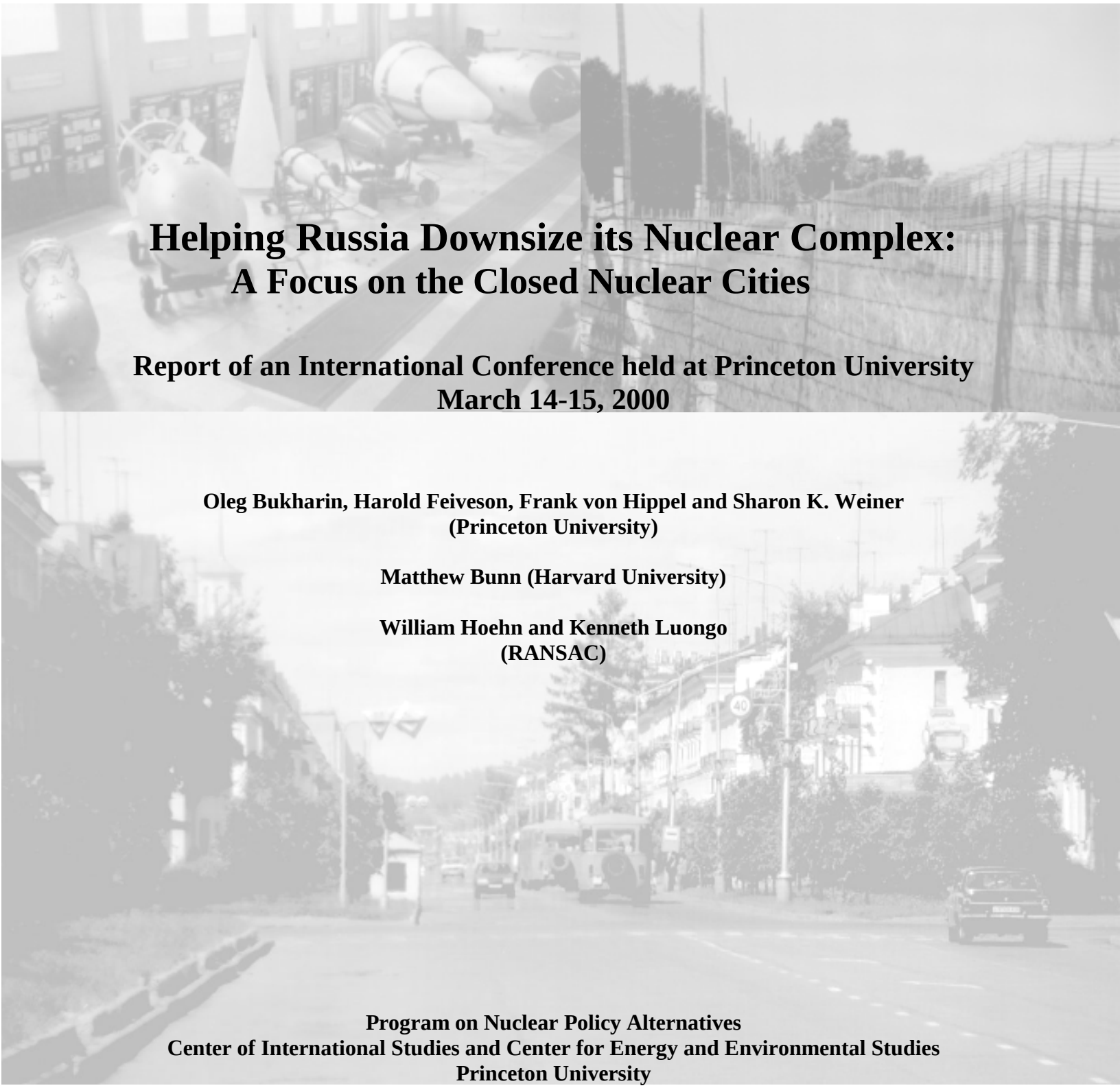


Helping Russia Downsize its Nuclear Complex:
A Focus on the Closed Nuclear Cities

Report of an International Conference held at Princeton University
March 14-15, 2000

Oleg Bukharin, Harold Feiveson, Frank von Hippel and Sharon K. Weiner
(Princeton University)

Matthew Bunn (Harvard University)

William Hoehn and Kenneth Luongo
(RANSAC)

Program on Nuclear Policy Alternatives
Center of International Studies and Center for Energy and Environmental Studies
Princeton University

June 2000

TABLE OF CONTENTS

Figures

Illustrations on the cover

1. Nuclear-weapons museum at VNIIEF in Sarov
2. Fence around a closed nuclear city
3. Town of Zheleznogorsk

PREFACE

The downsizing and stabilization of the oversized nuclear-weapons complex that Russia inherited from the Soviet Union remains a central international security challenge. It is essential that these goals be achieved as rapidly as possible in order to speed the process of irreversible nuclear arms reductions and to reduce the danger of proliferation of Russian nuclear weapons materials, technologies and expertise.

As part of an effort to facilitate these objectives, on March 14 and 15, 2000, Princeton University's Program on Nuclear Policy Alternatives[*] hosted an international conference on "Helping Russia Downsize its Nuclear Weapons Complex." This conference, which is referred to as the "Princeton Conference" in the remainder of this report, was made possible by a grant from the JJJ Foundation.

The core of Russia's nuclear-weapons complex is located in ten closed cities. The focus of the Princeton Conference was therefore on ways in which the United States and other governments and private foundations could assist these cities in their efforts to shift from nuclear weapons production to civilian activities.

Participants in the conference included scientists from the Russian nuclear cities and their counterparts from the US national laboratories, officials from the Russian and US executive branches, US congressional staff, program officers from interested US private foundations, European scientists interested in further involving their governments, US academic and non-governmental organization (NGO) experts, and journalists. A full roster of participants in included as Appendix 2.

This Report briefly summarizes some of the conclusions we have drawn from the conference. Since the conference was "on the record," we have footnoted individual contributions where appropriate.

[*] The Program on Nuclear Policy Alternatives is a research program under the joint auspices of the Center for Energy and Environmental Studies of the Princeton Environmental Institute and the Center of International Studies of the Woodrow Wilson School.

EXECUTIVE SUMMARY

Russia is struggling both to keep its nuclear-weapons complex from collapsing and to down-size it to an affordable size that is appropriate to its post-Cold War security requirements. Production of highly-enriched uranium (HEU) and plutonium for weapons have ended but the Russian Ministry of Atomic Energy (MinAtom) would like to shut two of four warhead-assembly plants, one of two fissile-component-production facilities and shrink its remaining nuclear-weapons facilities and their staffs. It hopes by 2005 to reduce the current number of nuclear-weapon workers by half.

The rate of implementation of these plans is limited by lack of funds. The federal budget for Russia's nuclear-weapons facilities is one seventh of what it was ten years ago and the average weapons worker gets a salary of only $56 per month. It will take additional funds to clean out excess facilities to make them available for non-weapons projects, to help create civilian jobs for excess weapons workers, and to allow older workers to retire with dignity.

