Launchers of ICBMs: Name/Location	ICBM Type Installed in a Converted Silo Launcher
—	—

Silo Launcher Group: (designation)

—

Silo Launchers:

—	—

(b) Russian Federation

Aggregate Number of Converted Silo Launchers —

ICBM Base for Silo Launchers of ICBMs: Name/Location	ICBM Type Installed in a Converted Silo Launcher
—	—

Silo Launcher Group: (designation)

—

Silo Launchers:

—	—

2. For each Party, the aggregate numbers of heavy ICBMs and eliminated heavy ICBMs are as follows:

(a) United States of America	Number
Deployed Heavy ICBMs	—
Non-Deployed Heavy ICBMs	—
Eliminated Heavy ICBMs	—

(b) Russian Federation	Number
Deployed Heavy ICBMs	—
Non-Deployed Heavy ICBMs	—
Eliminated Heavy ICBMs	—

V. Changes

Each Party shall notify the other Party of changes in the attribution and data contained in this Memorandum.

The Parties, in signing this Memorandum, acknowledge the acceptance of the categories of data contained in this Memorandum and the responsibility of each Party for the accuracy only of its own data.

This Memorandum is an integral part of the Treaty and shall enter into force on the date of entry into force of the Treaty and shall remain in force so long as the Treaty remains in force. As provided for in subparagraph 2(b) of Article V of the Treaty, the Parties may agree on such additional measures as may be necessary to improve the viability and effectiveness of the Treaty. The Parties agree that, if it becomes necessary to change the categories of data contained in this Memorandum or to make other changes to this Memorandum that do not affect substantive rights or obligations under the Treaty, they shall use the Bilateral Implementation Commission to reach agreement on such changes, without resorting to the procedure for making amendments set forth in Article VII of the Treaty.

Done at Moscow on January 3, 1993, in two copies, each in the English and Russian languages, both texts being equally authentic.

Source: US Arms Control and Disarmament Agency (ACDA), 'Official Text: Treaty between the United States of America and the Russian Federation on Further Reduction and Limitation of Strategic Offensive Arms' (ACDA: Washington, DC, 3 Jan. 1993), mimeo.

TRILATERAL STATEMENT BY THE PRESIDENTS OF THE UNITED STATES, RUSSIA AND UKRAINE

Moscow, 14 January 1994

Presidents Clinton, Yeltsin and Kravchuk met in Moscow on January 14. The three Presidents reiterated that they will deal with one another as full and equal partners and that relations among their countries must be conducted on the basis of respect for the independence, sovereignty and territorial integrity of each nation.

The three Presidents agreed on the importance of developing mutually beneficial, comprehensive and cooperative economic relations. In this connection, they welcomed the intention of the United States to provide assistance to Ukraine and Russia to support the creation of effective market economies.

The three Presidents reviewed the progress that has been made in reducing nuclear forces. Deactivation of strategic forces is already well underway in the United States, Russia and Ukraine. The Presidents welcomed the ongoing deactivation of RS-18s (SS-19s) and RS-22s (SS-24s) on Ukrainian territory by having their warheads removed.

The Presidents look forward to the

entry into force of the START I Treaty, including the Lisbon Protocol and associated documents, and President Kravchuk reiterated his commitment that Ukraine accede to the Nuclear Non-Proliferation Treaty as a non-nuclear-weapon state in the shortest possible time. Presidents Clinton and Yeltsin noted that entry into force of START I will allow them to seek early ratification of START II. The Presidents discussed, in this regard, steps their countries would take to resolve certain nuclear weapons questions.

The Presidents emphasized the importance of ensuring the safety and security of nuclear weapons pending their dismantlement.

The Presidents recognize the importance of compensation to Ukraine, Kazakhstan and Belarus for the value of the highly-enriched uranium in nuclear warheads located on their territories. Arrangements have been worked out to provide fair and timely compensation to Ukraine, Kazakhstan and Belarus as the nuclear warheads on their territory are transferred to Russia for dismantling.

