UNIDIR/2003/25

# Costs of Disarmament—Disarming the Costs:

## Nuclear Arms Control and Nuclear Rearmament

Susan Willett

UNIDIR
United Nations Institute for Disarmament Research
Geneva, Switzerland

**NOTE**

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries.

*
* *

The views expressed in this paper are those of the authors and do not necessarily reflect the views of the United Nations Secretariat.

UNIDIR/2003/25



UNITED NATIONS PUBLICATION
*Sales No.* GV.E.03.0.25
ISBN 92-9045-154-8

The United Nations Institute for Disarmament Research (UNIDIR)—an intergovernmental organization within the United Nations—conducts research on disarmament and security. UNIDIR is based in Geneva, Switzerland, the centre for bilateral and multilateral disarmament and non-proliferation negotiations, and home of the Conference on Disarmament. The Institute explores current issues pertaining to the variety of existing and future armaments, as well as global diplomacy and local entrenched tensions and conflicts. Working with researchers, diplomats, Government officials, NGOs and other institutions since 1980, UNIDIR acts as a bridge between the research community and Governments. UNIDIR's activities are funded by contributions from Governments and donors foundations. The Institute's web site can be found at URL:

http://www.unidir.org

Cover page: designed by Diego Oyarzún-Reyes (UNCTAD)

## CONTENTS

## PREFACE

Time and again in discussions on disarmament, experts repeat the myth that disarmament is a costly business. So costly in fact that we should not be surprised that progress in disarmament is so slow, the costs are assumed to be one of the driving factors in states reluctance to disarm.

In her first UNIDIR book on the issue, *Costs of Disarmament—Rethinking the Price Tag: A Methodological Inquiry into the Costs and Benefits of Arms Control*, Susan Willett demonstrated how many of the costs of disarmament have been wrongly attributed. Yes there are disarmament costs in verification and treaty conferences and so on, but the largest costs of all—the costs of dismantling the weapons—belong chiefly to the costs of the weapons themselves and therefore to those who made them or commissioned them. The dismantling of weapons is a part of the life-cycle of the weapons and should not be added to the burden of disarmament. Any additional constraints imposed by a disarmament treaty such as storage and increased urgency, are of course disarmament costs and need to be factored in.

As part of the UNIDIR research programme on treaty implementation, Susan Willett conducted research on the costs of disarmament. This second publication, *Costs of Disarmament—Disarming the Costs: Nuclear Arms Control and Nuclear Rearmament*, attempts to evaluate the costs and benefits of the nuclear arms control treaties between the United States of America and the Soviet Union/Russian Federation. Comparing the costs of the nuclear arms race with the costs of arms control shows clearly the benefits of the latter. And these are just the fiscal benefits. Harder to ascertain are the security and environmental benefits.

The study shows that as a result of restrictions on nuclear forces agreed to in START, the United States accrued savings of roughly US$ 1.52 billion over the period 1991-2001, once the costs of implementing the treaty, including those incurred to support implementation activities in the former Soviet Union and successor states, are taken into account. This compares more than favourably with the approximately US$ 2.63 trillion of military expenditure disbursed by the United States over the same period. Other

more intangible benefits gained from START include enhanced international security, increased trust and confidence and the establishment of desirable precedents.

This work is the product of long-term research. Many people have helped in its production and I should particularly like to thank Susan Willett for her work and originality. Special gratitude too goes to Alyson Bailes, currently Director of SIPRI, for having first suggested this line of research and for having encouraged us in our work, including hosting Susan Willett and myself in Brussels.

Thanks to UNIDIR's Deputy Director Christophe Carle for all of his substantive input and to Steve Tulliu and Anita Blétry for getting the book to publication. For administrative and technical support, thanks go to Isabelle Roger and Sonia Billard. Finally, I thank the Government of the United Kingdom for financial support for the project and for the input of key individuals.

Patricia LEWIS
Director, UNIDIR
Geneva
2003

## ACKNOWLEDGEMENTS

In acknowledging those that have supported me through the various stages of the Cost of Disarmament programme, I primarily want to give recognition to the great personal sacrifice that was made by my stoical and supportive husband, Fred Hasson. Not only did he endured my long and lonely abscences in Geneva, he also supported me through the many ups and downs associated with the project. At a more formal level I would like to acknowledge the generosity of time given by Sir Major General Hugh Beech and Dr Herbert Wulf. in providing constructive comments on my manuscript. Receiving their positive feedback was a welcome reward. Thanks also to Anita Blétry at UNIDIR for always maintaining her professionalism. Finally I would like to thank the Foreign and Commonwealth Office who generously agreed to fund the Cost of Disarmament project. They do not however, bear any responsibility for the findings and conclusions of this report, which remain solely those of the author.

## EXECUTIVE SUMMARY

- The implementation and verification of nuclear arms control regimes comes at a high and rising cost. Nevertheless these pale into insignificance when one compares the costs and benefits of arms control with the costs and risks of nuclear rearmament, and more critically with the rising costs and on-going consequences of the Cold War nuclear arms race legacy.

- In the case of the Strategic Arms Reduction Treaty (START), the US has found itself shouldering the burden of its own implementation requirements and those of the former Soviet Union via the Cooperative Threat Reduction (CTR) programme, which has cost so far a total of US$ 5.1 billion. This has led critics in the US to question the cost-benefit advantages of arms control.

- On detailed examination of the costs and benefits of START/CTR it is clear that while many unexpected costs and complications arose during the implementation phase, the security benefits far outweighed the costs. Moreover, even with the additional burden of the CTR programme, the US has managed to emerge with savings of roughly US$ 1.23 billion from the START process, once annual savings from the reductions in its strategic arsenal are taken into account.

- In May 2002 the START process was appended with the Strategic Offensive Reduction Treaty (SORT), which committed the US and Russia to deep cuts in their strategic nuclear forces, to between 1,700 and 2,200 warheads. However, as a less formal and more open-ended strategic arms reduction agreement, SORT does not provide sufficient control in the form of verification to prevent future "break out" by either party to the Treaty. The ambiguities inherent in the agreement make both its cost and benefits unpredictable.

- The security benefits of the strategic arms reductions have been eclipsed by Washington's announcement of a new nuclear doctrine (outlined in the 2002 *Nuclear Posture Review*), which reasserts the centrality of nuclear weapons to US security policy. The introduction of

a new generation of *useable* mini-nukes designed for bunker busting threatens to undermine both the Comprehensive Test Ban Treaty (CTBT) and the nuclear Non-Proliferation Treaty (NPT).

- The pursuit of an assertive unilateral security policy as outlined in the 2002 *National Security Strategy* includes counter-proliferation and pre-emptive strike. These strategies envisage a conventional/nuclear weapons continuum involving the deployment of national missile defences and a new generation of *useable* nuclear weapons. As such they have a high cost/risk premium in that they intensify asymmetries and exacerbate global instabilities and insecurities.

- In pursuit of a more belligerent security posture the George W. Bush administration has incurred rapidly rising defence expenditure, reaching US$ 396 billion in 2003, and rising. Between 2001- 2003 the military budget has so far risen by US$ 82 billion or 21%. Long-term plans foresee the national defence budget increasing to US$ 469 billion by FY 2007. These rapid rises occur at a time when the US economy is in recession. The simultaneous reduction in the fiscal base and rise in military expenditures are contributing to a rapidly growing budget deficit. US citizens are paying a high opportunity costs in terms of cuts in discretionary funding for health services, social welfare and education in order to meet defence budgetary targets.

- Nuclear rearmament is occurring at a time when the full costs of the Cold War nuclear arms race legacy are only just coming to light. In both the US and the Russia there are major environmental and human health problems linked to nuclear weapons programmes. Tens of thousands of people have been exposed to radiation causing fatal cancers or long-term debilitating diseases. High levels of radioactive contamination of ground water and aquifers in and around nuclear weapons complexes have been identified. To date there is still no known method of decontaminating ground water once radionuclides have seeped in. The US Department of Energy (DOE) has estimated that it will cost the over US$ 300 billion and over 75 years to clean up the nuclear weapons complex.

- One of the greatest risks associated with nuclear rearmament is the potential for proliferation. There is no long-term guarantee that nuclear weapons materials will not end up in the wrong hands. The

challenge of preventing nuclear proliferation from the former Soviet nuclear weapons complex has cost the US some US$ 5 billion to date. The G8 group has pledged a further US$ 20 billion over ten years to fight against proliferation. The only way future costs of non-proliferation can be reduced is to desist from nuclear weapons production in the first place.

- In conclusion it appears myopic to proceed with a new generation of nuclear weapons when no known method of controlling radioactive wastes exist, and when the thousands of victims of nuclear weapons turn out to be the very citizens they are ostensibly meant to protect. Policies that actively seek to control and eventually eliminate nuclear weapons are the only guarantee that the costs and risks associated with nuclear weapons can be eliminated.

## ACRONYMS

| | |
|---|---|
| ABM | Anti-Ballistic Missile Treaty |
| ALCM | Air-Launched Cruise Missile |
| ANA | Alliance for Nuclear Accountability |
| BMD | Ballistic Missile Defences |
| CBO | Congressional Budget Office |
| CFE | Conventional Forces in Europe Treaty |
| CIA | Central Intelligence Agency |
| CSP | Centre for Security Policy |
| CTBT | Comprehensive Test Ban Treaty |
| CTR | Cooperative Threat Reduction |
| CWC | Chemical Weapons Convention |
| DOD | Department of Defense |
| DOE | Department of Energy |
| DTRA | Defence Threat Reduction Agency |
| EPW | Earth Penetrating Weapon |
| FRP | Fire Resistant Pit |
| FSU | Former Soviet Union |
| GAO | General Accounting Office |
| GAP | Government Accountability Project |
| GDP | Gross Domestic Product |
| HEU | Highly Enriched Uranium |
| IEER | Institute for Energy and Environment Research |
| INF | Intermediate-range Nuclear Forces Treaty |
| ICBM | Intercontinental Ballistic Missile |
| IHE | Insensitive High Explosives |
| IPP | Initiative for Proliferation Prevention |
| JCIC | Joint Compliance and Inspection Committee |
| LEU | Low Enriched Plutonium |
| MAD | Mutual Assured Destruction |
| Minatom | Minister of Atomic Energy |
| MIRV | Multiple Re-entry Vehicle |
| MOU | Memorandum of Understanding |
| MOX | Mixed oxide |
| MPC&A | Materials Protection Control and Accounting |
| NATO | North Atlantic Treaty Organization |

| | |
|---|---|
| NCI | Nuclear Cities Initiative |
| NIS | Newly Independent States |
| NMD | National Missile Defence |
| NNSA | National Nuclear Security Administration |
| NPR | Nuclear Posture Review |
| NPT | Non-Proliferation Treaty |
| NTM | National Technical Means |
| NPR | Nuclear Policy Review |
| NSS | National Security of the United States |
| PDD 60 | Presidential Decision Directive 60 |
| PMP | Performance Management Plan |
| SALT | Strategic Arms Limitation Treaty |
| SBIRS | Spaced Based Infrared System |
| SCC | Siberian Chemical Combine |
| SIOP | Single Integrated Operational Plan |
| SLBM | Submarine-Launched Missile |
| SLV | Space Launch Vehicle |
| SNDV | Strategic Nuclear Delivery Vehicle |
| SRF | Strategic Rocket Force |
| SRV | Single Re-entry Vehicle |
| SORT | Strategic Offensive Reduction Treaty |
| SSP | Stockpile Stewardship Programme |
| START | Strategic Arms Reduction Treaty |
| TNW | Tactical Nuclear Weapon |
| WH | Warhead |
| WHO | World Health Organisation |
| WMD | Weapons of Mass Destruction |

## INTRODUCTION

The international security order is confronting a period of turbulent change. The Bush administration has consciously shifted US security policy away from the collective security order that had consolidated in the 1990s, towards a unilateral policy focused on a more bellicose military posture. In the administration's new *National Security Strategy of the United States of America,* previous policies that promoted multilateralism, containment and détente have been rejected in favour of pre-emptive strikes and offensive counter-proliferation strategies.[1] These policies have been put into practice with the 2003 war in Iraq. More specifically, as revealed in the *Nuclear Policy Review* (NPR) 2002, the Bush administration is planning to restore nuclear weapons to the centre stage of national security policy.[2]

Counter-proliferation strategies are designed with two objectives in mind: a) as an ultimate defence against possible attack by intercontinental ballistic missiles (ICBMs), and b) to seek and destroy illicit weapons of mass destruction (WMD) facilities. To achieve these goals the Bush administration has evolved a two-pronged strategy: the development of a comprehensive National Missile Defence (NMD) system, and a revamped nuclear strategy based on the introduction of a new generation of low-yield nuclear weapons designed to be *used* in missions against hardened underground command centres or hidden weapons facilities.[3] In both cases, arms control treaties have stood in the way of achieving these new strategic goals and have, therefore, been dispensed with. The Anti-Ballistic Missile (ABM) Treaty obstructed the full-scale development and deployment of NMD systems, while the Comprehensive Test Ban Treaty (CTBT) obstructs the testing of a new generation of nuclear weapons.

The NPR also outlines the circumstances in which nuclear weapons may be used against seven countries—two nuclear weapon states China and Russia, and five non-nuclear weapon states Iran, Iraq, Libya, North Korea and Syria.[4] The renuclearization of US security policy represents a major setback for nuclear arms control and disarmament and the norms and values that they are founded upon.

US support for unilateral nuclear rearmament has consolidated in the aftermath of the horrific events of 11 September. But the rejection of arms control and disarmament has been nascent for a number of years within influential Republican circles. During the 1990s the opponents of arms control subjected a range of arms control regimes to an unprecedented level of critical scrutiny.[5] The slow progress in negotiating formal arms control agreements and a general lack of confidence in verification regimes, led them to conclude that arms control has failed to prevent the proliferation of weapons of mass destruction.[6] As a consequence they perceive that arms control has increased US vulnerability to attack by disarming and "denuclearizing" US security forces.[7] It follows from this reasoning that arms control treaties-such as the ABM Treaty of 1972, the proposed CTBT, the Strategic Arms Reduction Treaties (START), constitute major obstacles to US national security.

Part of the campaign to undermine the credibility of arms control has focused on the growing burden associated with arms control implementation. The Centre for Security Policy (CSP) has been claiming for a number of years that arms control "holds out the false promise of cheap alternatives to costly military problems".[8] To this way of thinking *expensive* and *ineffectual* multilateral arms control regimes provide few security benefits, and have thus become superfluous or even detrimental to US security requirements.

That the burden of treaty implementation has been rising for the United States is an incontrovertible fact. Not only has Washington been responsible for the cost of meeting its own treaty implementation, but it has also found itself shouldering the burden of Russia's arms control obligations via the Cooperative Threat Reduction (CTR) programme. The rising financial demands, time delays and frustrations experienced with CTR funded programmes have been the subject of a succession of critical government audits conducted by the US General Accounting Office (GAO).[9]

That the cost of compliance with nuclear arms control treaties and CTR programmes has been rising is not at issue here. What is contentious, however, is the idea that these costs somehow outweigh their benefits, and that implicitly unilateral rearmament, is a more cost-effective alternative for securing national security. Unilateral rearmament based on the proposed conventional/nuclear weapons continuum outlined in the NPR comes at a

high and rising price as evident in the significant increases in budgetary allocations to programmes such as the Ballistic Missile Defences (BMD), the Stockpile Stewardship Program (SSP) and the improved earth penetrating nuclear weapons programme which are all contributing to the rapid rise in US military expenditure planned to increase to US$ 396 billion by FY2003.[10]

When the short-term costs of treaty implementation are considered in isolation from the long-term costs generated by rearmament and rising military expenditures a distorted perception can arise about the cost-benefit trade-offs in arms control. This observation applies with equal effect when one considers the security cost-benefit nexus of arms control. Security trade-offs are all too often assessed in the context of the short timeframes defined by the political life of an administration, rather than by longer-term security costs and risks for future generations.

As Stephen Schwartz and others have so diligently revealed in the *Atomic Audit* both the short-term and the long-term costs and risks associated with nuclear weapons are astronomically high.[11] This is because they involve, not only the outlays required for designing, producing, maintaining, stockpiling and eventually retiring nuclear weapons and the fissile materials associated with their production and deployment, but also because of the costs associated with the environmental impact and catastrophic effects that might arise as a results of accidents, proliferation, or actual use of nuclear weapons.[12] As this report attempts to show, the rising costs associated with implementing nuclear arms control treaties, although by no means inconsequential, pale into insignificance when compared with the cost/risk implications of nuclear weapons.

Elaborating on these issues this study focuses on the costs and benefits of the START process for both Russia and the United States. These costs are examined in the light of the costs of rearmament and the on-going burden associated with the superpowers Cold War nuclear arms legacy. In attempting this task the report is laid out in four parts. Part I examines the costs and benefits of the START process and the associated CTR programme. Part II examines the factors leading to the abandonment of the START process in favour of the Strategic Offensive Reduction Treaty (SORT) signed in Moscow on 24 May 2002. A brief analysis of the implications of this less formal approach to arms control is provided in this section. Part III examines the costs and implications of the US renuclearization in the

context of unilateral rearmament. And finally Part IV provides an assessment of the recurring costs of the Cold War nuclear arms race legacy, paying particular attention to the environmental and human costs of the nuclear weapons complexes in Russia and the US.

## CHAPTER 1

# NUCLEAR ARMS CONTROL

## THE COSTS AND RISKS OF THE NUCLEAR ARMS RACE

The ideological hostility and military competition between the United States and the Soviet Union produced an arms race of unprecedented proportions.[13] As each contestant sought to acquire sufficient military prowess to over-power the other, weapons of ever-greater lethality and destructiveness were amassed. The logical outcome of this arms race resulted in a strategic preoccupation with weapons of mass destruction. By the mid-1980s there were an estimated 70,000 nuclear warheads in the world, 98% of which belonged to the Soviet Union and the United States.[14]

The size and power of the superpowers' nuclear arsenals ensured that the world could be destroyed thousands of times over. The situation of massive overkill, or Mutually Assured Destruction (MAD), contributed to a stand off between the superpowers. The perception that national security depended on the ability to retaliate in kind, and to deter their use by a threat of retaliation in kind, gave rise to the logic of deterrence.[15] Advocates of deterrence argued that the possession of nuclear weapons by the two superpowers reduced the likelihood of war precisely because it made the cost of war so great.[16] It followed from this premise that the huge costs associated with procuring and maintaining nuclear weapons was a price worth paying.

The problem with this argument was that during the Cold War few policy makers, let alone the general public, had any idea of what the costs of sustaining the nuclear arms race actually were. For national security reasons, nuclear weapons expenditures were secured from public scrutiny in both the United States and the Soviet Union. Even very senior office holders had limited access to information on nuclear procurement expenditures. The lack of budgetary oversight meant that officials could not weigh the perceived benefits of deterrence against the actual costs. As a

consequence the allocation of resources to nuclear weapons had little discernable relationship to the level of threat these weapons were supposed to counter. The fact that both countries had the capacity to annihilate each other thousands of times over reflected a surreal preoccupation with a level of destruction that had lost sight of any sort of political or military utility. While the lack of transparency and accountability combined with high levels of secrecy meant that nuclear weapon expenditures raged out of control, with few, if any questions asked.

Stephen Schwartz has estimated that the United States cumulatively spent a total of US$ 5.5 trillion between 1945-1996 on its nuclear weapons programmes.[17] Because the Soviet Union did not have an accounting system based on market prices it may never be possible to estimate the total cost of its nuclear programme in the way that Schwartz has done for the US, but given the equal magnitude of its nuclear arsenal we can assume that the burden of nuclear weapons was as much, if not greater, for the Soviet Union. In both cases the purchase of nuclear weapons did little to enhance the productive capacities of either country as nuclear weapons have few multiplier effects within the civil economy. They did, however, create long-term demand for resources not only to support and maintain them during their lifetime, but also to secure and store the radioactive materials and waste they leave behind once they are retired. This long-term absorption of resources represents non-recoverable sunk costs. Nuclear weapons thus generate greater opportunity costs in absolute terms than any other weapon systems so far.

If the cost of nuclear deterrence has been high for both superpowers, it is not only because the costs of the weapons programmes ran out of control, but also because there was (and still is) the risk of nuclear weapons accidents.[18] Lloyd Dumas has observed that the collision between human fallibility and the awesome power of nuclear weapons is perilous, evident in the catalogue of serious nuclear weapons related accidents that have been publicly reported in the United States since 1950.[19] Dumas draws his evidence from a report issued in 1981 by the Department of Defence (DOD) entitled *Narrative Summaries of Accidents Involving US Nuclear Weapons 1950-1980* that listed 32 major nuclear accidents and incidents, involving the loss of nuclear weapons, burned weapons, dropped weapons, ruptured weapons and weapons in which high explosives were inadvertently detonated. Of the accidents listed several had not been previously disclosed despite the fact that radioactive contamination

occurred outside of military designated areas. Other credible sources have recorded a far higher number of incidents. A Greenpeace document that covers part of the same period lists a total of 383 incidents involving nuclear weapons between 1965-1977,[20] and a GAO report of 1985 notes 233 incidents involving nuclear weapons aboard US naval ships between 1965 and 1983.[21]

**Table 1:** Accidents Involving US Nuclear Weapons, Weapons Production Facilities and Nuclear Powered Submarines 1945-1993[22]

| Date | Nature of Accident |
|---|---|
| 02/12/1949 | Experiment "Green Run" contaminates communities up to 112km from Hanford nuclear weapons complex |
| 05/08/1950 | B-29 plane with nuclear weapons on board crashes, 19 people killed |
| 01/03/1954 | Fallout from US nuclear weapons test "Bravo" contaminated the inhabitants of Pacific Island Rongelap |
| 10/03/1956 | A B-47 plane disappears with nuclear weapons on board in the Atlantic Ocean |
| 27/07/1956 | US plane crashes into nuclear ammunition store in the Unite Kingdom |
| 22/05/1957 | B-36 accidentally releases nuclear bomb in New Mexico |
| 28/07/1957 | Plane losses two nuclear bombs in the Atlantic |
| 11/10/1957 | 15kg of plutonium catch fire at Rocky Flats complex |
| 26/11/1958 | B-47 plane catches fire destroying one nuclear weapon |
| 06/07/1959 | Plane carrying nuclear weapons crashes and catches fire |
| 12/01/1960 | Technicians trying to restart a reactor at Savannah River reprocessing plant almost send it out of control |
| 07/06/1960 | Fire at BOMARC-rocket in New Jersey causes plutonium release |
| 29/01/1961 | A B-52 plane carrying nuclear weapons crashes |
| 14/04/1961 | A B-52 plane crashes with nuclear bombs on board in California |
| 10/04/1963 | US nuclear submarine sinks in Atlantic |
| 13/01/1964 | A B-54 plane crashes with nuclear bombs on board in Maryland |
| 21/04/1964 | Satellite disperses 1.2kg of plutonium into atmosphere |
| 04/01/1965 | 6.5kg of plutonium sludge released from the Savannah River reprocessing plant |

| Date | Nature of Accident |
|---|---|
| 10/05/1965 | Release of eight cubic metres of cooling water from the Savannah River plant |
| 17/01/1966 | A B-52 plane crashes in Spain causing plutonium contamination |
| 12/02/1968 | A B-52 plane with nuclear bombs on board crashes near Toronto in Canada |
| 18/05/1968 | Accident during launch of US satellite spilling radioactive material into sea near California coast |
| 21/05/1968 | Nuclear submarine Scorpion sinks of Acores |
| 14/01/1969 | US Enterprise nuclear aircraft carrier, suffers fires and explosions |
| 11/05/1969 | Fire at Rocky Flats nuclear weapons plant causing plutonium to ignite |
| 28/05/1970 | Collision of nuclear submarine Daniel Boone |
| 04/10/1970 | Thousands of cubic metres of radioactive waste flow out of Hanford nuclear weapons complex |
| 20/04/1973 | Explosion on board nuclear capable destroyer |
| 03/05/1974 | Leakage at Hanford nuclear weapons complex |
| 03/09/1974 | Release of Radioactive waste at Los Alamos Nuclear Weapons Lab |
| 20/09/1977 | Nuclear submarine Ray hits sea bed |
| 03/06/1980 | Computer fault causes full scale alert for US Strategic Command |
| 19/10/1980 | US nuclear missile almost launched during exercises |
| 19/12/1980 | Plutonium transport accident |
| 09/04/1981 | US nuclear submarine George Washington collides with a freighter ship |
| 29/11/1982 | Nuclear submarine collides with destroyer |
| 21/03/1984 | Soviet nuclear submarine collides with US aircraft carrier Kitty Hawk |
| 17/05/1984 | Fire on board the US nuclear submarine Guitarro |
| 29/04/1986 | US nuclear submarine Atlanta grounded off Gibraltar |
| 31/10/1986 | Nuclear submarine Augusta involved in collision |
| 18/01/1989 | Radioactive contamination at Savannah River reprocessing plant |
| 15/10/1989 | Fire on board nuclear submarine Finback |

Chuck Hansen has assembled details of 96 US nuclear weapons accidents occurring between 1988 and 2000, about which the DOD has remained silent.[23] The DOD's failure to publicly acknowledge all the nuclear accidents that have occurred, suggests an active policy of suppressing information. On this subject Hansen observes that "Continued and unnecessary secrecy about past accidents only increases suspicion, both within and outside the United States, that other serious accidents have occurred and that there has been undisclosed radiological contamination in one or more of the countries that hosted US nuclear forces during the Cold War".[24]

The Soviet Union/ Russian Federation with its far more lax health and safety procedures has experienced an even larger number of nuclear accidents, many of which have yet to come to light.[25] Table 2 provides only a snap shot of the nuclear weapon accidents in the former Soviet Union. The high level of secrecy maintained by the Soviet authorities and the continuing denial and secrecy about safety conditions in the Russian nuclear weapons complex, means that the full picture may never be known. Based on in-depth interviews with workers at the Mayak nuclear weapons complex, Vladislav Larin has recorded hundreds of unreported nuclear accidents at the plant including one criticality accident.[26] One of the Mayak workers noted that: "The difference between the official figures and the vast number of accidents can be explained by the regime of absolute secrecy that was maintained. Under the regime, plant inspectors hid most of the accidents from both the heads of the nuclear industry and from government. It was the only way to avoid certain punishment."[27]

**Table 2**: Accidents Involving USSR/Russian Nuclear Weapons, Weapons Production Facilities and Nuclear Powered Submarines 1945-1990[28]

| Date | Nature of Accident |
|---|---|
| 29/09/1957 | Thousands of square miles contaminated by accident at the Chely-abinsk nuclear complex |
| 04/07/1961 | Incident on board soviet nuclear submarine K19 radiation releases kills 9 crew |
| 24/05/1968 | Incident aboard Soviet nuclear submarine K-27, 5 crew killed by radiation release |
| 11/04/1970 | Soviet nuclear submarine sinks in the Atlantic |

| Date | Nature of Accident |
|---|---|
| 14/04/1970 | Soviet nuclear submarine sinks with 52 crew members in Indian Ocean |
| 24/02/1972 | Accident on board Soviet nuclear powered submarine causes vessel to loose power |
| 27/09/1974 | Soviet nuclear capable destroyer sinks in Black Sea |
| 23/01/1978 | Soviet nuclear powered satellite Cosmos-954 crashes in Canada |
| 21/08/1980 | Accident aboard Soviet nuclear submarine 9 crew believed dead |
| 21/03/1984 | Soviet nuclear submarine collides with US aircraft carrier Kitty Hawk |
| 19/09/1984 | Collision of Soviet nuclear submarine |
| 10/08/1985 | Explosion on board Soviet nuclear submarine |
| 06/10/1986 | Soviet nuclear submarine sinks off Burmuda |
| 02/08/1987 | Elevated levels of radiation after Soviet nuclear test |
| 08/04/1989 | Soviet nuclear submarine Komsomolets sinks off Norway |
| 26/06/1989 | Fire and reactor damage on board Soviet nuclear submarine |
| 19/01/1992 | Radioactive leak, reactor shut down at the Kola nuclear power plant |
| 09/03/1992 | Fire at Kola nuclear power plant |
| 16/04/1992 | Technical failure of reactor shut-down system at Kola nuclear plant |
| 18/04/1992 | Technical failure during refuelling at Kola nuclear plant |
| 16/05/1992 | Reactor shut down at Kola nuclear plant |
| 12/09/1992 | Leakage of radioactive water at Kola nuclear power plant |
| 12/02/1993 | Failure of cooling pumps at Kola nuclear power plant |
| 06/04/1993 | Explosion at Tomsk-7 nuclear complex |
| 27/05/1993 | Reactor shut-down due to breakage of cooling system at Kola nuclear power plant |
| 02/03/1994 | Breakdown of cooling system at Kola nuclear power plan |
| 31/01/1996 | Leakage of radiation due to human error and technical failure at Dimitrovgrad nuclear research centre |

Another apparent cause for the absence of information on nuclear accidents in the Soviet Union was that until the Chernobyl accident in 1986, no official definition of what constituted a nuclear accident existed

in the Soviet Union. The Russian definition of a nuclear accident only emerged in 1996 some 50 years after the first Soviet plutonium production began at Mayak.

The suppression of information about nuclear accidents in both the Soviet Union/Russian Federation and the United States was for the most part, designed to prevent or assuage public concerns about the risks associated with nuclear weapons production and deployment.[29] For the duration of the Cold War, members of the public living close to nuclear weapons sites or who in the course of their working life were obliged to handle nuclear weapons and related radioactive materials were often exposed to unacceptably high levels of radiation. And as a consequence many have contracted cancers and died. The exposure of tens of thousands of people to unacceptably high levels of radiation is one of the great and tragic costs of the Cold War arms race, the scale of which is only just emerging.[30]

The production of nuclear weapons creates the additional threat of environmental devastation. The worst case occurred in the Soviet Union at the Chelyabinsk 40 (now known as Ozersk) nuclear weapons complex in 1957 when thousands of square miles surrounding the plant became contaminated. In the United States, where safety procedures are thought to be superior to those in the Soviet Union/Russian Federation, there has been environmental pollution of almost equal magnitude. In 1970 thousands of cubic metres of radioactive waste flowed out of the Hanford nuclear weapons complex, contaminating the ground water and flowing into the Columbia River.

In addition to the threats posed to human and environmental security caused by nuclear accidents, there is always the risk of accidental war. US nuclear warning systems generated more than 1,150 serious false alarms between 1977-1984.[31] The number of alarms tends to increase at times of crisis. The cost of nuclear war whether by accident or design is virtually impossible to calculate with any certainty, although, this has not prevented analysts from conducting such exercises. In 1982 the World Health Organisation (WHO) estimated that an all out nuclear war between the Soviet Union and the United States could have killed one billion people outright.[32] In addition, the fallout and dust from a nuclear exchange could have produced a nuclear winter that would probably have killed an additional one billion people. Thus in total about a third of the world's

population could have been killed, while the survivors would live a miserable, disease ridden and wretched existence.

Although the scenario of an all out nuclear exchange is unlikely to occur in the current strategic climate, the events of 11 September have focused attention on the possibility of nuclear terrorism.[33] The scale of threat posed by nuclear terrorism depends upon the means of attack, which can range from various types of nuclear devices and conventional explosive devices to attacks on fixed nuclear installations, dirty bombs and the covert release of radiation that does not involve explosive devices. A worst-case scenario would involve the use of a stolen nuclear weapon (most likely a tactical nuclear weapon), which is detonated in a densely populated urban area. A nuclear detonation of for instance a magnitude of 10-12 kilotons (that is, a yield equivalent to the bomb that destroyed Hiroshima) would have catastrophic results producing an estimated 100,000 immediate deaths and 200,000 more casualties of various kinds including roughly 48,000 burn victims and a large incidence of flash blindness within a radius of 11 kilometres. Buildings would be destroyed, together with highways, bridges, power grids and other infrastructure. Massive fires would be ignited around the periphery of the blast area that would continue to produce damage and casualties. Additional deaths and casualties would result from radiation fall-out for several miles from the blast site, with specific fallout patterns depending heavily on local wind and weather conditions.[34]

The catastrophic scenario outlined above is not implausible because the relative smallness of tactical nuclear weapons (TNWs) and therefore their relative portability increases their vulnerability to theft by terrorists. And indeed, there are persistent rumours of one or two of these weapons going astray during the break up of the Soviet Union.[35] Even in the hands of state militaries TNWs are more susceptible to unauthorized or accidental use than strategic weapons, as they are far more susceptible to communication problems under crisis conditions and can be fired without going through the stringent safety precautions that govern the launch of strategic warheads.

Other forms of nuclear terrorism, including conventional attacks on civilian sources of radiological materials, such as nuclear reactors or storage sites for spent fuel, are a more likely possibility and would have devastating consequences for the communities in close proximity to the site. Finally, there are the possibilities of “dirty bombs” or covert contamination which

would have a far less destructive effect than either of the two above-mentioned scenarios, but would nevertheless create a real sense of terror and would produce numerous casualties close to the site of explosion or radioactive release.

Even if the probability of an accidental nuclear war or nuclear terrorism is small, utilizing the concept of "Pascal's wager" where the expected costs of a nuclear incident is high, then by implication the strategy of deterrence has had a very high premium associated with its risks.

## Nuclear Arms Control

During the Cold War the ever-present risk of Armageddon either by accident or design, combined with the mounting costs associated with the development, production, deployment and maintenance of the vast nuclear arsenals, prompted the superpowers to seek to control and stabilize the nuclear arms race. This was pursued through a number of arms control initiatives aimed at nuclear weapons and their delivery systems, namely the 1972 ABM Treaty and the Strategic Arms Limitation Treaty (SALT) I of the same year, SALT II signed in 1979, the INF Treaty signed in 1987 and START I signed in 1991. The goals embodied within these arms control regimes were designed to:

- prevent an unconstrained nuclear arms race;
- manage the US-Soviet deterrence relationship around the concept of the most stable form of MAD that could be achieved;
- permit the development of ballistic missile defences that did not threaten the central US-Soviet deterrence relationship.

The persistence of the logic of deterrence undermined any serious consideration of nuclear disarmament despite the NPT article 6 being signed by the nuclear powers in 1968. Consequently bilateral arms control agreements between the United States and the Soviet Union were designed to stabilize the nuclear arms race at agreed levels of armaments, rather than to move them towards disarmament. Under these circumstances arms control became a means for turning arms competition and tendencies toward arms racing between the super powers and their allies, into a mechanism for promoting the maintenance of the military status quo.

Avoidance of arms racing was perceived to be necessary if nuclear deterrence was to be protected from the disturbing pressures of competitive technological change.[36] It was, therefore, consistent to find advocates and practitioners of nuclear deterrence acting as champions of nuclear arms control, while maintaining their opposition to nuclear disarmament.