The United States is playing an important role in helping stabilize the Russian complex and in securing the experts and nuclear materials that could find their way into the black market. Under the "HEU deal", over a period of 20 years, the United States is buying 500 tons of excess weapons uranium after it has been blended down to low enrichment for use in reactor fuel. Income from this deal is helping Russia's nuclear-weapon materials production and processing facilities convert to civilian work. The Department of Energy's Materials Protection, Control and Accounting (MPC&A) program is helping to strengthen the security of Russia's huge stockpile of weapon-useable uranium and plutonium. The Department of Defense is building a secure storage facility for some of Russia's excess weapons plutonium and is co-funding the conversion or replacement of three plutonium-production reactors which are still operating to produce heat for local populations. The International Science and Technology Center, the Initiative for Proliferation Prevention, and the Nuclear Cities Initiative are providing non-weapons work and salaries to key scientists in Russia's weapons-design institutes.

It is generally recognized, however, that US assistance has *not yet* been effective in facilitating the downsizing of Russia's nuclear-weapons design, fabrication and assembly complex. In particular, the Nuclear Cities Initiative, which was established in 1998 within the Department of Energy to help facilitate the transition of the ten "nuclear cities" that house the core of the complex, has made too slow a start and has been funded at too small a scale. Princeton University therefore hosted a conference on "Helping Russia Downsize its Nuclear Complex" on March 14-15, 2000 to understand better the obstacles to down-sizing and to share ideas as to how the international community can provide more effective assistance.

At the conference Lev Ryabev, First Deputy Minister of MinAtom, outlined the plan that the Ministry had developed over the past two years to downsize the complex and create jobs for the 50 percent of the weapons workers who it would make redundant.

He estimated that each of these two tasks would cost about $500 million. It was agreed subsequently that experts from seven of Russia's ten nuclear cities would provide more data about the downsizing and conversion plans at a follow-up workshop in Moscow at the end of June. (MinAtom excluded as "too sensitive" participation from the three nuclear cities which specialize in nuclear-warhead assembly and disassembly.)

Senator Pete Domenici (R-NM), who plays a key role in the appropriations process for US nuclear programs, sent a message to the Conference expressing support for a greatly enlarged Nuclear Cities Initiative if Russia would establish "verifiable milestones" for its downsizing program. Subsequently, on May 1, 2000, Senator Domenici submitted the "Nuclear Weapons Complex Conversion Act of 2000" to the Senate Armed Services Committee for consideration as an amendment to the FY 2001 Defense Authorization Act. Plans with such downsizing milestones are currently being developed by three of Russia's nuclear cities (Sarov, Snezhinsk and Zheleznogorsk) in cooperation with senior officials from three US nuclear labs (Los Alamos, Livermore and Sandia respectively).

At the conference, it was generally agreed that new business ventures will not provide jobs rapidly enough to absorb the excess weapons workers. Until Russia's tax system is rationalized and legal protections for investments are strengthened, both foreign and domestic investment will continue to be low. Indeed, even in the United States where conditions for investment are much better, when major nuclear-weapons facilities were shut down, the vacuum was filled with a huge cleanup program (currently running at about $6 billion per year) and major new nonproliferation programs, including the MPC&A program and other technical assistance programs in Russia. Russia cannot afford such programs but salaries are so low in Russia that the United States and other industrialized countries could employ a considerable number of excess Russian weapons personnel if they contracted a few percent of their cleanup and nonproliferation R&D funds to personnel at the Russian nuclear facilities. In fact, small initiatives of this type have been launched.

Energy efficiency was also identified as a major opportunity for employment. As energy prices have climbed, energy has become a major expense for the nuclear cities and facilities as it has for the rest of Russia. The low energy efficiency of Russia's infrastructure creates opportunities for high rates of return in terms of saved energy costs for well-design investments. Indeed, the World Bank is making major loans for energy-efficiency upgrades in Russia. This effort should be extended to the nuclear cities, starting with the establishment of analytical centers that could develop the necessary investment proposals.

A perennial complaint about the US assistance effort in Russia is that it is not coordinated. Each agency develops its owns program with little consideration of overlaps and possible synergisms with other programs. Stronger presidential support for coordination could result in much more "bang for the buck". Such coordination could

start with the development of a Presidential Decision Directive on the objectives and organization of US programs.

Finally, other possible sources of funding for conversion were canvassed, including additional or accelerated sales of blended down excess Russian HEU, lowered barriers in other industrialized countries to imports of Russian natural uranium and enrichment work, storage of foreign spent fuel, a “debt for security” swap, and the stripping of additional U^{235} from US depleted uranium.

GLOSSARY OF ABBREVIATIONS AND ACRONYMS

CENEF	Moscow Center for Energy Efficiency
CTR	Cooperative Threat Reduction Program
DOD	US Department of Defense
DOE	US Department of Energy
DU	depleted uranium
EBRD	European Bank for Reconstruction and Development
EM	Environmental Management
FSB	Federal Security Service of the Russian Federation
FSU	Former Soviet Union
FTE	full-time equivalent
FY	Fiscal Year
GAO	US General Accounting Office
HEU	highly enriched uranium (uranium that is greater that 20% U^{235})
I&C	instrumentation and control
IPP	Initiatives for Proliferation Prevention
ISTC	International Science and Technology Center (Moscow)
K-26	Krasnoyarsk-26 (City of Zheleznogorsk)
MinAtom	Ministry of Atomic Energy of the Russian Federation
MPC&A	material protection, control, and accounting
NCI	Nuclear Cities Initiative
NGO	Non-Governmental Organization
NIS	Newly Independent States
NP/AC	non-proliferation and arms control
NPP	nuclear power plant
NSC	US National Security Council
PDD	Presidential Decision Directive

RANSAC	Russian-American Nuclear Security Advisory Council
REPU	reprocessed uranium
RR	Russian Rubles
RTG	radioisotope thermal-electric generator
START	Strategic Arms Reductions Treaty
UEMZ	Urals Electro-Mechanical Plant
USEC	US Enrichment Corporation
VNIIEF	Institute of Experimental Physics (Sarov)
VNIITF	Institute of Technical Physics (Snezhinsk)

RUSSIA'S TEN CLOSED "NUCLEAR CITIES"

Former Name	**New Name**
Arzamas-16	Sarov
Chelyabinsk-65	Ozersk
Chelyabinsk-70	Snezhinsk
Krasnoyarsk-26	Zheleznogorsk
Krasnoyarsk-45	Zelenogorsk
Penza-19	Zarechny
Sverdlovsk-44	Novouralsk
Sverdlovsk-45	Lesnoy
Tomsk-7	Seversk
Zlatoust-36	Trekhgorny

INTRODUCTION

During the Cold War, the Soviet Union constructed a vast complex of facilities where plutonium and highly-enriched uranium (HEU) were produced, nuclear weapons were designed, and their components fabricated and assembled. The most sensitive of these facilities were located in ten secret nuclear cities known only by post-box numbers. Today the cities have names and are more accessible than in the past. But they are still fenced and open only to those cleared by Russia's security services. Together these nuclear cities have a combined population of about three-quarters of a million people, 60,000-70,000 of whom are still paid out of Russia's nuclear-weapons budget.