Presidents Clinton and Yeltsin expressed satisfaction with the completion of the highly-enriched uranium contract, which was signed by appropriate authorities of the United States and Russia. By converting weapons-grade uranium into uranium which can only be used for peaceful purposes, the highly-enriched uranium agreement is a major step forward in fulfilling the countries' mutual non-proliferation objectives.

The three Presidents decided on simultaneous actions on the transfer of nuclear warheads from Ukraine and delivery of compensation to Ukraine in the form of fuel assemblies for nuclear power stations.

Presidents Clinton and Yeltsin informed President Kravchuk that the United States and Russia are prepared to provide security assurances to Ukraine. In particular, once the START I Treaty enters into force and Ukraine becomes a non-nuclear-weapon state party to the Nuclear Non-Proliferation Treaty (NPT), the United States and Russia will:

– Reaffirm their commitments to Ukraine, in accordance with the principles of the CSCE Final Act, to respect the independence and sovereignty and the existing borders of CSCE member states and recognize that border changes can be made only by peaceful and consensual means; and reaffirm their obligation to refrain from the threat or use of force against the territorial integrity or political independence of any state, and that none of their weapons will ever be used except in self-defense or otherwise in accordance with the Charter of the United Nations;

– Reaffirm their commitment to Ukraine, in accordance with the principles of the CSCE Final Act, to refrain from economic coercion designed to subordinate to their own interest the exercise by another CSCE participating state of the rights inherent in its sovereignty and thus to secure advantages of any kind;

– Reaffirm their commitment to seek immediate UN Security Council action to provide assistance to Ukraine, as a non-nuclear-weapon state party to the NPT, if Ukraine should become a victim of an act of aggression or an object of a threat of aggression in which nuclear weapons are used; and

– Reaffirm, in the case of Ukraine, their commitment not to use nuclear weapons against any non-nuclear-weapon state party to the NPT, except in the case of an attack on themselves, their territories or dependent territories, their armed forces, or their allies, by such a state in association or alliance with a nuclear weapon state.

Presidents Clinton and Yeltsin informed President Kravchuk that consultations have been held with the United Kingdom, the third depositary state of the NPT, and the United

Kingdom is prepared to offer the same security assurances to Ukraine once it becomes a non-nuclear-weapon state party to the NPT.

President Clinton reaffirmed the US commitment to provide technical and financial assistance for the safe and secure dismantling of nuclear forces and storage of fissile materials. The United States has agreed under the Nunn-Lugar program to provide Russia, Ukraine, Kazakhstan and Belarus with nearly USD 800 million in such assistance, including a minimum of USD 175 million to Ukraine. The US Congress has authorized additional Nunn-Lugar funds for this program, and the United States will work intensively with Russia, Ukraine, Kazakhstan and Belarus to expand assistance for this important purpose. The United States will also work to promote rapid implementation of the assistance agreements that are already in place.

Annex

The three Presidents decided that, to begin the process of compensation for Ukraine, Russia will provide to Ukraine within 10 months fuel assemblies for nuclear power stations containing 100 tons of low-enriched uranium. By the same date, at least 200 nuclear warheads from RS-18 (SS-19) and RS-22 (SS-24) missiles will be transferred from Ukraine to Russia for dismantling. Ukrainian representatives will monitor the dismantling of these warheads. The United States will provide USD 60 million as an advance payment to Russia, to be deducted from payments due to Russia under the highly-enriched uranium contract. These funds would be available to help cover expenses for the transportation and dismantling of strategic warheads and the production of fuel assemblies.

All nuclear warheads will be transferred from the territory of Ukraine to Russia for the purpose of their subsequent dismantling in the shortest possible time. Russia will provide compensation in the form of supplies of fuel assemblies to Ukraine for the needs of its nuclear power industry within the same time period.