When in 1991 the Soviet Union collapsed, a window of opportunity opened to further engage Russia and the key successor states in a cooperative manner on nuclear arms control and related matters. However, a degree of urgency entered into bilateral arms control negotiations, because of fears about the safety and security of the Soviet Union's vast nuclear arsenal. Reflecting this concern, the US Congress enacted the Soviet Nuclear Threat Reduction Act (Public Law 102-228) in late 1991. The Act stated that: "The profound changes underway in the Soviet Union pose three types of danger to nuclear safety and stability, as follows:

- ultimate disposition of nuclear weapons among the Soviet Union and its republics, and any successor entities that is not conducive to weapons safety or to international stability;
- seizure, theft, sale, or use of nuclear weapons or components and;
- transfers of weapons, weapons components, or weapons know-how outside the territory of the Soviet Union, its republics, and any successor entities, that contribute to worldwide proliferation."[37]

Solutions to the proliferation threats posed by the large and poorly secured stocks of weapons-usable materials—plutonium and highly enriched uranium (HEU)—led to the instigation of trans-governmental programmes such as the CTR (initially called the Nunn-Lugar Program) and the Materials Protection Control and Accounting (MPC&A) programmes.[38] Both the CTR and the MPC&A have broken important new ground in terms of the principle of direct financial and technical support to induce arms reductions and non-proliferation in Russia and the other successor states. They also represent a new concept of "verification in practice" epitomized by the active support of US contractors and government departments and the process of regular audits and evaluations of programmes. The preventive threat reduction approach built upon and extended the more traditional and formal arms control approach embodied within the START process.

## START

Following the INF Treaty, the START process was the main focus for bilateral nuclear arms reductions between former Cold War adversaries. It has also constituted the central mechanism through which US-Russian security relations have been managed during the transition from the Cold War arms race to the more cooperative post-Cold War era. Viewed in this way the START process has been highly significant, but it has been fraught with both political and economic obstacles, not least because the costs of implementation have proved onerous to both Russia and the United States. But as this section attempts to argue the focus on rising costs have often blinded policy makers to the long-term benefits of START in both quantitative and qualitative terms.

### START I

The profoundly adversarial relationship between the two superpowers, the deep ideological divide, the suspicion of each other's political and strategic motives and their competition for worldwide influence was a prescription for protracted and laborious negotiations over reductions in strategic weapons holdings.[39] Indeed, during the course of the 1980s, negotiations became heavily politicized, on the one hand raising hopes of a "fast track" towards a nuclear weapons free world and, on the other hand, appearing hopelessly deadlocked over issues of strategic defences and naval arms control.[40] When negotiations had begun the Soviet Union and the United States had different negotiating strategies, agreeing only on the principal objectives of significant nuclear reductions and of strengthening strategic stability. Only hard bargaining and compromise produced a result, when finally after ten years of negotiation, START I was signed on 31 July 1991.

Five months later the Soviet Union collapsed, leaving four independent states in possession of strategic nuclear weapons: Russia, Belarus, Ukraine and Kazakstan. On 23 May 1992, the United States and the four nuclear capable successor states to the Soviet Union signed the Lisbon Protocol which made all five nations party to the START I agreement. START I entered into force on 5 December 1994 when the five treaty parties exchanged instruments of ratification in Budapest. The Treaty's implementation deadline was December 2001.

The treaty provided for "deep reductions" in strategic offensive nuclear forces, equal limits for both parties and "effective verification". The Treaty mandated the signatories to limit their strategic forces to 1,600 deployed strategic delivery vehicles (heavy bombers and ICBMs and submarine-launched ballistic missiles (SLBMs)) and 6,000 nuclear warheads, with sub-limits of 4,900 warheads attributed to ballistic missiles, 1,540 warheads attributed to heavy ICBMs and 1,100 warheads attributed to mobile ICBMs. Separate "politically binding" agreements limited sea-launched cruise missiles with a range of above 600 kilometres to 880 for each side, and the Soviet backfire bomber to 500 craft.

Because START I required reductions rather than the elimination of categories of weapons as the INF Treaty had done, agreement on counting rules within agreed sub-limits and verification of adherence to counting rules were crucial issues. Warheads were attributed to missiles and heavy bombers through counting procedures that indicated how many warheads each deployed missile or bomber would count under the Treaty's limit on warheads. The number of warheads attributed to ICBMs and SLBMs, usually equalled the number actually deployed on that type of missile, but the number attributed to heavy bombers were far fewer than the numbers that they can carry. The launchers being eliminated were designed to produce a 46% reduction of the former Soviet Union's throw weight (the payload that a missile is able to carry) setting a new throw weight level that neither side may exceed. The US did not have to reduce its aggregate throw weight, as it was already under the 3,600-ton limit. In addition, the Treaty allowed "downloading" (i.e. reducing the numbers) of warheads on some multiple warhead (MIRVed) missiles, and called for extensive notifications and inspections to help monitor compliance. Under these terms the Soviet Union was required to destroy 30-40% of its strategic nuclear force within seven years, while the US was required to destroy about one third of its strategic nuclear force. The timeframe for the monitoring of START I lasts 15 years, until 2006, with an option to extend for successive five-year periods.

START I is the most complex arms control treaty to have ever entered into force. In addition to the Treaty itself, which has 19 articles in all, there are agreements, joint statements, an extensive data exchange, a definitions annex, six protocols (all of which are related to verification), letters and correspondence and declarations totalling 280 pages. As such it reflects the degree of detail required to secure trust and confidence and to avoid ambiguity or misunderstandings between two highly armed adversaries. To

this list must be added the 23 May 1992 Lisbon Protocol signed between the United States and the four successor states that possessed weapons covered by START I, namely Russia, Belarus, Kazakhstan and Ukraine. Under the 1992 Protocol, all nuclear warheads of the former Soviet Union were to be withdrawn to Russia. In concert, these documents outline complex and costly procedures that the signatories must follow in order to comply with START I.

On 5 December 2001 the United States and the Russian Federation reported their accomplishments of their mandatory reductions. The reductions were completed in three phases within the seven years prescribed by the Treaty. Each side had reduced to 1,600 deployed ballistic missiles and heavy bombers, 6,000 warheads on those missiles and bombers and no more than 4,900 warheads on ballistic missiles.

START I was a major achievement in bilateral arms control as it was the first treaty to reduce long-range offensive nuclear weapons by both sides. Under the terms of the Treaty US strategic nuclear warheads declined by 20-25% while the Soviet Union/successor states made reductions of 30-35%. Ballistic missile warhead reductions amounted to 35% for the US and some 50% for the Soviet Union.[41] However, START I did have serious limitations in that it allowed for the replacement and modernization of strategic offensive arms, except where specifically prohibited. Both parties to the Treaty had modernization programmes at the time, which were not affected by Treaty rules. As Cowen Karp observed: "The START Treaty permits both sides to make the required force reductions among older, less capable systems, thus preserving the most modern and accurate ones. The Treaty's impact on offensive nuclear capability was therefore rather limited. Apart form the mandated cuts in SS-18s, the START Treaty did not begin to do more than eliminate redundant nuclear capability. Both sides were left with sufficient numbers of nuclear weapons to cover the targets prescribed by their respective operational plans. Thus, despite the size of the nuclear force cuts undertaken, the START Treaty cannot be viewed as anything more than a first step towards larger reductions."[42]

Despite these observable limitations the Treaty did achieve what was possible to achieve in the context of the Cold War confrontation in which strategic nuclear arms control was a conservative force in US-Soviet security relations.

## START II

Proposals for START II emerged in the context of a radically altered global strategic environment, not only because the Soviet Union no longer existed, but also because the entire intellectual and political framework that had circumscribed arms control approaches had collapsed. With the end of the Cold War and collapse of the Soviet Union the whole justification for maintaining large nuclear forces had disappeared. By the end of 1991 the world was a profoundly changed place and its new realities demanded a reassessment of disarmament options.

On 27 September 1991 President Bush (Snr) announced a series of unilateral arms control measures, and proposed that the Soviet Union take reciprocal steps in order to increase stability and achieve larger nuclear reductions. On 5 October 1991 President Gorbachev responded with unilateral steps and proposals for further arms control negotiations. The unilateral steps regarding the elimination of tactical land- and sea-based nuclear weapons provided a clear indication that each side felt that they could reduce nuclear armaments without jeopardising their respective security.

At the end of January 1992 the United States and Russia began negotiations on START II while, at the same time, they announced additional unilateral nuclear arms control measures.[43] In his State of the Union Speech President Bush (Snr) announced deep cuts including reduction of US SLBMs warheads of about a third below those agreed to in START I, if the Soviet successor states agreed to ban MIRVed ICBMs. However President Yeltsin announced that Russian nuclear ballistic missiles would no longer be directed against US military and civilian target.[44] For such pledges to be meaningful to each side, verification needed to occur, and for this a formal treaty framework was required.

In June 1992 President Bush (Snr) and President Yeltsin agreed to keep the START momentum going by accepting further strategic reductions, which led to the signing of START II) on 3 January 1993. The Treaty called for reducing deployed strategic arsenals to 3,000-3,500 warheads and banned the deployment of destabilizing multiple warhead land-based missiles. START II was to count nuclear warheads using the same method as START I and, like its antecedent, would insist on the destruction of delivery vehicles, but not warheads. The Treaty's greatest achievement was Russia's

willingness to ban MIRVed ICBMs, which was seen as a major gain for the United States. On a more mutual basis the Treaty's gains included the enhancement of strategic stability, an increase in predictability and transparency, and potential savings of resources, the latter being in Russia's greatest interest as it was facing a severe economic crisis in the aftermath of the collapse of the Soviet economy.

The Treaty's initial implementation deadline was January 2003, but because of Russia's concerns about meeting this deadline due to on-going economic difficulties, a 1997 protocol was agreed upon that extended the deadline until December 2007. However, under the protocol the Duma established as a stipulation for START II's entry into force, that the ABM Treaty's succession should be agreed simultaneously. Both the US Senate and the Russian Duma ratified the Treaty, but the US Congress, which already held deep reservations about the 1997 extension protocol, was adamantly opposed to tying START II's entry into force to the ABM Treaty's survival. The Treaty process became bogged down through its linkage to the ABM Treaty.

Under the terms of the ABM Treaty both the United States and Russia faced strict limitations on anti-ballistic missile deployments. The US administration, which has become fixated with the need for ballistic missile defence systems as a defensive shield against attack from "rogue states", sought to amend the Treaty to allow it to deploy ballistic missile defence systems where it saw fit. Moscow was unprepared to accept this demand. Exasperated by the deadlock the Bush administration threatened to withdraw from the AMB Treaty. The Russians retaliated by threatening to withdraw from START II. The standoff came to an end with the US withdrawal on 14 June 2002. The Russian Foreign Ministry retorted by informing the Duma that it considered START II officially dead.

In the act of withdrawal from the ABM Treaty the United States has lost some of its moral authority in global affairs. It cannot expect other countries to abide by international treaties, when it has chosen to abrogate them in pursuit of objectives that place its national interests above those of collective security. Nevertheless, the US decision to withdraw has not so far had the adverse consequences that many critics anticipated. Moscow's reaction was unusually mild, considering its previous hostility to any changes to the ABM Treaty, which it regarded as the "bedrock" of arms control. A new cordiality in US-Russian relations built around the global

coalition in the "war against terrorism", was largely responsible for Moscow's tempered response. President Putin, having little to bargain, has gambled that Russia will gain more from its new "partnership" with the US than if it had responded antagonistically. Despite the new accommodation, Moscow has not accepted US official arguments in favour of the withdrawal, nor does it consider the need for an extensive national ballistic missile defensive system, justified.[45]

## START III

In March 1997 at the Helsinki Summit, Presidents Clinton and Yeltsin agreed a basic framework for START III negotiations, which were to include a reduction in deployed strategic warheads to 2,000-2,500. In a departure from its predecessors, START III was to formally address the destruction of tactical nuclear warheads.[46] Up until this point TNWs were excluded from formal arms control negotiations in order to concentrate on the larger weapons that were considered more threatening to stability.

When the Soviet Union began to collapse in late 1991 the fate of the tactical nuclear arsenal became a growing concern to the West.[47] To prevent these weapons from falling into the hands of "rogue states" or dangerous individuals in the Soviet republics then President Bush announced unilateral reductions of US TNWs and proposed that Russia responds in kind. The Soviet Union under Mikhail Gorbachev and then Russia under Boris Yeltsin, reciprocated by agreeing to reduce the Soviet/ Russian nuclear arsenal. The reduction agreed upon under the so-called Presidential Nuclear Initiatives of 1991 and 1992 were considerable. The United States eliminated 3,050 TNWs while Russia is thought to have reduced its TNWs by as may as 18,000 either by removing them from operational service and storing them, or by decommissioning them. However, neither the Russian nor the US reductions have ever been verified fuelling international concerns about whether or not they have fulfilled their claims.[48] It was hoped that START III negotiations would formalize the reductions of TNWs and put in place a system of transparency and verification. But because the commencement of START III negotiations were linked to the entry into force of START II, formal negotiations on tactical weapons never took place.

**Table 3**: Comparisons of START Central Limits[49]

| | START I | START II Phase I | START II Phase II | START III |
|---|---|---|---|---|
| Total Strategic Warheads | 6,000 accountable | 3,800-4,250 | 3,000-3,500 | 2,000-2,500 |
| Ballistic Missile Warheads | 4,900 | No specific sublimit | No specific sublimit | No specific sublimit |
| MIRVed ICBM Warheads | N/A | 1,200 | 0 | 0 |
| SLMB Warheads | N/A | 2,160 | 1,700-1,750 | To be decided |
| Heavy ICBM Warheads | 1,540 | 650 | 0 | 0 |
| Mobile ICBM Warheads | 1,100 | START applies | START applies | START applies |
| Total Strategic Nuclear Delivery Vehicles | 1,600 | START applies | START applies | To be decided |

## The START Verification Regime

Effective verification mechanisms and a robust compliance process were seen as critical to ensure that START I would succeed in its objectives of limiting the strategic nuclear forces of the former Soviet Union and the United States. Past strategic arms control agreements relied on national technical means (NTM) for monitoring. NMT mainly consist of satellite observation. This capability remains the foundation of START verification and monitoring activities, but building on the INF and Conventional Forces in Europe (CFE) experiences there has been a growing emphasis on cooperative measures, including on-site inspections and data exchange.

As with the INF Treaty, START includes an extensive exchange of data detailing the numbers and locations of affected weapons. The initial data exchange occurred in 1990 before the Treaty was signed. A second data exchange occurred in 1994, some 30 days before the Treaty entered into force. Additional exchanges occur every six months for the duration of the Treaty's life until 2009.

In pursuance of verification, article XI of START I gives the right to each party to conduct inspections and to continuous monitoring activities in accordance with the procedures provided for in the Inspection Protocol and the Conversion or Elimination Protocol. Inspections may be conducted at sites declared to have items limited under the Treaty and at sites suspected of containing such items, but not listed in the official databases. The continuous portal-monitoring concept originated under the INF Treaty has established a regime of intrusive verification measures, which also allow the monitoring of missile assembly plants.

START I contained provisions for continuous portal monitoring activities at two former Soviet Union and one US site. The first US portal monitoring site was established at the Votkinsk Machine Building Plant in Votkinsk, Russia, which currently assembles rocket motors for the SS-25 and SS-27 ICBMs and space launch vehicles (SLVs). It is scheduled to continue until 4 December 2009, and can be extended in five-year increments as long as items of continuous monitoring are assembled there. After such assembly is declared to have ended, portal monitoring will continue for one more year. The second US portal monitoring facility was established at Pavlograd, Ukraine where SS-24 ICBMs were assembled. US monitoring operations at Pavlograd began within 30 days of START's entry into force, but ended four months later when Ukraine declared Pavlograd as a facility subject to suspect site inspections.

The START designated portal monitoring facility in the United States is located at the Thiokol Corporation's Strategic Operations facility in Promontory, Utah. Thiokol was the Peacekeeper final assembly facility. The Russians have not exercised their START rights to conduct portal monitoring in Promontory. And because the United States formally declared the cessation of Peacekeeper production on 27 April 2000, Russia's right to conduct portal monitoring at Promontory ended on the same date.[50]

All parties to START I are obliged to provide notification of activities such as the movement of limited items between declared facilities. All parties are to refrain from activities to encrypt or deny telemetry (missile test data) that is essential to monitoring many of the qualitative and quantitative limits. This includes the obligation to exchange tapes of telemetry that are broadcast during flight tests. Finally the Treaty established the Joint Compliance and Inspection Commission (JCIC) to allow parties to meet to discuss treaty implementation issues and compliance questions. The JCIC

has produced agreements that outline specific, detailed procedure that the parties must follow as they implement the Treaty. These agreements not only fill in details that were lacking from the main Treaty documents, they are also designed to ease implementation and build confidence in compliance with the Treaty.

## ASSESSING THE COST OF TREATY COMPLIANCE

The costs of START compliance can be divided into two categories: one time costs and recurring costs.[51] The one time costs cover the destruction of equipment and facilities, restructuring of forces and bases, inspections to verify declarations made in the Treaty and the setting up of facilities for on site inspections. The one time costs are incurred over a set period, laid out under the terms of Treaty compliance.

From the outset of START negotiations there have been a wide range of uncertainties about the one-time costs. This has arisen because the costs of full implementation were not fully recognized at the time of negotiation, and because of the changing economic circumstances of state parties notably the five successor states of the Soviet Union which substantially deteriorated, making the implementation costs onerous within the ten-year time-scale determined by the Treaty. This has resulted in the need for external aid to support the process of compliance. In these circumstances Treaty compliance has proved onerous to all state parties, even though the short-term costs of compliance is than the long-run savings.

Estimates of one-time disarmament costs very much depend upon judgements as to which costs should be ascribed to arms control and which should not. In the first report of the Cost of Disarmament series, entitled *Rethinking the Price Tag: A Methodological Inquiry Into the Cost and Benefits of Arms Control*, it was argued that many of the onerous costs currently associated with arms control and disarmament measures should be ascribed to the legacies of past arms races, and should not be confused with the actual costs of treaty implementation.[52] Most notable in the process of cost misallocation has been the ascription of those expenditures associated with the environmental clean up of nuclear sites, which has proven exceedingly expensive for both Russia and the US. Another misallocation is the cost of weapons destruction, which would occur with or without an arms control treaty, as a normal part of the life cycle costs of a nuclear weapon system.

By way of illustration, many of Russia's strategic nuclear weapons, due for destruction under START I were nearing the end of their operational life and would have had to be dismantled and destroyed with or without a treaty.[53] However, START specifically insists on a particular form of dismantlement of the silos and delivery vehicles to prevent nuclear *breakout*. In this context, the outlays associated with this specific dismantlement process are clearly *bona fide* costs of arms control implementation.

The more specific recurring costs of arms control and disarmament measures include the costs of routine inspections, inspections of sites suspected of clandestine activities and the continuous monitoring of certain sites or locations. Recurring costs commence within the first year of treaty implementation and continue for the stated period dictated by the terms of a treaty, in the case of START I, 15 years from entry into force.

These costs became increasingly troublesome to the state parties because the timeframes agreed upon during negotiations could not have anticipated the sort of "external shocks" experienced by the Soviet Union and its successor states. The sudden collapse of the Soviet Union in 1991, and the subsequent economic difficulties experienced by the successor states, significantly affected their ability to comply with START obligations within the required timeframes. A certain degree of flexibility over timeframes is routinely built into arms control treaties, which provides some leeway when such events occur. As we have seen in the case of START II the timeframe was extended under the terms of the Lisbon Protocol. Timeframes do mean that the costs are concentrated in time, and if a state or states have several treaty obligations then this can prove to be highly taxing during times of economic constraint. Nevertheless, treaty timeframes are an important source of external discipline without which treaty implementation would become meaningless.

In making an assessment of the overall costs and benefits of arms control treaties the total of one time and recurring costs need to be set against the savings accrued as a result of reducing or destroying the particular weapons.

The results of such calculations provide only a partial glimpse of the true costs and benefits, however, because such costs also need to be set against the alternative spending patterns that are incurred as a result of

rejecting arms control mechanisms. Thus, to fully appreciate the costs and benefits of the START process it is useful to consider a counterfactual or counter-scenario. The obvious counter-scenario to nuclear disarmament is nuclear rearmament. Estimating the costs of a future nuclear weapons programme presents real challenges, however, not least because of the degree of secrecy that is attached to current and future planned nuclear weapons programmes. What can be done, however, is to examine the known costs of existing nuclear weapons programmes, which provides some measure of the costs implications of retaining or enhancing strategic nuclear forces. These costs are highlighted as a benchmark against which to assess whether or not the costs associated with treaty implementation are excessive, for it is only when the costs of arms control are seen in this context, that a true assessment of the economic gains from arms control can be appreciated. This will be examined in some detail in Part III.

Having laid out the logic of assessing START's costs and benefits, it is necessary to add a degree of circumspection to the viability of the task. Despite remarkable improvements in transparency and accountability in military spending patterns and those related to arms control over the last ten years, it is not always possible to secure reliable and accurate data. This remains a frustrating problem in the successor states of the Soviet Union, but it also applies to some areas of US arms control activities. In the latter case it is not because of any desire to hide information from public scrutiny, but a problem in the way in which budgets are constructed and audited, which does not allow for a separating out of funding accruing to specific arms control treaties. That having been said, it is still a valid exercise to attempt to assess the costs and benefits of disarmament even with limited data, if for no other reason than to challenge the doubters that dismiss arms control and disarmament as being too costly and securing few benefits.

## THE US COST OF START COMPLIANCE

Towards the end of negotiating START I the US Congressional Budget Office (CBO) made some estimates of the likely costs of compliance and on-site inspection for START I and the INF Treaty. They estimated that the one-time costs that cover the destruction of equipment and facilities, restructuring of forces and bases, inspections to verify declarations made to the treaty and the setting up of facilities for on-site inspections would amount to between US$ 410 million-1.8 billion (1990 prices) in total, or

between US$ 136-320 million per annum for the first 3-5 years after treaty ratification. Additional annual costs (recurring costs) for on-site inspections and continuous monitoring were estimated to be US$ 100-390 million per annum, (1990 prices).[54] Regrettably the CBO figures do not separate out START and INF data. The same report estimated that the combined annual savings made by START and INF would average US$ 4.5 billion per annum.

Subsequent data, made available on START I's recurring costs give a better insight into its annual costs. In FY 1997 the DOD requested US$ 63.5 million for START I implementation costs.[55] More recent information supplied by the Treaty implementing agency, the Defence Threat Reduction Agency (DTRA), indicates that during the Fiscal Year of 2001 (1 October 2000-30 September 2001), the US government spent US$ 52.5 million on START-related activities.[56] This total includes costs incurred by the DTRA, the Navy and the Air Force. For details see Table 4.

**Table 4**: START related expenditures FY 2001 (US$, figures rounded)[57]

| | |
|---|---|
| Inspections in Russia | 6.4m |
| Escorting inspectors in the US | 1.14m |
| Conducting exercises at US facilities | 0.75m |
| General treaty support | 5.55m |
| **Sub-total** | **13.2m** |
| **Naval Base Inspections** | |
| Planning, base preparation and technical support | 20.5m |
| Mission operations to conduct inspections and facility support | 5.15m |
| **Sub-total** | **25.68m** |
| **Airforce Base Inspections** | |
| Notification systems | 1.2m |
| Base preparation and technical support | 4.8m |
| Mission operations to conduct inspections and facility support | 2.95m |
| Silo and bomber elimination | 4.63m |
| **Sub-total** | **13.6m** |
| **TOTAL** | **52.5m** |

If we take an average between the two years for which we have statistics the costs incurred for START verification and monitoring are an

estimated US$ 58 million per annum. This would make the long term recurring costs of START amount to roughly US$ 870 million over the fifteen year time frame of START I. Roughly US$ 640 million per annum were made in savings, accrued by reducing US strategic warheads from 8,000 to 6,000 under START I obligations.[58] This represents savings of up to US$ 4.5 billion over the seven-year period of treaty implementation, 1994 to 2001.

In 1998, in response to a Congressional request made by Thomas Daschle, the CBO conducted an assessment of the budgetary savings that would be gained from START II and START III.[59] CBO calculations estimated that reducing US strategic warheads from the 6,000 START I to START II levels of 3,000-3,500 by 2007, would generate an annual average saving of US$ 700 million. Savings from a 2,500 strategic warhead limit defined under the START III framework would translate to about US$ 1.5 billion a year when compared with START I levels, or about US$ 700 million per year when compared with START II levels. It might not yield any additional savings if few or no platforms are retired. Savings would be significant to the extent that submarines, land-based missiles, and bombers were eliminated. Savings from a 1,000 strategic warhead limit could amount roughly to US$ 2 billion [per year] in the long run compared with funding for today's forces under START I. However, savings would vary depending on how many Trident submarines, Minuteman missiles and B-52 bombers were maintained.

From the data gathered above it would appear that annual savings made from all the START agreements would outweigh the annual costs by a considerable margin. However against these savings has to be set the cost to the United States of aiding Russia's compliance with its treaty obligations under the CTR and the MPC&A programmes. When these costs are factored in, US savings appear far less significant. These costs will be examined in the following section.

## RUSSIA'S COSTS AND SAVINGS

Unravelling the costs and savings from START reductions in the former Soviet Union is far more problematic than in the United States. Two obstacles confront the task. The first is the general lack of transparency within the Russian defence budgetary process, resulting in a notable

absence of data on START's costs and savings.[60] The second relates to the fact that the prolonged economic crisis in Russia, rendered defence budgetary planning almost impossible for most of the 1990s, and placed severe constraints upon the Russian government's ability to meet its Treaty obligations. One Russian estimate, made in 2000, of the potential long-term savings made from proposed reductions in the Strategic Rocket Force (SRF) calculated the amount to be only 19 billion roubles over a 15-year period or 0.7% of the defence budget.[61] However, these savings relate to cuts in the SRF that are deeper than those even proposed by START III.

The fact that the savings fall far short of those accrued by the United States can be explained by the severity of the Russian economic crisis. Fiscal and monetary constraints forced a rapid decline in the Russian defence budgets, which fell from US$ 80.4 billion (1998 prices), in 1992 to a low of US$ 30.6 billion in 1998, a fall of 62%.[62] Against this background of budgetary collapse the costs of implementation took an increasing share of the defence budget. In the short-term, the downsizing of Russia's strategic nuclear force generated outlays beyond the means of the Russian government, forcing it to seek foreign assistance to meet its START I obligations.

One of the most burdensome aspects of START's requirements for the Russians was silo destruction. START I outlines complex silo destruction procedures that state parties are compelled to comply with. For example, when eliminating silo launchers for ICBMs the parties could not simply remove equipment that would be used to launch ICBMs and seal the launchers or use them for other purposes. The parties were obliged to excavate the silo to a depth of eight metres and explode the silo to a depth of six metres so that it could never again hold or launch a ballistic missile. For the most part, these provisions were designed to ensure that the weapons elimination process was irreversible, so that none of the parties of the treaty could *break out* of the limits imposed by the Treaty, by restoring weapons that had been removed from service.

The costs of on-site inspections were also a cause for concern for the former Soviet republics. Suggestions were made that the requirements for inspections could be eased, so that the costs for the republics could be reduced. The United States, while recognizing that START implementation costs were proving onerous for the former Soviet republics, was nevertheless unwilling to renegotiate the elimination procedures or

inspection procedures, because it did not want to have to introduce new uncertainties into the verification process. Instead, the US opted to provide financial and technical assistance under the CTR programme. Indeed, details on CTR funding provide the best insight into the costs of START compliance for the former Soviet Union.

## COOPERATIVE THREAT REDUCTION PROGRAMME

In 1991, the US Congress directed the DOD to help secure and dismantle former Soviet weapons of mass destruction via the CTR programme. The CTR's mission was to provide assistance to eligible states of the former Soviet Union (FSU) in order to aid both disarmament and to reduce the threat of proliferation.

The CTR programme has accomplished much in its first ten years, however three major achievements stand out which have made a fundamental change to the political and strategic landscape of the former Soviet Union:

- CTR assistance helped Kazakhstan become a non-nuclear weapons state in April 1995;
- Ukraine, which once had the potential to become the third largest nuclear power, became a non-nuclear weapons state in June 1996;
- Belarus became a non-nuclear weapons state in November 1996.

Through the CTR programme US assistance was also provided to Russia and the other successor states for the destruction of their nuclear weapons, strategic delivery vehicles and silos. It also provided support for the transfer and safe storage of nuclear weapons awaiting destruction, in order to prevent the leakage and nuclear proliferation.[63] Much of the initial assistance for START provided under the CTR programme was in a non-fungible form, and included:

- equipment and services to help eliminate 258 SLBM launchers;
- equipment and services to help dismantle 50 ICBM silos;
- equipment and services to dismantle 42 heavy bombers;
- assistance in the disposal of 100,000 tons of liquid propellant from ballistic missiles;

- equipment and services which resulted in the elimination of 119 SS-11s, 10 SS-17s, 116 SS-18s, and 13 SS-19 ICBMs, along with 30 SLBMS;
- assistance in the destruction of 160 SLBM launchers.

As the CTR programme has matured, however, more of the assistance provided has taken the form of contractual services designated for tasks such as the dismantlement of nuclear submarines, warhead deactivation, strategic bomber elimination, etc. Table 5 provides a breakdown of current and future weapons disposal tasks undertaken by the CTR programme.

**Table 5**: CTR Strategic Offensive Arms Elimination (Russia and FSU)[64]

| | **April 2002** | **2004 (proj.)** | **2007 (proj.)** |
|---|---|---|---|
| Nuclear warheads deactivated | 5,829 | 8,266 | 9,882 |
| ICBMs destroyed | 449 | 659 | 1,025 |
| ICBM silos eliminated | 429 | 430 | 565 |
| ICBM mobile launchers destroyed | 1 | 100 | 208 |
| Ballistic missile submarines destroyed | 21 | 32 | 41 |
| Sub-launched ballistic missiles eliminated | 291 | 573 | 677 |
| SLBM launchers eliminated | 368 | 480 | 612 |
| Strategic bombers eliminated | 94 | 125 | 131 |
| Long-range nuclear ALCMs destroyed | 483 | 713 | 713 |
| Nuclear test holes/tunnels sealed | 194 | 194 | 194 |

Further assistance was provided for the storage and transportation of nuclear weapons and the construction of a large, secure fissile material storage facility at Mayak. Improvements have also been made at plutonium and uranium storage depots. Radiation detection equipment has been installed at Russian border crossings to help detect and halt nuclear smuggling. Plutonium laden fuel rods from nuclear power reactors have been secured.

The CTR programme has evolved from a hastily established one-year project, into a wide- ranging multi-year programme that currently costs the US government an average of US$ 800 million per annum. As Michael Krepon has observed, "Quietly without much fanfare and below the horizon of partisan debate, the daily practice of cooperative threat reduction became the primary means of reducing the dangers associated with weapons of mass destruction. While bilateral treaties were tied-up in the politics of ratification, legislative conditions and domestic divisions, cooperative threat reduction initiatives expanded. With strengthening efforts for multilateral non-proliferation and disarmament treaties nullified by lowest common denominator negotiations cooperative threat reduction initiatives became more essential."[65]

The programme has cumulatively cost the United States over US$ 7 billion between 1991-2001.[66] Of this total, the DOD has obligated more than US$ 2.5 billion to help the successor states destroy nuclear weapons, their delivery vehicles and silos, transport and store fissile materials and weapons to be destroyed in support of START I objectives.[67] This averages out to US$ 250 million per annum over the ten-year period during which the CTR programme has been operational. Despite these considerable outlays the United States has still managed to emerge from the START process with savings of just under US$ 400 million per annum. The success of the CTR programme can be gauged by the Russian Federation's timely implementation of its START I obligations by the Treaty deadline of December 2001, which would not have been achieved without timely US assistance.

The achievements of the CTR's disarmament programme has not prevented it from becoming the target of criticism in certain Congressional circles. Apprehension has been expressed that US efforts to reduce Russia's nuclear arsenal may have cost more and have achieved less than originally planned.[68] The cost of implementing CTR programmes has escalated dramatically in the last few years, largely because of Russia's inability to fund its share of the programme and because of expanding programme requirements. On taking power the Bush administration instigated a major review of all CTR programmes in March 2001. Simultaneously, President Bush proposed a budget cut in key programmes of approximately US$ 100 million. However, before the completion of the review, the attacks of 11 September occurred, which had the effect of concentrating the minds of Congress on the benefits of the CTR's non-proliferation objectives.

Congress immediately reversed the budget cuts, and provided a supplemental allocation of US$ 135 million to enhance its non-proliferation operations. Table 6 shows the breakdown of proposed funding for each US government department involved in threat reduction programmes.

**Table 6**: DOD, Department of Energy, and State Department Budgets WMD non-proliferation in the FSU (All amounts in millions, US$)

| Agency | FY 2002 request | FY 2002 regular appropriation (excluding supplemental) | FY 2002 final appropriation (including supplemental) | FY 2003 request |
|---|---|---|---|---|
| Energy | 229.3 | 283.7 | 417.6 | 419.7 |
| Defence | 417.6 | 411.7 | 411.7 | 428.3 |
| State | 112.7 | 112.7 | 184.9 | 108.9 |
| **Total** | **759.6** | **808.1** | **1,014.2** | **956.9** |

Overall, the total funding proposed for cooperative threat reduction efforts in FY 2003 is approximately US$ 957 million.[69] When compared to the regular congressional appropriation for these activities in FY 2002, the fiscal year 2003 request represents a modest, but nonetheless, significant increase (approximately US$149 million, or 18%). However, this request is approximately US$ 57 million (or 6%) less than the total funding originally approved by Congress for FY 2002, when the supplemental funds provided after 11 September are included in the total.

Most CTR and related programmes have been fully reinstated, but the effect of the temporary funding cut, combined with the delays in programme implementation due to the uncertainties about future programming arising as a result of the review process, had the unfortunate effect of temporarily retarding progress on programme goals and objectives.

The START process played a crucial role in stabilizing relations between two heavily armed nuclear weapon states, however, in the vastly altered circumstances of the post-Cold War environment, the emergence of the CTR programme was essential in aiding the FSU to meet their Treaty objectives. As INF and START reductions proceeded transparency measures

and comprehensive cradle-to-grave controls over fissile materials became more essential. As an arduously negotiated treaty, START I, did not have the wherewithal to be able to respond to rapidly changing circumstances. In this context the greater informality and flexibility of the CTR programme became an essential adjunct to START I's implementation.

## THE SECURITY BENEFITS OF START/CTR

The flexibility of the CTR programme enabled a broadening and deepening of the START agenda in several notable ways. Firstly, it augmented the security and control of nuclear weapons and fissile materials in the Russian Federation and other successor states. Secondly, it promoted greater military transparency and cooperation, which was initially viewed as a spin-off from the programme, but has now become an end in itself. And thirdly, preventive threat reduction has encompassed an increasingly diversified set of approaches and means, which are designed to simultaneously aid disarmament and counter the proliferation of weapons of mass destruction. In assessing the specific benefits of the combined START /CTR process a number of qualitative gains can thus be identified:

- enhanced bilateral security;
- improved international security and stability;
- increased transparency, a reduction of the risk of miscalculation;
- trust and confidence building;
- the building of international norms and a set of desirable precedents.

### Enhanced Bilateral Security

The bilateral reductions in nuclear weapons enhance security by reducing the risk of nuclear war. In this respect the contribution of the CTR programme has been to improve the safety and security of nuclear weapons and materials in Russia, which has reduced the risk of accidents and proliferation.

### Improved International Security and Stability

Actions by Moscow and Washington to reduce their first strike capability as well as to change the operational practices that could lead to inadvertent or accidental war created a more stable and secure geo-strategic environment during the 1990s. Global stability was also achieved

through the termination of the nuclear arms race. With the collapse of the Soviet Union, managing the major strategic and political transformation, became an imperative of the CTR programme.