With the end of the Cold War, Russia does not need such a huge nuclear-weapons complex. Nor can it afford it. State defense orders are one seventh of their level in 1990.[1] The average salary for nuclear-weapons workers in 1999 was barely above $50 per month.[2] The complex must be downsized and the excess workers transitioned to new, civilian activities. Until alternative work can be found or adequate pensions provided for those ready to retire, however, Russia's Ministry of Atomic Energy (MinAtom) feels that it would be irresponsible to lay off its excess workers. Desperate nuclear scientists and technicians might be willing to sell their skills or stolen nuclear materials to countries seeking nuclear weapons. Developing effective conversion strategies for the nuclear cities must therefore be a high priority for both Russia and the international community.

The US government has been trying to help with various programs. These efforts have been hampered, however, by a lack of mutual understanding. MinAtom feels that it cannot downsize its weapons complex as quickly as it would like because it lacks the funds to demilitarize and clean up the facilities to be converted and to employ the workers made excess. The US Congress is unwilling to supply serious funding for conversion until Russia has made firm commitments to shut down major weapons-production facilities.

The Princeton conference may have been a first step toward creating the necessary understanding. Senior MinAtom officials – especially First Deputy Minister Lev Ryabev – elaborated on the Ministry's conversion plans. And New Mexico Senator Pete

---

[1] Presentation by L.Ryabev at the Princeton Conference.

[2] At 25 rubles per dollar, the average salary in the weapons production complex during the first nine months of 1999 was $56 ("Salary paid on time but level remains very low," *Atom-Pressa 34 (365)*, October 1999, quoted in "Russia's Closed Nuclear Cities: Social and Economic Conditions," by Anatoli S. Diakov, paper presented at the Princeton Conference). Other data presented by Diakov indicate that the salaries in Seversk and Novouralsk, which earn income from commercial uranium enrichment and from blending down excess weapons uranium for reactor fuel, are about twice as high as in Sarov, Lesnoy and Zarechny, which depend primarily on weapons work. It should be noted, however, that nuclear workers and members of their families receive substantial economic and social benefits, including subsidized education, healthcare, and housing.

Domenici (R-NM), a key congressional actor on nuclear matters,[3] put forward a framework for a legislative package that would sharply increase US support for job creation in the nuclear-cities if Russia's weapons-complex is downsized in parallel.

In the following, we summarize the difficulties confronting the conversion of Russia's nuclear cities, the problems affecting US efforts to help conversion in these cities, and some proposed elements for an expanded, more effective effort.

Figure 1. Russia's Closed Nuclear Cities (Source: DOE NCI)

MINATOM'S DOWNSIZING PLANS[4]

During the Cold War, the Soviet Union expanded its nuclear-weapons complex steadily until the end of the 1980's. Today, the complex comprises 17 industrial enterprises and scientific research institutes and employs approximately 75,000 persons directly in nuclear-weapon-related projects. Its core elements are located in MinAtom's ten closed nuclear cities. These cities, whose locations are shown on the map in Figure 1, were built originally to produce and process fissile materials for the weapons program; and to design and produce nuclear bombs and warheads. Their populations and approximate nuclear workforces are given in Table 1. The summed population of these cities is approximately 760,000 persons. Approximately 150,000 have jobs in the nuclear facilities – about half in civilian activities such as uranium enrichment for nuclear-power-reactor fuel, and half in nuclear-weapon-related projects.[5] (For details see

[3] Senator Domenici is chairman of the Senate Appropriations Committee Subcommittee on Energy and Water. This subcommittee deals with the budget of the Department of Energy through which most US assistance programs to MinAtom's nuclear facilities are channeled.

[4] This discussion is primarily based on the presentations by L.Ryabev and V.Starosotnikov at the Princeton Conference.

[5] The total presumably includes workers in transportation, utilities and other support divisions. Many of these divisions have recently been transferred to municipal control.

Appendix 1). For comparison, Table 2 shows the nuclear-weapons-related expenditures and employment at US Department of Energy's (DOE) facilities in fiscal year 1998. The end of the Cold War brought significant changes to Russia's nuclear-weapon complex – just as it did to that of the United States. No highly-enriched uranium or plutonium is being produced for weapons. Nuclear testing has ended. And the nuclear-warhead stockpiles have been cut approximately in half. Still, nuclear weapons play an important role in Russia's security planning and some of the closed nuclear cities will continue to have major roles in maintaining Russia's future nuclear weapons stockpile. Other critical tasks, which will involve most of the former HEU- and plutonium-production sites as well, include dismantling thousands of excess nuclear weapons; storing, processing and disposing of hundreds of tons of weapons-useable HEU and plutonium; and environmental cleanup. These missions must be carried out at the same time the complex is being downsized and restructured.

The task of defense conversion is particularly challenging for the ten closed nuclear cities. They have high concentrations of scientific and engineering expertise, which is attractive to commercial entities, but their isolation and security controls make difficult the development of normal business relationships. In addition, many of the excess nuclear facilities are radioactively contaminated. The option of leaving the cities for work elsewhere in Russia is open to young, unmarried workers but is much more difficult for families for a variety of reasons, including problems with finding affordable apartments in open cities.

During the last two years, MinAtom and the nuclear weapons facilities have been working to develop a comprehensive strategy to downsize the nuclear-weapons complex. A plan has been completed with two major interrelated components, each with an estimated cost of about $500 million:

1) Consolidation of the nuclear-weapons activities and emptying out and rehabilitating excess facilities for new missions, and

2) Creation of civilian jobs for excess workers.

At the Princeton conference, senior officials from MinAtom headquarters and the leading nuclear-weapon design centers in Sarov and Snezhinsk provided a general overview of these downsizing and conversion plans. (First Deputy Minister Ryabev emphasized that the estimated total cost of $1 billion did not include the ongoing joint program for replacing or converting the plutonium-production reactors in Seversk and Zheleznogorsk.)

Table 2. Defense-Program (DP) Workers and Expenditures at US DOE Nuclear Facilities, FY 1998[7]

Facility	DP Missions	DP Workers	DP Funding (millions of dollars)
Lawrence Livermore National Lab	Nuclear weapon R&D and stockpile stewardship	3,450	651
Los Alamos National Lab	Nuclear weapon R&D, stockpile stewardship, plutonium and non-nuclear component production	4,000	793
Sandia National Labs	Nuclear weapon R&D, stockpile stewardship, non-nuclear component production	4,000	657
Oak Ridge Y-12 Plant	Storage of HEU and lithium-deuteride materials and components, surveillance and dismantlement of warhead secondary assemblies	4,200	429
Savannah River Site	Tritium management	1,400	157
Pantex Plant	Warhead assembly/disassembly	2,650	260
Kansas City Plant	Non-nuclear components production	2,600	294
Nevada Test Site	Subcritical tests, testing readiness	1,780	242
Total		24,080	3,483

[7] *FY 2000 Stockpile Stewardship Plan* (US DOE, Office of Defense Programs, March 15, 1999, Sanitized Version, July 29, 1999), Fig. 10-6.