Ukraine will ensure the elimination of all nuclear weapons, including strategic offensive arms, located on its territory in accordance with the relevant agreements and during the seven-year period as provided by the START I Treaty and within the context of the Verkhovna Rada statement on the non-nuclear status of Ukraine. All SS-24s on the territory of Ukraine will be deactivated within 10 months by having their warheads removed.

Pursuant to agreements reached between Russia and Ukraine in 1993, Russia will provide for the servicing and ensure the safety of nuclear warheads and Ukraine will cooperate in providing conditions for Russia to carry out these operations.

Russia and the United States will promote the elaboration and adoption by the International Atomic Energy Agency of an agreement placing all nuclear activities of Ukraine under IAEA safeguards, which will allow the unimpeded export of fuel assemblies from Russia to Ukraine for Ukraine's nuclear power industry.

Source: *Arms Control Today*, vol. 24, no. 1 (Jan.–Feb. 1994), pp. 21–22.

Annexe C. British, Chinese, French and US strategic nuclear forces*

Table C1. British nuclear forces, January 1994[a]

Type	Designation	No. deployed	Date deployed	Range (km)[b]	Warheads x yield	Warheads in stockpile
Aircraft[c]						
GR.1	Tornado	72	1982	1 300	1–2 x 200–400 kt	100[e]
S2B	Buccaneer	27	1971	1 700	1 x 200–400 kt[d]	
SLBMs						
A3-TK	Polaris	48	1982[f]	4 700	2 x 40 kt	100[g]

[a] The US nuclear weapons for certified British systems have been removed from Europe and returned to the USA, specifically for the 11 Nimrod ASW aircraft based at RAF St Magwan, Cornwall, UK, the 1 Army regiment with 12 Lance launchers and the 4 Army artillery regiments with 120 M109 howitzers in Germany. Squadron No. 42, the Nimrod maritime patrol squadron, disbanded in Oct. 1992, but St Magwan will remain a forward base for Nimrods and will have other roles. The 50 Missile Regiment (Lance) and the 56 Special Weapons Battery Royal Artillery were disbanded in 1993.

[b] Range for aircraft indicates combat radius, without in-flight refuelling.

[c] The Royal Air Force will eventually operate 8 squadrons of dual-capable strike/attack Tornados. The 3 squadrons at Laarbruch, Germany (Nos 15, 16, 20) were disbanded between Sep. 1991 and May 1992. A fourth squadron there (No. 2) was equipped with the Tornado reconnaissance variant and went to RAF Marham to join a reconnaissance squadron already there (No. 13). The 2 squadrons previously at Marham (Nos 27 and 617) will redeploy to Lossiemouth, Scotland, in 1993–94, replacing Buccaneer squadrons Nos 12 and 208 in the maritime/strike role. The Tornado squadrons will be redesignated Nos 12 and 617. The 4 squadrons at RAF Bruggen, Germany (Nos 9, 14, 17, 31) will remain. All 8 squadrons, including the 2 reconnaissance squadrons, will be nuclear-capable, down from 11.

[d] The US Defense Intelligence Agency has confirmed that the RAF Tornados 'use two types of nuclear weapons, however exact types are unknown'. The DIA further concludes that each RAF Tornado is capable of carrying 2 nuclear bombs, 1 on each of the 2 outboard fuselage stations.

[e] The total stockpile of WE-177 tactical nuclear gravity bombs was estimated to have been about 200, of which 175 were versions A and B. The C version of the WE-177 was assigned to selected Royal Navy (RN) Sea Harrier FRS.1 aircraft and ASW helicopters. The WE-177C existed in both a free-fall and depth-bomb modification. There were an estimated 25 WE-177Cs, each with a yield of approximately 10 kt. Following the Bush–Gorbachev initiatives of 27 Sep. and 5 Oct. 1991, British Secretary of State for Defence Tom King said that 'we will no longer routinely carry nuclear weapons on our ships'. On 15 June 1992 the Defence Minister announced that all naval tactical nuclear weapons had been removed from surface ships and aircraft, that the nuclear mission would be eliminated and that the 'weapons previously earmarked for this role will be destroyed'. The 1992 White Paper stated that 'As part of the cut in NATO's stockpile we will also reduce the number of British free-fall nuclear

* The tables in this annexe are from Lockwood, D., 'Nuclear weapon developments', *SIPRI Yearbook 1994* (Oxford University Press: Oxford, 1994), pp. 282–83, 298–99, 302 and 305.

bombs by more than half'. A number of British nuclear bombs were returned to the UK. In table 8.4, a total inventory of strike variants of approximately 100 is assumed, including those for training and for spares. The 1993 White Paper stated that the WE-177 'is currently expected to remain in service until well into the next century'.