### Increased Transparency, Reducing Uncertainty and the Risk of Miscalculation

The extent to which arms control negotiations and agreements enhance transparency, through regular data exchange and on site inspections, has helped to reduce the uncertainties and miscalculations about each side's nuclear forces. Mutual knowledge of each other's thinking, holdings and intentions in the nuclear arena has in turned helped to enhance mutual security. CTR programmes have augmented START I verification procedures and greatly improved transparency within the successor states via lab-to-lab collaboration, weapons dismantlement programmes, fissile materials storage and improving the security of plutonium stockpile.

### Trust and Confidence

A web of official, personal, organizational and non-government interactions linked to the START and CTR processes and the multitude of institutions and structures that are used for government-to-government discussion, treaty implementation and sub-governmental cooperation have helped to build trust and confidence between Russia and the United States. Though perhaps less prominent than the direct benefits of the START/CTR process to the former adversaries, are the reassurances that other countries have gained from the downsizing and stabilizing process.

### International Norms

The START process and even more so CTR, represented significant steps towards creating an international norm in favour of nuclear arms control and nuclear non-proliferation. Under the Clinton administration, these process and principles went some way towards creating an international environment more conducive to arms control and disarmament resulting in dramatic progress in other arms control and non-proliferation initiatives such as the Chemical Weapons Convention (CWC) and the CTBT. Yet, as we will see in the next section, the Bush administration has consciously rejected arms control initiatives, describing

them as relics of the past. In so doing, many of the normative gains made through the START and CTR achievements are now under threat.

In more quantitative economic terms START I has generated direct savings via the specific cuts in the nuclear arsenals of both nuclear weapon states, estimated at around US$ 400 million per annum for the United States. START also helped to produce savings elsewhere in the world by contributing to a reduction in bilateral tensions, which in turn induced a more general process of demilitarization of the global security environment. This process is captured in the significant declines in global military expenditure that occurred throughout most of the 1990s.

## CHAPTER 2

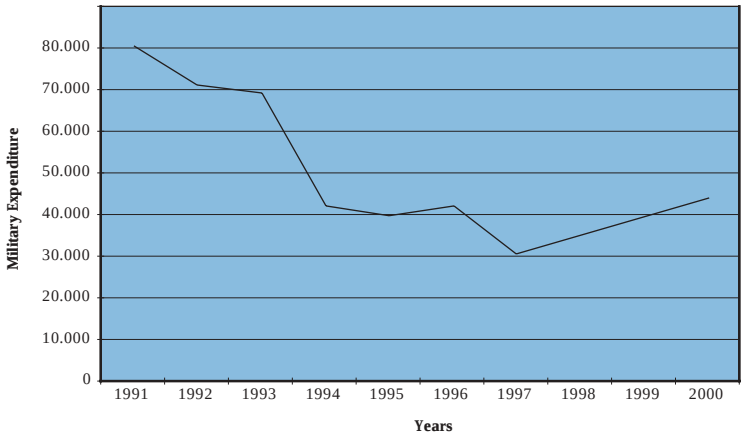
# THE END OF START

Towards the end of the 1990s events began to outstrip the pace at which negotiated arms control reductions could keep up with rapidly changing strategic and economic circumstances. Independently of each other both the United States and the Russian Federation opted to reduce their strategic nuclear arsenals to levels well below those proposed by the START III negotiations. The impetus for deeper reductions derives from quite distinct motivations, however. In the case of the Russian Federation economic constraints combined with the demands of the on-going war in Chechnya forced a reorientation of its strategic priorities, resulting in a reduced role for its nuclear forces. In contrast the US rationale for deeper cuts is rooted in the Bush administration's desire for greater strategic flexibility in US nuclear weapons policies.

## RUSSIA'S STRUCTURAL DISARMAMENT

The demise of the Soviet Union and the prolonged economic crisis in the Russian Federation placed severe constraints upon the Russian government's ability to meet its defence commitments. With the exception of 1997, the Russian economy contracted every year of the 1990s until 1999, with an accumulated decline of 40% between 1991-1998. In the second half of 1998 the general economic and financial situation worsened further, the rouble was devalued and the government defaulted on domestic and some foreign debt. The government was forced to take extraordinary measures to cut the federal budget. The defence budget declined dramatically between 1991-1997, placing severe pressures across the military services. (See Graph 1.)

**Graph 1**: Russian Military Expenditure (US$ in thousands, 1998 Prices)[70]




As the defence budget declined the various segments of the armed forces become embroiled in a vicious competition to maintain their share of Russia's inadequate military resources.[71] The fate of Russia's strategic nuclear forces lay at the heart of this rivalry.[72]

Current budget allocations for Russia's strategic nuclear forces including the SFR, the air force and navy are insufficient to perform the maintenance and modernization necessary to maintain the current arsenal. For much of the 1990s the modernization of the SRF received priority funding. But even with the SRF consuming 18% of the Russian defence budget (late 1990s) and between 40-60% of the R&D budget,[73] it was only able to produce 10-12 silo-based Topol-Ms per year, develop the mobile variant of the Topol-M and modernize the ageing liquid fuel ICBMs. Not only was the SRF's consumption of the lion's share of the declining defence budget inadequate for meeting the desired degree of nuclear weapons modernization, it was also diverting urgently required resources for the Chechen campaign and the procurement of much needed conventional weaponry. As a result, a group of senior military officers known as the "Chechen Generals" became vociferous opponents of the SRF.

The fight over resources came to a head in July 2000 when Anotoli Kvashnin, the Chief of the General Staff, made known the details of a wide-

ranging plan of military reform, detailing a dramatic shift of emphasis away from nuclear weapons to conventional forces. The rational for this move lay in the perception that the main threats to the Russian Federation came not from the North Atlantic Treaty Organization (NATO) or China, but from militant Islamic radicals on Russia's southern borders. The plan proposed a radical restructuring of the limited defence budget with the aim of strengthening the conventional component of the armed forces in order to enable it to successfully fight limited conflicts like the war in Chechnya.

The effective "denuclearization" of Russia's defence posture envisaged a consolidation and effective reduction in the number of ICBM divisions from the current 19 to 2, a reduction in the number of ICBMs from the current level of 756 to 150, a cut in the production of ICBMs from 10-12 per annum to two, and the overall size of Russia's strategic nuclear force to be reduced to 1,500 warheads.[74]

Kvashin's plan was by no means a new idea. For several years Moscow had advocated reducing the Russian and US strategic arsenals to 1,500 deployed warheads in the context of the START III agreement. There was, however, fierce resistance to such proposals, not least from the Minister of Defence Igor Sergeyev, who had previously headed the SRF. He and his "missile mafia" insisted that concentrating resources into Russia's nuclear arsenal best preserved Russia's security and international standing.[75] In 1999 and 2000 Sergeyev increased Russia's reliance on nuclear weapons, but it was clear that President Putin, aspiring to reform the military and boost morale, shared sympathies with the Kvashnin's plan. Subsequently, Segeyev was removed and the SRF budget was pared down with some of the savings allocated to the restoration of the naval nuclear forces, which has deteriorated since the collapse of the Soviet Union, and the rest used to improve Russia's conventional weapons capabilities.[76]

Since 1999 the Russian economy has made a remarkable recovery. Gross domestic product (GDP) grew by 3.2% between 1999-2000 largely due to the rise in oil prices and the effect of the devaluation of the rubble, which made Russia's exports more competitive. The resurgence of the Russian economy has allowed for a dramatic increase in defence spending, which rose by roughly US$ 13 billion between 1999-2000. President Putin, however, remains focused on restructuring and reforming Russia's conventional forces, so that they would be better equipped to deal with the external and internal threats, and particularly those from terrorist attacks.

For the time being at least, the decreasing importance on Russia's strategic nuclear force appears to have been maintained.

## US Desire for Flexibility

The central organizing principle of strategic arms control during the Cold War was to maintain stability in order to prevent a devastating nuclear exchange between the superpowers. The core principle of MAD, that underwrote the theory of deterrence, was codified in arms control treaties. With the end of the Cold War, however, these principles began to appear redundant. Briefly in the early 1990s it appeared as if nuclear weapons would become redundant. A view took shape that the emerging threats to US security came less from Russia's declining strategic power, than from regional powers and terrorist groups. Of particular concern were potentially hostile powers or "rogue states" armed with weapons of mass destruction. Fuelled by these concerns, the pro-nuclear lobby saw the opportunity for a new nuclear targeting strategy.[77] As a 2001 CBO report on US defence allocations commented: "The ability, as well as the motivation, to acquire nuclear weapons increased during the 1990s. The nuclear ambitions of regional powers were freed from the constraints of their former Cold War protectors. In addition, the collapse of the Soviet Union and the loosening of the old security apparatus boosted the risk that such powers could get hold of the necessary technologies, materials and know-how to develop their arsenals. The accelerating pace of proliferation was brought home vividly in 1998 when India and Pakistan tested nuclear weapons and North Korea, India, Pakistan and Iran tested intermediate-range ballistic missiles."[78]

The 1997 Presidential Decision Directive 60 (PDD60) confirmed a shift in US nuclear policy. The contents of PDD 60 gave guidelines on US nuclear targeting policy, which included options for targeting "rogue states".[79] PDD 60 formally opened up the possibility of *using* nuclear weapons in retaliation against the weapons of mass destruction of "rogue states". With the election of George W. Bush in January 2001 the reinstatement of nuclear weapons at the heart of US security policy gather paced, as did the erosion of US support for arms control.

In his inaugural speech, President Bush rejected the concept of MAD as the central organizing principle for strategic nuclear weapons. In a

speech at the National Defence University in May 2001 he argued for a "clear and clean break" with the past, challenging America and the world to "think the unthinkable".[80] He announced that traditional arms control would be replaced with "a new framework" in which unilateral measures would gain greater prominence. With a greatly reduced threat from Russia, Washington no longer needed to retain such large contingencies of strategic nuclear forces. President Bush committed the United States to reduce its deployed strategic forces to between 1,700 to 2,200 warheads over a ten-year period. Although this level is within the START III range, the Bush administration had no inclination to enter protracted negotiations with the Russians, which might impose constraints on the sort of strategic flexibility that the US security community now sought. In January 2002, the NPR was released. The proposals in the NPR reflect the Pentagon's efforts to enhance the credibility of the threat to use nuclear weapons as a means of counter-proliferation, thus removing any previous ambiguity about this function. More generally it has raised the profile of the nuclear arsenal in strategic planning. The devastating consequences of the 11 September attacks have reinforced the Bush administrations determination to reorient its strategic objectives towards counter-proliferation and pre-emptive strikes, in order to defeat "rogue states" and terrorist groups. Washington is intent on meeting its deterrent needs by improving flexibility in both its offensive and defensive capabilities. In so doing it has firmly reoriented its national security policy to rely on military means, rather than on treaties or the tools of diplomacy.

## SORT: A New Strategic Accommodation?

The US determination to pursue its strategic reductions unilaterally was, however, modified by the President Putin's willingness to accept a less formal and more open-ended agreement on strategic weapons reductions. At the Washington/Crawford Summit in November 2001, Presidents Putin and Bush, announced in a joint statement that: "We have agreed that the current levels of our nuclear forces do not reflect the strategic realities of today. Therefore, we have confirmed our respective commitments to implement substantial reductions in strategic offensive weapons."[81] The cuts were formally confirmed with the signing of SORT at Moscow on 24 May 2002.[82]

The Treaty requires each party to reduce and limit its strategic nuclear warheads to 1,700-2,200 by 31 December 2012. Each side may determine for itself the composition and structure of its strategic forces consistent with this limit. A Bilateral Implementation Commission is to meet at least twice a year to discuss issues related to the Treaty. Before its entry into force, SORT requires approval by both the US Senate and the Russian Duma.

START I continues in force unchanged, and its comprehensive verification regime will provide the foundation for transparency and predictability regarding implementation of the new bilateral Treaty. As noted in the Joint Declaration on the New Strategic Relationship issued on the same day, the United States and Russia will also continue to explore new ways to enhance transparency and predictability.

While some arms control experts have heralded the agreement as an unprecedented step towards progressive arms limitations, others believe that SORT has done little to contribute to long-term US-Russian strategic stability. Rather they point to a number of shortcomings that undermine previous arms control gains. The three-page Treaty is one of the shortest arms control agreements in history. It defers key unresolved issues to the implementation phase, including the timetable for decommissioning warheads, the numbers to be destroyed, versus those placed in deep storage, for possible redeployment at a later date, and how to protect the decommissioned warheads' fissile material from theft.

Under article 1, parties are obliged to "reduce and limit strategic warheads… so that by December 31, 2012 the aggregate number of such warheads does not exceed 1,700-2,200 for each Party." Under this loose specification Moscow and Washington would be able temporarily to increase their strategic arsenals as long as they comply with their obligations by 31 December 2012. The two countries can achieve their reductions either by dismantling their warheads or by removing them from their delivery vehicles and storing them in stockpiles. This process known as "downloading" is far simpler and much cheaper than dismantlement but it does allow for "uploading" and relatively rapid redeployment. The United States intends to make extensive use of downloading by maintaining roughly 2,400 warheads in its SSP as a "responsive force".

As with START, each party has the right to withdraw from SORT, but the notice period is only three months, rather than the standard six months,

and "extraordinary events" do not have to occur for withdrawal to be justified.

The most worrying issue from an arms control perspective is the Treaty's complete lack of verification mechanisms.[83] In the pursuit of strategic flexibility, the US negotiators rejected the opportunity to verify the elimination of excess nuclear weaponry. Proposals to expand data sharing and improve monitoring of Treaty compliance were on the table, but the two sides failed to reach an agreement on these issues. As it stands at present, data exchange and transparency will occur on a voluntary basis. Moreover, SORT places no restrictions on strategic delivery systems allowing each side to determine the composition of its deployed nuclear forces. In addition, delivery systems do not have to be destroyed as they would under the START process, thus allowing for rapid "breakout" in the event that either country wanted to expand its deployments of nuclear weapons. In effect US negotiators have secured an agreement that allows the United States to disregard the START framework, while providing greater freedom to modernize its nuclear force on a unilateral basis when the new treaty expires in 2012.[84]

By failing to significantly alter the number of existing nuclear delivery systems the residual nuclear potential of the United States and Russia is only marginally affected by SORT reductions. In effect the Treaty creates thousands of "phantom warheads" making it difficult to predict force levels over the next decade. While the Bush administration has pledged to dismantle some warheads, it also intends to maintain the capability to redeploy at least 2,400 warheads from its active reserves within three years of the conclusion of the agreement, giving the US the capability to deploy at least 4,600 strategic warheads when the Treaty expires in 2012. Several thousand more warheads in lower stages of readiness could also be redeployed over a longer period of time. This sets a dangerous precedent if Russia decides to follow suit. If Russia mirrors the US policy of warehousing, rather than eliminating, its strategic warheads, Moscow will be adding to a vast and insecure nuclear weapons complex, which already poses a significant proliferation risk.

Another issue that critics find troubling is that Russia's most powerful delivery system the multiple-warhead SS-18 missile can stay in the deployed arsenal as long as the total warheads drop to the 1,700-2,200 range. In accordance with the never-implemented START II provisions,

Russia would have had to dismantle its entire stock of SS-18s. This has led many arms control analysts to believe that the new treaty is a major step back from gains that would have been made by START II.

The final concern with SORT is that it does not deal with the issue of TNWs, as START III had intended to do. This is a major setback for arms control and non-proliferation goals as tactical weapons housed in Russia have been identified as those, which more likely than other types of nuclear weapons to end up in the hands of terrorists because of their small size and thus portability.[85]

The Treaty's general lack of specificity poses a challenge to both the US and Russia to finalize the terms of implementation by means that will advance the larger aim of strategic cooperation that was outlined in the joint declaration that the Presidents also signed on 24 May 2002. At the proposed level that the strategic force will remain, each state will still be capable of obliterating the other. This suggests rather more continuity with the concept of MAD than Bush had suggested in his inaugural speech. Continuity also remains within nuclear targeting plans, which suggests that SORT falls far short of the "clean break" with the past that Bush also promised. Nuclear deterrence remains very much intact, even at force levels below those of START III. Of this trend, Michael Krepon has observed that: "Downsizing nuclear deterrence is necessary, but it is also insufficient. Deterrence alone cannot promote successful preventive diplomacy or coalition building. … And deterrence, by itself does not reduce or eliminate dangerous weapons and materials."[86]

As it stands, SORT sets a dangerous precedent. It represents continuity in the use of strategic forces, rather than change, its ambiguity and non verifiability sows the seeds of insecurity and ripens the conditions for mistrust and instability to flourish between the Russian Federation and the United States, undermining the recent rapprochement.

## CHAPTER 3

# UNILATERAL NUCLEAR REARMAMENT

## THE PUSH FOR NUCLEAR REARMAMENT

In the early 1990s the collapse of the Soviet Union and the rapprochement between former adversaries led to expectations of an era in which nuclear weapons would play an ever-diminishing role in global security relations. Behind the scenes, however, the pro-nuclear lobby in the United States were busy defining new tasks and roles for nuclear weapons. The focus of their arguments centred on the key role that non-strategic nuclear weapons could play in "new" threats to US security.

A unifying theme of official US statements about future security challenges centred on the perils posed by the "uncertainty" of the post-Cold War environment. Two major threats to global stability and by implication US security were identified, regional conflict and the emergence of international terrorism.[87] This assessment was boosted by the perception of the growing risk from WMD armed "rogue states", which included Iran, Iraq and North Korea. President Bush has more recently described these states as the "axis of evil".

Efforts to develop a new *raison d'être* for nuclear weapons became increasingly focused on the possession of hardened underground bunkers by hostile states. The US government's preoccupation with the threat posed by these facilities was stimulated by the activities of a number of "rogue states" that were suspected of conducting clandestine weapons of mass destruction programmes in underground facilities. A BASIC research report entitled *Bunker Busters: Washington's Drive for New Nuclear Weapons* has observed that: "Defeat of HDBT's rapidly emerged as the mission most likely to justify the development and deployment of new nuclear weapons in the post-Cold War environment."[88]

The perception of threat from "rogue states" and international terrorism was dramatically intensified by the 11 September attacks. The Bush administration's national security strategy, which was released in September 2002, is unambiguous in its preoccupation with defeating "rogue states" and international terrorist organizations intent on acquiring WMD capabilities. The document entitled *The National Security Strategy of the United States* (NSS) states that "the nature and motivations of these new adversaries, their determination to obtain destructive powers hitherto unavailable only to the worlds strongest states, and the greater likelihood that they will use weapons of mass destruction against us, make today's security environment more complex and more dangerous."[89] Noting that "traditional concepts of deterrence will not work against a terrorist enemy whose avowed tactics are wonton destruction and targeting of innocents" the document asserts "that we must adapt the concept of imminent threat in judging adversaries and deciding on action."

The NSS highlights the role of counter-proliferation and pre-emptive action in counteracting theses threats. The DOD first launched counter-proliferation in December 1993, as the Defence Counter-Proliferation Initiative. The initiative called for the development of offensive and defensive capabilities to prevail over an adversary that threatens or uses weapons of mass destruction.[90] As for pre-emptive action the NSS argues that: "The United States has long maintained the option of pre-emptive actions to counter a sufficient threat to our national security. The greater the threat, the greater the risk of inaction and the more compelling the case for taking anticipatory action to defend ourselves, even if uncertainty remains as to the time and the place of the enemy's attack. To forestall or prevent such hostile acts by our adversaries, the United States will, if necessary, act pre-emptively."[91] The unique aspect of pre-emptive action being contemplated by the Bush administration is the actual *use* of non-strategic nuclear weapons. The declared intention to use nuclear weapons against "rogue states", an intention which undermines the taboo about nuclear weapons use which has been in place since the devastating attacks of Hiroshima and Nagasaki, was formally outlined in the 2002 NPR.

The NPR indicates that nuclear weapons will "play a critical role in the defence capabilities of the United States." Based on a new triad, a more flexible nuclear force structure has been introduced that incorporates a more limited strategic nuclear force, robust missile defence systems and new nuclear weapons designed to deter enemy use of WMD. One of the

key features of this force structure is the introduction of a conventional/ nuclear weapons continuum, which allows for the ready escalation from the use of conventional weaponry to the use of non-strategic nuclear weapons such as "bunker busters" or mini-nukes.

The shift in strategy to an overt renuclearization of US security policy has a number of economic and security ramifications. Adopting a highly offensive strategy that incorporates a new generation of nuclear weapons comes at a price and one that is driving up US military expenditures at an alarming rate, at a time when the US economy is in recession. In security terms, the renuclearization of US security policy is highly destabilizing to the rest of the world and sets a counter-productive precedent which may undermine efforts elsewhere of controlling both vertical and horizontal proliferation of weapons of mass destruction. In the following sections the costs and security ramifications of two aspects of the new security approach, ballistic missiles and nuclear weapons developments, are examined in more detail.

## NUCLEAR POSTURE REVIEW

The release of details of the NPR in the *Los Angeles Times* on 9 March 2002 confirmed the Bush administration's strong preference for nuclear rearmament and further confirmed the administration's move away from arms control. In the Foreword of the NPR, Donald Rumsfeld, states that "this Nuclear Posture Review puts in motion a major change in our approach to the role of nuclear offensive forces in our deterrent strategy and presents a blueprint for transforming our strategic posture."[92]

The NPR is designed to move the United States beyond Cold War nuclear force planning. Russia, with its much-depleted military strength, is no longer seen as a major threat to US security. Accordingly the DOD has shifted planning for America's strategic forces from a threat-based approach to a capabilities-based approach. This is designed to provide a credible deterrent at a lower level of nuclear armaments, but one which has greater flexibility than was the case under the now much discredited Single Integrated Operational Plan (SIOP).[93] According to the NPR "Greater flexibility is needed with respect to nuclear forces and planning than was the case during the Cold War." With threats coming from diverse sources including terrorists and WMD armed "rogue states" the US is thought to

require the capability to "hold at risk a wide range of target types".[94] In addition to the strategic force of some 1,700–2,200 warheads the DOD has envisioned a "responsive force" of warheads that would be met from its strategic active stockpile, many of which would have been downloaded from existing delivery systems under the SORT agreement. "The responsive force is intended to provide a capability to augment the operationally deployed force to meet potential contingencies."[95] The responsive force could be mobilized in matters of weeks or months in response to an evolving crisis. It would also provide a reserve from which replacements could be provided for operationally deployed weapons. This stress on a responsive force undercuts the principle of irreversibility that was built into the START process and could have disturbing implications for global stability.

The reconfigured nuclear forces will be based on a new triad composed of three legs:

- offensive strike systems (both nuclear and non nuclear);
- defences both active and passive;
- a revitalized defence infrastructure that will provide new capabilities in a timely fashion to meet emerging threats.

The old triad was also based on three legs the air-, land- and sea-based strategic delivery systems including ICBMs, SLBMs and heavy bombers. The new triad incorporates all these three systems into the first leg combined with non-nuclear strike capabilities including precision-guided munitions.

The second leg is composed of BMDs. Nuclear weapons alone are thought to be an insufficient deterrent against aggressors such as "rogue states" and international terrorists, thus a broader array of capabilities is to be adopted to complement the nuclear deterrent in order to dissuade hostile states from undertaking political, military or technical actions that threaten US security. In particular, "Missile defences are beginning to emerge as systems that can have an effect on the strategic and operational calculations of potential adversaries. They are now capable of providing active defence against short-to-medium-range threats."[96] The withdrawal of the United States from the ABM Treaty in June 2002 cleared the way for active missile defences to become part of US strategic policy.

The missile defence leg of the new triad is likely to confound further offensive force reductions with Russia and, in the more distant future, China and other nuclear-armed states.[97] A more immediate policy concern is the nuclear/conventional continuum that this leg of the triad promotes. There are three dangers inherent in this approach:

- it obscures the fact that there are qualitative differences between nuclear and conventional weapons such as radiation effects;
- there are normative issues of a political, legal and moral nature that clearly distinguish the boundaries between conventional and nuclear weapons that this continuum ignores;
- a conventional/nuclear continuum makes the use of nuclear weapons more likely, breaking the 50-year taboo of nuclear weapons restraint.

The third leg places emphasis on the need to modernize the existing nuclear infrastructure. "The technology base and production readiness of infrastructure of both DOD and NNSA [National Nuclear Security Administration] must be modernized so that the United States will be able to adjust to rapidly changing situations… adjustments may be needed to match capabilities of the remaining nuclear forces to new missions… a need may arise to modify, upgrade, or replace portions of the extant nuclear forces or develop concepts for follow-on nuclear weapons better suited to the nations needs."[98] One particular weapons development programme that the NRP highlights are the EPWs the so-called "bunker busters" which are being designed to counter the use of hardened and deeply buried facilities by US adversaries.

## BUNKER BUSTERS

Three EPW options are to be examined in a DOD and Department of Energy (DOE) feasibility study over the next two to three years. The study's estimated costs are US$ 45 million. The options the feasibility study will examine include:

- conventional weapons;
- modifications of existing nuclear weapons;
- development of new nuclear weapons.

The second and third options are particularly controversial.[99] For some time the Pentagon has been re-engineering the B61-11 bomb to penetrate hardened shelters like underground command and control centres and chemical, biological and nuclear weapons manufacturing facilities. The B61-11 is a low-yield nuclear weapon of roughly 5 kilotons, (a kiloton is equivalent to blast damage created by 1,000 tons of conventional explosives).

Tests have show that the B61-11 can only penetrate about 6 metres when dropped from 12,000 metres.[100] Not only would such a bomb be questionable in achieving its desired objective of destroying underground facilities, but it would also produce tremendous lethal radioactive fallout into the atmosphere.

Faced with the limitations and dangers of the B61-11 some nuclear weapons scientists have proposed developing a whole new class of low-yield nuclear weapons.[101] These weapons would be designed with an even lower explosive yield, as low as a fraction of a kiloton, to minimise radioactive fallout. They would have missile and bomb casings with deeper penetrating capabilities. Theoretically these mini-nukes are designed to bridge the gap between conventional and nuclear weapons. Underlying this conventional/nuclear continuum is the desire to make nuclear weapons more useable in counter-proliferation operations against "rogue states". As one analyst has observed: "This dubious proposition is grounded in the notion that a low-yield weapon could more readily be used as a threat, or actually dropped on a target, without sparking nuclear retaliation by another nuclear power."[102]

Scientific scepticism also exists about the possibility of developing such a "benign" nuclear weapon.[103] Dr Nelson has argued that: "A missile made of hardest steel cannot survive the severe ground impact stresses at velocities greater than about one kilometre per second without destroying itself" moreover, "this limits the maximum possible penetration depth into reinforced concrete to about four times the missile length approximately 12 meters for a missile 3 meters long." Based on Dr Nelson"s calculations, "A one kiloton earth penetrating mini-nuke, used in a typical third-world urban environment, would spread a lethal dose of radioactive fallout over several square kilometres, resulting in tens of thousands of civilian fatalities."[104]

The desire to develop these mini-nukes is currently thwarted by a national law that was passed in 1993 which forbids the US government from designing new nuclear weapons with a yield below 5 kilotons.[105] Consequently the development of a very low-yield mini-nuke is on hold, with the DOE focusing its attentions on modifying the B61-11 under its Robust Nuclear Earth Penetrator Program.

Prominent members of the arms control community, scientists and representatives of scientific organizations, have spoken out against the development of mini-nukes citing the adverse political costs of crossing the nuclear threshold if the United States would ever use these weapons.[106] One analyst in particular has expressed concern that the US is pursuing its new strategic doctrine in direct violation of international law.[107]

## BREAKING TABOOS

The NPR contains language that strongly indicates that the Bush administration has authorized the DOD to develop plans for *using* nuclear weapons against seven states five of which are non-nuclear nations. Significantly, these five states Iran, Iraq, Syria, Libya and North Korea are parties to the NPT that took effect in 1970. As parties to NPT, these states have certain rights bestowed on them by international law. For instance the United Nations Security Council provides non-nuclear weapons states with specific "negative security assurances", the most recent being United Nations resolution 984, which was unanimously passed in April 1995. This binding resolution protects the non-nuclear weapons states from the use or threatened use of nuclear weapons by the nuclear weapons states. The 2000 NPT Review Conference endorsed the nuclear weapons states' commitment to resolution 984, while stressing that such a guarantee strengthens international non-proliferation. In direct violation of United Nations resolution 984 the current US Under-Secretary of State for Arms Control, John Bolton, announced in February 2002 that the United States would no longer be bound by "negative security guarantees", although State Department officials quickly acted to dispel concern and said that the US government sticks to all its previous security assurance.[108]

The NPR states that the United States would consider using nuclear weapons as a legitimate option in three circumstances: in response to an attack on the United States using weapons of mass destruction, in order to

destroy vital targets invulnerable to conventional weapons, and in the event of "surprising military developments".[109] Bolton's statement combined with the NPR's implicit threat to use nuclear weapons against non-nuclear states signifies a flouting of both international law and universal norms regarding the use and abuse of nuclear weapons.

In accordance with its aspiration to develop a new generation of nuclear weapons, the NRP reveals Washington's desire to resume nuclear testing: "The need is clear for a revitalized nuclear weapons complex that will…be able if directed, to design, develop, manufacture, and certify new warheads in response to new national requirements and maintain readiness to resume underground nuclear testing if required."[110] Although Washington has not ended its moratorium on testing, there are strong indications within the NPR that it may be preparing to do so. The report recommends reducing the readiness time for nuclear testing from the existing two to three years down to a year or less. It also points out that the skills of the testing personnel have deteriorated in recent years because they have not been exercised and suggests activities to enhance test-specific skills. Finally measures to improve US test facilities and readiness are proposed such as replacing key underground test components, modernizing test diagnostic capabilities and decreasing the time to show regulatory and safety compliance.[111]

## THE COSTS IMPLICATIONS OF THE NPR

It is too early to put a figure on the financial implications of the new nuclear doctrine outlined in the NPR. Donald Rumsfeld, in the Foreword of the document, commented that: "Constructing the New Triad, reducing our deployed nuclear weapons and increasing flexibility in our strategic posture has resource implications. It costs money to retire old weapon systems and create new capabilities. Restoring the defence infrastructure, developing and deploying strategic defences, improving our command and control, intelligence, planning and non-nuclear strike capabilities require new defense initiatives and investments. However, these can make the US more secure while reducing our dependence on nuclear weapons."[112] If the costs of past and existing nuclear weapons are a measure of what is likely to be incurred in the future then we can be certain that they will be substantial and will place increasing upward pressure on the US defence

budget. Whether such expenditures will achieve greater security is less certain.

The intentions laid out in the NPR are designed to enhance US security against all possible forms of aggression against its territorial integrity and overseas interests, but far from enhancing security it has made the world a far more dangerous and uncertain place. Dr Bruce Blair, the President of the Center for Defence Information and a former Minuteman launch officer in the Strategic Air Command, has observed that: "Bush's strategists' are not only making the use of nuclear weapons by the United States more probable, they are unwittingly encouraging our adversaries to redouble their pursuit of weapons of mass destruction. We have put chemical and biological weapons on a par with nuclear weapons if we regard them all as equally threatening to us and equally deserving of a US nuclear response. This message hardly serves to dissuade the rogue states from acquiring any or all of the above. On the contrary, if chemicals and germs confer status on par with nukes, these states may value them more than ever as a means of deterring a US nuclear or conventional attack"[113] In so doing the world becomes a more dangerous and less secure place.

## Ballistic Missile Defences

BMDs are designed to provide the defensive element of the conventional/nuclear weapons continuum. BMD began as President Reagan's grandiose ''Star Wars'' programme, conceived as a shield against a massive Soviet nuclear attack. The programme was largely abandoned because of technical failures, rapidly rising costs and the more benign security environment that materialized towards the end of the Cold War. Support for the concept of a defensive shield remained unshaken within the defence industry despite the funding cuts. Following intense lobbying during the early to mid-1990s the concept was revived in the form of a ''thin'' defence against missiles fired by so called "rogue states" that were assessed by the CIA as having the potential to fire intercontinental ballistic missiles at the United States within a matter of 15 years.[114] In August 1998, when North Korea tested its Taepo Dong-1 missile, strength was added to arguments that favoured the deployment of a national missile defence system.

The Clinton administration proposed the introduction of a "limited" NMD system designed to provide protection to US territories from incoming missile attacks. Although promoted as a defensive system, the Russian Federation and China vociferously opposed NMD arguing that it would stimulate a new strategic arms race, as it would destabilize the principle of deterrence.

Undeterred by international concerns about the geo-strategic instabilities that might be generated by the US ballistic missile programmes, President Bush has made missile defences one of his administration's top priorities, giving it prominence in funding, policy and organization. The programme has been expanded by the introduction of the concept of a "layered" ballistic missile defence system. Secretary of Defence, Donald Rumsfeld outlined the administration's missile defence objectives as: "First, to defend the US, deployed forces, allies and friends. Second, to employ a Ballistic Missile Defence System (BMDS) that layers defences to intercept missiles in all phases of their flight (i.e. boost, mid-course and terminal) against all ranges of threat. Third, to enable the Services to field elements of the overall BMDS as soon as practicable."[115]

The NPR outlines the specific elements of the national missile defence system that the Bush administration wants to have in place between 2003-2008. An air-based laser to shoot down missiles of all ranges during their boost phase, a ground-based mid-course system, a sea-based system with rudimentary mid-course capability against short-and medium-range threats, terminal defences against long-range ICBMs capable of reaching the United States and a system of satellites to track enemy missiles and distinguish re-entry vehicles from decoys.[116] The space-based laser currently being developed as part of the layered missile defence systems represents an incremental creep towards the militarization of space, which has worrying implications for the arms control community's aspiration to prevent the weaponization of space.[117]

In the aftermath of the US withdrawal form the ABM Treaty, fears that ballistic missile defence systems would set off a new arms race appear somewhat hollow, President Putin's new accommodation with the United States and the binding of strategic missions in the war against terrorism have ensured that Moscow's reactions to Washington's Treaty abrogation have been muted. This is partly because, in the short-term at least, Moscow is secure in the knowledge that a US national missile defence system is

unlikely to erode Russia's deterrence capability. Nevertheless, many Russian security analysts think that the decision to abandon the ABM Treaty and deploy an NMD system may have sacrificed a degree of strategic stability in US-Russian relations over the long term.

President Putin's much lauded partnership with the United States belies a high degree of mistrust that still exists within influential Russian military circles about US strategic intentions. The renuclearization of US security policy and the linking of offensive and defensive systems within the new triad as outlined in the NPR and the conflict over Iraq have fuelled a deep suspicion that President Putin's pro-Western policy is working against Russia's long-term security interests. According to this point of view NMD could become a threat to Russia's deterrence capability if it gains the capacity of intercepting more incoming warheads than Russia can effectively retaliate with against a theoretical first strike by the United States.[118] In this context, NMD is perceived to be part of an offensive rather than a purely defensive force.[119] This observation is likely to be reinforced if in the longer term the United States proceeds with developing nuclear tipped interceptors, which the Russian military assume the US will have to do in order for NMD to guarantee the destruction of incoming targets. In such a context Russia's response would be to refuse to reduce its nuclear warheads on a scale agreed under SORT, and to proceed with modernizing its deterrent capacity by testing and deploying new MIRVed ICBMs. The possibility of any meaningful reduction in strategic nuclear weapons would soon disappear.