Progress to Date

MinAtom has already shut down or converted a number of major facilities and decisions have been made to convert others:

- The uranium-enrichment plants have been shifted from producing HEU for weapons to producing low-enriched uranium for nuclear-power-plant fuel.

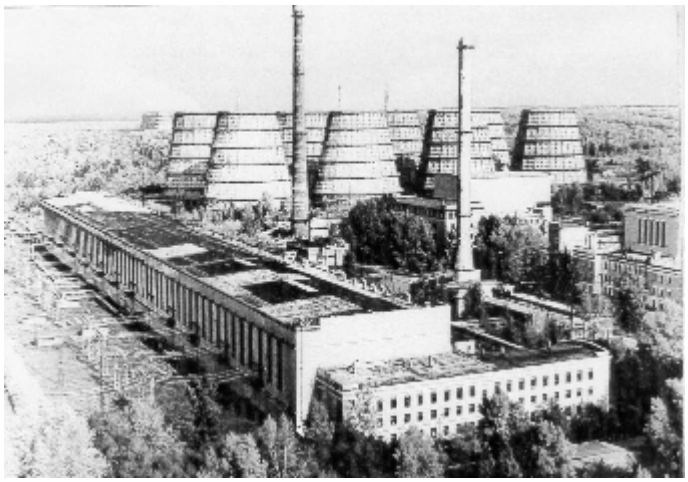


Figure 2. EI-2 and ADE-3 plutonium production reactors in Seversk (shutdown in 1990 and 1992 respectively).

- Ten of thirteen plutonium-production reactors have been shut down. The remaining three continue to operate only because they are needed to supply heat and power to nearby populations. A joint US-Russian effort is working to provide either replacement energy sources or to convert the reactors to a fuel cycle that does not produce separated plutonium.

- Annual production of nuclear weapons has declined by a factor of 10 or more.[8]

- Production of new weapons has ended at two out of four warhead assembly/disassembly facilities (Avangard plant in Sarov and the PO Start plant in Zarechny)[9] and warhead dismantlement is expected to end at these facilities by 2003, when they will have dismantled all the warheads they originally produced. Nuclear materials and production equipment are being packaged and removed from these plants. Environmental cleanup is under way. There are preparations for civilian production at the Avangard plant.

- Manufacturing of fissile weapons components has ended at one of two sites (Seversk). In the future, these operations will be carried out only at the PO Mayak facility in Ozersk.[10]

[8] Presentation by L.Ryabev at the Princeton Conference.
[9] Presentation by L.Ryabev at the Princeton Conference.
[10] Presentation by L.Ryabev at the Princeton Conference.

Table 3. Downsizing Projections for Weapons Workers in Russia's Nuclear Cities[11]

City	Weapons Activities (Discontinued Activities)	Weapons Workers (2000)	Projected Weapons Workers (2005)
Sarov (Arzamas-16)	Nuclear weapon R&D, stockpile stewardship, warhead disassembly (warhead assembly)	19,000	12,900
Snezhinsk (Chelyabinsk-70)	Nuclear weapon R&D, stockpile stewardship	9,000?	7,000?
Ozersk (Chelyabinsk-65)	Tritium, fissile component production, fissile material management (plutonium production)	6,000	4,000?
Seversk (Tomsk-7)	Fissile material storage and management (Plutonium, HEU, fissile component production)	5,000	0?
Zheleznogorsk (Krasnoyarsk-26)	Fissile material storage (plutonium production)	4,000	0?
Novouralsk (Sverdlovsk-44)	(HEU production)	0	0
Zelenogorsk (Krasnoyarsk-45)	(HEU production)	0	0
Lesnoy (Sverdlovsk-45)	Warhead assembly, disassembly	7,000-10,000	5,000?
Trekhgorny (Zlatoust-36)	Warhead assembly, disassembly	3,600	2,800
Zarechny (Penza-19)	Warhead disassembly (warhead assembly)	7,000-10,000	few hundred?
Total		60-67,000	32,200?

[11] The mission and weapons-program workforce (current and projected) data are from the authors (see Appendix 1 for a discussion of the methodology).

- At other facilities, weapons activities are being concentrated at a smaller number of production shops. For example, at the UEMZ plant in Yekaterinburg, defense personnel are being reduced to one-eighth of the initial workforce size and all nuclear-weapons work will be conducted in a single shop.

Overall, MinAtom's goal is to reduce defense employment in the Russian nuclear-weapons complex from approximately 75,000 today to 40,000 by 2005.[12] Most of these reductions are to take place in the closed nuclear cities (see Table 3).

There are several Russian sources of funding for restructuring and conversion: central-government budget allocations, MinAtom's internal funds,[13] and special government tax benefits to the closed cities established to attract businesses. In addition, the United States and other countries have created conversion assistance programs (see below).

MinAtom began receiving governmental funds to implement restructuring and defense conversion programs in 1998. In 1999 the government allocated 1.7 billion Russian Rubles – RR ($40 million), half to be used for restructuring and half for job creation.[14] However, only about one fourth of these allocations had been received as of October 1, 1999. For the year 2000, the allocations are RR 2.8 billion ($60 million), once again half for restructuring and half for job creation. The Russian government in addition provides $30-50 million in annual subsidies to the closed cities to support social and municipal infrastructure and services. There is also a program to facilitate the creation of jobs in the closed city communities, which is implemented by MinAtom in coordination with the mayors of local governments.[15]

MinAtom estimates that, with the funding expected to be available from the Russian government and its own internal resources, the planned downsizing/conversion task might not be completed for 10-12 years. With significant international assistance, it could be implemented in five to seven years.

In sum, MinAtom estimates that it needs from Russian and external sources approximately:

- $500 million for complex restructuring,
- $500 million for reemployment of downsized personnel, and

---

[12] Presentation by L.Ryabev at the Princeton Conference.

[13] Among these is a 1.5-3% internal tax on the production cost of commercial products such as uranium enrichment and services that the Russian government has directed MinAtom to use for commercial R&D and defense conversion.

[14] Presentation of L.Ryabev at the Princeton Conference. In his presentation, Ryabev provided both the Russian Ruble and dollar amounts for the projected 1999 and 2000 governmental allocation of funds. It should be noted that these data correspond to an exchange rate of over RR40 per one US dollar, which is higher than the conventionally assumed rate of RR25 per one US dollar.

[15] The level of federal funding for job creation (capital investment) in the closed nuclear cities in 2000 is approximately $2.4 million. (Anatoli Diakov, presentation at the Princeton Conference.)

- Several hundred million dollars for plutonium-production reactor replacement or conversion in Seversk and Zheleznogorsk.