[f] The 2-warhead Polaris A3-TK (Chevaline) was first deployed in 1982 and has now completely replaced the original 3-warhead Polaris A-3 missile, first deployed in 1968.

[g] It is now thought that the UK produced only enough warheads for 3 full boatloads of missiles, or 48 missiles, with a total of 96 warheads. In Mar. 1987 French President Mitterrand stated that Britain had '90 to 100 [strategic] warheads'.

Sources: Norris, R. S., Burrows, A. S. and Fieldhouse, R. W., *Nuclear Weapons Databook Vol. V: British, French and Chinese Nuclear Weapons* (Westview: Boulder, Colo., 1994), p. 9; 'Nuclear notebook', *Bulletin of the Atomic Scientists*, Sep. 1993, p. 57.

Table C2. Chinese nuclear forces, January 1994

Type	NATO designation	No. deployed	Year first deployed	Range (km)	Warheads x yield	Warheads in stockpile
Bombers[a]						
H-5	B-5	30	1968	1 200	1 x bomb	150
H-6	B-6	120	1965	3 100	1 x bomb	
Q-5	A-5	30	1970	400	1 x bomb	
H-7	?	0	1994?	?	1 x bomb	
Land-based missiles[b]						
DF-3A	CSS-2	50	1971	2 800	1 x 1–3 Mt	50
DF-4	CSS-3	20	1980	4 750	1 x 1–3 Mt	20
DF-5A	CSS-4	4	1981	13 000	1 x 3–5 Mt	4
DF-21	CSS-6	36	1985–86	1 800	1 x 200–300 kt	36
DF-31	–	0	Late 1990s?	8 000	1 x 200–300 kt	?
DF-41	–	0	2010?	12 000	MIRV	?
SLBMs[c]						
JL-1	CSS-N-3	24	1986	1 700	1 x 200–300 kt	24
JL-2	CSS-N-4	0	Late 1990s	8 000	1 x 200–300 kt	?

[a] All figures for bomber aircraft are for nuclear-configured versions only. 150 bombs are assumed for the force. Hundreds of aircraft are deployed in non-nuclear versions. The aircraft bombs are estimated to have yields between 10 kt and 3 Mt.

[b] The Chinese define missile ranges as follows: short-range, < 1000 km; medium-range, 1000–3000 km; long-range, 3000–8000 km; intercontinental-range, > 8000 km.

[c] Two SLBMs are presumed to be available for rapid deployment on the Golf Class submarine (SSB). The nuclear capability of the M-9 is unconfirmed and thus not included.

Sources: Norris, R. S., Burrows, A. S. and Fieldhouse, R. W., *Nuclear Weapons Databook Vol. V: British, French and Chinese Nuclear Weapons* (Westview: Boulder, Colo., 1994), p. 11; 'Nuclear notebook', *Bulletin of the Atomic Scientists*, Nov. 1993, p. 57; Lewis, J. W. and Hua D., 'China's ballistic missile programs: technologies, strategies, goals', *International Security*, vol. 17, no. 2 (fall 1992), pp. 5–40.