This is all very hypothetical, however, because no one, including the Americans are sure about how technological developments with NMD will proceed. And current thoughts in Russia about how to respond to NMD remain divided. President Putin and military experts close to the leadership argue that even if the United States is not serious about a real partnership with Moscow there is no immediate threat to Russia's deterrence capacity and therefore there is no need to proceed with bolstering its strike capacity or defences. Others from the military establishment believe that NMD presents a very real threat and that certain minimum counter-measures should be taken without delay.

The deployment of ballistic missile defences is more destabilizing in terms of Sino-US relations. Currently, with only an estimated 20 ICBMs, BMD threatens to undermine the deterrence function of China's strategic

force. Intelligence reports on China's strategic weapons development indicate that China is upgrading its nuclear force and will increase the number of ICBMs that could be targeted at the United States from the current estimate of 20 to around 60 by 2010.[120] In addition, China might enhance its nuclear deterrent by equipping some of its multiple warhead CSS-4 Mod 1 missiles, liquid fuelled ICBMs capable of reaching the mainland United States. Modernization of China's nuclear arsenal will produce both modified and new weapons. The CSS-4 Mod 1 is due to be replaced by the CSS-4 Mod 2 by 2005. In addition it is estimated that the deployment of the solid fuelled DF-31 (also known as the CSS-X-9) could begin production by the mid-decade. This missile has the potential range to reach Alaska. A Pentagon report released in July 2002 has speculated that these developments in Chinese nuclear force levels are taking place in response to the US plans to develop and deploy a missile defence systems.[121] In the meantime, as Philip Coyle, the former director of the NMD programme has argued, US policy makers should be wary of basing US foreign and security goals on a system that does not work at present and may not work in the foreseeable future. No weapon system can substitute for sound foreign and security policies.[122]

## COSTS OF BMD

There is no simple way to calculate the total costs of ballistic missile defence systems. The question of exactly how much has been spent on BMD since its inception in 1983, as President Reagan's "Star Wars" programme, is both controversial and problematic. Analysts do not agree on what exactly to count, or how to count it once identified. The DOD official estimates for BMD, for the period FY 1984-FY1994 is US$ 32.6 billion.[123] This figure accounts for the research and development spending on a broad range of technologies associated with BMD, but not necessarily designated to specific BMD systems.

A report by the CBO that was released in April 2000 put the projected costs of the Clinton administration's blueprint for a limited national missile Defence system at nearly US$ 60 billion.[124] (See Table 7.)

**Table 7**: Estimates of Costs of "Limited" NMD System[125]

| | **Expanded Capability I** | **Expanded Capability II** | **Expanded Capability III** |
|---|---|---|---|
| **Threat** | Several tens of incoming missiles with simple counter-measures | A few incoming missiles with sophisticated counter-measures | Several tens of incoming missiles with sophisticated counter-measures |
| **Development** | 100 ground-based interceptors at a single location in Alaska, 1x band radars, 5 upgraded early warning satellites that are part of the Defense Support programme, 4 SBIRS- high and 6 SBIRS low satellites | 100 ground-based interceptors at a single Alaska location, 4x band radars, 5 upgraded early warning satellites, 5 SBIRS-high and 24 SBIRS low satellites | 250 ground-based interceptors at two locations one in Alaska the other probably Grand Forks, 9x band radars, 6 upgraded early warning satellites, 5 SBIRS- high and 24 SBIRS low satellites |
| **Cost** | US$ 29.5 billion through to 2015 | US$ 35.6 billion through to 2015 | US$ 48.8 billion through to 2015 |

**NB**: None of these costs include those of the Spaced Based Infrared System (SBIRS) low satellites as these will be deployed for other missions as well that are not necessarily part of the NMD system. CBO estimates that the cost of the SBIRS low system is US$ 10.6 billion bringing the total cost of the Expanded Capability III to US$ 59.4 billion.

The Bush administration has dramatically increased DOD spending on its ambitious "layered" programme. In its first defence budget the administration requested a 57% increase from US$ 5.3 billion to US$ 8.3 billion of which it received US$ 7.8 billion from Congress. Total funding for missile defences, including programmes not covered by the NMD, will total US$ 8.6 billion in FY2003 and official funding is expected to rise to over US$ 11 billion annually by FY 2007.[126] In January 2002 the CBO produced a total estimate for the Bush administration's more elaborate "layered" ballistic missile defence system, which could cost up to US$ 238 billion by 2025.[127]

Many questions remain about the efficacy and affordability of the proposed BMD systems. Philip Coyle has expressed cynicism about the ability of the Bush administration to meet its BMD goals by the year 2008, due to the technical difficulties being experienced within the research and development programme, that have led to time delays and cost overruns. Coyle warns that: "the Bush administration should not base its foreign and security policy on the assumption that during its tenure it will be able to deploy defences to protect the US from strategic missiles."[128] Taking into account the challenges the average time for a major military programme to enter into service is 25 years and the technical reliability required to turn BMD into an operational system particularly given the interoperability of a complex systems and subsystems it is highly unrealistic to think that the United States will be able to deploy an effective layered missile defence system within the next six years.

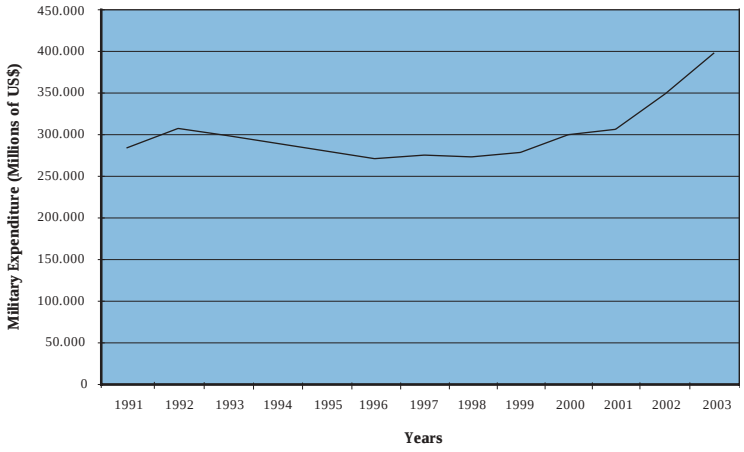
## THE COSTS OF US REARMAMENT

Not withstanding the burgeoning costs of the open-ended war against terrorism, the multi-layered NMD system and the production of a new generation of mini-nukes are both instrumental in the dramatic rises in US military expenditure. Defence spending in FY 2002 totalled US$ 343 billion, a US$ 32.6 billion increase over the FY 2001 level. President Bush has requested US$ 396 billion budget for FY 2003, an increase of US$ 52.8 billion. Long-term plans foresee the national defence budget increasing to US$ 469 billion by FY 2007.[129] That is 11% higher than the Cold War average. Such an increase in military expenditure is historically unprecedented, even for the United States.

Since the 11 September attacks and now since the conflict in Iraq it would appear that the Bush administration has instigated an "open purse" policy towards Pentagon spending. The open-ended nature of the war on terrorism and "rogue states" has been used to justify the large hikes spending, but certain critics point to a more cynical explanation. Michelle Ciarrocca puts forward a strongly supported argument that the spectacular hikes in military expenditure are attributable to the fact that defence allocations have been unduly influenced by US defence contractors: "More than any administration in history, the Bush team has relied on the expertise of former weapons contractors to outline US defence needs."[130] Ciarrocca goes on to point out that thirty-two major appointees within the Bush

administration were former executives, consultants, or major shareholders of top weapons contractors. The political influence of the US defence industry is further sealed by the millions of dollars that they provide for funding electoral campaigns. In 2000 the top six defence contractors spent US$ 6.5 million on supporting candidates and political parties. In the same year they spent US$ 60 million on lobbying for defence contracts.[131]

**Graph 2**: US Military Expenditure in US$ (constant prices)[132]




For the US defence industry, the current expenditure patterns promise bountiful profits, but for the rest of the economy the burden of high and rising military will take its toll. Coming at a time of recession, the additional budgetary claims made by the DOD are placing strains on the Federal budget. Almost US$ 4 trillion of projected surpluses disappeared from the US federal budget between 2001-2002 due to the combined effect of tax reductions, declining fiscal revenues and increases in defence spending.[133] The US government currently has a deficit of US$ 3.35 trillion (2002 prices) and rising.

The increases in defence allocations are also generating high socio-economic opportunity costs elsewhere in the federal budget by crowding out expenditures on other discretionary budgets. The following domestic discretionary programs suffered funding cuts in the fiscal year 2001:

- US$ 189 million from higher education;
- US$ 541 million from Training and Employment Services;
- US$ 1.026 billion from Law Enforcement Assistance, Community Policing and other justice programs;
- US$ 223 million from Small and Minority Business Assistance, a 31% reduction;
- US$ 227 million from disaster relief;
- US$ 109 million from Small Business Administration Disaster loans, a 59% reduction;
- US$ 338 million from Energy Supply programmes;
- US$ 354.1 million from clean up programs at former defence sites;
- US$ 756 million from Water Resources programmes, including flood prevention efforts;
- US$ 498 million from Pollution Control and Abatement programmes;
- US$ 1.23 billion from Conservation and Land Management programmes;
- US$ 144 million from Animal and Plant Inspection programmes.

For FY2002, planned discretionary spending was US$ 660.7 billion. Military expenditures accounted for 50.7% of this total.

The Bush administration has high expectations that that rising military expenditures will pump prime the ailing US economy, in good old-fashioned Keynesian demand management style. Military expenditure increases will undoubtedly offer a counter-cyclical boost to the defence companies who experienced a prolonged downturn during the 1990s, but with few backward linkages into the civilian economy, generous defence procurement contracts are unlikely to be able to counteract the recessionary trends in the civil economy. It will, however, continue to generate large opportunity costs in the already beleaguered areas of health and welfare spending.[134]

The long-term socio-economic costs of pursuing high military spending targets does not appear to be a controversial issue for the average American taxpayer, as yet. The effect of 11 September on the collective psyche of the American people seems to have engendered much support for the Bush's administration's promotion of a bellicose unilateralist posture. In the longer term, however, when the high opportunity costs of rising military expenditures feed through into greatly reduced welfare, education and health expenditures there may be less sympathy for maintaining such a

huge military burden. As the deficit grows, increases in the public cost of borrowing will put pressure on long-term interest rates and crowd out private-sector borrowing, and thus investment. This points to slower growth and a prolonged recession, or even an economic depression.[135]

In the long-term, the benefits of militarization may be short lived, while the economic burden militarism imposes may cause the gradual erosion of economic power.[136] This is because high and rising military expenditures inevitably contribute to serious budgetary deficits, public debt and macro-economic instability. As US military expenditure once again fuels a budget deficit, renewed concerns are being expressed about its long-term effects on the US economy.[137]

Currently, US citizens seem to concur with the idea that military might, rather than arms control and disarmament, is the only way to secure national security. The extent to which rearmament and the renuclearization of the US strategic posture can guarantee national security, is however, highly questionable. In the short term, the benefits of unilateral military action seem apparent in the US defeat of the Taliban and Al Qaeda forces in Afghanistan. But in a post-Iraq conflict it is unclear if these gains will translate into greater long-term security for US citizens. The expectation of further terrorist attacks against US targets, possibly via the use of weapons of mass destruction, suggest that military actions alone maybe insufficient, or even counter-productive to the long-term aim of eradicating terrorism or overcoming asymmetric warfare. If anything the current policies of retribution are likely to inflame greater passions and fanaticism not less.

The response of some of those countries or groups that harbour resentment or grievance towards the United States, or feel vulnerable to US attack, is likely to be an even more resolute pursuit of WMD. China will probably seek to counter the US advantage in missile defences by expanding the size and potency of their own nuclear arsenals and by developing NMD counter-measures. Other countries are likely to choose less orthodox weapons of mass destruction such as dirty bombs, along with unconventional means of delivery to counter the huge asymmetries in the balance of military power that derive from US technological supremacy. In such circumstances, asymmetric warfare will intensify making the world a less secure and more dangerous place, and one in which US citizens, despite their huge and destructive arsenals, will become increasingly vulnerable too.

## CHAPTER 4

# RECURRING COSTS OF NUCLEAR ARMS

## THE FULL COSTS OF NUCLEAR WEAPONS

At a time when the option of nuclear arms control and disarmament appears to have been rejected by the world's leading military power, and when regional powers aspire to become fully-fledged nuclear weapon states, it is worth pausing to consider the full costs of the nuclear option. As with arms control, nuclear weapons have short-term initial costs associated with their research, development testing, production and deployment, and also long-term recurring costs. Given the problem of radioactivity associated with nuclear weapons technology, the recurring costs of nuclear weapons are exceptional even by the standards of other WMD.

From an economic point of view the capital outlays on nuclear weapons are generally regarded as unproductive investments because nuclear weapons production has limited forward or backward linkages into the civil economy. They do, however, create a long-term demand for resources, not only to support and maintain nuclear weapons during their in-service life, but also for the storage of radioactive materials long after the weapons are retired. Given the enduring life-cycle of radioactive materials and the need to safely store and guard such dangerous by-products of nuclear weapons, the decision to allocate resources on nuclear weapons carries a greater opportunity cost in absolute terms than the initial budgetary outlays indicate. These long-term outlays represent non-recoverable or sunk costs. They cannot be converted to alternative uses for a number of reasons, as the Russians have discovered:

- nuclear facilities are usually isolated for security reasons;
- the technology used in the manufacture of nuclear weapons has few applications in civil manufacturing;
- buildings and other facilities become highly contaminated;

- much on-site groundwater is contaminated with little prospect of decontamination;
- the scientific and technical staff have difficulty adapting their highly specialized skills to commercial practice.[138]

As William Weida has observed: "These economic 'penalties' are the unfortunate outcome of believing that nuclear weapons are an optimal form of defence and deterrence."[139] These economic penalties are closely linked to the environmental risks posed by radioactive wastes produced by nuclear weapons programmes which will continue to impose a heavy economic and environmental burden for generations to come long. Selected details of this costly legacy are examined in the following sections.

## THE US NUCLEAR WEAPONS LEGACY

The United States built some 70,000 nuclear weapons between 1945-1991 based on 65 different designs for 116 kinds of delivery systems refined through 1,030 nuclear tests and maintained by an elaborate complex which employs tens of thousands of scientists and technicians. Its nuclear weapons range from tactical nuclear weapons to strategic bombs and warheads deployed on ICBMs. The annual production of nuclear weapons exceeded 7,000 per annum between 1959-60. The explosive power of the US nuclear arsenal in 1996 was estimated to be about 120,000-130,000 times that of the Hiroshima bomb.[140] Some twelve years after the demise of the Cold War the US still has the most sophisticated and extensive nuclear arsenal in the world, retaining some 7,000 strategic nuclear weapons of nine distinct designs.

In the1950s when nuclear weapons were first deployed by the United States, they were regarded as an inexpensive way to inflict maximum damage on an opponent hence the term "a bigger bang for a buck". The idea that nuclear weapons were a low-cost option had little validity in reality. Between 1945-96 the average annual expenditure on developing and maintaining the US nuclear arsenal was US$ 3.6 billion (1996 prices) cumulatively this cost the US taxpayer more than US$ 5.5 trillion dollars.[141] Spending peaked in 1985 at US$ 5.49 billion (1996 prices). By any standard this is vast sum which can only be described as "big bucks for a big bang".

US government officials, politicians and tax payers never fully understood either the annual or the cumulative costs associated with building, maintaining and operationalizing the US nuclear arsenal, due to the pervasive secrecy associated with nuclear programmes, which prevented costs being tracked over time. As a consequence, US decision makers were unable to weigh the perceived benefits of nuclear deterrence against the actual costs. The general lack of oversight by Congress and an absence of auditing meant that nuclear weapons programmes ran out of control in terms of cost and size, with the result that the US nuclear arsenal reached a magnitude that had little discernible relationship to the level of threat these weapons were supposed to deter.

The majority of expenditures associated with nuclear weapons programmes were not spent on building the nuclear warheads, but on the variety of delivery vehicles used to transport them to their targets. These included strategic bombers, ballistic missiles, artillery shells, depth charges and nuclear landmines. Table 8 presents a breakdown of cumulative expenditures on nuclear weapon.

**Table 8**: Estimated Incurred Costs of
US Nuclear Weapons Programmes 1940-1996[142]

| **Programme** | **Expenditure US$ bn (96 prices)** | **Percentage** |
|---|---|---|
| R&D, Testing and Production | 409.4 | 7 |
| Deployment (delivery systems) | 3,241.6 | 55 |
| Targeting and Controlling | 831.1 | 14.3 |
| Defending against the bomb | 937.2 | 16.1 |
| Dismantlement | 31.1 | 0.5 |
| Nuclear waste management and environmental remediation | 365.1 | 6.3 |

Current US spending on nuclear weapons has been estimated at US$ 35 billion a year or 14% of the defence budget. This amounts to more than US$ 96 million a day.[143] About US$ 25 billion of the total goes toward operating and maintaining the nuclear arsenal, with the remaining US$ 10 billion used to manage and clean nuclear waste, verify arms control

agreements and conduct research into ballistic missile defences. These outlays are considerably lower than they were during the peak spending years of the Cold War, but they are on the increase again, due to the resurgence of nuclear weapons in US strategic planning. The component parts of continuing nuclear weapons costs include:

- the manufacture of plutonium, highly enriched uranium and tritium;
- research, development and testing costs;
- stockpile stewardship, currently the US spends US$ 4.5 billion per annum on maintaining its nuclear stockpiles;
- monitoring radioactive waste (even when material production activities have been abandoned the monitoring of nuclear materials has to go on indefinitely);
- long term environmental costs of radioactive contamination;
- costs to human health from radioactive exposure.

The US production of nuclear explosives, fissile materials and nuclear testing have all ceased. Despite this fact the US nuclear weapons complex remains a vast network of some 316 state and privately owned laboratories, research institutions, production companies, storage sites, testing facilities and nuclear reactors, which employ roughly 600.000 staff.[144] The state sector run by the DOE consists of 13 major facilities. (See Table 9.)

In addition to these sites, there are a number of very large DOE run sites that are no longer in productive use, but contain vast quantities of radioactive waste and other hazardous materials related to the production of nuclear material. The largest of these sites include Hanford Reservation in Washington State and the Rocky Flats Environmental Technology Site.

The production of nuclear weapons was halted in 1991. Since then the nuclear weapons complex has continued to service the large stockpile of nuclear weapons and to dismantle weapons removed from operation. The stockpile contains three categories of warheads: those with active operational forces usable in minutes or hours along with spares kept at bases where nuclear weapons are deployed; augmentation or "hedge" warheads not necessarily associated with active nuclear delivery systems; and reliability replacement warheads kept in storage.

The stockpile operational, hedge, and reliability replacement contains nine warhead types, with the Los Alamos National Laboratory responsible

for the stewardship of five (B61, W76, W78, W80, W88) and the Lawrence Livermore National Laboratory responsible for the stewardship of four (W62, W84, W87, B83).

**Table 9**: DOE Nuclear Weapons Complex

| Site | Function | Location |
|---|---|---|
| The Lawrence Livermore National Laboratories | Weapons research and design Stockpile stewardship | California |
| The Sandia National Laboratories | Weapons research and design, plutonium processing, manufacture of test devices, testing new design concepts | California |
| Los Alamos National Laboratories | Designs, tests and sometimes manufactures nuclear weapons. Potential plutonium pit production facilities, stockpile stewardship | New Mexico |
| The Ames Laboratories | Stockpile stewardship | Iowa |
| Argonne National Laboratories | Stockpile stewardship | Illinois |
| Idaho National Engineering and Environment Laboratories | Plutonium storage | Idaho |
| Brookhaven Laboratories | Waste reprocessing | New York |
| The Nevada test Site | Sub-critical experiments, disassembling damaged nuclear explosives | Nevada |
| The Pantex Plant | Production of nuclear weapon components, assembles and stores nuclear warheads, disassembly of retired warheads | Texas |
| Holston Army Ammunition Plant | High explosives | |
| Oakridge Reservation | Uranium enrichment | Tennessee |
| Kansas City Plant | Production of non-nuclear components | Missouri |
| Savannah River Site | Plutonium processing plants and plutonium storage | South Carolina |

***The active stockpile.*** The number of warheads in the operational nuclear stockpile those warheads that accompany deployed forces is composed of about 5,000 warheads. This number can be expected to decline under the terms of SORT.

***Augmentation/hedge.*** Supplementing the fielded warheads are another 2,500 augmentation warheads (referred to as the "hedge"), a contingency stockpile available for redeployment back onto missiles and aircraft. The formal decision to establish the hedge came from the NPR, announced in September 1994. Warheads that are, or will be, in the hedge include the W62 and W78 from the Minuteman III ICBM, W76s from downloaded Trident SLBMS, and B61 and B83 bombs and W80 air-launched cruise missile warheads for B-1 bombers that could return to the nuclear strike force.

***Reliability replacement warheads.*** A third set of warheads are kept in inactive reserve status to replace warheads in the active stockpile should they develop reliability or safety problems. They are stored in military depots and are not scheduled for disassembly at this time.

When the United States stopped producing nuclear weapons, disassembly became a major activity within the nuclear weapons complex, supplemented by a small amount of modification and evaluation work. The DOE has custody of retired warheads, which are disassembled at the Pantex Plant near Amarillo, Texas. About 60 warheads are dismantled annually during routine quality assurance inspection and reliability testing. In the past ten years, approximately 10,500 warheads have been retired and dismantled. In 1997, Pantex dismantled only about half of the warheads scheduled due to several problems and accidents, which caused all work to be halted for a time. Dismantlement is due to be completed by September 2003. As the workload has decreased, the number of employees at Pantex has dropped from some 3,400 in 1998 to about 1,600 in 2003. Its annual operating budget is US$ 265 million.

Finally, there is a "strategic reserve" of plutonium pits and secondaries under the custody of the DOE. Plutonium pits are the plutonium core of nuclear warheads. Some 12,000 pits are stored at Pantex, with 5,000 designated as a strategic reserve. This amounts to about 15 tons of plutonium. Another 32 tons will remain in intact weapons, for a total of 47 tons to be retained for weapons use. The US government has declared that

an additional 38 tons of weapon-grade plutonium is "surplus" and may be permanently withdrawn. The surplus is composed of the other 7,000 pits at Pantex, and what exists as scrap or waste.

An essential part of a thermonuclear weapon is the "secondary", the component of fusion material and fissile material that is ignited by the explosion of the fission primary that produces the high yields of modern weapons. After basic disassembly at Pantex, secondaries are trucked almost the entire way on Interstate 40 to the Y-12 Plant at Oak Ridge, Tennessee. Some secondaries are taken apart while others are stored as part of the strategic reserve. It is possible that as many as 5,000 secondaries are being stored, to match the number of pits, although the actual number could be more or less.

The laboratories continue to work on warhead designs. Los Alamos is busy working on a replacement warhead for the Mk5 (Trident II) re-entry vehicle. Livermore is engaged in exploring how to reuse pits from older warhead types in new designs. The labs are also looking into incorporating modern safety features into SLBM warheads. Neither the W88 nor the W76 currently have insensitive high explosive (IHE) or fire resistant pits (FRP). Sandia is working on two classified studies, "System Development A" and "System Development B". About US$ 10 million has been spent at Sandia on the B61 program to design, analyse, and manufacture a prototype of the existing B61-11 to transform it into a stand-off glide bomb. Sandia is also doing engineering work on the high-yield W62 Minuteman warhead originally scheduled to be retired for use on the single re-entry vehicle (SRV). Livermore's W62 design dates from the 1960s. The first W62s entered the stockpile in 1970.

An ambitious and costly SSP, also run by the DOE, has been set up to allow for the support and limited production of weapons components, and to store downloaded nuclear warheads. Ironically, the average annual cost of the stockpile stewardship programme at US$ 4.5 billion per annum is some US$ 1.5 billion per annum higher than the equivalent activities were when large-scale testing and production was underway.

Since the 1980s the DOE has been carrying out activities around the Hanford and Rocky Flats sites to clean up, contain, safely store and dispose of the hazardous materials at these redundant sites. It is a daunting challenge, involving the development of complicated technologies.[145] In

addition, the disposition of huge stockpiles of plutonium present the DOE with an expensive challenge.

## THE STOCKPILE STEWARDSHIP PROGRAM

The SSP was instituted in response to FY 1994 National Defence Authorisation Act (P.L.103-106) to "ensure the preservation of the core intellectual and technical competencies of the United States in nuclear weapons".

Since its inception the SSP has experienced high and rising costs. In 2002 the programme cost an estimated US$ 4.5 billion, an increase of 3.1% on FY 2001 expenditures.[146] These funds cover all the DOE's activities conducted in support of the maintenance, evaluation and certification of the nuclear stockpile. SSP funds accounts for a large proportion of the DOE's nuclear weapons related activities. (See Table 10.)

**Table 10**: Budget of the Weapons Activities of the National Nuclear Security Administration of the DOE 2000-2002 (US$ in thousands)[147]

| Weapons Activities | FY 2000 | FY 2001 | FY2002 | FY2002/ FY2001 | FY2002/ FY2001 % change |
|---|---|---|---|---|---|
| Stockpile steward-ship | 3,875,891 | 4,351,512 | 4,487.192 | +135,680 | +3.1% |
| Secure transportation | 104,463 | 115,117 | 121,800 | +6,683 | +5.8% |
| Safeguards and security | 393,788 | 394,664 | 448,881 | +54,217 | +13.7% |
| Programme direction | 238,005 | 250,566 | 271,137 | +20,571 | +8.2% |
| Use of prior year balances | -20,668 | -13,647 | - | + 13,647 | +100.0 |
| Less security charge for reimbursable work | -27,974 | -28,923 | -28,985 | -62 | -0.2% |
| **Total** | **4,563,505** | **5,069,289** | **5,300,025** | **+230,736** | **+4.6%** |

As more nuclear weapons enter temporary and long-term storage as a result of the proposed SORT reductions, we can assume that the SSP budget will continue to rise in the coming years. However, a far greater cost of

maintaining such a huge nuclear stockpile that can be readily "uploaded" are the uncertainties and instabilities that it generates.

Part of the DOD's justification for maintaining a large stockpile of non-deployed warheads in the United States is that Russia has maintained its warhead production capacity, and could easily gain strategic advantage by building new nuclear warheads in large numbers.[148] Appearing before Senate Armed Service Committee in February 2002 Under-Secretary of Defense Douglas Feith defended the US decision for storing rather than destroying warheads removed from service:

> Russia has a large [nuclear weapons] infrastructure. They have a warm production base capable of producing large numbers of new nuclear weapons annually. The United States has not produced a new nuclear weapon in a decade, and it will take nearly a decade and a large investment of money before we will be in a position to produce a new nuclear warhead. So the issue of… whether we choose to build up a large infrastructure that would put us in a position to create new nuclear weapons if circumstances in the world changed and warranted it, versus taking weapons and rendering them unavailable for use in the near term by putting them in storage is an issue that needs to be examined…[149]

Evidence that Russia has the intention, or indeed the real capability, given resource constraints, to breakout and renew large-scale warhead production has been challenged by Oleg Bukharin, in a detailed analysis of both countries' warhead production capabilities.[150] His study shows that the United States has far greater breakout potential than the Russian Federation despite the fact that the latter is still engaged in warhead production. This is because Russia does not have readily available plutonium pits and would find it far harder than the United States to step up the scale of its warhead production. What Bukarin does stress, however, is the fact that the US plans to maintain an even larger stockpile of stored warheads, particularly the so-called "responsive force", have raised concerns in Moscow that the US has consciously planned to maintain a substantial breakout capability, that would give it strategic superiority over the Russian nuclear arsenal. This potential to upset the nuclear balance is very destabilizing, from the perspective of Russian military planners.

The upshot of removing US warheads to the SSP, rather than dismantle them via a verifiable process, is that it contributes to an atmosphere of

mistrust and insecurity. On this issue Bukarin has noted that US concerns about the breakout potential of the Russian warhead production infrastructure while not justified at present threaten to hinder the further easing of the Cold War nuclear threat.[151] What urgently needs to be done is for the United States and Russia to work together on eliminating any breakout potential by drastically consolidating their respective nuclear weapons production infrastructures and increasing the transparency of their respective nuclear operations. In addition, limits on the number of strategic delivery systems remains important for limiting stockpile reconstitution capabilities.

## HUMAN COSTS

Members of the public living close to nuclear test sites, nuclear production sites, personnel in the nuclear weapons complex and members of the armed services handling nuclear weapons were often exposed to unacceptably high levels of radiation. As a consequence many have contracted cancers such as leukaemia, multiple myeloma, non-Hodgkin's lymphoma, and cancers of the breast, oesophagus, stomach, small intestine, pancreas, bile duct, gall bladder and liver.

The United States formerly discontinued nuclear testing above ground, undersea and in outer space following the entry into force of the Partial Test Ban Treaty in October 1963; however, the effects of the tests carried out at the Nevada Test Site are only just coming to light. A US government study conducted by the National Cancer Institute and the Centre for Disease Control and Prevention claims that the fall out from nuclear tests carried out in the 1950s and 1960s has caused the deaths of approximately 15,000 Americans.[152] The report also estimated that a further 22,000 people are likely to be suffering from non-fatal diseases. The largest number of deaths are in the age group of people born in 1951 because on average this group received higher doses of radioactive isotopes such as iodine 131 at younger ages when they are more vulnerable to the effects than groups born earlier or later.

These figures only reflect part of the casualties caused by radioactive contamination from the US nuclear programme, as they do not include those who worked in the US nuclear weapons complex or those who handled nuclear weapons.

Although no data exists on the total numbers contaminated, a number of highly influential studies have begun to shed some light on the extent of the problem. In 1996 the Institute for Energy and Environment Research (IEER) published a number of papers on the health and environmental impacts of nuclear weapons production at the DOE Feed Materials Production Centre (the Fernald Plant) in Ohio.[153] A number of accidents at the plant led to uranium being released into the atmosphere contaminating the areas and communities surrounding the plant. The IEER estimated that uranium releases were in the range of 270,000-1.3 million kilograms, with a middle estimate of 409,000 kilograms.[154] Throughout the history of the plant's operation the DOE and its contractors consistently asserted that the off-site residents were not harmed by its operation and that exposures were within allowable limits. These assertions were challenged in a 1985 class-action lawsuit brought against National Lead of Ohio by neighbours of the plant.[155] The DOE, which defended the lawsuit on behalf of the contractor, settled the suit for US$ 78 million in mid-1989, but admitted no wrong-doing, or even any technical problems in its own or its contractors' work.

A more recent report produced by the IEER under a contract to the newspaper *USA Today* calculated estimates for radiation exposure of workers at three privately-owned and operated factories in the United States that processed uranium, including one that also processed thorium, in the 1940s and 1950s for use in the production of nuclear weapons.[156] The report concludes that working conditions at the three plants were very poor, that doses to many of the workers far exceeded the prevailing standards, and that some workers had a high probability of getting cancer as a result of their exposure.

The authors of the report claim that the authorities deliberately misled workers about the dangers to which they were being exposed:

> There is ample evidence that plant authorities as well as the government of the United States, which contracted with these privately-owned companies to process material for its nuclear weapons program, were well aware at the time that workers at these plants were being severely overexposed over prolonged periods of time. There is also evidence that the US government deliberately misled workers about health and safety issues by concealing the facts of very poor working conditions from them and by failing to undertake the needed level of radiation dose surveillance, including frequent and widespread urine sampling, that

was warranted. A number of documents discuss inadequate controls of contamination and recommendations for improvement that were only sometimes taken into account.

The IEER report goes on to observe that: "Heretofore, we have assumed, based on available evidence, that worker exposures were far higher in the Soviet Union that in the United States. However, the partial estimates that we have made here are so high that this assumption may need to be revisited for many of the workers at these forgotten nuclear weapons plants." Finally the authors argue that: "It is clear that the effects of the nuclear weapons enterprise on society are even vaster than heretofore acknowledged. The tasks of health monitoring for affected populations, health care for the sick, and environmental remediation of the legacy of nuclear weapons production will be even more complex and larger than currently anticipated."[157]

In April 2000, after decades of denial, the DOE acknowledged that nuclear weapons production had harmed US workers due to exposure to radioactivity and toxic chemicals. The lion's share of attention generated by this announcement has been given to workers at the major, DOE-owned and operated sites. While this official concern is long overdue, the IEER has underscored the responsibility of the US government to also acknowledge those who worked at private facilities involved in nuclear weapons production. Furthermore, plant neighbours and the family members of nuclear weapons workers may also have been exposed to radioactive and toxic materials as a result of work at these sites.

In October 2000 the US government enacted a law entitled the *Energy Employees Occupational Illness Compensation Act* providing health care provision and compensation for nuclear weapons workers, and the government tacitly acknowledged the risks that it had exposed large numbers of people too.[158] Despite compensation provisions it is extremely difficult for radiation victims to prove that their cancers have been caused by the wilful negligence of the DOE. Government officials estimate that 70,000 claims will be filed each year over the next four to five years from weapons plants across the country, but that only 11,000 claims will be approved. Preliminary estimates are that the programme will cost almost US$ 500 million to administer and that US$ 1.8 billion in benefits will be paid.[159] The disparity between the number of claims and the number of approvals represents a deep reluctance of the part of the DOE to fully

compensate workers despite existing legislation.[160] Moreover, the amount it has allocated for compensation is dictating the amount of successful claims the DOE is prepared to acknowledge.

The exposure of thousands of people to unacceptably high levels of radiation is one of the tragic human costs of the Cold War arms race and the scale of which that we are only just becoming aware.[161] The risk of further exposure to radioactive contamination by workers and communities close to nuclear sites still remains a very real possibility. Even with the majority of DOE weapons production related plants closed, most sites contain highly radioactive and toxic materials, which will pose a risk for generations to come.

The DOE is responsible for the safety and security of the closed production sites, yet it has a very poor safety record. According to Robert Alverez, a former senior adviser to the Secretary of Energy, under the Clinton administration, tens of thousands of tons of plutonium and highly enriched uranium remain in unsafe or questionable storage containers around the country.[162] Many unresolved problems persist such as unstable nuclear solid residues, metals and powders in deteriorating containers and tanks, a wide variety of fire and explosion risks, degraded equipment and safety systems, deteriorating storage facilities etc. Alvarez asserts that the potential for criticality accidents is prevalent at sites such as Oak Ridge, Hanford, Rocky Flats, Idaho, Los Alamos, the Livermore Labs and Savannah River.[163] Criticality occurs when a relatively small amount of fissile material is concentrated and starts a nuclear chain reaction that sets off a burst of radiation with a characteristic blue flash. While not as serious as reactor meltdowns, nuclear criticalities are among the most serious accidents in the nuclear industry. According to Alvarez there have been eight criticality accidents at federal facilities controlled by the DOE. The DOE recognizes the problem of unsafe nuclear materials storage, but its attempts to rectify the situation have been delayed.

## ENVIRONMENTAL COSTS

Closely linked to health and safety issues is the problem of environmental degradation and pollution caused by the nuclear weapons complex. Environmental impact statements and regulations governing the

safe and secure handling of nuclear materials were relatively unknown on military bases and nuclear weapons facilities during the Cold War.

The DOE, which is responsible for overseeing the environmental impact of the nuclear weapons facilities, possesses one of the world largest inventories of dangerous nuclear materials. Among the highly toxic pollutants are: plutonium uranium, thorium, radon gas, radium, technetium-99, ammonia, hydrofluoric acid, fluorine, nitric acid, kerosene, chromium and lead.