US ASSISTANCE PROGRAMS[16]

The US government, by itself or as part of international efforts, has launched over a dozen programs in support of nuclear disarmament and nonproliferation in Russia. All of them to some degree impact the closed cities. The most important are:

- Highly-enriched uranium (HEU) blend-down and purchase agreement
- Nuclear Cities Initiative (NCI)
- Initiatives for Proliferation Prevention (IPP)
- International Science and Technology Center (ISTC)
- Cooperative Threat Reduction Program (CTR)
- Nuclear Material Protection, Control, and Accounting (MPC&A) upgrades.

Each of these programs has made a positive contribution. However, it is generally agreed in both the United States and Russia that their combined effect is, in Senator Domenici's words, "far less than it could be and needs to be."[17]

The programs apparently have their Russian critics as well. For example, at the Princeton Conference, MinAtom First Deputy Minister Ryabev quoted a letter to the government from Duma Deputy Nikitchuk from the Sarov district. The letter demanded that cooperation with the United States be halted because the assistance initiatives have so far provided little technical or economic support for conversion and have achieved no results. Nikitchuk and like-minded Russian critics see the primary aim of US assistance to be to collect intelligence and undermine the Russian nuclear complex.

HEU blend-down and purchase agreement. According to a February 1993 US-Russian agreement, the United States agreed to buy 500 metric tons of excess weapon-grade uranium (90% U^{235}) after it had been blended down to 4-5% enrichment for use as nuclear power reactor fuel. The HEU deal employs thousands of workers to dismantle warheads, tear down the HEU components, purify the HEU of contaminants, produce a slightly-enriched blend-stock, and blend down the HEU.

The HEU deal has thus far involved payments in excess of $1.5 billion to Russia for low-enriched uranium derived from 81 tons of weapon-grade uranium.[18] About two

[16] The discussion of current US programs is based primarily on Sharon Weiner's presentation to the Princeton Conference.

[17] Senator Pete V. Domenici, "Congressional Interest and Concern for the Nuclear Cities," statement to the Princeton Conference (presented by Peter Lyons).

[18] As of March 1, 2000 (USEC web site: http://www.usec.com/Structure/Navigation/

thirds of this has gone to MinAtom, of which about 30% (about 20% of the total) is paid to the facilities in the nuclear cities involved in the process of dismantling the warheads and blending the HEU. The remaining one third of the funds go to the central government.[19]

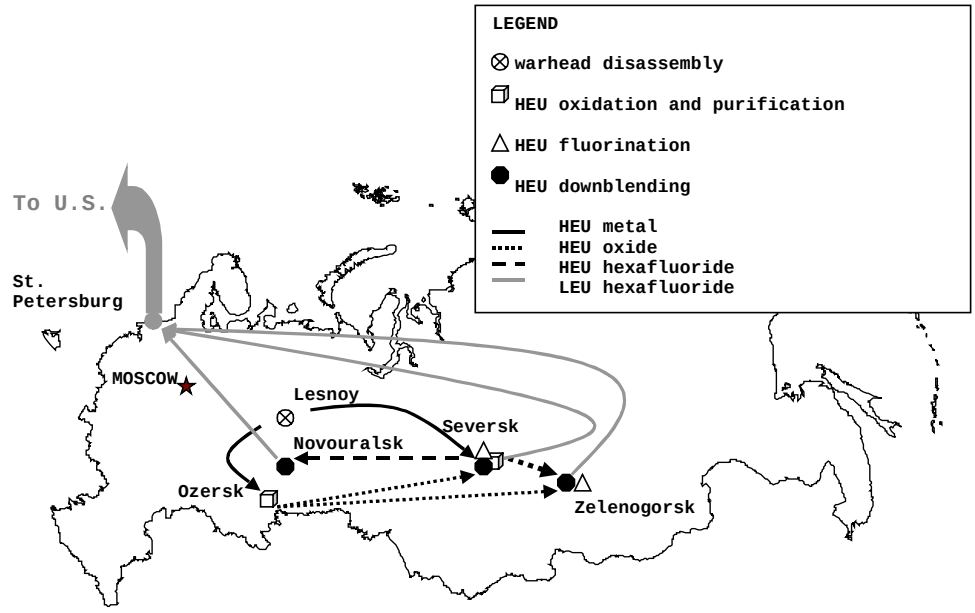


Figure 3. HEU to LEU flows within Russia

Most of the funding to MinAtom's conversion program comes from the HEU deal. Furthermore, it is itself a conversion program. For example, most of the workers in Seversk who formerly made weapons components are now involved in dismantling excess weapons components and blending down the recovered HEU.

This program, often known as "the HEU deal," was originally designed to be entirely self-financing, without requiring government funds. The LEU delivered to the United States is sold to utilities as fuel. However, problems resulting from the privatization of the U.S. Enrichment Corporation (USEC), the US executive agent for the agreement, contributed to Senator Domenici taking the initiative, in 1998, to provide a $325 million taxpayer bailout to save the agreement.[20]

ThirdTier/newsreleases/08-24-98p.htm).

[19] See, for example, "We Must Save the Best" (Press-Conference with L.Ryabev), *Gorodskoy Kuryer* (Sarov), March 5, 1998. HEU revenues are deposited in a "special MinAtom account" that is controlled by the Ministry of Finance. Tenex, the executive agent on the Russian side, receives one percent as commissions. The remainder is expended as approved by the Ministries of Finance and Economics. The division of revenues into two streams corresponds to the notion that the natural uranium that was used to make the enriched uranium is an asset of the state and that the proceeds from its sale (approximately one third of the total revenues) belong to the state. MinAtom, which contributed the enrichment work, claims the remaining two thirds of the revenues.

[20] Thomas Neff, "Privatizing U.S. National Security: The U.S.-Russian HEU Deal at Risk," *Arms Control Today*, August, September 1998, p.8.

The HEU deal continues to stagger from crisis to crisis, most recently because of the financial problems of USEC. An interagency oversight committee for the agreement exists, but does little to address its fundamental design weaknesses.[21] Nor are opportunities to expand the initiative being energetically pursued. Such an expansion could down-blend more proliferation-prone HEU more quickly and raise additional revenue for targeted conversion initiatives in the closed nuclear cities.

Nuclear Cities Initiative. The NCI was created within the US Department of Energy in 1998 to help create non-weapons jobs for scientists, engineers, and technicians and to facilitate the downsizing of the Russian nuclear-weapon complex. The program also focuses on community and infrastructure development in the closed cities and works to engage US and international agencies and organizations in projects in the nuclear cities.