Table C3. French nuclear forces, January 1994

Type	No. deployed	Year first deployed	Range (km)[a]	Warheads x yield	Warheads in stockpile
Land-based aircraft					
Mirage IVP	18	1986	1 570	1 x 300 kt ASMP	18
Mirage 2000N	45[b]	1988	2 750	1 x 300 kt ASMP	42
Carrier-based aircraft					
Super Etendard	24	1978	650	1 x 300 kt ASMP	20[c]
Land-based missiles					
S3D	18	1980	3 500	1 x 1 Mt	18
Hadès[d]	(30)	1992	480	1 x 80 kt	30
SLBMs[e]					
M-4A/B	64	1985	6 000	6 x 150 kt	384

[a] Range for aircraft indicates combat radius, without in-flight refuelling, and does not include the 90- to 350-km range of the ASMP air-to-surface missile (where applicable).

[b] Only 45 of the 75 Mirage 2000Ns have nuclear missions. On 11 Sep. 1991 President Mitterrand announced that as of 1 Sep. the AN-52 gravity bomb, which had been carried by Jaguar As and Super Etendards, had been withdrawn from service. Forty-two ASMPs are allocated to the 3 squadrons of Mirage 2000Ns.

[c] The Super Etendard used to carry 1 AN 52 bomb. At full strength, the AN 52 equipped 3 squadrons of Super Etendards (24 of the 36 nuclear-capable aircraft): Flottilles 11F, 14F and 17F based at Landivisiau and Hyères, respectively. From mid-1989 these squadrons began receiving the ASMP missile. By mid-1990, all 24 aircraft (to be configured to carry the ASMP) were operational. Although originally about 50–55 Super Etendard aircraft were intended to carry the ASMP, because of budgetary constraints the number fell to 24.

[d] France has decided to store 15 Hadès launchers and 30 Hadès missiles at Suippes.

[e] Upon returning from its 58th and final patrol on 5 Feb. 1991, *Le Redoutable* was retired along with the last M-20 SLBMs. The 5 remaining SSBNs are all deployed with the M-4A/B missile. Although there are 80 launch tubes on the 5 SSBNs, only 4 sets of SLBMs were bought and thus the number of TN 70/71 warheads in the stockpile is assumed to be 384, probably with a small number of spares.

Sources: Norris, R. S., Burrows, A. S. and Fieldhouse, R. W., *Nuclear Weapons Databook Vol. V: British, French and Chinese Nuclear Weapons* (Westview: Boulder, Co., 1994), p. 10; 'Nuclear notebook', *Bulletin of the Atomic Scientists*, Oct. 1993, p. 56.

Table C4. US strategic nuclear forces, January 1994

Type	Designation	No. deployed	Year first deployed	Range (km)[a]	Warheads x yield	Warheads in stockpile
Bombers						
B-52-H[b]	Stratofortress	95	1961	16 000	ALCM 5–150 kt	1 200
B-1B[c]	Lancer	95	1986	19 000	ACM 5–150 kt	460
B-2[d]	Spirit	1	1993	11 000	Bombs, various	1 400
Total		**191**				**3 060**
ICBMs[e]						
LGM-30F[f]	Minuteman II	200	1966	11 300	1 x 1.2 Mt	200
LGM-30G[g]	Minuteman III					
	Mk 12	200	1970	13 000	3 x 170 kt	600
	Mk 12A	300	1979	13 000	3 x 335 kt	900
LGM-118	MX/Peacekeeper	50	1986	11 000	10 x 300 kt	500
Total		**750**				**2 200**
SLBMs						
UGM-96A[h]	Trident I C-4	240	1979	7 400	8 x 100 kt	1 920
UGM-133A[i]	Trident II D-5	144	1990	7 400	8 x 100–475 kt	1 152
Total		**384**				**3 072**

[a] Range for aircraft indicates combat radius, without in-flight refuelling.

[b] B-52Hs can carry up to 20 ALCMs/ACMs each, but only about 1000 nuclear ALCMs and 460 ACMs are available for deployment; the 95 B-52Hs listed above include 2 test planes at Edwards AFB, California. The DOD now plans to reduce the B-52H fleet to 48 in FY 1995, but the ongoing Nuclear Posture Review could lead to a decision to retain a higher number.