The failure of the DOE to invest early in preventive measures has come home to haunt the DOE, as the full burden of the clean-up and waste-handling costs have become apparent. According to Alvarez, the DOE's past malpractice is largely responsible for many of the costly and complex environmental remediation problems that it faces today. Not mincing his words, Alvarez accuses the DOE of creating "several of the most contaminated areas in the Western hemisphere."[164] For example in the 1940s and 1950s some 440 billion gallons of contaminated liquids were discharged into the grounds of the Hanford site. That is enough to create a lake 24-metres deep roughly the size of Manhattan.[165]

In 1989, the DOE established the Environmental Restoration and Waste Management programme, now called the Environmental Management programme, to consolidate ongoing activities and accelerate efforts to address the inactive production facilities and sites and the accumulated waste, contamination and materials. Thirteen years later, this programme is responsible for the maintenance and stabilization as well as the environmental restoration and waste management work at virtually the entire nuclear weapons complex, not being used for continued weapons activities. The Environmental Management programme is the largest environmental stewardship program in the world, covering 150 sites in approximately 30 states including Puerto Rico. The Environmental Management programme is faced with cleaning-up:

- 2,700 tons of spent fuel created by defence activities that it must be safely disposed of;
- 36 million cubic metres of radioactive and other hazardous wastes;
- 79 million cubic metres of contaminated soil and 2 billion cubic metres of contaminated groundwater;

- 585 million kilograms of depleted uranium, mostly in the form of uranium hexaflouride.[166]

The DOE's environmental task is without technical or historical precedent. It faces problems for which no solutions have yet been found. Because it is impossible to destroy radionuclides, the DOE has rejected the greenfield concept the idea that all nuclear weapons sites can or should be returned to their original condition. Instead it has opted for an "in-place containment " strategy wherever possible. This also helps to contain the possibility of "secondary waste", caused by radioactive contamination through transportation, storage, treatment and final disposal.

Estimating the cost of the Environmental Management programme has been fraught with controversies. In 1995 the DOE produced its first report to make an estimate entitled *Estimating the Cold War Mortgage,* which put the total cost of the Environmental Management programme's mission at between US$ 200-350 billion over a 75-year period.[167] Also in 1995 the GAO estimated that the DOE's clean-up operations "will cost at least US$ 300 billion (and perhaps as much as US$ 1 trillion) and take more than 30 years to complete."[168] Under considerable pressure from Congress the DOE's remediation costs have been revised downwards to US$ 220 billion. This revised estimate may, however, be at the cost of genuine remediation. As one critic of the DOE's remediation programme has argued that term "clean-up" is misplaced because most of what the DOE is attempting to do is merely store and stabilize highly dangerous waste, which in itself is proving an enormously challenging technical task.[169]

The DOE's budget for environmental remediation is currently about US$ 6 billion per annum.[170] Table 11 provides a breakdown of the DOEs environmental clean-up budgets for the years 2000-2002.

**Table 11**: DOE Expenditures on Environmental Impact of Nuclear Weapons (US$ in thousands)[171]

| | FY 2000 | FY 2001 | FY 2002 | FY2000-FY2001 US$ | FY2000-FY2001 % |
|---|---|---|---|---|---|
| Defence Environ-ment Restoration and Waste Management | 4,586,227 | 4,965,955 | 4,548,708 | -417,247 | -8.4 |

| | FY 2000 | FY 2001 | FY 2002 | FY2000-FY2001 US$ | FY2000-FY2001 % |
|---|---|---|---|---|---|
| Defence Facilities Closure Projects | 1,062,177 | 1,080,331 | 1,050,538 | -29,793 | -2.8 |
| Defence Environmental Management Privatisation | 82,609 | -32,000 | 141,537 | 173,537 | +542.3 |
| Non-defence environmental management | 301,579 | 279,195 | 228,553 | -50,642 | -18.1 |
| Uranium Facilities Maintenance and Remediation | 336,109 | 392,502 | 363,425 | -29,077 | -7.4 |
| **Subtotal** | **6,368,701** | **6,685,983** | **6,332,761** | **-353,222** | **-5.3** |
| Uranium Enrichment D&D Fund Discretionary Payments | -420,000 | -419,076 | -420,000 | -924 | -0.2 |
| **Total** | **5,948,701** | **6,266,907** | **5,912,761** | **-354,146** | **-5.7** |

About two thirds of the DOEs environmental management funds are concentrated at its six largest sites, Hanford, Savannah River, Idaho Falls, Roky Flats, Oak Ridge and Fernald. These are the sites of some of the worst environmental pollution in the Western hemisphere. A number of key projects receive priority funding. These include:

- The Handford site in Washington. This is a nuclear waste storage complex. Apart from the high costs of ensuring the safe operation of the underground high-level waste storage tanks, the DOE is involved in the design and construction of the Hanford Waste Treatment and Immobilisation Plant project a vitrification plant designed to immobilise the high risk, highly radioactive waste currently stored in heavy water tanks. The Office of River Protection, which oversees these programmes, has a budget allocation of US$ 812.5 million for FY2002, a US$ 57 million increase on FY 2001.

- Vitrification of highly radioactive waste at the Savannah Site in South Carolina and a selection of technology to pre-treat a portion of the

waste. The Savannah River Site treats and disposes of legacy materials and wastes resulting from nuclear materials produced during the Cold War. The FY 2002 budget allocation for this site is US$ 391.4 million a decline from US$ 430.9 million in 2001.

- Clean up and close the Rocky Flats Environmental Technology Site in Colorado and the Fernald Environmental Management Site in Ohio. The Rocky Flats Plant was established by the Atomic Energy Commission in 1951 as one of seven production plants in the US Weapons Complex. Nuclear weapons were manufactured on site using materials such as plutonium, beryllium and uranium. Deactivation, decommissioning and demolition of site facilities, clean-up closure and conversion of the site for a safe alternative use are estimated to cost just over US$ 600 million per annum.[172] The Fernald site encompasses 425 hectares where high purity uranium metal products were produced from 1951 to 1989. The DOE is overseeing the facility shut-down, the shipment of nuclear materials, the processing of 9 billion litres of wastewater, the processing and shipment of 92,570 cubic metres of waste pit materialto a permitted disposal facility. In FY 2002 alone the cost of this operation was US$ 285.3 million.[173]

- The clean up of the Portsmouth Gaseous Diffusion Plant in Ohio. This plant was opened in 1952 as a uranium enrichment plant. Clean-up activities include soil remediation and ground water treatment, the safe storage and disposal of low-level waste. The budget request for this operation in FY 2002 is US$ 113.9 million, up by US$ 40 million on the FY 2001 budget allocation.[174]

- The shipment of transuranic waste to the Waste Isolation Plant in New Mexico to support closure or compliance requirements including shipments from Idaho National Engineering and Environmental Laboratory in support of the Idaho Settlement Agreement. Transuranic wastes are contaminated with radioactive elements heavier than uranium such as plutonium and take a very long time to decay. Most transuranic waste is contaminated rags, protective clothing, laboratory equipment and tools. Numerous DOE sites generate transuranic waste, which is temporarily stored on site in metal drums or boxes in shallow trenches covered with soil or on above-ground asphalt pads.

Progress on environmental remediation has been painfully slow, despite the huge allocations that the DOE receives for the task. Concerned at the high costs and lack of progress, Congress has instructed the GAO to subject the DOE's remediation programmes to a rigorous level of scrutiny.[175] The subsequent reports have exposed widespread mismanagement practices resulting in the inefficient use of resources. Congress has demanded that the DOE to implement a number of reforms to improve management practices, speed up programme progress and improve cost effectiveness. In response the DOE conducted an internal review of its practices and announced a new initiative aimed at improving management of the clean-up programme, shortening the programme's life by at least 30 years, and reducing programme costs by at least US$ 100 billion.[176]

Under its reform initiative the DOE aims to accelerate clean-up projects at some sites, revise other clean-up plans, reduce costs and concentrate funding more on clean up and less on maintenance and non-clean-up activities. In pursuit of these objectives Performance Management Plans (PMPs) have been instigated for each site. PMPs, have, however, been severely criticized by a number of influential civil society watchdogs.

In a report entitled *Critiquing the Department of Energy's Accelerated Cleanup Plans: A Summary of Comments Made to DOE Site Performance Management Plans,* the Alliance for Nuclear Accountability (ANA), has drawn attention to the fact that the DOE is proposing to reclassify wastes as more benign than previously considered, in order to allow less-intensive, and hence less costly, clean-up procedures.[177] The ANA's report also details the manner in which the DOE is leaving contamination in the ground, eroding clean-up standards and reneging on previous clean-up agreements.

The PMP for the Hanford site reveals provides a worrying example of the DOE's drift in environmental remediation. The Hanford site is a former nuclear weapons production facility owned by the DOE and operated under contract by private companies. Located in south-eastern Washington State, Hanford's primary mission until the end of the Cold War was the production and processing of plutonium. The legacy of Hanford's Cold War operations is a staggering quantity of deadly radioactive waste, which includes an estimated 298 million litres of radioactive waste stored in 177 underground tanks. As a result of the corrosive nature of their contents

these tanks have leaked roughly four million litres of high-level nuclear waste into the groundwater, which flows directly into the Columbia River. According to the Government Accountability Project (GAP) the DOE's Accelerated Clean-up Plan does not address remediation of this contamination.[178] Instead, one of the world's largest inventories of long-lived radioactive and toxic materials will either be disposed of directly in shallow land burial sites or simply abandoned near the Columbia River, the largest freshwater artery of America's Pacific Northwest. Specifically, the Hanford PMP calls for the use of cement for "stabilizing tank waste", replacing retrieval and treatment with simply pouring cement into the tanks on top of the waste. Even more alarming, the plan calls for the opening of Hanford's Mixed Waste disposal landfill to waste from across the nation. This plan would turn Hanford into a national radioactive waste dump, importing massive amounts of radioactive waste into Washington State for burial at Hanford in unlined soil trenches, a practice not even allowed for municipal garbage.

According to the GAP the DOE's plan reveals that receiving transuranic waste has gained higher priority than cleanup work. The effect will be to turn the Hanford Reach National Monument and Columbia River into a national nuclear waste zone.[179] The GAP review of the Hanford PMP described it as a "drift by the Bush administration towards the policies and practices of the former Soviet Union nuclear weapons program, which unabashedly wrote off large areas of land and water".[180]

There is already damning evidence of unacceptably high levels of radioactive contamination in the regions surrounding nuclear weapon sites. The condition under which plutonium is currently being stored has raised many environmental and health and safety concerns.[181] There are reports of radioactive material in combination with the acids they are stored in, slowly eroding storage units, with the result that radioactive sludge is seeping out into the surrounding area. In some cases hydrogen gas has accumulated inside some of the sealed cans and drums. At Hanford and the Savannah River sites plutonium is slowly collecting on the bottoms of tanks, where if enough collects, criticality could occur.[182]

A recent GAP report entitled *Hanford Radioactivity in Salmon Spawning Grounds*, revealed that 60% of the riverbed of the Hanford Reach, part of the Columbia River, is contaminated with previously unreported radioactive wastes from the Hanford site.[183] The Hanford

Reach is an important salmon spawning ground. More than two years of taking water samples from the Columbia River revealed high levels of thorium, some ten times normal background levels. This radioactive contamination apparently resulted from the disposal of solid radioactive waste from a project at Hanford in which uranium 233 was produced for TNWs. The U-233 created a by-product thorium, which was subsequently released into the Hanford Reach. The U-233 was stockpiled, but apparently never used in a weapon, as the programme was eventually terminated in the 1990s. Records indicate that at least 590 kilograms of U-233 were produced at Hanford and over 450,000 kilograms of thorium was irradiated as part of the U-233 output.

The DOE's Hanford experience suggests that compromises are being made that will have dangerous long-term implications for the environment. Hanford is by far the worst case of radioactive pollution in the United States, but other nuclear weapon sites such as Fernald, Rocky Flats and the Savannah River sites, also have appalling records of environmental pollution caused by radioactive leakage into surrounding areas.[184] Reforming the DOE's management practices, while necessary and long overdue, is not in itself providing a solution to the huge environmental legacy of the Cold War. If anything the reforms are encouraging the DOE to cut corners in order to come in on budget, at the expense of leaving unsolved environmental problems to future generations to deal with. While much of the blame for this compromise rests with the ineptitude of the DOE, its culture of secrecy and its reluctance to allow oversight, part of the problem also lies with Congress, which for the most part, has failed to appreciate the scale and risks associated with the environmental legacy of the nuclear arms race. The continuing failure of Congress to make adequate risk assessments of the environmental and health impacts of nuclear weapons on its own society, contributes to an environment in which nuclear weapons are once again being contemplated as a viable strategic option for securing national security. In reality they contribute to high levels of human and environmental insecurity.

## US Plutonium Disposition Costs

The US nuclear weapons programme has over the years produced some 90,000 kilograms of weapon grade plutonium. As nuclear weapons are dismantled, either as a result of arms control agreements, or as a result

of coming to the end of their operational life, large stockpiles of "excess" plutonium have been amassed. In addition when plants that manufactured plutonium Rocky Flats, Hanford and Savannah River were shut down, tons of plutonium were left in intermediate stages. This plutonium is in a wide variety of forms, from plutonium dissolved in acid, to rough pieces of metal, to nearly finished weapon parts. In an age concerned about the possible theft of weapons usable plutonium by terrorist organizations, the need to transform plutonium into a non-usable form has become a pressing imperative. Plutonium-239, with a half-life of 24,400 years, must be inspected, guarded and accounted for and the buildings that house it must be maintained and secured. However, the storing and disposition of fissile materials has proven a formidable and costly challenge.[185]

The method of disposition became a hotly disputed topic for much of the 1990s.[186] The debate polarized into those who argued for the immobilization of plutonium through a process of vitrification, whereby plutonium was locked into glass logs and then buried in deep underground chambers; and those who argued for the reprocessing of plutonium into mixed oxide (MOX) fuel, a plutonium-uranium blend that could be burned in modified power generating reactors to provide power for the civilian economy.

Failure to resolve this dispute led to a compromise being made in the form of a "dual track" approach, whereby half of the plutonium would be immobilized through vitrification, and the rest would be used up in the MOX method. Part of the reason for adopting the dual track approach was that under the US-Russian Plutonium Agreement both countries had agreed to dispose of 50 tons of plutonium via the MOX system.

The immobilisation method entailed embedding the plutonium into ceramic disks 6.5 centimetres in diameter and 2.5 centimetres high, which would then be stacked, canned, and placed in steel frames inside 3 metre-tall canisters.[187] However, from a non-proliferation point of view the can-in-canister approach raised concerns that it might be relatively easy to recover the plutonium at some future date. In contrast the MOX method involves incorporating the plutonium taken from weapons into MOX fuel rods for burning in commercial power reactors. The advantage of this system from a non-proliferation standpoint is that it the plutonium is used up in the civilian fuel cycle and is thus non-reusable.[188]

The DOE's preliminary estimates for both programmes indicate that disposition would cost approximately US$ 42.2 billion over the next 25 years.[189] On assuming power the Bush administration expressed concern about the rising costs of plutonium disposition and reviewed the programme's options.[190] On 23 January 2002 the DOE announced plans to dispose of surplus weapons-grade plutonium by turning it into MOX fuel to be burned in nuclear reactors, thus abandoning the government's previous dual-track approach.

The Bush administration's rejection of immobilisation via vitrification, was based on an assessment of the unacceptable costs and associated technical difficulties.[191] At the time of writing there had been no official indication of what the eventual cost of US plutonium disposition will be. Nevertheless given the high levels of subsidies provided to MOX power plants elsewhere in the world, it can be fairly safely assumed that this option will still involve considerable cost and commitment for many years to come.

## The Recurring Costs of Russia's Nuclear Weapons Legacy

During the Cold War the Soviet Union built a total of about 55,000 nuclear weapons.[192] By the end of the confrontation the Soviet Union had an estimated 30,000 nuclear weapons, 650 tons of weapons usable nuclear materials and 2,500 systems including missiles, bombers and submarines for the delivery of weapons of mass destruction. Not withstanding the reductions made under the START I process, Russia's nuclear arsenal was still estimated to be around 20,000 (of which 5,000 strategic) in the year 2000.[193] This figure includes warheads in active operational forces, non-deployed warheads awaiting dismantlement and weapons in reserve.[194]

The fact that the Soviet Union was a command economy and lacked market prices means that measuring the costs of any economy activity, let alone nuclear programmes that were subject to great secrecy, was essentially impossible. One may nevertheless infer from the scale of the effort that the cumulative costs were high, no doubt comparable to the US and in certain cases, such as fissile materials production, probably much higher.[195] The widespread practice of dumping radioactive waste directly into the sea may have reduced the life-cycle costs of nuclear weapons in the short run, but the result has been to produce a severe environmental legacy,

which continues to have grave repercussions for the people of Russia and neighbouring Norway.

Given the less developed nature of the Soviet economy the opportunity costs of building and sustaining nuclear weapons will have been far greater for the Soviet Union than for the United States. Moreover, it is thought that towards the end of the Cold War, the burden of sustaining its nuclear weapons complex had became so great that it constituted one of the major contributing factors to the demise of the Soviet economy.

Russian warheads (strategic, tactical and reserve) are located at 60 weapon storage sites spread across the Federation in over 100 storage bunkers. The huge stockpiles of weapons-grade plutonium and heavily enriched uranium are scattered at more than 50 sites in several hundred buildings under the control of several different agencies. The development, production, deployment and maintenance of this vast arsenal resulted in the development of a huge nuclear weapons complex, which still to this day employs over a million people.

The Russian complex is very large relative to both the US complex and to the projected size of Russia's nuclear weapons stockpile. Because of manufacturing and technology techniques that limit the lifetime of Russian warheads to 10-15 years and because of stockpile management practices that emphasize routine rebuilding of nuclear warheads, the Russian complex has kept open its nuclear weapons production capacities.[196]

The complex is composed of a large network of huge production plants, including the uranium enrichment plants at Sverdlovsk-44, Krasnoyarsk-45, Tomsk-7 and Angarsk; plutonium production plants at Chelyabinsk-65 (Mayak), Tomsk-7 and Krasnoyarsk-26; and weapons assembly and disassembly plants at Avangard (Sarov), Sverdlovsk-45, Penza-19 and Zlatoust-36. The complex also contains numerous non-nuclear weapons component plants.[197] In addition there is an extensive network of R&D facilities including the three nuclear weapons laboratories VNIIEF/Arzamas-16 in Sarov, VNIITF/Chelya-binsk-70 in Snezhinsk and VNIIA in Moscow; dozens of specialized defence institutes throughout the Soviet Union; and several dedicated universities. Two very large nuclear test sites are located at Semipalatinsk (now in the independent Kazakhstan) and Novaya Zemlya (an island above the Arctic Circle). Reportedly, the Russian budget for its nuclear weapons complex is far lower than what

would be needed to support the current complex, which has prompted international concerns about the safety and security of weapons and weapons related materials.[198]

Safety issues pertain to both the loose nukes syndrome (dealt with below) and with the safety against accidents and environmental degradation. The lax health and safety procedures of the Soviet authorities resulted in a number of notorious accidents at nuclear weapons sites, the scale of which are only just coming to light.[199]

Russia's ability to deal with the Cold War arms legacy has been undermined by its continued practice of secrecy and denial and by the prolonged economic crisis, which has not only limited resources for much needed environmental remediation, but has exacerbated an already critical situation at many nuclear weapons complex through on-going neglect, or, as in the case of the Northern Fleet, outright abandonment.

## Environmental Legacy and Human Cost of Russia's Nuclear Weapons

The environmental legacy of the Cold War is vast and complex. There have been numerous accidents at various nuclear weapons sites resulting in the release of high levels of radioactive contamination into surrounding areas, affecting both human health and delicate ecologies. Such sites are in urgent need of environmental remediation. A huge stockpile of spent radioactive fuel and of solid and liquid radioactive waste exists, that is in urgent need of being safely deposited in final storage facilities. There has been the dumping of radioactive wastes into the Kara and Barents Seas leading to concerns about the marine ecology, fishing industries and health of the communities bordering these waters. And finally there is widespread environmental pollution caused by toxic waste by-products of nuclear weapons production process such as acids, solvents, nitrates, oils, heavy metals, fluorides, explosives, mercury and beryllium that needs to be dealt with.

One particular aspect of the environmental legacy of the Soviet Union's nuclear weapons programme that has attracted a considerable amount of international concern is the fate of the Northern Fleet. The Kola

region, of which Murmansk is the capital, in north-west Russia, hosts Russia's once mighty Northern Fleet, which operated two-thirds of the 250 nuclear powered submarines built in the Soviet Union. Today, the submarine fleet has fallen to 34 nuclear powered vessels. The remaining 115 submarines have been taken out of active service and are currently scattered along the coastline of the Kola Peninsula and in Arkhangelsk county, awaiting decommissioning. The Northern Fleet's dilapidated infrastructure for managing spent nuclear fuel and radioactive waste has turned into ruins during the past decade.[200]

Lacking an adequate infrastructure for storing or managing the spent fuel and radioactive waste from decommissioning submarines, much of it was routinely dumped into the Barents and Kara seas. Between 1958-1992 approximately 1-3 million curies of radioactive materials were dumped at sea.[201] Dumping involved three methods:

1. the dumping of unconfined high, medium and low level liquid radioactive waste;
2. the dumping of thousands of tons of solid high-level radioactive waste in various forms of containment;
3. the dumping of 16-18 nuclear reactors 6-7 with all of their fuel and reportedly after the submarines had met with accidents of varying gravity.

The Soviet Union/Russia have been responsible for dumping twice as much nuclear waste and spent fuel as the combined nuclear powers of the world. Spent nuclear fuel becomes more dangerous as it ages. Uranium-238 transforms into Radon gas as it decays. Radon can escape from the sediments it is trapped in, leaking into the water and causing radioactive pollution of the marine environment. Because water moves so fluidly it is almost impossible to track where this radioactive pollution may end up. The environmental pollution that has occurred in the Arctic Ocean as a result of submarine decommissioning has generated international concerns about cross border environmental risks.[202] The US, Norway and other members of the international community are trying *ex post* to address the problem and prevent further unseen environmental pollution, but the task is proving formidable and has raised the question of whether environmental impact assessments methods should be included *ex ante* into arms control agreements.[203]

The reduction of SLBMs under the START Treaty necessarily entailed the disarming and decommissioning of 31 ballistic missile submarines that were part of the Northern Fleet. Decommissioning these submarines and the attendant environmental challenges that this presented could not be separated from the much larger problem of managing the spent nuclear waste.[204] The US stepped in with funding under the CTR programme. To ensure the decommissioning of ballistic missile submarines the US has created an infrastructure for their elimination both at the shipyards in north-west Russia—Nerpa at the Kola Peninsula and Zvezdochka in Severodvinsk, Arkhangelsk county—and in the Russian Far East where the Pacific Fleet is based—Zvezda shipyard. Later the CTR programme started to contract shipyards directly to carry out the decommissioning of submarines, as well as to create the infrastructure for spent fuel management. In 2002 a nuclear fuel-unloading site was commissioned at Zvezdochka shipyard. The first submarine to be de-fuelled there is a Typhoon class (TK-202)—the world's biggest submarine. Spent nuclear fuel from 15 dismantled ballistic missile submarines has been shipped to the Mayak reprocessing plant for reprocessing and storage. This facility was built using co-operative threat reduction money although it had to be granted a waiver, because of Congress's non-reprocessing policy. In total the CTR programme aims to dismantle 41 ballistic missile submarines by 2007.

CTR has been highly successful in terms of securing the decommissioning the SSBNs, in addition the programme has assisted in creating the needed infrastructure to dismantle submarines and to manage unloaded spent nuclear fuel, as well as to process liquid radioactive waste generated as a result of decommissioning. But any assistance that goes beyond the weapons' destruction has been never popular among Republicans in the US Congress.

Starting in 1996, the US Congress added amendments to funding bills to limit CTR's authority in assisting with environmental remediation projects and has continued to include prohibitive language in defence authorization bills. In today's reality, however, it is very difficult to separate environmental and non-proliferation issues. Securing radioactive and nuclear material has become crucial, not only for the environment, but also to a larger extent for preventing proliferators from getting their hands on such materials.

Fortunately, European countries have recently shown greater interest in providing assistance for environmental remediation in Russia. In July

2002, the Northern Dimension Environmental Partnership (NDEP), a European initiative to channel funds to environmental problems in north-west Europe, arranged a pledging conference, where European Union countries, Norway and Russia contributed 110 million euro, including 62 million euro exclusively for nuclear safety issues in north-west Russia.[205] In the draft projects list, and sites which were not covered by CTR due to the restrictions imposed on the programme by Congress, may well be secured with the European assistance. Among those sites earmarked for remediation is Andreeva Bay, an infamous dumping ground for spent nuclear fuel and radioactive waste in the western part of the Kola Peninsula. Another international initiative that may help to address Russia's Cold War environmental legacy is the G8's "*Global Partnership Against the Spread of Weapons and Materials of Mass Destruction*" announced by the world's leading industrial nations at the G8 Summit on 27 June 2002. The initiative is aimed at accounting, securing and clearing up Russia's vast nuclear legacy.[206]

Although the main focus of international attention has been on the fate of the Northern Fleet and the Kola Peninsular, there is equal urgency elsewhere in Russia's nuclear weapons complex. Conditions at many of the nuclear weapons production sites are deplorable, with dangerously high levels of radioactive contamination affecting nearby communities and fragile ecological systems. One such site is Mayak in the Urals.

The Mayak Chemical Combine was created for the sole purpose of producing nuclear bombs and reprocessing spent fuel for plutonium to make more bombs. Today, in a dilapidated and aged state, it has a theoretical capacity to reprocess 400 tons of nuclear waste a year. The reprocessing plant, RT-1, opened in 1959, was modified in 1976 to handle energy plutonium and uranium contained in spent nuclear fuel from reactors on board submarines and icebreakers, from research reactors, the BN-30 and BN-600 fast neutron reactors, and from the first and second generation Soviet pressurised water reactors—the VVER-440s. RT-1 is seen as a prime contender by the Ministry of Atomic Energy (Minatom) for the reprocessing of foreign spent nuclear fuel.

The Soviet nuclear weapons programme once operated six plutonium-producing reactors at Mayak—five uranium graphite moderated reactors and one heavy water reactor. The first reactor—designated as "A"—began operation in 1948. The plutonium produced by the reactor was used in the

first Soviet atomic bomb, which was tested at the Semipalatinsk nuclear test range in Kazakhstan on 29 August 1949. The reactor was operational for 39 years, and was finally shut down in 1987. Today, there are only two reactors in service at Mayak. Nicknamed "Lyudmila" and "Ruslan," they were used to produce tritium for hydrogen bombs. Today they are used to produce isotopes for civilian purposes.

On September 29th 1957, one of the cooling pipes in one of Mayak's radioactive waste tank systems overheated and exploded.[207] The total release of radioactivity was 740 pétabecquerel, and 90% of the radionuclides (666 pétabecquerel) were spread over a small area near the tank. About 74 pétabecquerel of the total activity was swept up to a height of one kilometre, leading to the radioactive contamination of certain parts of neighbouring Sverdlovsk and Tyumen regions and on Chelyabinsk, home to one million people. The accident has come to be known as the Kyshtym Tragedy.

The Kyshtym Tragedy and other accidents, involving discharges from routine operations at Mayak, have contaminated a total area of approximately 26,000 square kilometres with a total radioactivity of 185 pétabecquerel. Approximately 500,000 people have been subjected to increased levels of radiation, and of these, 180,000 were evacuated.[208] Literally thousands of people have received medical treatment for damage caused by radiation accidents at the Mayak enterprise.[209] In total 42,280 people have been registered on the Urals region's medical and dosimetric list. More than 26,000 of them children who have received rehabilitation treatment.

Mayak is not, however, the worst case of radioactive contamination in Russia. Accidents involving radioactive contamination from the Tomsk-7 complex in Siberia have been much worse. In 2000 the US-based GAP sent a small scientific team to Russia to join the Siberian Scientists for Global Responsibility to investigate allegations of a large discharge of nuclear contaminants from the Tomsk-7, otherwise known as the Seversk. Severesk is understood to be the world's largest nuclear weapons complex. There were originally 5 nuclear reactors run by the Siberian Chemical Combine (SCC) at Severesk. Currently SCC is thought to operate two closed-loop-cooled nuclear reactors, uranium scrap processing services, contracted civilian nuclear fuel reprocessing and nuclear fuel element fabrication services.

The GAP report released in November 2000 revealed that dangerous levels of radioactivity are entering the Tom River from the facility just 25 kilometres north of the city of Tomsk, which has 500,000 inhabitants.[210] Field detectors showed radioactivity readings of long-lived Strontium-90 at 250,000 pico curies per litre and short-lived Phosphorous-32. According to the report "the discovered pollution is probably the largest present-day discharge of radio-activity to the open aquatic environment anywhere in the world."[211] Until the 1990s the plutonium production reactors dumped hot wastewater directly into the Tom River. At one point Tomsk-7 dumped over one billion curies of plutonium into the aquifer. This is twenty-two times the amount of radiation released by Chernobyl.

The release of radioactive contamination into the open river presents a major risk to fishermen, local inhabitants and farm animals. In addition to the effect of dumping, the local environment was contaminated by a major nuclear accident which occurred in 1993 as a result of an explosion of a nuclear process tank. The explosion released 200 curies of plutonium and tons of uranium into the air. The effects of the accident were to cause a high rate of mutation in the local vegetation and to increase rates of sickness and death amongst the local towns inhabitants.[212] Local farmland and nearby villages were severely contaminated and farmers to this day are forbidden to sell their crops. According to Tom Carpenter, one of the GAP team members, the radioactive contamination is greater than that of any previously reported river contamination, including that of the River Techna near Mayak, described as an open radioactive sewer, and also that of the Columbia River where radioactive contamination has caused genetic mutations in salmon which spawn close to the Hanford site in the US.[213]

The problem of tackling the environmental legacy of the Cold War nuclear weapons complex in Russia is compounded by the increasing limits on access to environmental information and insufficient transparency in the environmental decision-making process. A statement produced by an international conference on Ecology and Human Rights held in Chelyabinsk argued that: "A particularly serious state involving violations of environmental rights is occurring in countries of the FSU, where despite current legislation in this field, the number of environmental rights violations has become massive, the access in defending ones environmental rights has become more limited, pressure and direct persecution of environmental activists, scientists and journalist have become more

widespread, and the mass media does not pay any attention to the problems of these violations and the defence of the public interests."[214]

Two recent high profile cases have highlighted the erosion of environmental and human rights, those of Aleksandr Nikitin and Gregory Pasko. Nikitin was arrested and charged with high treason for making an environmental report about the Northern Fleet. He was fully acquitted in December 1999 by St Petersburg City Court. Pasko was convicted by the Pacific Fleet Military Court to four years in prison on 25 December 2001 for having the *intention* to transfer allegedly secret information about the declining state of the Pacific Fleet to a Japanese journalist. The actual fact of the transfer was not proven, as the transfer never took place. Pasco, a journalist, produced articles that focused primarily on nuclear safety issues in the Russian Pacific Fleet. He has recently been sent to a hard labour camp.

## PROLIFERATION RISKS OR THE "LOOSE NUKES" SYNDROME

With the collapse of the Soviet Union in 1991, the security of the nuclear materials and weapons in the former empire became a source of serious international concern.[215] The attempted coup in August 1991 and the attendant uncertainties about the control and security of the Soviet nuclear arsenal, underscored this disquiet. The danger of proliferation posed by the large and poorly secured stock of weapons-usable materials—plutonium and HEU—have subsequently been identified as one of the major threats to global security in the post Cold War environment.[216] The economic implosion that followed the collapse of the rouble in August 1998 heightened proliferation concerns particularly given that Iran, Iraq and North Korea, are reported by certain intelligence agencies to be actively seeking to acquire nuclear weapons capabilities.[217] Al Qaeda's reported attempts to access nuclear know-how has heightened the sense of acute urgency about proliferation since the 11 September attacks.

The extent of the problem of nuclear materials leakage from Russia is not known with any certainty, and there has been much speculation and sensationalism reported in the press.[218] Nevertheless, the possibility that Russian nuclear materials such as plutonium have ended up in the hands of "rogue states" or terrorists, is being taken seriously by the international security community.[219] While the heart of the "loose nukes" problem in Russia lies in the country's continuing political and economic crisis, there

are also some specific features of the Russian nuclear weapons complex that have contributed to the problems of keeping track of dangerous nuclear materials. The sheer scale of the quantities of nuclear materials and weapons systems, the lack of modern storage facilities, the unreliable accounting and control systems and the laxity in export control mechanisms, all assist the ease with which nuclear materials can leak out of the country and into the wrong hands.

Solutions to these threats have required a high degree of cooperation between Russia and the United States as reflected in the development of a number of trans-governmental programmes funded under the CTR and the MPC&A programmes.[220] A broad range of measures has been implemented including programmes that focus on making warheads or weapons-usable nuclear materials (fissile materials) more secure. Others have concentrated on keeping weapons scientists from being tempted to sell their skills abroad. Still others have worked to improve both countries' ability to measure and monitor each other's stockpiles of fissile materials.

The CTR and the MPC&A have broken important new ground in terms of the principle of direct financial and technical support to encourage non-proliferation in Russia and the other successor states. In effect they represent a new concept of "verification in practice" epitomised by the hands-on support of US contractors, government departments and the process of regular audits and evaluations of programmes. The preventive threat reduction approach which the CTR and MPC&A programmes exemplify, builds on, but also extends and broadens the more traditional approaches to arms control embodied within the START process.

Specific programmes including the MPC&A programme, the HEU deal, the Initiative for Proliferation Prevention (IPP) and the Nuclear Cities Initiative (NCI) are briefly reviewed below.

## The Nuclear Materials Protection Control and Accounting (MPC&A) Programme

The DOE established MPC&A programme in 1995 to help Russia and the other countries of the FSU to secure their fissile materials and set up modern systems of accounting to keep track of these materials.