NCI received a total of $22.5 million in funding in fiscal years (FY) 1999 and 2000. However, because of congressional restrictions, it was not authorized to begin spending its initial funds until March 1999 (halfway through FY1999). The program has concentrated initially on three nuclear cities: Sarov, Snezhinsk, and Zheleznogorsk. To date, it has created a modest 160 jobs in these cities. Success stories include the Open Computing Center (OCC) in Sarov (with a second OCC to open in Snezhinsk this year), saving and expanding jobs at the Argus Optics and Eyewear company in Snezhinsk, and, in conjunction with the Russian-American Nuclear Security Advisory Council (RANSAC), establishing an Analytical Center for Nonproliferation in Sarov (with a second center scheduled to open in Snezhinsk). NCI has established international business development centers in two of the three cities (Zheleznogorsk and Snezhinsk). NCI has also provided $1.5 M to hire, train and station loan officers of the European Bank for Reconstruction and Development (EBRD) in Sarov, Snezhinsk and Zheleznogorsk. EBRD believes that $10 M in loans could be made in each city over the 18 months of NCI funding support.[22]

There have been complaints from DOE's Congressional oversight committees that NCI got off to a slow start and had few achievements in its first year. NCI has also been the target of inter-agency turf fights with the State Department, through which the United States funds the International Science and Technology Center (see below). There have also been complaints from the Russian institutes about inflexible contract negotiations, inconsistent procedures for developing proposals and monitoring expenditures, excessive time lags between commitments to projects and the expenditure of funds, and excessive "nuclear tourism" to the Russian closed cities by US participants.[23] As of the end of fiscal year 1999 (September 1999), only $3.8 million had actually been spent. According to MinAtom, as of the end of calendar 1999, only $1 million of NCI funds had been spent in

[21] Presentation by Thomas Neff at the Princeton Conference.
[22] Private communication from Willliam Desmond, Director of the NCI Program, May 30, 2000.
[23] Complaints about "nuclear tourism" are not unique to NCI. They have been leveled at many US assistance programs.

the nuclear cities.[24] As a result of this slowness and congressional concerns about lack of focus, NCI's second-year funding request of $30 million for FY 2000 was cut to $7.5 million. This vote of low confidence from the Congress was a major impetus for the organization of the Princeton Conference to rethink the US government's assistance to MinAtom's downsizing and conversion program.

Initiatives for Proliferation Prevention. IPP, originally named the Industrial Partnering Program, was created in 1994 and is also run by the DOE. Its mission is to engage US industry in the task of creating civilian jobs for people in the former Soviet Union (FSU) or Newly Independent State (NIS) military-industrial complex. "Thrust I" projects involve cooperation between the US DOE national laboratories and FSU institutes to identify and develop, through collaborative research, technologies of potential commercial interest. Thrust II projects involve cost sharing between the DOE labs and US industry to further the development of technologies with commercial potential. In Thrust III projects, industry becomes a full partner in commercialization efforts.

As of March 2000, IPP had committed $22 million to fund 83 projects with participation from the closed cities.[25] Of this amount, $9 million is committed to the US national lab partners, leaving $13 million for NIS participants, including those from the closed-city institutes.

Unfortunately, thus far, few IPP projects have led either to the successful commercialization of a technology or permanent reemployment of FSU weapons workers. Of the 83 projects involving the closed cities, only 16 have reached Thrust II or Thrust III and only a small number of permanent jobs have been created. This has led to the charge from some critics that IPP projects are merely short-term subsidies to support weapons-program personnel (some of whom continue to do weapons work part time) until Russia can once again fund them to work on nuclear weapons. A second criticism stems from the fact that such a large portion of IPP funding goes to US labs. Although projects in the closed cities did somewhat better in this area, a 1999 GAO study reported that through June 1998, 63% of IPP funding went to US labs. Of the remaining 37%, IPP was unable to determine how much went to salaries as opposed to institute overhead, equipment, taxes or other fees.[26] Since this time, however, DOE has limited the amount of money that can be spent in the US laboratories to roughly one-third of a project's budget.

---

[24] Letter from MinAtom First Deputy Minister Lev Ryabev to Senator Pete Domenici, May 10, 2000. The letter also complains that "Out of 12 priority projects planned for implementation in 1999, implementation has begun on only 2…100 jobs have been created…In 1999 on NCI business alone, 200 US specialists visited Sarov, Snezhinsk and Zheleznogorsk, where jobs creation projects are being considered...By the most optimistic calculation 850 new jobs will be created…in 1999-2000…which amounts to only 2% of what is needed."

[25] This includes all projects that involve an institute in one of the closed cities, regardless of whether that institute plays a lead or supporting role. Therefore, a significant fraction of this money actually goes to institutes outside the closed cities.

[26] General Accounting Office, *Nuclear Nonproliferation: Concerns with DOE's Efforts to Reduce the Risks Posed by Russia's Unemployed Weapons Scientists*, (Washington, DC: GAO, February 1999).

International Science and Technology Center. The ISTC is a multinational effort involving the United States, the European Union, Japan, Norway and South Korea. These countries make contributions which, like the IPP, fund projects to reemploy FSU personnel with knowledge and skills related to making weapons of mass destruction.[27]

ISTC activities are governed by an international agreement that provides for tax exemption, direct payments to participating scientists (with a small overhead to their home institutes), and audits. The ISTC board includes representatives from Russia. ISTC initially focused primarily on projects involving basic research but in recent years it has been providing business training and helping with technology commercialization as well.

FSU scientists make proposals for projects to the ISTC and member countries then review these proposals using their own criteria to determine which ones to fund and at what level. The State Department administers US involvement. Most ISTC projects fall under the category "Science Projects"; that is, they involve funding only from ISTC. Partner projects, however, provide private industry, governments and NGOs opportunities to contract with scientists and institutes for research of interest to them, using the established ISTC mechanisms to obtain tax-exemption, management, and auditing. The Sarov and Snezhinsk non-proliferation centers, for example, are ISTC partner projects.

Roughly two-thirds of ISTC project funding goes for salaries with the remainder being for equipment, travel and institute overhead. No ISTC funding goes to support the participation of Western partners, who have to raise their own money. The average full-time-equivalent salary for someone working on an ISTC project is $5200 per year.

Since its first project in 1994, the ISTC has committed over $41 million to fund 291 projects involving the closed cities.[28] This includes three significant projects with commercial partners. One is a $1.2 million project to commercialize high-temperature fluoride battery technology, and a second is a $330,000 project to model oil flow in porous media. The third is confidential. To date, ISTC projects involving institutes in the closed cities have committed about 5,000 FTE-years of support, including participating FSU personnel from outside the nuclear cities.[29]

ISTC, like IPP, has been criticized for its lack of permanent job creation and for subsidizing scientists who also work part time on weapons of mass destruction. Additionally, because of the process by which project proposals are developed and approved, ISTC has been criticized for having no coordinated strategy for project selection or job creation.

---

[27] A second science and technology center, in Kiev, is responsible for programs in Ukraine.

[28] As with IPP funding, this includes all projects that involve an institute from the closed cities, regardless of whether than institute plays a lead or supporting role. Therefore, much of this money actually goes to institutes outside the closed cities.

[29] Again, as with IPP, some of these projects involve collaboration with other institutes outside of the closed cities.

Cooperative Threat Reduction (CTR) Program. The CTR program was established in 1991 within the Defense Department to help the FSU destroy its excess weapons of mass destruction and to support related nonproliferation objectives. It is funding two major projects in the nuclear cities. The first, to which over $165 million has been obligated thus far, is the construction of a facility in Ozersk for the safe and secure storage of fissile material removed from nuclear weapons. The project employs hundreds of Russian workers.[30]

Figure 4. High-security fissile-material storage facility under construction in Ozersk

Figure 5. The DOE MPC&A program is funding the installation of concrete blocks at a plutonium storage area in Ozersk to prevent unauthorized access to plutonium.