[c] The B-1B can carry the B53/B62/B83 bombs. Rockwell built 100 B-1Bs. Four have crashed, and 1 is used as a trainer at Ellsworth AFB, South Dakota, and is not considered 'operational'. The USA plans to 'reorient' all of its B-1Bs to conventional missions. These aircraft will count towards START I Treaty limits, but not towards START II Treaty limits.

[d] The B-2 can carry the B61/B83 bombs. The first operational B-2 was delivered to Whiteman AFB, Missouri, on 17 Dec. 1993. Four additional B-2s are scheduled for delivery in FY 1994, and the Air Force plans to field a total of 20 operational B-2s by the late 1990s.

[e] The criterion for whether an ICBM is included in this table (e.g., Minuteman IIs) is whether the missile is still in the silo; that is, once a missile has been removed from its silo, it is considered, for the purposes of this table, to be retired. This is not the same as being START-accountable. The START I Treaty requires that the silos are blown up; for example, if the strict START Treaty counting rules were applied, nearly 450 Minuteman IIs are still accountable.

[f] Approximately 250 Minuteman II missiles had been removed from their silos by Jan. 1994. The remaining 200 missiles (90 at Malmstrom AFB, Montana; 90 at Whiteman AFB, Missouri; and 20 at Ellsworth AFB, South Dakota) are scheduled to be removed from their silos by 1995. The first Minuteman II silo was destroyed in Dec. 1993 at Whiteman AFB.

[g] During this decade, the Air Force plans to consolidate its Minuteman III missiles at 3 bases. To this end, it has begun to deploy Minuteman III missiles in empty Minuteman II silos at Malmstrom AFB, Montana. (Consequently, the current number of Minuteman III missiles now exceeds 500 but will decline again to 500 when 1 of the 3 other existing Minuteman III bases is closed.) Eventually, Malmstrom AFB will have 200 Minuteman IIIs and the other 300 Minuteman IIIs will be divided between the 2 remaining bases.

[h] In calendar year 1993, 7 Poseidon submarines were deactivated. The remaining 3 Poseidon SSBNs will be removed from service in FY 1994. The 240 Trident I C-4 missiles are deployed on 3 16-missile Poseidon submarines and on the 8 24-missile Ohio Class submarines in the Pacific Fleet. (The 3 remaining Poseidon submarines—the *USS Simon Bolivar*, the *USS Stonewall Jackson* and the *USS Vallejo*—based in Charleston, South Carolina, are scheduled to be decommissioned in FY 1994.)

[i] The 144 Trident II D-5 missiles are deployed on 6 Ohio Class submarines stationed at King's Bay, Georgia, the newest of which, the *USS Nebraska*, is scheduled to begin patrols in 1994. By 1997, 4 more Ohio Class submarines are scheduled to be delivered to King's Bay, providing the Navy with a total of 10 SSBNs in the Atlantic Fleet carrying 240 Trident II D-5 missiles and 8 SSBNs in the Pacific Fleet carrying 192 Trident I C-4 missiles.

Sources: Les Aspin, Secretary of Defense, *Annual Report to the President and the Congress*, Jan. 1994, p. 7; Dick Cheney, Secretary of Defense, *Annual Report to the President and the Congress*, Jan. 1993, p. 68; US Air Force Public Affairs, personal communications; US Navy Public Affairs, personal communications; Department of Defense, 'The Bottom–Up Review: forces for a new era', 1 Sep. 1993, p. 17; Mosher, D., *Rethinking the Trident Force* (Congressional Budget Office (CBO): Washington, DC, July 1993), p. 11; Natural Resources Defense Council (NRDC); Department of Appropriations, Fiscal Year 1994, Hearing before the Subcommittee on the Department of Defense of the Committee on Appropriations (US Government Printing Office: Washington, DC, 1993), Part 4, p. 186; *US Naval Institute Proceedings*, Dec. 1993, p. 111; *US Naval Institute Proceedings*, Sep. 1993, pp. 107–109; author's estimates.

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