**Table 12**: MPC&A Developments 1993-2000[221]

| | |
|---|---|
| **1993** | The DOD and Minatom sign an implementing agreement to pursue "cooperative efforts to secure our common nuclear legacy" |
| **1994** | The Lab-to-Lab programme was started with cooperation between nuclear scientist from DOE laboratories and their former Soviet counterparts to explore whether MPC&A techniques and technologies could be implemented in a cooperative programme. The US and Russia also signed a government-to-government agreement to pursue nuclear security programmes at the Minatom facility Eleron |
| **1995** | Presidential Decision Directive-41 (PDD-41) recognized that securing fissile materials in the former Soviet Union was one of the US's top national security priorities and designates DOE as the Executive Agency for implementing the MPC&A programme |
| **1996** | New Russian nuclear facility sites are added to the MPC&A programme as part of the Ministerial meeting between US Secretary of Energy and Russian Minister of Minatom |
| **1997** | MPC&A upgrades continue to be performed at over sites in Russia and the newly independent states |
| **1998** | Weapons-useable nuclear materials recorded at 53 sites. Development of MPC&A training and regulatory measures begin to enhance and ensure the sustainability of the rapid upgrades. Expansion of work into Naval sites |
| **1999** | DOE and the Russian federation announce that nuclear materials on a Russian navy submarine service ship have been secured against insider and outsider theft |
| **2000** | Material Consolidated and Conversion and Site Operations and Sustainability initiatives are started to bolster sustainability and ensure that at the MPC&A site wide progress continues |

The MPC&A began by improving the security of civilian nuclear facilities and has since expended into some naval facilities and weapons design and production complexes. Between 1996-2001, 85 buildings were upgraded, securing 50 tons of weapons useable fissile material or 7% of the estimated total of 650 tons. Upgrades are in progress at 72 buildings leaving an estimated 147 buildings still in need of securing.[222]

In 1995 US officials working on the MPC&A programme estimated that the challenge of securing nuclear materials in the former Soviet Union at

80-100 facilities would costs roughly US$ 800 million through to 2002 or about US$ 10 million per facility.[223] By the late 1990s however, it became apparent that US officials had not fully anticipated the scope of the problem. It is now realized that Russia has far more fissile materials in more buildings in its nuclear weapons complex than was originally estimated approximately 650 tons of fissile materials housed in some 300 buildings. In light of this new information, it is acknowledged that the US will have to continue spending on the MPC&A programme long after the initial deadline in 2002, to ensure that Russia establishes and maintains the infrastructure and organization necessary for securing its fissile materials well into the future.[224]

During the FY 2001, almost US$ 170 million was allocated to the MPC&A program. This amount included US$ 24 million provided under DOE's Long-Term Russia Non-proliferation Initiative (described below). For FY 2002, it was proposed to scale back MPC&A funding to US$ 138.8 million, approximately an 18% decrease. While the proposed budget would increase funding for MPC&A efforts at some of the larger Minatom defence-related nuclear material storage locations, and also increase nuclear material consolidation and conversion at Russian civilian storage sites, it would do so at the expense of MPC&A activities with the Russian Navy, (a decrease of US$ 39.5 million), efforts to strengthen security of civil plutonium stored at the Mayak facility, and other programmes to ensure sustainable operation and maintenance of MPC&A security systems over the long-term. The programme has, however, received renewed support from the Bush administration since the 11 September attacks, because its non-proliferation goals have become a top priority for the US government in its war against terrorism.

## HIGHLY ENRICHED URANIUM DEAL

The HEU Purchase Agreement Deal was signed between the United States and the Russian Federation in 1993. Under the HEU agreement, 500 megatons of highly enriched uranium from dismantled Russian nuclear weapons is to be converted into low enriched uranium (LEU) for use in US commercial power reactors. As of May 2001, over 115 megatons of HEU had been blended down for sale to the United States. The estimate total value of the programme is US$ 12 billion to be paid to Tekhsnabeksport

(Tenex) the Russian executive agent for the agreement, over 20 years to 2013.

The FY 2002 request reduces funding for the activity slightly from the FY 2001 level. The DOE notes in its budget that this reduction will necessitate closure of its Permanent Presence Office at Novouralsk (one of the facilities where Russia conducts downblending activities) for three months of the year.

The success of the programme as a commercial deal is questionable, but as a non-proliferation programme it has been highly successful. Russia has been keen to accelerate the transfer of its weapon-grade uranium to the United States in order to receive much-needed foreign exchange.[225] This incentive has supported the uranium deal's most important goal, which is to secure as much weapons-grade uranium as quickly as possible.

The Initiative for Proliferation Prevention was established to prevent a "brain drain" and to gainfully employ former weapons scientists in the development and production of commercially viable technologies. The programme also matches scientific and technical expertise in Russia with potential industrial partners in the United States. As of 2001 there were 120 projects underway, including 40 in the closed cities of Sarov, Snezhinsk and Zheleznogorsk. The IPP programme supports about 6,000 Russian scientists and science centre programmes in Russia and the Ukraine and provides temporary work for another 24,000 scientists and technicians. The scientists are paid about US$ 600 per month to work on projects that last for a few years.

So far the programme has produced only a handful of viable commercial ventures.[226] According to Fred Wehling of the Centre for Non-proliferation Studies, only seven projects have reached full commercialisation creating 260 jobs and generating US$ 9.4 million in sales.[227] The programme has been beset with difficulties. Technologies have been developed without first determining whether demand for them exists. In particular the program has laid emphasis on high-end technologies for which there is little domestic demand in the Russian economy and even less in export potential.

US commercial partners have often found Russian bureaucracy overbearing, reflecting the problems of attempting to forge relations across

the cultural divide of the US private sector and Russian parastatal bodies. Patent rights have been another major concern for commercial partners.

In the first few years of the programme, Congress allocated about US$ 30 million annually for IPP, but as criticisms of the programme have grown Congress became reluctant to sustain the level of funding. In 1999 Congress reduced the program spend to US$ 25 million. The FY 2002 budget request was further reduced to approximately US$ 22.1 million (about US$ 2.0 million less than in FY2001). This amount can only support about 20 projects, those that DOE believes hold substantial long-term commercial promise.

## THE NUCLEAR CITIES INITIATIVE

Throughout the Cold War, the Soviet Union developed and built its nuclear weapons in an archipelago of 10 secret nuclear cities spread across Russia, that were closed to the outside world. These cities are operated by Minatom an agency similar to the DOE. In the past the citizens of the nuclear cities were regarded as highly privileged and were generously remunerated. Since the collapse of the Soviet Union the dilemma about what to do with these cities and their occupants continues to trouble both Russia and the United States

From the outset of downsizing Russia's nuclear weapons complex the authorities were confronted with two dilemmas. Laying off workers in the closed cities risked serious social unrest, while opening up the cities for business development posed a major proliferation risk. There were several confirmed thefts of nuclear materials in the early 1990s, albeit of small quantities, but they highlighted the vulnerability of the Russian nuclear complex in the more fluid and anarchic post-Cold War era.[228]

The NCI, which was devised by the DOE in 1997, has had two main goals: stabilizing the nuclear cities to reduce proliferation risks, and helping Russia to consolidate its nuclear complex to match the needs of smaller nuclear forces. The US concern with stabilizing the nuclear cities has primarily centred on reducing the incentives for weapons scientists and other nuclear workers to take their skills or nuclear materials elsewhere. But stabilization is also designed to help Minatom retain enough skilled staff

who understand and can provide effective stewardardship of the fissile materials that will remain at the Russian nuclear facilities indefinitely.

For Russia, the point of consolidating the nuclear complex has been to reduce operating costs at a time when it cannot afford to retain large excess capacity. Consolidation should also make it easier for Russia to establish an effective national accounting system for fissile materials—an important component for reducing the chances of theft.

The twin goals of the NCI are somewhat contradictory, however. To be efficient, consolidation would quickly eliminate most of the jobs at the facilities that were closed. For non-proliferation reasons, the last thing that the United States would like to see is large numbers of weapons scientists thrown out of work, particularly when Russia's economy offers them little chance of alternative employment. In rising to this challenge the NCI was designed to aid Russian weapons scientists make the transition to the commercial sector—for example, by attracting businesses to those cities and creating private enterprises there.

From its very inception the programme has been beset with problems. Many of the uncertainties, questions and criticisms relating to the NCI have been highlighted in a number of GOA reports.[229] One of the fundamental problems appears to be the differing views about priorities between the DOE and Minatom. The DOE has attempted to involve many of its own laboratories in developing opportunities for the closed cities. Consequently, it has placed very few of the initial NCI funds into the closed cities themselves. For its part, Minatom has been reluctant to open up the nuclear cities to full access by US officials without a demonstration that the money will actually flow into the cities. These tensions have created an atmosphere of acrimony and mistrust between Russian and US government officials, which have hampered constructive progress in both conversion and consolidation.[230]

In FY 2001, US$ 26.6 million was appropriated for the program. The proposed budget for 2002 requested only US$ 6.6 million, a 75% reduction from FY 2001. This is the lowest level of funding ever proposed for this programme and it will be extremely difficult to sustain it at this level of funding. Prior to this year, the programme's lowest appropriation was US$ 7.5 million in FY 2000. The DOE officials have stated that at the proposed fiscal year 2002 requested funding level it will most likely have to

curtail its efforts at two of the closed cities (probably Snezhinsk and Zheleznogorsk), and concentrate its remaining resources on only one.

## PLUTONIUM DISPOSITION

Russia is estimated to have between 140-162 tons of weapons grade plutonium.[231] This is the largest single stockpile of weapons grade plutonium in the world and accounts for over half the global stockpile, which has been estimated at between 242-267 tons.

Plutonium disposition has been another area of troublesome cooperation between Russia and the United States. Major differences have arisen over appropriate methods of disposition. US officials favoured vitrification while the Russians favour the conversion of plutonium into MOX fuel to be used in the civil nuclear energy processing. These complications have arisen because the Russian and US governments have differing goals and objectives. The United States is primarily driven by security concerns, particularly those of proliferation, Russia, however, views the weapons disposition program as a way to establish a plutonium fuel economy. According to Minatom: "Disposition of weapons plutonium must be seen as the first step in developing a technology for a future closed nuclear fuel cycle. The basic direction in the disposition of excess weapons plutonium, as with plutonium from spent nuclear fuel, is the use of mixed uranium-plutonium fuel of fast reactors, which forms the basis for future large-scale nuclear power engineering. The disposition of a limited amount of weapons plutonium in thermal reactors, if this requires political approval, can be carried out under the financial and technological cooperation of the world community."[232]

After several years of hard and fraught negotiation, the United States compromised and Russia and the US signed the Plutonium Management and Disposition Agreement on 1 September 2000, which provides for the disposition of 34 tons of surplus weapons grade plutonium by each country. Under the terms of the agreement Russia will convert all of its weapons plutonium into MOX fuel. At least 2 tons per year will be converted, with provision to increase this by another 2 tons per year, once the MOX fuel plants are built in Russia (the target date for which is currently 2007). On this calculation it will take between 8.5 and 17 years for Russia to put its 34 tons into non-weapons usable form. Russia would be allowed to reprocess

MOX spent fuel after the 34 tons has been used in reactors under international safeguards.

The commercial plutonium industry in Russia and elsewhere is currently uneconomical and survives only with vast subsidies from taxpayers and electricity ratepayers. The US-Russian disposition agreement will provide the MOX fuel programme with even more subsidies, of which a large percentage will be provided through foreign assistance, and which will be used to provide new life to Russia's moribund breeder reactor programme.

The estimated cost of this programme to the Russians is US$ 1.6 billion.[233] This figure does not, however, include the cost of running the MOX plants or the cost of items such as insurance, and extra security to ensure materials are not stolen. Thus the final net cost of the Russian MOX plan is a matter of some debate. The US contribution to Russia's plutonium disposition programme has so far totalled some US$ 6.6 billion from 1997-January 2002.[234] Table 13 provides details of US funding.

**Table 13**: Details on US Funding of Russian Plutonium Disposition (US$ in thousands)[235]

| **Russian Plutonium Disposition** | **FY 2000** | **FY 2001** | **FY 2002 request** | **Delta '01 vs. '02** | **Percent change** |
|---|---|---|---|---|---|
| Russian Surplus Plutonium Disposition facilities | 4,168 | 16,650 | 42,000 | +25,350 | +152.3 |
| Advanced Reactor Development | 5,000 | 9,857 | 1,000 | -8,857 | -89.9 |
| US Oversight of Russian Activities | 20,777 | 28,000 | 14,000 | -14,000 | -50.0 |
| **Subtotal, Russian Plutonium Disposition** | **29,945** | **54,507** | **57,000** | **+2,493** | **+4.6** |
| Less use of prior year balances | ------ | -15,000 | -42,000 | -27,000 | -180 |
| **TOTAL, Russian Plutonium Disposition** | **29,945** | **39,507** | **15,000** | **-24,507** | **-62.0** |

Concern about the cost of US contributions to Russia's disposition programme and worries about the length of time it will take to dispose of Russia's plutonium, has led to a US to review its programme in order to find a cheaper and quicker options. Cuts have been made in areas such as oversight functions and advanced reactor development. Further options for cuts are believed to be under consideration include changing the plan of burning the MOX fuel in commercial nuclear power reactors to burning in more advanced gas-cooled reactors. However, the latter option is likely to cause delays to the programme, which would contradict the US aim of speeding up the disposition process.

In the fiscal year 2002 budget proposal there was a slight funding increase for the DOE's support of plutonium disposition work in Russia (from US$ 54.5 million to US$ 57 million). In addition, the United States has committed an additional US$ 400 million to assist Russia in the construction of facilities necessary to implement its side of the program. Of this total, US$ 200 million is for the construction of Russian disposition facilities, while the remaining US$ 200 million was to be provided through annual appropriations over the next four or five years.

## PROBLEMS WITH US-RUSSIAN COOPERATION

After a decade of US-Russian threat reduction cooperation much has been achieved in reducing the vulnerability of Russia's nuclear stockpiles.[236] The CTR programme has helped to downsize Russia's nuclear weapons complex; deactivate and eliminate WMD; and secure, protect, blend down and vitrify stocks of weapons-usable fissile material. According to the US government's Defense Threat Reduction Agency, as of 11 July 2002, CTR has deactivated 5,970 nuclear warheads and put beyond use various nuclear-capable delivery systems. Security of nuclear weapons in transit to storage facilities has been improved. When completed, the Mayak Fissile Material Storage Facility will house fissile material from 12,500 dismantled nuclear warheads and store 50 tons of weapons-grade plutonium. The MPC&A programme transferred to the DOE has provided for the continued installation of security, control and accounting equipment to help safeguard weapons-usable fissile material stockpiled in the former Soviet Union, facilitated the re-location of it from the newly independent states (NIS) to Russia and the United States, and has consolidated it into fewer sites.

Much remains to be accomplished, however, and future tasks are likely to impose a further drain on US resources. Sizeable quantities of fissile materials in Russia still remain unprotected; no effective export-control system or enforcement mechanism exists to ensure that stolen materials or warheads are not smuggled out of the country; and thousands of weapons scientists and nuclear workers continue to face economic hardship. The Russians, aware of these problems, lack the resources to develop their own solutions and have thus become dependent on external aid, mainly from the United States.

For its part the United States has, according to certain critics, suffered a dearth of strategic vision in its formulation and implementation of cooperative threat reduction policies. The former Director of the Los Alamos National Laboratories, has observed that "A lack of a clear, coherent, and sustained US strategy to deal with the new nuclear dangers in Russia and the other NIS of the former Soviet Union resulted in a patchwork quilt of nuclear programs—often lacking coordination not only with Russia, but also within the US interagency community. Furthermore, some of the programmes promoted by the United States did not adequately incorporate Russian strategic objectives, forcing the Russian government to choose between following its national interest and receiving much-needed financial assistance."[237] Differences over the goals of programmes are reflected in conflicts over how much of the cooperative security budget is spent in Russia versus the United States. At present a significant proportion of the budget is spent in the United States. Tensions also exist over the levels of US access to sensitive facilities in Russia. There are political issues such as the tendency of some US officials to treat collaboration with Russia as a client-donor relationship, with Russia acting as a subcontractor to the United States rather than a partner. Russian participants in the collaborative programmes have made it be known their desire to modify the way the United States behaves towards its Russian counterparts. Russian officials acknowledge their proliferation problems, but they would elect to cooperate on a more equitable basis, as a security and scientific partner rather than as a potential proliferator.[238]

These problems have affected the pace and success of programme implementation. As a result they have been subjected to much criticism from GAO.[239] It is all too easy to see the devil in the detail, however. Given that cooperative threat reduction is a relatively new approach that has been finding its feet during a period of major upheaval, there have inevitably

been hiccups in programme design and implementation. But at a general level cooperative threat reduction represents a positive step towards addressing the dangers inherent in the demise of a nuclear weapons state. Reductions in strategic forces, whether on a unilateral, bilateral or multilateral basis, do not in and of themselves remove the dangers of nuclear weapons proliferation, cooperative threat reduction does. As such, cooperative threat reduction represents a new organizing principle around which disarmament and non-proliferation can be achieved in the new strategic environment defined by asymmetric warfare.

## New Threat Reduction Initiatives

Renewed concerns about nuclear proliferation in the aftermath of 11 September has led to some positive new initiatives for US-Russian cooperation on non-proliferation, which were agreed to at the summit between Presidents Bush and Putin in May 2002. Two notable initiatives include the Working Group on Advanced Nuclear Technologies and the Working Group on Nuclear Materials Reduction.

## US-Russia Working Group on Advanced Nuclear Technologies

Presidents Bush and Putin agreed to establish a joint experts group to develop recommendations for potential US-Russian collaboration on advanced nuclear fuel cycle research and development. The working group is formed around the idea that the development of advanced nuclear reactor and fuel cycle technologies would help to significantly reduce the volume of waste produced from civil nuclear reactors, would be highly proliferation-resistant, and could be used in the longer term to reduce stocks of excess weapons-grade plutonium and other potentially dangerous nuclear materials.

The joint experts group will be headed by the US Secretary of Energy and the Russian Minister of Atomic Energy and will be established to develop recommendations for potential collaborative US and Russian research and development on advanced nuclear fuel cycle technologies.

Implementation of the recommendations will be in keeping with US non-proliferation goals.

## US-Russia Working Group on Nuclear Materials Reduction

Both the United States and Russia have recognised that one way to reduce the chances of nuclear weapons material ending up in the hands of hostile states or terrorist groups is to reduce the amount of weapons grade material available. Under existing agreements, the United States and Russia are committed to reducing the amount of nuclear weapons-grade material, through the elimination of 34 tons each of plutonium and through US purchase of 500 tons of Russian HEU for use in commercial nuclear reactor fuel. More than 140 tons of HEU have already been delivered under the latter agreement.

These programs will eliminate enough material for almost 25,000 nuclear weapons. Nevertheless, President Bush and President Putin agreed that they should seek to do more. Therefore, a joint experts group under will examine near- and longer-term, bilateral and multilateral means to reduce inventories of plutonium and HEU still further.

The joint experts group will begin work immediately, and report its findings to Secretary Abraham and Minister Rumyantsev within six months. It will consult closely with industry to ensure that commercial markets would not be adversely affected by any new recommended initiatives to eliminate more weapons-grade plutonium and HEU.

There is no denying that the results of the May 2002 Presidential summit were, on the whole, positive for cooperative threat reduction. But the set of agreements seem to accomplish more politically than they do in actual non-proliferation terms because they do not adequately meet the current worldwide proliferation threat. While the new pact has gone a long way to eradicate any lingering Cold War animosity between Russia and the US, the growing significance that the Bush administration is placing on the role of nuclear deterrence for future US security policy does not augur well for either nuclear non-proliferation or cooperative threat reduction.

## SUMMARY AND CONCLUSIONS

At a moment in time when the whole edifice of arms control appears to be collapsing under the pressure of US rearmament, it is a sobering exercise to compare the costs and benefits of arms control with the costs and benefits of nuclear arms racing. The effective implementation of START I came at a high and rising price, the vast burden of which was shouldered by the United States. Yet the sums involved are paltry when compared with the magnitude of resources required to maintain existing nuclear arsenals, let alone build a new generation of nuclear weapons. Juxtaposing the costs of START with the legacy of the Cold War nuclear arms race provides an even more salutary insight. The cumulative costs of which were astronomical and were no doubt a major factor in bankrupting of the Soviet system. However, it is the environmental and health impacts of this legacy that represent the most worrisome aspects of this destructive inheritance. Not only because there is no way of knowing with any certainty of what the costs of environmental remediation and the health and safety implications of nuclear weapons will be, but also because the longevity of radioactive pollution it is likely to affect the health and well-being of generations to come. The ultimate tragedy of nuclear weapons is that they have and are likely to go on killing the very people that they were supposedly designed to protect.

The most chilling aspect of the Cold War nuclear arms legacy is, however, the spectre of "loose nukes" and the horrendous possibility of nuclear terrorism. That the world has come to this state of insecurity is directly attributable to the folly of nuclear arms racing and the theory of deterrence, which so naively assumes a sense of rationality in producing and deploying these awesomely dangerous weapons of mass destruction. The current dilemma posed by nuclear weapons proliferation is unlikely to be solved by building yet more nuclear weapons, let alone ones that are designed to be used. In threatening to break the long-held taboo about the usability of nuclear weapons the United States is setting a dangerous new precedent that is likely to take the world a step closer to nuclear war the ultimate cost of humankinds' madness.

## COST AND BENEFITS OF START

START as a bilateral arms control processes was predicated on the desire to stabilize the nuclear arms race between Cold War adversaries. Its progression was far from perfect and its implementation costs proved unsustainable for crisis-prone Russia and other successor states. To its credit, the United States found itself shouldering a double burden. Its own costs of implementation, and most of the costs for the successor states. Nevertheless, the benefits of START in both a quantitative and qualitative form have proven to outweigh the costs. To summarize:

**One time costs** incurred over the ten-year period of implementation from 1991-2001 included the destruction of equipment and facilities, the restructuring of forces and bases, the initial inspections to verify declarations and the setting up of facilities for site inspections. These activities were estimated to have cost the United States US$ 1.8 billion.

The **recurring costs** of START I include the verification and monitoring costs, which commenced from the date of the Treaty's entry into force in 1991. Total recurring costs have been estimated at US$ 580 million over the period 1991-2001.

**Savings accrued** as a result of cuts in US nuclear forces as a result of START imposed reductions have been estimated at US$ 6.4 billion over the period of Treaty implementation 1991-2001. Once the costs are subtracted, savings amount to roughly US$ 4.02 billion. Added to this the United States has shouldered the lions share of the former Soviet Unions implementation costs. These amounted to US$ 2.5 billion between 1991-2001. This means that even with the burden of the successor states implementation cost the United States still managed to save US$ 1.52 billion (1991-2001).

As a quantifiable "peace dividend" these savings are miniscule as a proportion of annual US military expenditures, which averaged at US$ 263 billion per annum during the period 1991-2001. To expect substantial economic gain is, however, to miss the point of the peace dividend as the real benefits of the START process measured in terms of enhanced security and stability. The tangible benefits from the combined START /CTR process are:

- enhanced bilateral security;
- improved international security and stability;
- increased transparency;
- a reduction in the risk of miscalculation and therefore of accidental war;
- increased trust and confidence;
- the building of international norms;
- the establishment of a set of desirable precedents.

While these costs and benefits stand alone as a testimony to the advantages of an arms control process, a far stronger argument can be made in favour of arms control and disarmament when these costs are juxtaposed against those of rearmament.

## Costs of Rearmament

In the very short period of time in which the George W. Bush administration has been in office its new security policy has generated a large increase in US military expenditures. Growing from US$ 311 billion in 2001 to a US$ 396 billion in 2003, is has increased by **US$ 85 billion**, or **21%**. The war in Iraq will increase these figures still further. Long-term plans foresee the national defence budget increasing to US$ 469 billion by FY 2007. This rate of increase is unprecedented even in US terms. Not withstanding the costs generated by the war against terrorism, the war in Iraq and recent pay increases for personnel, the budget is being pushed up by the mounting costs of the ballistic missile defence programme and by the rising costs of its nuclear weapons arsenal. Coming at a time of economic downturn with a much reduced fiscal base rising military expenditures are a major factor affecting the rising budget deficit and has acted to crowd out discretionary spending on health, education and social welfare.

## Recurring Cost of Nuclear Arms

Vast resources were expended in the Soviet Union and the United States on the research, development, testing, production and maintenance of nuclear weapons, during the Cold War. The Cold War may be over but

the nuclear arms legacy continues to exact a high cost to the environment and to human health. Many of these costs are only just coming to light.

- ***Economic Cost.*** The US has spent roughly **US$ 5.5 trillion** between 1945-1996. It is assumed that the Soviet Union spent an equivalent amount although the burden was likely to have been far greater, because of the less developed nature of its economy. In both cases opportunity costs have been substantial, as nuclear weapon expenditures are sunk costs. In the Soviet Union the opportunity costs were of a magnitude sufficient to contribute to the collapse of the Soviet economic system.

- ***Human Costs.*** Numerous incidents involving the dispersal of radioactive materials are responsible for **thousands of deaths and disease** in and around nuclear weapons plants in both the former Soviet Union and the United States. Atmospheric nuclear weapons tests carried out in the 1950s and early 1960s are thought to have caused **11,000 deaths** in the US due to radioactive contamination. A further **22,000** people are thought to have become seriously ill as a result of radiation exposure. The most notorious accidents have been at the Mayak and Tomsk-7 nuclear weapons plants in Russia and at the Ferdal and Hanford sites in the US. Currently there is no official data in either country on the scale of radiation contamination or of its full impact on human health and mortality. Whistleblowers in both countries face harassment, loss of employment and in the case of Russia imprisonment if they attempt to draw public attention to lax health and safety procedures or accidents.

- ***Environmental Pollution*.** Independent scientists in both the Russian Federation and the United States have recorded evidence of large-scale radioactive contamination of both human and natural habitats in areas adjacent to nuclear weapons complexes. In Mayak and Tomsk-7 in Russia and Hanford Reservation in the United States contaminated ground water has seeped into aquifers and rivers, polluting fish stocks, drinking water, arable land, livestock and local communities. Radioactive contamination is exceedingly difficult, if not impossible, to retrieve once it has reached major rivers. The contamination problems in the River Tom dwarf those of the Columbia River. The Tomsk-7 practice of dumping billions of curies of plutonium into the river has created a radioactive sewer.

- ***Cost of Environmental Remediation*.** The challenge of environmental remediation at nuclear weapons complexes is a costly and problematic process. In 1996 the DOE estimated that it would cost the United States over **US$ 300 billion** and take 75 years to implement. Cost cutting exercises imposed on the DOE by Congress have reduced the DOE's estimates to US$ 220 billion over a 30-year period. Clean-up procedures are being compromised in order to comply with the reduced budget. In Russia the scale of the problem is far more severe than in the United States, but there are far fewer national resources to deal with the problem. International assistance for environmental remediation via the CTR programme and the Northern Dimension Environmental Partnership, which has pledged **110 million euros**, has started to address the problem. Most of these resources are targeted at the radioactive waste problems in north-west Russia, particularly those affecting the Baltic and Barents Sea. However, resources are urgently needed to tackle the environmental problems at Mayak and Tomsk-7, which are not covered by existing donor programmes.

- ***Loose Nukes.*** The collapse of the Soviet Union fuelled fears about the security and safety of nuclear weapons and fissile materials. In response the United States has funded a number of programmes under the CTR and the MPC&A programmes aimed at reducing the threat of nuclear proliferation. To date the US has spent **US$ 7 billion** on non-proliferation activities in Russia. The US has sought to internationalize assistance for cooperative threat reduction by encouraging other G-8 countries to contribute. Under the *Global Partnership Against the Spread of Weapons of Mass Destruction* the G-8 group have pledged **US$ 20 billion** to help Russia and other former Soviet states, to secure and destroy their weapons of mass destruction over the next ten years.

Without a full appreciation of all the costs associated with nuclear weapons it appears myopic and irresponsible to add to humanities burden by renuclearizing security policies. US policy makers considering a new generation of nuclear weapon systems, or for that matter other countries ill-advisedly considering the nuclear option, should be made to reflect long and hard on the future costs and risks that such programmes are likely to engender. This means looking beyond the short-run costs of production, development and operational maintenance, to the long-term and costly challenges of future stockpiling, dismantlement, decommissioning, environmental clean-up and proliferation control. These *total* costs need to

be built into calculations at the beginning of the procurement cycle, so that a more realistic picture of the costs and risks of nuclear weapons are known.

If there is a lesson to be learned from this study, it is that the costs and threats associated with an historical arms race do not disappear with the end of confrontation, particularly where nuclear weapons are concerned. The huge environmental problems associated with the Cold War nuclear weapons legacy, plus the ever-present threat of proliferation by terrorist groups that may be foreign or home grown, generate costs and insecurities for many generations to come. Set in this context, controlling these weapons through arms control treaties is not only a less expensive option but also one that guarantees far greater military, human and environmental security in the long run.

## Notes

1 *National Security Strategy of the United States of America*, Washington D.C.: US Government Printing Office, September 2002.

2 See excerpts of the *Nuclear Posture Review* (NPR) submitted to Congress on 31 December 2001, www.globalsecurity.org/wmd/library/policy/dod/npr.htm.

3 For a detailed discussion on nuclear weapons designed to destroy hardened and deeply buried targets see M. Bromley, D. Graham and C. Kucia, *Bunker Busters: Washington's Drive for New Nuclear Weapons*, BASIC Research Report, Washington and London: BASIC, July 2002.

4 NPR, op. cit. note 2.

5 Center for Security Policy, "The Bush Nuclear Posture Review Adults at Work on Restoring the Credibility of Americas Deterrent", *Decision Brief*, No. 02-D 14, 11 March 2002.

6 K. Kartchner and G.Pitman, "Alternative Approaches to Arms Control in a Changing World", *Disarmament Diplomacy*, No. 62, January/February 2002, http://www.acronym.org.uk/dd/index.htm.

7 Center for Security Policy, op. cit. note 5.

8 Center for Security Policy, "The New Arms Control Gambit: US Disarmament that Masquerades as Noblesse Oblige", *Decision Brief*, No. 97-D 84, 23 June 1997, www.security-policy.org/papers/1997/97-D84.

9 GAO, *Nuclear Non-proliferation: Limited Progress in Improving Nuclear Material Security in Russia and the Newly Independent States*, GAO/RCED/NAISD-00-82, 16 March 2000, http://www.gao.gov; GAO, *Weapons of Mass Destruction: Efforts to Reduce Russian Arsenals May Cost More, Achieve Less than Planned*, GAO/NSIAD-99-76, 13 April 1999, http://www.gao.gov; GAO, *Nuclear Non-proliferation and Safety: Uncertainties About the Implementation of US-Russian Plutonium Disposition Efforts*, GAO/RCED-98-46, 14 January 1998, http://www.gao.gov; GAO, *Weapons of Mass Destruction; Status of the Cooperative Threat Reduction Programme*, GAO/NSIAD 96-222, 27 September 1996, http://www.gao.gov.

10 See Centre for Defence Information, www.cdi.org/issues/budget.

11 S. Schwartz (ed.), *Atomic Audit: The Costs and Consequences of US Nuclear Weapons Since 1940*, Washington D.C.: Brookings Institute,

1998. See also S. Schwartz, "Four Trillion Dollars and Counting", *Bulletin of Atomic Scientists*, Vol. 51, No. 6, November/December, 1995.

12 J. Dhanapala, "The Environmental Impacts of Manufacturing, Storing, Deploying and Retiring Weapons", paper presented at the Arms and the Environment Conference, University of Tulsa, Oklahoma, 9-10 December 1999.

13 For insights into the Cold War arms race see M. Thee, *Military Technology, Military Strategy and the Arms Race*, London: Croom Helm, 1986, and M. Evangelista, *Innovation and the Arms Race: How the United States and the Soviet Union Develop New Military Technologies*, Ithaca: Cornell University Press, 1988.

14 NRDC, "Taking Stock: Worldwide Nuclear Deployments 1998", March 1998, http://www.nrdcpro/tkstock/tssum.html.

15 The policy concerns and conceptual developments of "the golden age of high strategy" that produced the notion of deterrence have been captured in L. Freedman, *The Evolution of Nuclear Strategy*, 2nd edition, London: Macmillan, 1989 and C. Gray, *Nuclear Strategy and National Style*, Lanham: University Press of America 1986. For a discussion of deterrence in the post Cold War era see L. Friedman, "Does deterrence have a future?", *Arms Control Today*, October 2000, http://www.armscontrol.org/act/2000_10/detoct00.asp.

16 S. Sagan and K. Waltz, *The Spread of Nuclear Weapons: A Debate*, New York and London: Norton and Co. 1995, C. Gray, *Weapons Don't Make War Policy Strategy and Military Technology*, Lawrence: University of Kansas Press, 1993 and G. Hammond, *Ploughshares into Swords: Arms Races in International Politics*, Columbia: University of South Carolina Press, 1993.

17 Schwartz (ed.), op. cit. note 11.

18 P. Green, *The Hidden Cost of Deterrence: Nuclear Weapons Accidents*, London: Brassey's, 1990 and S. Sagan, *The Limits of Safety: Organisations, Accidents and Nuclear Weapons*, Princeton: Princeton University Press, 1993.

19 L. Dumas, "No Room for Mistakes: Rethinking Nuclear Technology", *Foreign Policy in Focus*, Vol. 6, No. 34, October 2001.

20 Greenpeace, *Selected Accidents Involving Nuclear Weapons 1950-1993*, www.greepeace.org/-comms/nukes/ctbt/read3html.

21 GAO, *Observations on Navy Nuclear Weapon Safeguards and Nuclear Weapon Accident Emergency Planning*, GAO/NSIAD-85-123, 29 July 1985, http://www.gao.gov.

22 See www.greepeace.org/-comms/nukes/ctbt/read3html.

23 C. Hansen, "The Oops List", *The Bulletin of the Atomic Scientists*, Vol. 56, No. 6, November /December 2001, http://www.thebulletin.org/issues/2000/nd00/nd00hansen.html.

24 Ibid.

25 See Greenpeace, op. cit. note 20. See also "Notable Nuclear Accidents", *World Almanac and Book of Facts 1995*, http://cid.unomaha.edu/-ajuska/SOC3850/nuclear.htm and T. Nilsen, I. Kudrik and A. Nikitin, "The Russian Northern Fleet Nuclear Submarine Accidents", *Bellona Report*, No. 2, 1996, www.bellona.no/e/russia.nfl/nfi8.htm.

26 V. Larin, "Mayak's Walking Wounded", *The Bulletin of the Atomic Scientists*, Vol. 55, No. 5, September/October 1999, http://www.thebulletin.org/issues/1999/so99/so99larin.html.

27 Ibid., p. 20.

28 See www.greenpeace.org/-comms/nukes/ctbt/read3htm.

29 See A. Makhijani, "The burden of proof", *Bulletin of the Atomic Scientists*, Vol. 57, No. 4, July/August 2001, http://www.thebulletin.org/issues/2001/ja01/ja01makhijani.html and M. Flynn, "A Debt Long Overdue", *The Bulletin of the Atomic Scientists*, Vol. 57, No. 4, July/August 2001, http://www.thebulletin.org/issues/2001/ja01/ja01flynn.html.

30 Ibid.

31 Dumas, op. cit. note 19.

32 Study quoted by D. Babst, "Preventing an Accidental Armageddon", Nuclear Age Peace Foundation, February 2000. See also C. Sagan, "The Nuclear Winter", Council for a Liveable World, Education Fund, Boston, M.A., 1983.

33 T. Putnam, "Communicating Nuclear Risk: Informing the Public about the Risks and Realities of Nuclear Terrorism", Center for International Security and Cooperation (CISAC), Institute of International Studies, Stanford University, October 2002, http://ldml.stanford.edu/cisac/pdf/NuclearRisk.pdf.

34 Ibid.

35 See Taina Sisiluoto (ed.), *Tactical Nuclear Weapons: Time for Control*, UNIDIR, Geneva: United Nations, 2001, p. xvii.

36 B. Buzan and E. Herring, *The Arms Dynamic in World Politics*, Boulder and London: Lynne Reinner Press, 1998, p. 213.

37 *Soviet Nuclear Threat Reduction Act*, Public Law 102-228, November 1991.

38 For a detailed assessment of the evolution and outcomes of US preventive threat reduction programmes see L. Dunn (et. al.), "An Assessment of Preventive Threat Reduction", a report prepared for the Advanced Systems and Concepts Office, Defence Threat Reduction Agency, Fort Belvoir, Virgiania, by the Science Application International Corporation, 8 February 2001.

39 R. Cowen-Karp, "The START Treaty and the Future of Strategic Nuclear Arms Control", *SIPRI Yearbook 1992: World Armaments and Disarmament*, New York: Oxford University Press, 1992, p. 13.