In a second project, over $50 million has been obligated thus far to convert the cores of two plutonium-production reactors in Seversk and one at Zheleznogorsk which supply heat to the local populations. This project is still in its design phase – and may indeed be cancelled in favor of shutting down the reactors and replacing them with fossil-fuel-fired heating and combined heat and electricity "co-generation" plants.

Nuclear Material Protection, Control and Accounting Program. The purpose of the DOE-managed MPC&A program is to help strengthen the security of weapons-useable fissile materials in the FSU. There are MPC&A programs in seven of the ten closed cities.[31] A significant fraction of the funds go to employing Russian workers and purchasing Russian-made equipment. To date, however, there have been no efforts to document the extent of job creation resulting from these activities. A recent Government Accounting Office report criticized the program for not be able to determine how much of the program funds go to paying Russian taxes.[32] This is a common complaint about all US assistance programs, except for the multinational ISTC program, which operates under a tax-exemption agreement that appears to be generally respected by tax authorities at all levels, and the CTR program which is also exempted by a government-to-government agreement.[33]

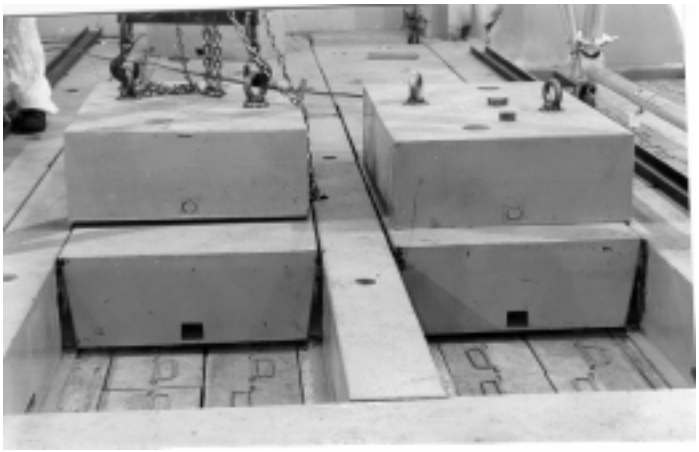
---

[30] Estimates vary between 400 and 1,500 Russian workers.

[31] Because of new and more stringent access requirement, imposed by DOE managers in the fall 1999, no cooperative MPC&A activities are currently taking place at the four warhead assembly/disassembly facilities. At the warhead-design institutes in Sarov and Snezhinsk, work is continuing under old contracts; no new contracts, however, are being signed because of the access issue. For an in-depth discussion of the issue of access and other aspects of US-Russian MPC&A cooperation see: O.Bukharin, M.Bunn, K.Luongo *Renewing the Partnership: Recommendations for Accelerated Action to Secure Nuclear Material in the Former Soviet Union*, RANSAC, [forthcoming, 2000].

[32] General Accounting Office, *Nuclear Nonproliferation: Limited Progress in Improving Nuclear Material Security in Russia and the Newly Independent States*, (Washington, DC: General Accounting Office, March 2000).

[33] The US-funded Civilian Research and Development Foundation also has a tax-exemption agreement.



A WAY FORWARD

The Domenici Initiative

Given the importance of the nuclear reduction and non-proliferation mission in Russia and the difficulties that existing efforts have faced in addressing these concerns, a new overall strategy to guide US assistance for the Russian downsizing and conversion effort is clearly required. Such a strategy would integrate the strengths of each of the individual programs. In our view, a valuable first step toward the needed new charter for the US effort has been devised by Senator Domenici of New Mexico.

In the statement that Senator Domenici sent to the Princeton conference, he announced that:

> "I'm now drafting legislation that [will] substantially increase the funding and scope of the NCI to assist the Russian Federation in downsizing its military nuclear complex, to authorize a variety of mechanisms in addition to commercialization, and to measure its progress against realistic and transparent milestones."

Subsequently, on May 1, 2000, he introduced a draft "Nuclear Weapons Complex Conversion Act of 2000" that was referred to the Senate Armed Services Committee (see Box).[34]

[34] 106th Congress, 2d Session, S. 2492, "Nuclear Weapons Complex Conversion Act of 2000."

Key Elements of Senator Domenici's Draft
"Nuclear Weapons Complex Conversion Act of 2000"

The United States should "enter into negotiations with the Russian Federation for purposes of the development by the Russian Federation of a plan to restructure the Russian Nuclear Complex in order to meet changes in the national security requirements of Russia by 2010."

"To effectively address threats to United States national security interests, progress with respect to the nuclear cities must be expanded and accelerated." The groundwork has in particular been laid "for an immediate increase in investment and potential for immediate risk reductions in the cities of Sarov, Snezhinsk, and Seversk."

"However, to gain sufficient advocacy for additional support, the [downsizing] program must demonstrate (A) rapid progress in conversion and restructuring; and (B) an ability for the United States to track progress against verifiable milestones that support a Russian nuclear complex consistent with their future national security requirements."

The Secretary of Energy "shall facilitate the enhanced use of the technology, and the research and development services, of the Russia Ministry of Atomic Energy…by (1) fostering the commercialization of peaceful, nonthreatening technologies of the Ministry…(2) authorizing the Department of Energy, and encouraging other departments…to utilize [the Ministry's] research and development services…including activities relating to (a) remediation of the environmental consequences of…nuclear weapons activities; (b) nonproliferation…(c) global energy and environmental matters; and (d) basic scientific research."

The President should designate a "National Coordinator for Non-Proliferation Matters to coordinate the various programs in the nuclear cities and related programs."

In summary, Senator Domenici proposes that:

1) The Russian Federation develop a clear plan for downsizing, whose progress can be measured by well-defined milestones.

2) The United States and other cooperating nations develop a more coordinated strategy for the assistance programs already underway, and that non-commercial (e.g. R&D contracts with US government programs) as well as commercial opportunities for conversion be pursued.

3) If the prerequisites for an effective program are achieved in the first year, the increase in the amounts of money going into restructuring and conversion activities be

sustained in subsequent years. First-year funding from the United States would be $50 million.

We discuss each of these elements below.

Development of a Russian Plan for Downsizing

The first and most important element in the Domenici legislation is the need for a US-Russia agreement on a well-defined plan with milestones for reductions in Russia's nuclear-weapons-production complex. The START I Treaty provided a plan with milestones for the downsizing of Russia's strategic nuclear forces. This is one of the reasons why the US DOD's Cooperative Threat Reduction program, which assists Russia in achieving the START I objectives, has received relatively consistent support in Congress. The US DOE's MPC&A program has also had good support because it has been able to report each year on additional FSU facilities where fissile-material security has been upgraded.