40 R. Einhorn, "Revising the START process", *Survival*, Vol. 32, No. 6, November/December 1990, pp. 497-505.

41 R. Cowen Karp, "US-Soviet nuclear arms control' *SIPRI Yearbook 1991: World Armaments and Disarmament*, New York: Oxford University Press, 1991, pp. 383-402.

42 Ibid., p. 28.

43 For details see R. Fieldhouse, R. Norris and W. Arkin, "Nuclear weapon developments and unilateral reduction initiatives", *SIPRI Yearbook 1991, World Armaments and Disarmament*, New York: Oxford University Press, 1991, pp. 66-84.

44 J. Lloyd and L. Barber, "Yeltsin pledges to direct missiles away from US", *Financial Times*, 27 January 1992.

45 For a discussion of the various Russian responses to the NMD and the US withdrawal from the ABM Treaty see S. Menshikov, "Russia and Strategic Arms Issues", paper presented at the Sixth Annual Middlesex Conference on Economics and Security, London, 21-22 June 2002.

46 The definition "tactical" or "sub-strategic" nuclear weapons is somewhat vague as it embraces many criteria such as range, yield, target, national ownership, delivery vehicle and capability. On the whole they have a smaller explosive force than strategic nuclear weapons and are generally intended for "battlefield" use against enemy forces rather than against strategic locations. The yields of tactical nuclear weapons can be relatively low (0.1 kiloton), i.e. equal to those dropped on Nagasaki and Hiroshima, or they can be very high.

47 For a detailed analysis of tactical nuclear weapons and arms control see William Potter et al., *Tactical Nuclear Weapons: Options for Control,* UNIDIR, Geneva: United Nations, 2000 and Susiluoto (ed.), op. cit. note 35, pp. 53-75.

48 For a discussion about post September 11th strategies towards tactical nuclear weapons see A. Miller, "The Pressing Need for Tactical

Nuclear Weapons Control", *Arms Control Today*, May 2002, http://www.armscontrol.org/act/2002_05/millarmay02.asp.

49 See www.fas.org/nuke/control/start-comp.htm.

50 See Defence Threat Reduction Agency factsheet on "Continuous Portal Monitoring", www.dtra.mil/fact/nw_cpm.html.

51 CBO, *US Costs of Verification and Compliance Under Pending Arms Treaties*, Washington D.C.: US Government Printing Office, September 1990, p. xi.

52 S. Willett, *Rethinking the Price Tag: A Methodological Inquiry Into the Cost and Benefits of Arms Control*, UNIDIR, Geneva: United Nations, 2002.

53 A. S. Krass, "The Costs, Risks, and Benefits of Arms Control", Center for International Security and Cooperation (CISAC), Institute of International Studies, Stanford University, February 1996, p. 24.

54 CBO, op. cit. note 51.

55 A. F. Woolf, "Strategic Arms Reduction Treaties: Verification and Compliance Issues", CRS Report 91-139, Congressional Research Service, 1997.

56 Data provided by the Defence Threat Reduction Agency by e-mail received on 21 November 2001.

57 See Defence Threat Reduction Agency, http://www.dtra.mil/.

58 This very rough calculation is made by halving the CBO's estimated savings from the combined INF and START I savings and then subtracting the one time and recurring costs accumulated during the course of START implementation and monitoring periods.

59 CBO, *Estimated Budgetary Impacts of Alternative Levels of Strategic Forces*, www.cbo.gov/byclasscat.cfm?cat=43.

60 For a discussion of the problems in analysing the Russian defence budget see *The Military Balance 2000/2001*, London: Oxford University Press, October 2000, pp. 118-119.

61 A. Goltz, "Poslednii shans technokrata", *Itogi*, 27 July 2000, www.itogi.ru.

62 See the SIPRI military expenditure database, http://projects.sipri.org/milex/mex_database1.html.

63 For details see GAO, *Weapons of Mass Destruction: US Efforts to Reduce Threats from the Former Soviet Union,* Testimony, GAO/T-NSIAD/RCED-00-119, 3 June 2000, http://www.gao.gov.

64 M. Roston and D. Smigielski, "Accomplishments of Selected Threat Reduction and Non-proliferation Programs in Russia, By Agency", US-Russian Nuclear Security Advisory Council, May 2002.

65 M. Krepon, "Moving from MAD to Cooperative Threat Reduction: Life After the ABM Treaty", The Henry L. Stimpson Centre, 2002, www.stimpson.org/southasia/pdf.MADtoCTR.pdf, p. 7.

66 K. Luongo, Perspectives on G8 Global Partnership Against the Spread of Weapons of Mass Destruction, testimony to the US Senate Committee on Foreign Relations, 9 October 2002.

67 GAO, *Cooperative Threat Reduction: DOD has Adequate Oversight of Assistance, but Procedural Limitations Remain*, GAO-01-694, June 2001, http://www.gao.gov.

68 GAO, *Weapons of Mass Destruction: Effort to Reduce Russian Arsenals May Cost More, Achieve Less Than Planned*, GAO/NSIAD-99-76, 13 April 1999, http://www.gao.gov.

69 For a detailed discussion of cooperative threat reduction funding see W. Hoehn, "Analysis of the Bush Administration Fiscal Year 2003 Budget Request for US-Former Soviet Union Non-proliferation Programmes", Russian-American Security Advisory Council, April 2002, www.ransac.org/new-website/index-olbrowser.html.

70 See SIPRI military expenditures database 2002, http://projects.sipri.org/milex/mex_database1.html.

71 N. Sokov, "The 'Denuclearisation' of Russia's Defence Policy", *Disarmament Diplomacy*, No. 48, July 2000, http://www.acronym.org.uk/dd/index.htm.

72 P. Bleek, "Russia Ready to Reduce to 1,500 Warheads, Addressing Dispute Over Strategic Forces Fate", *Arms Control Today*, September 2000, http://www.armscontrol.org/act/2000_09/startsept00.asp.

73 Sokov, op. cit. note 72.

74 Ibid.

75 A. Gromyko and A. Gromyko, "Russia's Nuclear Imperative", *Global Dialogue*, Vol. 1, No. 2, Autumn 1999, www.gromyko.ru/english/cwd/nuclear.htm.

76 On 6 February 2002 General Staff Deputy Chief Colonel General Baluyevskiy announced that Russia would shift its attention to the modernization of the naval strategic forces. *Interfax*, 6 February 2002, cited in Centre for Non-proliferation Studies, "Greater Attention Pledged to Russian Triads Naval Leg", *Research Story of the Week*, Monterey Institute of International Studies, 4 March 2002, www.cns.miis.edu.

77 Strategic Advisory group of the Joint Strategic Target Planning Group, US Strategic Air Command, "The Role of Nuclear Weapons in the New

World Order", *Navy News and Undersea Technology*, Washington D.C.: King Publishing, 13 January 1992.

78 CBO, "Chapter Four: Options for National Defence", *Budget Options*, Washington D.C.: US Government Printing Office, February 2001, p. 26.

79 For details see Nautilus Institute, "Sun City Extended Study", *Nuclear Strategy Project*, www.natilus.org/nukesstrat/USA/Force/SunCityEx.html.

80 For details of President Bush's speech see www.whitehouse.gov/news/releases/2001/05/20010501-10.html.

81 "Joint Statement in New US-Russian Relationship", Office of the Press Secretary, The White House, 13 November 2001, www.whitehouse.gov/news/releases/2001/11/20011113-html.

82 For details of the Treaty see Appendix III.

83 For a discussion of SORT verification challenges see N. Sokov, "No SORT of verification", *Trust and Verify*, No. 103, July-August 2002, pp. 1-3.

84 W. D. Hartung, "Bush's Nuclear Doctrine: From MAD to NUTS", *Foreign Policy in Focus*, November 2001, www.fpif.org.

85 Presidents Bush (Snr) and Gorbachev and Yeltsin took steps in 1991 and 1992 to reduce substantially the Cold War deployments of TNWs. In 1997 Presidents Clinton and Boris Yeltsin agreed that TNWs would be addressed in the context of the START III negotiations. For details see A. Millar, "The Pressing Need for Tactical Nuclear Weapons Control", *Arms Control Today*, May 2002, http://www.armscontrol.org/act/2002_05/millarmay02.asp.

86 Krepon, op. cit. note 66, p. 8.

87 J.-M. Guehenno, "The Impact of Globalisation on Strategy", *Survival*, Vol. 40, No. 4, Winter 1998/99, p. 10.

88 Bromley, Grahame and Kucia, op. cit. note 3, p. 9.

89 *The National Security Strategy of the United States of America*, op. cit. note 1, p. 13.

90 For details see GAO, *Weapons of Mass Destruction DOD's Actions to Combat Weapons Use Should Be More Integrated and Focused,* GAO/NSIAD-00-97, 26 May 2000, http://www.gao.gov.

91 Ibid., p. 15.

92 NPR, op. cit. note 2.

93 J. Nolan, "Preparing for the 2001 Nuclear Posture Review", *Arms Control Today*, November 2000, http://www.armscontrol.org/act/2000_11/Nolan.asp.

94 NPR, op. cit. note 2, p. 7.
95 Ibid., p. 17.
96 Ibid., p. 11.
97 J. Mendelsohn "The US Nuclear Posture Review: Plus ça change, plus c'est la même chose", *Disarmament Diplomacy*, June 2002, http://www.acronym.org.uk/dd/index.htm, p. 4.
98 NPR, op. cit. note 2, p. 23.
99 For a discussion on mini-nukes see Centre for Defence Information, "Mini-Nukes, Bunker-Busters and Deterrence: Framing the Debate", CDI Terrorism Project, 26 April 2002, www.cdi.org/nuclear/.
100 R. Nelson, "Low Yield Earth Penetrating Nuclear Weapons", *Journal of the federation of American Scientists*, January/February 2002, http://www.fas.org/faspir/2001/v54n1/weapons.htm.
101 S. Younger, *Nuclear Weapons in the Twenty First Century*, Los Alamos National Laboratory Report, LAUR-00- 2850, 27 June 2000, www.fa.org/nuke/guide/usa/doctrine/doe/younger.htm, and T. Dowler and J. Howard, "Countering the Threat of the Well Armed Tyrant: A Modest proposal for Small Nuclear Weapons", *Strategic Review*, Fall 1991.
102 Hartung, op. cit. note 84.
103 Nelson, op. cit. note 100.
104 Ibid.
105 National Defense Authorization for Fiscal Year 1994 (PL 103-106), *Congressional Bills*, 103d Congress (1993-94), http://www.access.gpo.gov/congress/cong009.html.
106 "Scientists Urge President to Limit Nuclear Missions", Union of Concerned Scientists, Press Release, http://www.ucsusa.org/.
107 A. DiFilippo, "Bush's Nuclear Weapons Policy: Where the Rule of Law Doesn't Matter", *Foreign Policy In Focus*, 26 June 2002, www.foreignpolicy-infocus.org/commentary/2002/0206nukepolicy.html.
108 N. Kravelev, "US Drops Pledge on Nukes: Won't Rule Hitting Any States", The *Washington Times,* 22 February 2002.
109 Excerpts from the original report are available at http://www.globalsecurity.org.
110 NPR, op. cit. note 2, p. 30.
111 Ibid., p. 36.
112 NPR, op. cit. note 2.
113 B. Blair, "Nuclear Time Warp", *Nuclear Issues*, Centre for Defence Information, 8 April 2002, www.cdi.org/nuclear.

[114] See "Global Trends 2015: A Dialogue About the Future with Nongovernment Experts", December 2000, http://www.odci.gov/nic/pubs/2015_files/2015.htm, and statement by Director of Central Intelligence Agency, George J. Tenet, before the Select Committee on Intelligence on "Worldwide Threat 2001: National Security in a Changing World", 7 February 2001, http://www.odci.gov/cia/public_affairs/speeches/archives/2001/UNCLASWWT_02072001.html.

[115] Quoted in P. Coyle, "Rhetoric or Reality? Missile Defense Under Bush", *Arms Control Today*, May 2002, http://www.armscontrol.org/act/2002_05/coylemay02.asp.

[116] The Space Based Infrared System Low Earth Orbit satellites and the Space Based Infrared System-High will serve the "layered" BMD systems. In the longer term space may also host as many as 1,500 brilliant pebbles anti-missile satellites.

[117] For a debate on the weaponization of space see opposing positions of B. DeBlois and R. Garwin, *Six Incentives for Space Weaponisation,* White Paper, Council on Foreign Relations Study Group on United States Space Posture for the 21st Century, Washington DC, 2002, and P. Coyle and J. Rhinelander, "Drawing the Line: the Path to Controlling Weapons in Space", *Disarmament Diplomacy*, No. 66, September 2002, http://www.acronym.org.uk/dd/index.htm.

[118] S. Menshikov, "Russia and Strategic Armaments Issue", paper presented at the Sixth Annual Misddlesex Conference on Economics and Security, London, 21-22 June 2002, p. 7.

[119] Ibid. p. 8.

[120] C. Kucia, "Chinese Nuclear Forces Continue to Grow, Report Says", *Arms Control Today*, 20 September 2001, http://www.armscontrol.org/act/2002_09/chinanuc_sept02.asp.

[121] Ibid.

[122] Ibid.

[123] Figures quoted by C. Hellman, "The Cost of Ballistic Missile Defense", Centre for Defense Information, www.cdi.org/missile-defense/costs.

[124] CBO, *Budgetary and Technical Implications of the Administrations Plan for National Missile Defences*, Washington D.C.: US Government Printing Office, April 2000.

[125] Ibid.

[126] Centre for Defence Information, *Highlights of the FY'03 Budget Request*, 4 February 2002, www.cdi.org/issues/budget/FY03Highlights-pr.cfm.

127 Reported at www.cdi.org/missile-defense/costs.
128 Coyle, op. cit. note 115.
129 This estimate was made before the conflict in Iraq.
130 M. Ciarrocca, "Post 9/11 Economic Windfalls for Arms Manufacturers", *Foreign Policy in Focus*, 26 September 2002, www.fpif.org.
131 Ibid.
132 See *SIPRI Yearbook 2002, World Armaments and Disarmament*, New York: Oxford University Press, 2002.
133 "Trillions Disappear", *International Herald Tribune*, 25 January 2002.
134 CBO, op. cit. note 78.
135 See M. Pemberton, "The Economic Costs of Going to War With Iraq", *Foreign Policy in Focus*, 13 September 2002, http://www.fpif.org/commentary/2002/0209warimpact.html.
136 P. Kennedy, *The Rise and Fall of the Great Powers: Economic Change and Military Conflict from 1500-2000*, London: Fontana, 1989.
137 The IMF warned in its *World Economic Outlook 2002* that the US current account deficit is unsustainable over the medium term to long-term. In response, the US Treasury Secretary called the current account a meaningless concept.
138 For a detailed analysis of the barriers to conversion in the nuclear weapons industry see C. Anderson, "Weapons Labs in a New World", *Science*, Vol. 26, No. 2, October 1993, pp. 168-171, and Office of Technology Assessment, *Defence Conversion: Redirecting R&D*, OTA-ITE-522, Washington D.C.: US Government Printing Office, 1993, pp. 3-120.
139 W. Weida, "The Economic Implications of Nuclear Weapons and Nuclear Deterrence", in Schwartz (ed.), op. cit. note 11, p. 529.
140 K. O'Neill, "The Cost of Building the Bomb", in Schwartz (ed.), op. cit. note 11, p. 44.
141 Schwartz (ed.), op. cit note 11, p. 29.
142 Ibid.
143 Ibid, p. 30.
144 This figure is derived from a DOE list published on 10 January 2001 The published list is of sites covered by the Energy Employees Occupational Illness Compensation Act of 2000. The list includes three types of facilities Atomic Weapons Employers: privately owned plants that process or produce radioactive materials for nuclear weapons; DOE facilities, buildings, structures or premises at which radioactive materials and beryllium were handled; and institutions with which the

DOE has a contractual relationship including universities and private companies contracted to provide management, environmental remediation, construction and maintenance services. For details see "The Sites", *Bulletin of Atomic Scientists*, Vol. 57, No. 4, July/August 2001.

145 GAO, *Waste Clean-up: Status and Implications of DOE's Compliance Agreements*, report to the Chairman, Subcommittee on Oversight and Investigations, Committee on Energy and Commerce, House of Representatives, GAO-02-567, May 2002, http://www.gao.gov, p. 6.

146 DOE, *Budget Highlights: Fiscal Year 2002 Budget Request*, April 2001, http://www.energy.gov/DOEBudget/Highlght.pdf, p. 41.

147 DOE, *Budget Highlights 2001*, Washington D.C.: US Government Printing Office, 2001.

148 O. Bukharin, "A Breakdown of Breakout: US and Russian Warhead Production Capabilities", *Arms Control Today*, 20 October 2002 http://www.armscontrol.org/act/2002_10/bukharinoct02.asp.

149 Senate Armed Service Committee, Hearing the Results of the Nuclear Posture Review, 14 February 2002 quoted in ibid.

150 Ibid.

151 Ibid.

152 J. Koplan, "Report to Congress: A Feasibility Study of the Health Consequences to the American Population of Nuclear Weapons Test Conducted by the United States and Other Nations", Centers for Disease Control and Prevention, Department of Health and Human Sciences, Atlanta, Georgia, August 2001, p. 6.

153 See the collection of articles in the special edition of the journal *Science for Democratic Action* entitled "Health and Environmental Impacts of Nuclear Weapons Production", Vol. 5, No. 3, October 1996, www/ieer.org/sdafiles/vol_5/v5n3_1.html.

154 A. Makhijan, "Radioactivity in the Fernald Neighbourhood", Vol. 5, No. 3, October 1996, www.ieer.org/sdafiles/vol_5/5-3/fern-res.html.

155 The plant was operated by National Lead of Ohio from 1951 through 1985.

156 A. Makhijani, B Franke and H. Zerriff, "Preliminary Partial Dose Estimates from Processing of Nuclear Materials at Three Plants during 1940and 1950s", IEER report for *USA Today*, 16 August 2000, www.usatoday.com/news/poison/uranium.htm.

157 Ibid.

158 Makhijani, op. cit. note 29 and Flynn, op. cit. note 29.

159 Figures reported in "Sick Plant Workers Could Get Sate Aid" *The Paducah Sun*, 20 June 2001.

160 For details of workers claims that are refused see B. Smith, "200 Pack Hearing on LANL Illnesses", *Albuquerque Journal North*, 12 May 2002, J. Carroll "Ill Paducah workers claims get difficult handling: Energy Departments slowness attacked: labours agency's speed praised", *The Courier Journal*, 19 May 2002, and "Sick Plant Workers Could Get Sate Aid", *The Paducah Sun*, 20 June 2001.

161 Makhijani, op. cit. note 158.

162 R. Alvarez, "Energy in Decay", *The Bulletin of the Atomic Scientists*, Vol. 56, No. 3, May/June 2000, http://www.thebulletin.org/issues/2000/mj00/mj00alvarez.html.

163 Ibid.

164 Ibid.

165 Ibid.

166 For details of levels of nuclear contamination N. Sachs, "Risky Relapse into Reprocessing: Environmental and Non-Proliferation Consequences of the Department of Energy's Spent Fuel Management Program", IEER Report, 1996, www.ier.org/reports/risky.htm, M. Fioranvanti and A. Makhijani, "Containing the Cold War Mess", IEER Report, 1997, www.ieer.org/reports/cleanup/summary.htm.

167 DOE, *Estimating the Cold War Mortgage: Baseline Environmental Management Report Vol 1*,Washington D.C.: US Government Printing Office, 19 May 1995.

168 GAO, *Nuclear Weapons Complex Establishing A National Risk Based Strategy for Clean Up*, GAO/T-RCED-95-120, 6 March 1995, http://www.gao.gov.

169 L. Rothstein, "Nothing clean about clean-up", *The Bulletin of the Atomic Scientists*, http://www.thebulletin.org/issues/1995/mj95/mj95.rothstein.html.

170 DOE, op. cit. note 146.

171 Ibid.

172 Ibid. p. 68.

173 Ibid. p. 69.

174 Ibid. p. 83.

175 GAO, *Waste Cleanup: Status and Implications of DOE's Compliance*, GAO-02-567, May 2002, http://www.gao.gov; GAO, *Nuclear Waste: DOE's Hanford Spent Nuclear Fuel Storage Project—Cost, Schedule and Management Issues*, GAO/RCED-99-267, September 1999, http://www.gao.gov; GAO, *Nuclear Waste: Department of Energy's Hanford*

*Tank Waste Project—Schedule, Cost and Management Issues*, GAO/RCED-99-13, 8 October 1998, http://www.gao.gov.

176 DOE, *A Review of the Environmental Management Program*, 4 February 2002, http://www.em.doe.gov/ttbr.pdf.

177 Alliance for Nuclear Accountability, *Critiquing the Department of Energy's Accelerated Cleanup Plans: A Summary of Comments Made to DOE Site Performance Management Plans*, August 2002, www.ananuclear.org/slushfundsummary.html.

178 GAP, *Blowing Off Safety at the Hanford Tank Farms, Toxic Negligence at Tank 103-C*, August 1997, http://www.whistleblower.org/uploads/103c.pdf.

179 Ibid.

180 R. Alvarez and T. Carpenter, *Review of the US Department of Energy's Closure Plan for the Hanford Site: Implications for the Columbia River and the People of the Pacific North West*, GAP, 4 June 2002, www.whistleblower.org/www/hanford.htm.

181 GAP, op. cit. note 179.

182 Rothstein op. cit. note 170.

183 N. Buske, *Hanford Radioactivity in Salmon Spawning Grounds: Quality, Extent and Some Implications*, Washington D.C.: US Government Printing Office, August 2002.

184 See details in Larin op. cit. note 26.

185 See for instance details in GAO, *Hanford Spent Fuel Storage Project-Cost, Schedule, and Management Issues*, GAO/RCED-99-267, Washington D.C.: US Government Printing Office, 20 September 1999,and GAO *Nuclear Waste Management Problems at the Department of Energy's Hanford Spent Fuel Storage Project*, GAO/T-RCED-98-119, 12 May 1998, http://www.gao.gov.

186 For different sides of the debate on plutonium disposition see articles in the special plutonium edition of *The Bulletin of the Atomic Scientists*, Vol. 57, No. 3, May/June 2001, http://www.thebulletin.org/issues/2001/mj01/mj01toc.html.

187 A. Macfarlane, F. von Hipple, J. Kang and R. Nelson, "Plutonium Disposal: The Third Way" *The Bulletin of the Atomic Scientists*, Vol. 57, No. 3, May/June2001, http://www.thebulletin.org/issues/2001/mj01/mj01vonhippel.html.

188 GAO, *Nuclear Nonproliferation and Safety: Uncertainties About the Implementation of US-Russian Plutonium Disposition Efforts,* GAO/RCED-98-46, 14 January 1998, http://www.gao.gov, p. 5.

189 Ibid. p. 2.

190 See "New Plans—Or No Plans—For Plutonium?", *The Bulletin of the Atomic Scientists*, 30 August 2001, http://www.thebulletin.org/bulletinwirearchive/BulletinWire010830.html.

191 See "Energy Department Tosses Immobilization", *The Bulletin of the Atomic Scientists*, 24 January 2002, http://www.thebulletin.org/bulletinwirearchive/BulletinWire020125.html.

192 R. Norris and W. Arkin, "NRDC Nuclear Notebook, Global Nuclear Stockpiles, 1945-2000", *The Bulletin of the Atomic Scientists*, March/April 2000, Vol. 56, No. 2, http://www.thebulletin.org/issues/nukenotes/ma00nukenote.html.

193 Ibid.

194 Roughly 50% of Russia's stockpile is active and the other 50% is retired or in reserve.

195 C. Gaddy, *The Price of the Past: Russia's Struggle with the Legacy of a Militarized Economy*, Washington D.C.: Brookings Institute, 1996, p. 11.

196 O. Bukharin, "A Breakdown of Breakout: US and Russian Warhead production Capabilities", *Arms Control Today*, 20 October 2002, http://www.armscontrol.org/act/2002_10/bukharinoct02.asp.

197 O. Bukharin, "Downsizing Russia's Nuclear Warhead Production Infrastructure", *The Nonproliferation Review*, Spring 2001, http://cns.miis.edu/pubs/npr/vol08/81/81bukh.pdf, p. 116.

198 M. Bunn, "Controlling Nuclear Warheads and Materials: New Priorities for a New President", Presentation to Seventh Annual International Nuclear Materials Policy Forum, Alexandria, VA, 8 September 2000, www.ksg.harvard.edu/bcsia/atom.

199 N. Buske, S. Pashenko and A. Toropov, *Radioactive Waste of River Tom*, 1 November 2000, www.whistleblower.org/Tomsk/River%20Tom%20web.pdf and Rothsteins, op. cit. note 170.

200 For details see the Bellona Foundation website at www.bellona.no.

201 This dumping was conducted under the utmost secrecy but during the period of Glasnost. The more open conditions led to the publication of an official report known as the Yablokov Report, which revealed the scale of the dumping.

202 For details see E. J. Kirk, "The Environmental Implications of Arms Control Agreements", paper prepared for the symposium Arms and the Environment: Preventing the perils of Disarmament, University of Tulsa, Tulsa Oklahoma, 9-10 December 1999.

203 This was the main subject of a conference held at the University of Tulsa, Tusla Oklahoma, 9-10 December 1999, entitled Arms and the

Environment: Preventing the Perils of Disarmament organized by the National Energy-Environment Law and Policy Institute (NELPI) The University of Tulsa College of Law, University of Oklahoma.

204 G. Lakshman and J. B. Aamodt, "Nuclear Arms Control: The Environmental Dimension", *Colorado Journal of International Environmental Law and Politics*, Vol. 267, 1999.

205 For more details see Z. Moss, "The Northern Dimension Environmental Partnership (NDEP)", Bellona Position Paper, 4 October 2002, http://www.bellona.no/en/international/russia/waste-mngment/ipwg/26350.html.

206 Under an initiative known as 10 Plus 10 Over 10 the G7 countries have pledged to spend up to US$ 20 billion over the next ten years to help Russia and the other successor states to secure and destroy their nuclear, chemical and biological weapon stockpiles and materials. The participatory countries are being encouraged to negotiate bilateral implementation deals with Russia. In the nuclear field the programme aims to prioritize the decommissioning of Russia's nuclear powered submarines, employ former nuclear scientists and secure Russia's vast stockpile of fissile materials. In executing these tasks the G7 have adopted a number of guidelines for the projects management and have pledged to annually review programmes under the initiative, including the creation of milestones to measure implementation. These measures have been adopted to avoid the sort of pitfalls that US-Russian bilateral cooperation efforts have encountered over the last ten years. See Appendix IV.

207 C. Digges, "Duma Deputy Mitrokhin to Fight for Evacuation of Mayak Area", 25 October 2002, http://www.bellona.no/en/international/russia/nuke_industry/siberia/mayak/26971.html.

208 Ibid.

209 Larin, op. cit. note 26.

210 For the full report see N. Buske, S. Pashenko and A. Toropov, *Radioactive Waste of River Tom*, GAP, 1 November 2000, www.whistleblower.org/Tomsk/River%20 Tom%20web.pdf.

211 Ibid. p. 2.

212 T. Carpenter, *Blowing the Whistle on Russia's Nuclear Roulette*, GAP, August 2000, www.whistleblower.org/Tomsk/.

213 Ibid.

214 Resolution from international Conference on Ecology and Human Rights, Chelyabinsk State University, Miass City, Chelyabinsk Oblast, 18-19 June 2002.

[215] For a discussion on loose nukes see A. W. M Gerrits, "Russia, the West and the Loose Nukes Syndrome", *International Relations*, Vol. XIV, No. 6, December 1999.

[216] See for instance G. T. Allison, *Avoiding Nuclear Anarchy: Containing the Threat of Loose Russian Nuclear Weapons and Fissile Materials*, Cambridge Mass.: The MIT Press, 1996 and R. Falkenrath, "Confronting Nuclear, Biological and Chemical Terrorism", *Survival*, Vol. 40, No. 3, Autumn 1998.

[217] G. Bertsch and S. Grillot (eds), *Arms on the Market: Reducing the Risk of Proliferation in the Former Soviet Union*, London: Routledge, 1998.

[218] For details on the smuggling of nuclear materials see R. Lee, *Smuggling Armageddon: The Nuclear Black Market in the Former Soviet Union and Europe*, New York: St Martin's Press, 1998 and R. Jones et al., *Tracking Nuclear Proliferation: A Guide in Maps and Charts 1998s*, Washington D.C.: Carnegie Endowment for International Peace, 1998. See also reports from the Bellona Foundation I. Kudruk, "Plutonium smuggler apprehended: Security of nuclear materials at issue in plutonium run", 21 May 1999, http://www.bellona.no/en/international/russia/nuke-weapons/nonproliferation/8838.html, T. Nilsen, "Collapse leads to nuclear smuggling", 4 September 1998, www.bellona.no/e and T. Nielsen, "Russian nuclear materials seized in Turkey", 8 September 1998, www.bellona.no/e.

[219] CBO, *Cooperative Approaches to Halt Russian Nuclear proliferation and Improve the Openness of Nuclear Disarmament*, May 1999, www.fas.oreg/nuke/control/ctr/news/990500-cbo-ctr.htm.

[220] For a detailed assessment of the evolution and outcomes of US preventive threat reduction programmes see Dunn (et. al.), op. cit. note 38.

[221] Ibid.

[222] Ibid., p. III-87.

[223] CBO, op. cit. note 219.

[224] Ibid.

[225] C. D. Ferguson, "The price for nuclear security", *The Progressive*, September 1998.

[226] GAO, *Nuclear Nonproliferation: Concerns with DOE's Efforts to Reduce the Risks Posed by Russia's Unemployed Weapons Scientists*, GAO/ RCED-99-54, February 1999, http://www.gao.gov.

[227] F. Wehling, "The Way Forward for US-Russian Nonproliferation Cooperation", *CNS Report*, 25 July 2001, http://cns.miss.edu.

228 For a recent discussion of nuclear smuggling attempts see R. Edwards, "Nuclear Boom," *New Scientist Magazine*, 9 May 2001.

229 GAO, *Nuclear Nonproliferation: DOE Efforts to Assist Weapons Scientists in Russia's Nuclear Cities Face Challenges*, GAO-01-429, 3 May 2001, http://www.gao.gov and GAO, op. cit. note 229.

230 S. Hecker, "Thoughts about an Integrated Strategy for Nuclear Cooperation with Russia", *The Non-proliferation Review*, Vol. 8 No. 2, Summer 2001.

231 R. Norriss and W. Arkin, "Nuclear Notebook: World Plutonium Inventories, 1999", *Bulletin of Atomic Scientists*, Vol. 55, No. 5, September/October 1999, http://www.thebulletin.org/issues/nukenotes/so99nukenote.html, p. 71.

232 Minatom, *Strategy for the Development of Power Engineering in Russia for the First Half of the 21st Century: Principal Provisions*, Moscow: Ministry of Atomic Power Engineering of the Russian Federation, 2000, pp. 17-18.

233 For the Russian cost estimate, see Joint US-Russian Working Group on Cost Analysis and Economics in Plutonium Disposition, *Preliminary Cost Assessment for the Disposition of Weapon-Grade Plutonium Withdrawn from Russia's Nuclear Military Programs*, April 2000, www.doe-md.com/, p. iii.

234 A. Koch, "US Review to Aid Russia's WMD Legacy Programmes", *Jane's Defence Weekly*, 9 January 2002.

235 Hoehn, op. cit. note 70.

236 For recent details of the achievements of the threat reduction programmes see M. Roston and D. Smigielski, *Accomplishments of Selected Threat Reduction and Nonproliferation Programs in Russia, By Agency*, US-Russian Nuclear Security Advisory Council, May 2002, www.ransac.org.

237 Hecker, op. cit. note 233.

238 K. Luongo, *Options for Increased US-Russian Non-proliferation Co-operation and Project Costs*, US-Russian Nuclear Security Advisory Council, October 2001, www.ransac.org.

239 GAO, op. cit. note 9, GAO, *Weapons of Mass Destruction: Effort to Reduce Arsenals May Cost More, Achieve Less Than Planned*, GAO/NSIAD –99-76, April 1999, http://www.gao.gov, GAO, op. cit. note 9, GAO, *Weapons of Mass Destruction: Status of the Cooperative Threat Reduction Programme*, GAO/NSIAD 96-222, 27 September 1996, http://www.gao.gov.

## APPENDIX 1

## STRATEGIC NUCLEAR FORCES OF THE FORMER SOVIET UNION[1]

**Number of "START-Accountable" Strategic Warheads**
(As of 31 July 2001)

| | Russia | Ukraine | Kazakhstan | Belarus |
|---|---|---|---|---|
| ICBMs | 3,364 | 130 | 0 | 0 |
| SLBMs | 1,868 | 0 | 0 | 0 |
| Bombers | 626 | 0 | 0 | 0 |
| **Total** | **5,858** | **130** | **0** | **0** |

**Number of "START-Accountable" Strategic Nuclear Delivery Vehicles**

| | Russia | Ukraine | Kazakhstan | Belarus |
|---|---|---|---|---|
| ICBMs | 742 | 13 | 0 | 0 |
| SLBMs | 376 | 0 | 0 | 0 |
| Bombers | 80 | 0 | 0 | 0 |
| **Total** | **1,198** | **13** | **0** | **0** |

***Notes***

1. START I limits the United States and Russia to 6,000 "accountable" warheads each, with an implementation deadline of December 2001. All data is taken from the initial START I Memorandum of Understanding (MOU) of 1 September 1990 and the most recent MOU of 31 July 2001. Figures are based on START counting rules, as negotiated between the United States and the Soviet Union and specified

[1] See Arms Control Today, *Fact Sheet*, 2001, http://www.armscontrol.org/factsheets/.

in the Treaty text. Thus, numbers do not necessarily reflect those weapons systems that are operationally deployed.

2. Strategic nuclear weapons were located in Russia, Ukraine, Belarus and Kazakhstan when the Soviet Union dissolved in 1991. Belarus and Kazakhstan rapidly transferred nuclear warheads back to Russia and transferred or destroyed their associated delivery systems. Ukraine completed the transfer of nuclear warheads back to Russia in 1996 but continues to destroy delivery systems, including missile silos and heavy bombers that remain START accountable until their final destruction.

**Changes in Former Soviet Strategic Forces since 1990**

| | Soviet Union September 1990 | | Former Soviet Union July 2001 | |
|---|---|---|---|---|
| | **Delivery Vehicles** | **Warheads** | **Delivery Vehicles** | **Warheads** |
| **ICBMs** | | | | |
| SS-11 | 326 | 326 | 0 | 0 |
| SS-13 | 40 | 40 | 0 | 0 |
| SS-17 | 47 | 188 | 0 | 0 |
| SS-18 | 308 | 3,080 | 166 | 1,660 |
| SS-19 | 300 | 1,800 | 150 | 900 |
| SS-24 (silo) | 56 | 560 | 6 | 60 |
| SS-24 (rail) | 33 | 330 | 36 | 360 |
| SS-25 | 288 | 288 | 360 | 360 |
| SS-27 (silo) | 0 | 0 | 24 | 24 |
| **Subtotal** | **1,398** | **6,612** | **742** | **3,364** |
| **SLBMs** | | | | |
| SS-N-6 | 192 | 192 | 0 | 0 |
| SS-N-8 | 280 | 280 | 36 | 36 |
| SS-N-17 | 12 | 12 | 0 | 0 |
| SS-N-18 | 224 | 672 | 128 | 384 |
| SS-N-20 | 120 | 1,200 | 100 | 1,000 |
| SS-N-23 | 112 | 448 | 112 | 448 |
| **Subtotal** | **940** | **2,804** | **376** | **1,868** |

| | Soviet Union September 1990 | | Former Soviet Union July 2001 | |
|---|---|---|---|---|
| | **Delivery Vehicles** | **Warheads** | **Delivery Vehicles** | **Warheads** |
| **Bombers** | | | | |
| Bear (ALCM) | 84 | 672 | 63 | 504 |
| Bear (Non-ALCM) | 63 | 63 | 2 | 2 |
| Blackjack | 15 | 120 | 15 | 120 |
| **Subtotal** | **162** | **855** | **80** | **626** |
| | | | | |
| **Total** | **2,500** | **10,271** | **1,198** | **5,858** |

**Legend**

| | |
|---|---|
| ALCM | Air-Launched Cruise Missile |
| ICBM | Intercontinental Ballistic Missile |
| SNDV | Strategic Nuclear Delivery Vehicle |
| SLBM | Submarine-Launched Ballistic Missile |
| WH | Warhead |

## APPENDIX 2

## CURRENT US STRATEGIC NUCLEAR FORCES[1]

**Number of "START-Accountable" Strategic Nuclear Forces**
(As of 5 December 2001)

| | Delivery Vehicles | Warheads |
|---|---|---|
| **ICBMs** | 551 | 1,701 |
| **SLBMs** | 432 | 3,120 |
| **Bombers** | 255 | 1,128 |
| **Total** | 1,238 | 5,949 |

***Notes***

1. The United States met the START I implementation deadline of 5 December 2001, seven years after the Treaty's entry into force. The Treaty limits the United States and Russia each to 6,000 "accountable" warheads and 1,600 delivery vehicles (missiles and bombers). All data is taken from the initial START I MOU of 1 September 1990 and December 2001 interviews with US Department of State officials.

2. All figures are based on START counting rules, as negotiated between the United States and the Soviet Union and specified in the Treaty text. Thus, numbers do not necessarily reflect those weapons systems that are operationally deployed. For example, under START I, heavy bombers that are not equipped to carry long-range nuclear air-launched cruise missiles will be counted as carrying only one warhead, regardless of the number of bombs or short-range attack missiles that they actually carry. Moreover, 150 US heavy bombers that are capable of carrying ALCMs will be counted as carrying only 10 missiles each, even though they have the capacity to hold 20 missiles each.

---

1 See Arms Control Today, *Fact Sheet*, 2002, http://www.armscontrol.org/factsheets/.

**Changes in US Strategic Forces Since 1990**

| | Delivery Vehicles | | Warheads | |
|---|---|---|---|---|
| | **September 1990** | **December 2001** | **September 1990** | **December 2001** |
| **ICBMs** | | | | |
| MX/Peacekeeper | 50 | 50 | 500 | 500 |
| Minuteman III | 500 | 500 | 1,500 | 1,200 |
| Minuteman II | 450 | 1 | 450 | 1 |
| **Subtotal** | **1,000** | **551** | **2,450** | **1,701** |
| SLBMs | | | | |
| Poseidon (C-3) | 192 | 0 | 1,920 | 0 |
| Trident I (C-4) | 384 | 168 | 3,072 | 1,008 |
| Trident II (D-5) | 96 | 264 | 768 | 2,112 |
| **Subtotal** | **672** | **432** | **5,760** | **3,120** |
| **Bombers** | | | | |
| B-52 (ALCM) | 189 | 97 | 1,968 | 970 |
| B-52 (Non-ALCM) | 290 | 47 | 290 | 47 |
| B-1 | 95 | 91 | 95 | 91 |
| B-2 | 0 | 20 | 0 | 20 |
| **Subtotal** | **574** | **255** | **2,353** | **1,128** |
| | | | | |
| **Total** | **2,246** | **1,238** | **10,563** | **5,949** |

**Legend**

| | |
|---|---|
| ALCM | Air-Launched Cruise Missile |
| ICBM | Intercontinental Ballistic Missile |
| SLBM | Submarine-Launched Ballistic Missile |

## APPENDIX 3

## STRATEGIC OFFENSIVE REDUCTIONS TREATY AND JOINT STATEMENT OF PRESIDENT BUSH AND PRESIDENT PUTIN

### Treaty Between the United States of America and the Russian Federation on Strategic Offensive Reductions

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

Embarking upon the path of new relations for a new century and committed to the goal of strengthening their relationship through cooperation and friendship,

Believing that new global challenges and threats require the building of a qualitatively new foundation for strategic relations between the Parties,

Desiring to establish a genuine partnership based on the principles of mutual security, cooperation, trust, openness, and predictability,

Committed to implementing significant reductions in strategic offensive arms,

Proceeding from the Joint Statements by the President of the United States of America and the President of the Russian Federation on Strategic Issues of July 22, 2001 in Genoa and on a New Relationship between the United States and Russia of November 13, 2001 in Washington,

Mindful of 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,

Mindful of their obligations under Article VI of the Treaty on the Non-Proliferation of Nuclear Weapons of July 1, 1968, and

Convinced that this Treaty will help to establish more favorable conditions for actively promoting security and cooperation, and enhancing international stability,

Have agreed as follows:

**Article I**

Each Party shall reduce and limit strategic nuclear warheads, as stated by the President of the United States of America on November 13, 2001 and

as stated by the President of the Russian Federation on November 13, 2001 and December 13, 2001 respectively, so that by December 31, 2012 the aggregate number of such warheads does not exceed 1700-2200 for each Party. Each Party shall determine for itself the composition and structure of its strategic offensive arms, based on the established aggregate limit for the number of such warheads.

**Article II**

The Parties agree that the START Treaty remains in force in accordance with its terms.

**Article III**

For purposes of implementing this Treaty, the Parties shall hold meetings at least twice a year of a Bilateral Implementation Commission.

**Article IV**

1. This Treaty 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.

2. This Treaty shall remain in force until December 31, 2012 and may be extended by agreement of the Parties or superseded earlier by a subsequent agreement.

3. Each Party, in exercising its national sovereignty, may withdraw from this Treaty upon three months written notice to the other Party.

**Article V**

This Treaty shall be registered pursuant to Article 102 of the Charter of the United Nations.

Done at Moscow on May 24, 2002, in two copies, each in the English and Russian languages, both texts being equally authentic.

FOR THE UNITED STATES OF AMERICA: [signed]

FOR THE RUSSIAN FEDERATION: [signed]

*Source*: *White House, 2002.*

## Joint Statement

The United States of America and the Russian Federation,

Recalling the accomplishments at the Ljubljana, Genoa, Shanghai, and Washington/Crawford Summits and the new spirit of cooperation already achieved;

Building on the November 13, 2001 Joint Statement on a New Relationship Between the United States and Russia, having embarked upon the path of new relations for the twenty-first century, and committed to developing a relationship based on friendship, cooperation, common values, trust, openness, and predictability;

Reaffirming our belief that new global challenges and threats require a qualitatively new foundation for our relationship;

Determined to work together, with other nations and with international organizations, to respond to these new challenges and threats, and thus contribute to a peaceful, prosperous, and free world and to strengthening strategic security;

Declare as follows:

### A Foundation for Cooperation

We are achieving a new strategic relationship. The era in which the United States and Russia saw each other as an enemy or strategic threat has ended. We are partners and we will cooperate to advance stability, security, and economic integration, and to jointly counter global challenges and to help resolve regional conflicts.

To advance these objectives the United States and Russia will continue an intensive dialogue on pressing international and regional problems, both on a bilateral basis and in international fora, including in the UN Security Council, the G-8, and the OSCE. Where we have differences, we will work to resolve them in a spirit of mutual respect.

We will respect the essential values of democracy, human rights, free speech and free media, tolerance, the rule of law, and economic opportunity.

We recognize that the security, prosperity, and future hopes of our peoples rest on a benign security environment, the advancement of political and economic freedoms, and international cooperation.

The further development of US-Russian relations and the strengthening of mutual understanding and trust will also rest on a growing network of ties between our societies and peoples. We will support growing economic interaction between the business communities of our two countries and people-to-people and cultural contacts and exchanges.

**Political Cooperation**

The United States and Russia are already acting as partners and friends in meeting the new challenges of the 21st century; affirming our Joint Statement of October 21, 2001, our countries are already allied in the global struggle against international terrorism.

The United States and Russia will continue to cooperate to support the Afghan people's efforts to transform Afghanistan into a stable, viable nation at peace with itself and its neighbors. Our cooperation, bilaterally and through the United Nations, the "Six-Plus-Two" diplomatic process, and in other multilateral fora, has proved important to our success so far in ridding Afghanistan of the Taliban and al-Qaida.

In Central Asia and the South Caucasus, we recognize our common interest in promoting the stability, sovereignty, and territorial integrity of all the nations of this region. The United States and Russia reject the failed model of "Great Power" rivalry that can only increase the potential for conflict in those regions. We will support economic and political development and respect for human rights while we broaden our humanitarian cooperation and cooperation on counter-terrorism and counter-narcotics.

The United States and Russia will cooperate to resolve regional conflicts, including those in Abkhazia and Nagorno-Karabakh, and the Transnistrian issue in Moldova. We strongly encourage the Presidents of Azerbaijan and Armenia to exhibit flexibility and a constructive approach to resolving the conflict concerning Nagorno-Karabakh. As two of the Co-Chairmen of the OSCE's Minsk Group, the United States and Russia stand ready to assist in these efforts.

On November 13, 2001, we pledged to work together to develop a new relationship between NATO and Russia that reflects the new strategic reality in the Euro-Atlantic region. We stressed that the members of NATO and Russia are increasingly allied against terrorism, regional instability, and other contemporary threats. We therefore welcome the inauguration at the May 28, 2002 NATO-Russia summit in Rome of a new NATO-Russia Council, whose members, acting in their national capacities and in a manner consistent with their respective collective commitments and obligations, will identify common approaches, take joint decisions, and bear equal responsibility, individually and jointly, for their implementation. In this context, they will observe in good faith their obligations under international law, including the UN Charter, provisions and principles contained in the Helsinki Final Act and the OSCE Charter for European Security. In the framework of the NATO-Russia Council, NATO member states and Russia will work as equal partners in areas of common interest. They aim to stand together against common threats and risks to their security.

As co-sponsors of the Middle East peace process, the United States and Russia will continue to exert joint and parallel efforts, including in the framework of the "Quartet," to overcome the current crisis in the Middle East, to restart negotiations, and to encourage a negotiated settlement. In the Balkans, we will promote democracy, ethnic tolerance, self-sustaining peace, and long-term stability, based on respect for the sovereignty and territorial integrity of the states in the region and United Nations Security Council resolutions. The United States and Russia will continue their constructive dialogue on Iraq and welcome the continuation of special bilateral discussions that opened the way for UN Security Council adoption of the Goods Review List.

Recalling our Joint Statement of November 13, 2001 on counternarcotics cooperation, we note that illegal drug trafficking poses a threat to our peoples and to international security, and represents a substantial source of financial support for international terrorism. We are committed to intensifying cooperation against this threat, which will bolster both the security and health of the citizens of our countries.

The United States and Russia remain committed to intensifying cooperation in the fight against transnational organized crime. In this

regard, we welcome the entry into force of the Treaty on Mutual Legal Assistance in Criminal Matters on January 31, 2002.

**Economic Cooperation**

The United States and Russia believe that successful national development in the 21st century demands respect for the discipline and practices of the free market. As we stated on November 13, 2001, an open market economy, the freedom of economic choice, and an open democratic society are the most effective means to provide for the welfare of the citizens of our countries.

The United States and Russia will endeavor to make use of the potential of world trade to expand the economic ties between the two countries, and to further integrate Russia into the world economy as a leading participant, with full rights and responsibilities, consistent with the rule of law, in the world economic system. In this connection, the sides give high priority to Russia's accession to the World Trade Organization on standard terms.

Success in our bilateral economic and trade relations demands that we move beyond the limitations of the past. We stress the importance and desirability of graduating Russia from the emigration provisions of the US Trade Act of 1974, also known as the Jackson-Vanik Amendment. We note that the Department of Commerce, based on its ongoing thorough and deliberative inquiry, expects to make its final decision no later than June 14, 2002 on whether Russia should be treated as a market economy under the provisions of US trade law. The sides will take further practical steps to eliminate obstacles and barriers, including as appropriate in the legislative area, to strengthen economic cooperation.

We have established a new dynamic in our economic relations and between our business communities, aimed at advancing trade and investment opportunities while resolving disputes, where they occur, constructively and transparently.

The United States and Russia acknowledge the great potential for expanding bilateral trade and investment, which would bring significant benefits to both of our economies. Welcoming the recommendations of the Russian-American Business Dialogue, we are committed to working with

the private sectors of our countries to realize the full potential of our economic interaction. We also welcome the opportunity to intensify cooperation in energy exploration and development, especially in oil and gas, including in the Caspian region.

**Strengthening People-to-People Contacts**

The greatest strength of our societies is the creative energy of our citizens. We welcome the dramatic expansion of contacts between Americans and Russians in the past ten years in many areas, including joint efforts to resolve common problems in education, health, the sciences, and environment, as well as through tourism, sister-city relationships, and other people-to-people contacts. We pledge to continue supporting these efforts, which help broaden and deepen good relations between our two countries.

Battling the scourge of HIV/AIDS and other deadly diseases, ending family violence, protecting the environment, and defending the rights of women are areas where US and Russian institutions, and especially non-governmental organizations, can successfully expand their cooperation.

**Preventing the Spread of Weapons of Mass Destruction: Non-Proliferation and International Terrorism**

The United States and Russia will intensify joint efforts to confront the new global challenges of the twenty-first century, including combating the closely linked threats of international terrorism and the proliferation of weapons of mass destruction and their means of delivery. We believe that international terrorism represents a particular danger to international stability as shown once more by the tragic events of September 11, 2001. It is imperative that all nations of the world cooperate to combat this threat decisively. Toward this end, the United States and Russia reaffirm our commitment to work together bilaterally and multilaterally.

The United States and Russia recognize the profound importance of preventing the spread of weapons of mass destruction and missiles. The specter that such weapons could fall into the hands of terrorists and those who support them illustrates the priority all nations must give to combating proliferation.

To that end, we will work closely together, including through cooperative programs, to ensure the security of weapons of mass destruction and missile technologies, information, expertise, and material. We will also continue cooperative threat reduction programs and expand efforts to reduce weapons-usable fissile material. In that regard, we will establish joint experts groups to investigate means of increasing the amount of weapons-usable fissile material to be eliminated, and to recommend collaborative research and development efforts on advanced, proliferation-resistant nuclear reactor and fuel cycle technologies. We also intend to intensify our cooperation concerning destruction of chemical weapons.

The United States and Russia will also seek broad international support for a strategy of proactive non-proliferation, including by implementing and bolstering the Treaty on the Non-Proliferation of Nuclear Weapons and the conventions on the prohibition of chemical and biological weapons. The United States and Russia call on all countries to strengthen and strictly enforce export controls, interdict illegal transfers, prosecute violators, and tighten border controls to prevent and protect against proliferation of weapons of mass destruction.

**Missile Defense, Further Strategic Offensive Reductions, New Consultative Mechanism on Strategic Security**

The United States and Russia proceed from the Joint Statements by the President of the United States of America and the President of the Russian Federation on Strategic Issues of July 22, 2001 in Genoa and on a New Relationship Between the United States and Russia of November 13, 2001 in Washington.

The United States and Russia are taking steps to reflect, in the military field, the changed nature of the strategic relationship between them.

The United States and Russia acknowledge that today's security environment is fundamentally different than during the Cold War.

In this connection, the United States and Russia have agreed to implement a number of steps aimed at strengthening confidence and increasing transparency in the area of missile defense, including the exchange of information on missile defense programs and tests in this area, reciprocal visits to observe missile defense tests, and observation aimed at

familiarization with missile defense systems. They also intend to take the steps necessary to bring a joint center for the exchange of data from early warning systems into operation.

The United States and Russia have also agreed to study possible areas for missile defense cooperation, including the expansion of joint exercises related to missile defense, and the exploration of potential programs for the joint research and development of missile defense technologies, bearing in mind the importance of the mutual protection of classified information and the safeguarding of intellectual property rights.

The United States and Russia will, within the framework of the NATO-Russia Council, explore opportunities for intensified practical cooperation on missile defense for Europe.

The United States and Russia declare their intention to carry out strategic offensive reductions to the lowest possible levels consistent with their national security requirements and alliance obligations, and reflecting the new nature of their strategic relations.

A major step in this direction is the conclusion of the Treaty Between the United States of America and the Russian Federation on Strategic Offensive Reductions.

In this connection, both sides proceed on the basis that 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, remains in force in accordance with its terms and that its provisions will provide the foundation for providing confidence, transparency, and predictability in further strategic offensive reductions, along with other supplementary measures, including transparency measures, to be agreed.

The United States and Russia agree that a new strategic relationship between the two countries, based on the principles of mutual security, trust, openness, cooperation, and predictability requires substantive consultation across a broad range of international security issues. To that end we have decided to:

- establish a Consultative Group for Strategic Security to be chaired by Foreign Ministers and Defense Ministers with the participation of other senior officials. This group will be the principal mechanism through which the sides strengthen mutual confidence, expand transparency, share information and plans, and discuss strategic issues of mutual interest; and
- seek ways to expand and regularize contacts between our two countries' Defense Ministries and Foreign Ministries, and our intelligence agencies.

THE PRESIDENT OF THE UNITED STATES OF AMERICA:

THE PRESIDENT OF THE RUSSIAN FEDERATION:

Moscow
May 24, 2002

## APPENDIX IV

## KANANASKIS SUMMIT
## CANADA, 2002

### STATEMENT BY THE GROUP OF EIGHT LEADERS

### The G8 Global Partnership Against the Spread of Weapons and Materials of Mass Destruction

The attacks of September 11 demonstrated that terrorists are prepared to use any means to cause terror and inflict appalling casualties on innocent people. We commit ourselves to prevent terrorists, or those that harbour them, from acquiring or developing nuclear, chemical, radiological and biological weapons; missiles; and related materials, equipment and technology. We call on all countries to join us in adopting the set of non-proliferation principles we have announced today.

In a major initiative to implement those principles, we have also decided today to launch a new G8 Global Partnership against the Spread of Weapons and Materials of Mass Destruction. Under this initiative, we will support specific cooperation projects, initially in Russia, to address non-proliferation, disarmament, counter-terrorism and nuclear safety issues. Among our priority concerns are the destruction of chemical weapons, the dismantlement of decommissioned nuclear submarines, the disposition of fissile materials and the employment of former weapons scientists. We will commit to raise up to $20 billion to support such projects over the next ten years. A range of financing options, including the option of bilateral debt for program exchanges, will be available to countries that contribute to this Global Partnership. We have adopted a set of guidelines that will form the basis for the negotiation of specific agreements for new projects, that will apply with immediate effect, to ensure effective and efficient project development, coordination and implementation. We will review over the next year the applicability of the guidelines to existing projects.

Recognizing that this Global Partnership will enhance international security and safety, we invite other countries that are prepared to adopt its common principles and guidelines to enter into discussions with us on

participating in and contributing to this initiative. We will review progress on this Global Partnership at our next Summit in 2003.

## The G8 Global Partnership: Principles to prevent terrorists, or those that harbour them, from gaining access to weapons or materials of mass destruction

The G8 calls on all countries to join them in commitment to the following six principles to prevent terrorists or those that harbour them from acquiring or developing nuclear, chemical, radiological and biological weapons; missiles; and related materials, equipment and technology.

1. Promote the adoption, universalization, full implementation and, where necessary, strengthening of multilateral treaties and other international instruments whose aim is to prevent the proliferation or illicit acquisition of such items; strengthen the institutions designed to implement these instruments.

2. Develop and maintain appropriate effective measures to account for and secure such items in production, use, storage and domestic and international transport; provide assistance to states lacking sufficient resources to account for and secure these items.

3. Develop and maintain appropriate effective physical protection measures applied to facilities which house such items, including defence in depth; provide assistance to states lacking sufficient resources to protect their facilities.

4. Develop and maintain effective border controls, law enforcement efforts and international cooperation to detect, deter and interdict in cases of illicit trafficking in such items, for example through installation of detection systems, training of customs and law enforcement personnel and cooperation in tracking these items; provide assistance to states lacking sufficient expertise or resources to strengthen their capacity to detect, deter and interdict in cases of illicit trafficking in these items.

5. Develop, review and maintain effective national export and transshipment controls over items on multilateral export control lists, as

well as items that are not identified on such lists but which may nevertheless contribute to the development, production or use of nuclear, chemical and biological weapons and missiles, with particular consideration of end-user, catch-all and brokering aspects; provide assistance to states lacking the legal and regulatory infrastructure, implementation experience and/or resources to develop their export and transshipment control systems in this regard.

6. Adopt and strengthen efforts to manage and dispose of stocks of fissile materials designated as no longer required for defence purposes, eliminate all chemical weapons, and minimize holdings of dangerous biological pathogens and toxins, based on the recognition that the threat of terrorist acquisition is reduced as the overall quantity of such items is reduced.

## The G8 Global Partnership: Guidelines for New or Expanded Cooperation Projects

The G8 will work in partnership, bilaterally and multilaterally, to develop, coordinate, implement and finance, according to their respective means, new or expanded cooperation projects to address (i) non-proliferation, (ii) disarmament, (iii) counter-terrorism and (iv) nuclear safety (including environmental) issues, with a view to enhancing strategic stability, consonant with our international security objectives and in support of the multilateral non-proliferation regimes. Each country has primary responsibility for implementing its non-proliferation, disarmament, counter-terrorism and nuclear safety obligations and requirements and commits its full cooperation within the Partnership.

Cooperation projects under this initiative will be decided and implemented, taking into account international obligations and domestic laws of participating partners, within appropriate bilateral and multilateral legal frameworks that should, as necessary, include the following elements:

(i) Mutually agreed effective monitoring, auditing and transparency measures and procedures will be required in order to ensure that cooperative activities meet agreed objectives (including irreversibility as necessary), to confirm work performance, to account for the funds

expended and to provide for adequate access for donor representatives to work sites;

(ii) The projects will be implemented in an environmentally sound manner and will maintain the highest appropriate level of safety;

(iii) Clearly defined milestones will be developed for each project, including the option of suspending or terminating a project if the milestones are not met;

(iv) The material, equipment, technology, services and expertise provided will be solely for peaceful purposes and, unless otherwise agreed, will be used only for the purposes of implementing the projects and will not be transferred. Adequate measures of physical protection will also be applied to prevent theft or sabotage;

(v) All governments will take necessary steps to ensure that the support provided will be considered free technical assistance and will be exempt from taxes, duties, levies and other charges;

(vi) Procurement of goods and services will be conducted in accordance with open international practices to the extent possible, consistent with national security requirements;

(vii) All governments will take necessary steps to ensure that adequate liability protections from claims related to the cooperation will be provided for donor countries and their personnel and contractors;

(viii) Appropriate privileges and immunities will be provided for government donor representatives working on cooperation projects; and

(ix) Measures will be put in place to ensure effective protection of sensitive information and intellectual property.

Given the breadth and scope of the activities to be undertaken, the G8 will establish an appropriate mechanism for the annual review of progress under this initiative which may include consultations regarding priorities, identification of project gaps and potential overlap, and assessment of consistency of the cooperation projects with international security

obligations and objectives. Specific bilateral and multilateral project implementation will be coordinated subject to arrangements appropriate to that project, including existing mechanisms.

For the purposes of these guidelines, the phrase "new or expanded cooperation projects" is defined as cooperation projects that will be initiated or enhanced on the basis of this Global Partnership. All funds disbursed or released after its announcement would be included in the total of committed resources. A range of financing options, including the option of bilateral debt for program exchanges, will be available to countries that contribute to this Global Partnership.

The Global Partnership's initial geographic focus will be on projects in Russia, which maintains primary responsibility for implementing its obligations and requirements within the Partnership.

In addition, the G8 would be willing to enter into negotiations with any other recipient countries, including those of the Former Soviet Union, prepared to adopt the guidelines, for inclusion in the Partnership.

Recognizing that the Global Partnership is designed to enhance international security and safety, the G8 invites others to contribute to and join in this initiative.

With respect to nuclear safety and security, the partners agreed to establish a new G8 Nuclear Safety and Security Group by the time of our next Summit.

## Kananaskis Principles
## NPT Preparatory Committee Meeting (Geneva, 2 May 2003)

- The G8 Summit held in Kananaskis, Canada, in June 2002, was the first meeting of G8 leaders following the attack of 11 September 2001. The Kananaskis Summit provided an opportunity to pool G8 efforts to face the terrorist threat. In their Statement at the end of the Summit, the G8 leaders reaffirmed their determination to undertake sustained and far-reaching action to deprive terrorists from all support and reduce the threat they represent. More generally, this initiative is part of the efforts by G8 countries to combat the proliferation of weapons of mass

destruction. This concerns in particular nuclear weapons and the use of related materials and technology, as well as materials that may be used to manufacture radiological bombs.

- To this end, the G8 leaders have taken a twofold initiative:

  - they adopted a set of ***six principles*** ***to prevent terrorists, or those who harbour them, from acquiring or developing weapons of mass destruction and related materials***;

  - they launched a new ***G8 Global Partnership against the Spread of Weapons and Materials of Mass Destruction***. The G8 countries have pledged to raise up to $20 billion over the next ten years to support this initiative. This Global Partnership is aimed at putting in place a new framework for cooperation between donor and recipient countries, on the basis of agreed guidelines. These ***guidelines for new or expanded cooperation projects***, and the six principles defined at Kananaskis, appear in the Statement by G8 leaders on the Global Partnership published at the end of the Kananaskis Summit.

- **The principles defined at Kananaskis** aim to promote the adoption, universalization and full implementation of the multilateral instruments whose aim is to prevent the proliferation or illicit acquisition of the materials concerned (**Principle 1**). These principles are also aimed at developing and maintaining effective measures for the control of facilities for the production, use, storage and domestic and international transport of such items (**Principles 2 and 3**). These principles are further aimed at developing and maintaining effective border controls to deter illicit trafficking in such items (Principle 4); and at controlling national exports and transshipments of items on multilateral export control lists or which contribute to the development, production and use of weapons of mass destruction (**Principle 5**). Finally, these principles aim to promote the disposition of stocks of weapons-grade fissile materials designated as no longer required for defence purposes and the elimination of all chemical weapons, and to minimize holdings of dangerous biological pathogens and toxins (**Principle 6**).

- These principles apply fully to nuclear technology, and help to supplement the list of major international instruments promoting non-proliferation, disarmament and nuclear security. In this sense, the Kananaskis Principles help to further the NPT objectives.

- These principles demonstrate the G8's will to increase security on a global scale. **The G8 therefore invites all countries to join G8 countries in adhering to and implementing these six principles.** This can be done by sending a Note Verbale to France as holder of the G8's Chair, through the French Mission to the United Nations in New York.

## RECENT UNIDIR PUBLICATIONS[1]

Research Reports / Rapports de recherche

***Desarme nuclear: Regímenes internacional, latinoaméricano y argentio de no proliferación***, por Marcelo F. Valle Fonrouge, 2003, 146p., United Nations publication, Sales No. GV.S.03.0.24.

***Coming to Terms with Security: A Lexicon for Arms Control, Disarmament and Confidence-Building***, by Steve Tulliu and Thomas Schmalberger, 2003, 252p., United Nations publication, Sales No. GV.E/A.03.0.21.

* Also available in Arabic, 278p., Sales No. GV.E/A.03.0.21.

***Destroying Surplus Weapons: An Assessment of Experience in South Africa and Lesotho***, by Sarah Meek and Noel Stott, 2003, 102p., United Nations publication, Sales No. GV.E.03.0.18.

***Lutte contre la prolifération des armes légPres en Afrique de l'Ouest: Manuel de formation des forces armées et de sécurité***, sous la direction de Anatole Ayissi et Ibrahima Sall, 2003, 150p., publication des Nations Unies, numéro de vente: GV.F.03.0.17.

***Coming to Terms with Security: A Handbook on Verification and Compliance***, 2003, 158p., United Nations publication, Sales No. GV.E/A.03.0.12.

* Also available in Arabic, 172p., Sales No. GV.E/A.03.0.12.

***Internal Conflict and Regional Security in South Asia: Approaches, Perspectives and Policies***, by Shiva Hari Dahal, Haris Gazdar, S.I. Keethaponcalan and Padmaja Murthy, 2003, 62p., United Nations publication, Sales No. GV.E.03.0.10.

***The Scope and Implications of a Tracing Mechanism for Small Arms and Light Weapons***, 2003, 238p., United Nations publication, Sales No. GV.E.03.0.7.

***Participatory Monitoring of Humanitarian Mine Action: Giving Voice to Citizens of Nicaragua, Mozambique and Cambodia***, by Susan Willett (ed.), 2003, 122p., United Nations publication, Sales No. GV.E.03.0.6.

---

1 For a complete list, please see our Web site at www.unidir.org, or contact Anita Blétry: Tel.: +41(0)22 917.42.63, Fax: 917.01.76, abletry@unog.ch.

***The Treaty of Pelindaba on the African Nuclear-Weapon-Free Zone***, by Oluyemi Adeniji, 2002, 332p., United Nations publication, Sales No. GV.E.03.0.5.

***Project Coast: Apartheid's Chemical and Biological Warfare Programme***, by Chandré Gould and Peter Folb, 2002, 300p., United Nations publication, Sales No. GV.E.02.0.10.

***Tactical Nuclear Weapons: Time for Control***, by Taina Susiluoto, 2002, 162p., United Nations publication, Sales No. GV.E.02.0.7.

***Le Conseil de sécurité à l'aube du XXIème siècle : quelle volonté et quelle capacité a-t-il de maintenir la paix et la sécurité internationales ?***, par Pascal Teixeira, 2002, 106p., publication des Nations Unies, numéro de vente: GV.F.02.0.6.

***Costs of Disarmament—Rethinking the Price Tag: A Methodological Inquiry into the Cost and Benefits of Arms Control***, by Susan Willett, 2002, 70p., United Nations publication, Sales No. GV.E.02.0.3.

***Missile Defence, Deterrence and Arms Control: Contradictory Aims or Compatible Goals?***, in cooperation with Wilton Park, 2002, 39p., United Nations publication, UNIDIR/2002/4.

***Disarmament as Humanitarian Action—A discussion on the occasion of the 20th anniversary of the United Nations Institute for Disarmament Research (UNIDIR)***, in cooperation with the United Nations Department for Disarmament Affairs (DDA), 2001, 24p., United Nations publication, UNIDIR/2001/23.

***Cooperating for Peace in West Africa: An Agenda for the 21st Century***, by Anatole Ayissi (ed.), 2001, 159p., United Nations publication, Sales No. GV.E/F.01.0.19 / ***Coopération pour la paix en Afrique de l'Ouest : Agenda pour le XXIème siècle***, sous la direction d'Anatole Ayissi, 2001, 169p., publication des Nations Unies, numéro de vente: GV.E/F.01.0.19.

***Illicit Trafficking in Firearms: Prevention and Combat in Rio de Janeiro, Brazil—A National, Regional and Global Issue***, by Péricles Gasparini Alves, 2000, 66p., United Nations publication, Sales No. GV.E.01.0.2.

***Tactical Nuclear Weapons: A Perspective from Ukraine***, by A. Shevtsov, A. Yizhak, A. Gavrish and A. Chumakov, 2001, 95p., United Nations publication, Sales No. GV.E.01.0.1.

***Tactical Nuclear Weapons: Options for Control***, by William C. Potter, Nikolai Sokov, Harald Müller and Annette Schaper, 2000, 87p., United Nations publication, Sales No. GV.E.00.0.21.

***Bound to Cooperate: Conflict, Peace and People in Sierra Leone***, by Anatole Ayissi and Robin-Edward Poulton (eds), 2000, 213p., United Nations publication, Sales No. GV.E.00.0.20.

***Coming to Terms with Security: A Lexicon for Arms Control, Disarmament and Confidence-Building***, by Steve Tulliu and Thomas Schmalberger, 2000, 246p., United Nations publication, Sales No. GV.E.00.0.12.

***The Small Arms Problem in Central Asia: Features and Implications***, by Bobi Pirseyedi, 2000, 120p., United Nations publication, Sales No. GV.E.00.0.6.

***Peacekeeping in Africa: Capabilities and Culpabilities***, by Eric G. Berman and Katie E. Sams, 2000, 540p., United Nations publication, Sales No. GV.E.00.0.4.

***West Africa Small Arms Moratorium: High-Level Consultations on the Modalities for the Implementation of PCASED***, by Jacqueline Seck, 2000, 81p., United Nations publication, UNIDIR/2000/2 / ***Moratoire ouest-africain sur les armes légères : Consultations de haut niveau sur les modalités de la mise en œuvre du PCASED***, par Jacqueline Seck, 2000, 83p., United Nations publication, UNIDIR/2000/2.

***The Potential Uses of Commercial Satellite Imagery in the Middle East***, 1999, 58p., United Nations publication, UNIDIR/99/13.

***Small Arms Control: Old Weapons, New Issues***, by Lora Lumpe (ed.), 1999, 302p., ISBN 0 7546 2076 X, published for UNIDIR by Ashgate Publishing Limited (Aldershot).

***Fissile Material Stocks: Characteristics, Measures and Policy Options***, by William Walker and Frans Berkhout, 1999, 66p., United Nations publication, Sales No. GV.E.99.0.15.

Disarmament Forum / *Forum du désarmement*
(quarterly / trimestriel)

two • 2003 Nuclear Terrorism
deux • 2003 Le terrorisme nucléaire

one • 2003 Making Space for Security?
un • 2003 Un espace de sécurité ?

four • 2002 The CWC Review Conference
quatre • 2002 La Conférence d'examen de la convention sur les armes chimiques

three•2002 Children and Security
trois•2002 Les enfants et la sécurité

two•2002 Human Security in Latin America
deux•2002 La sécurité humaine en Amérique latine

one•2002 NGOs as Partners
un•2002 Les ONG comme partenaires

four•2001 (R)Evolution in Military Affairs
quatre•2001 (R)évolution dans les affaires militaires

three•2001 Education for Disarmament
trois•2001 L'éducation pour le désarmement

two•2001 The Middle East
deux•2001 Le Moyen-Orient

one•2001 NMD: Jumping the Gun?
un•2001 NMD : la fuite en avant?

four•2000 Biological Weapons: From the BWC to Biotech
quatre•2000 Les armes biologiques: de la Convention aux biotechnologies

three•2000 Peacekeeping: evolution or extinction?
trois•2000 Maintien de la paix : évolution ou extinction?

two•2000 Small Arms Control: the need for coordination
deux•2000 Maîtrise des armes légères : quelle coordination?

one•2000 What Next for the NPT?
un•2000 Où va le TNP?

four•1999 Framework for a Mine-free World
quatre•1999 Vers un monde sans mines

three•1999 On-site Inspections: Common Problems, Different Solutions
trois•1999 Les inspections sur place : mêmes problèmes, autres solutions

two•1999 Fissile Materials: Scope, Stocks and Verification
deux•1999 Un traité sur les matières fissiles : portée, stocks et vérification

one•1999 The New Security Debate
un•1999 Le nouveau débat sur la sécurité