In contrast, the DOE's NCI and IPP programs have been heavily criticized because they have not demonstrated a successful approach to the problem of creating sustainable non-weapons jobs for large numbers of excess Russian weapons experts, or for bringing about substantial reductions in the size of the Russian nuclear weapons complex.[35] The Domenici proposal, with its requirement for the development of specific milestones, is therefore an essential prerequisite to a willingness on the part of Congress to fund a more ambitious downsizing and conversion program.

The Nuclear Cities Initiative has asked different US national laboratories to take the lead in collaborating in the development of an overall downsizing conversion plan for each of the three cities currently covered by the program: Sarov (Los Alamos National Laboratory), Snezhinsk (Lawrence Livermore National Laboratory), and Zheleznogorsk (Sandia National Laboratories). As of the time of the Princeton conference, the plan for Sarov was furthest developed because of the initiative of former Los Alamos Director Sigfried Hecker and his team (see Box).

[35] Despite its vulnerability to similar criticism, the ISTC has been relatively popular. This has been in part due to its successful effort to distinguish itself from the IPP and NCI programs in other respects. These include its success in having its aid exempted from Russian taxes; its relatively low overhead (matching funds are not provided to cooperating organizations in the donor countries); its established mechanism for proposal submission and review; and the fact that it pays salaries directly into the personal accounts of the scientists and technicians working on ISTC projects, while IPP and NCI grants go to the institutes. (The institutes may, however, mandate the redistribution of ISTC salaries.)

The Sarov Conversion Initiative

Sarov is the home of two major MinAtom facilities: the Avangard weapons assembly and disassembly facility and Russia's largest nuclear-weapons design laboratory, the All-Russian Institute of Experimental Physics (VNIIEF). Avangard currently has 3,500 employees, 2,700 in "defense production" (primarily warhead dismantlement today). Avangard's management would like to convert 1,800 of the defense workers to civilian production by 2005, leaving only 900 defense workers (primarily in conventional weapons work). The facility has 30 years of experience of manufacturing physical protection equipment (including for the Kremlin buildings and the Russian Central Bank); 10 years manufacturing medical equipment (especially kidney dialysis equipment); and expertise in metalworking, machining, wiring, testing and precision assembly. The conversion plan focuses initially on partnerships with Western industry on kidney dialysis equipment, expanded production of MPC&A equipment, such as portal monitors, and production of SF_6 switches for Russia's power industry. MinAtom has agreed to make a number of buildings available for this purpose and move fences so that they will be outside the fence around the area where weapons work is conducted.

VNIIEF currently has 18,000 employees, only 1,000-2,000 of whom work in civilian programs (including diamond cutting and polishing). The institute's leadership proposes to downsize its defense workforce to 12,000, by retiring 2,000 and shifting 3,000 to work on civilian R&D and production. Supplements to make pensions more adequate and 3,000 additional civilian jobs are therefore required. New civilian jobs are proposed in three areas: i) commercial production – most likely primarily for the domestic market, ii) "research services," and iii) nonproliferation programs such as MPC&A and plutonium disposition.

Commercialization of research services is a particularly promising area because former weapons scientists and engineers can do R&D for foreign clients without large capital investments. Intel led the way by contracting for a modest amount of software work and then establishing a Software Technology Laboratory as an Intel-VNIIEF joint venture. After three trial years this laboratory employs 100 people doing "mission-critical" work for Intel. The Sarov Open Computing Center was established in 1999 and already employs 100 doing contract software development for various customers. Hopefully, the establishment of these centers has provided a precedent for the creation of firms that would hire former weapons experts to provide a broad range of R&D services to foreign and Russian customers at low cost.

A More Coherent Strategy for US Programs

US nonproliferation assistance programs are managed by several agencies (for the nuclear cities, primarily the DOD, DOE and State Department) and are coordinated through interagency meetings organized by the National Security Council (NSC) staff. However, in the Clinton Administration, interagency coordination has been more a matter of exchanging information than cooperation on an overall strategy. Agencies have been relatively free to design programs for which they receive funding in the budget, subject only to congressional oversight, with little synergy and integration enforced by the White House. This has the strength of allowing different agencies to experiment with different approaches and avoids the danger of all being forced to adhere to a counterproductive strategy. However, its weakness is that obvious potential synergies between different programs are not explored. Consider the following examples:

- The ISTC, IPP, and NCI programs all are focused on the need to provide alternative employment for Russian nuclear scientists. ISTC mostly funds basic research, IPP is focused on developing technologies for commercialization and NCI seeks to develop commercial opportunities in the closed cities. Yet these complementary programs rarely work in concert to achieve efficiencies in the employment conversion quest and often are competitive.

- The DOD's Cooperative Threat Reduction program has since 1994 episodically examined various ways to replace the heat now generated by the three plutonium-production reactors in Seversk and Zheleznogorsk, which could then be shut down. However, it still does not have solid numbers for the heat demand in these cities or estimates of the possibilities for large cost-effective investments to reduce this demand. Making such estimates could have been facilitated by using NCI funds to set up energy-efficiency analytical centers in the nuclear cities. Additionally, the analysis of the replacement energy source for the reactors does not include an evaluation of benefit or negative impact that various options may have on the potential conversion activities at these sites.

- The DOE has very large programs for radioactive-waste-cleanup R&D and the promotion of exports of US energy-efficiency technologies. Senior officials should look for opportunities in these and other areas where nuclear cities scientists could perform research and testing that will simultaneously advance their programmatic objectives and the US Government's nonproliferation objectives. Specifically, the Secretary of Energy should ask each Assistant Secretary managing R&D funds to attempt to designate a percentage that could be contracted to Russian experts from the nuclear cities. This could help accomplish DOE missions at lower cost while providing millions for R&D contracts for the closed cities.

At the moment, US government agencies have no incentives to explore such potential synergisms. Indeed, they may have an incentive to avoid cooperation because

close contact might expose the weaknesses of their programs to agencies competing with them for funding and turf. What is needed is a senior official with presidential authority to overcome such resistance.

As a first step toward building a coherent program, the Administration should develop a Presidential Decision Directive (PDD) on US assistance for the restructuring and downsizing of the Russian complex that spells out roles, implementation responsibilities and coordination of different agency programs. PDDs were a very successful device for forcing coordination and strategic planning in earlier efforts to deal with national-security challenges in the FSU. Every agency has a chance to provide input in the development of such a plan.

The US and Russian governments should also welcome complementary efforts by other governments and concerned non-governmental organizations. A group of European scientists is trying to build support for a European Nuclear Cities Initiative that would complement the US program. RANSAC is developing a non-governmental "Closed City Consortium" and hopes to bring together NGOs and universities to create pilot projects in areas that the NCI and other programs have not yet emphasized. RANSAC and Princeton University have already had a successful partnership with the NCI and ISTC programs in launching nonproliferation-analysis centers in Sarov, the Kurchatov Institute of Atomic Energy in Moscow, the Institute of Physics and Power Engineering in Obninsk, and Snezhinsk. The involvement of non-governmental analysts also facilitates more informed independent analysis and constructive criticism of governmental initiatives.

Promising Initiatives

Encouraging private-sector growth. There are substantial obstacles to doing business in Russia's nuclear cities -- including the difficulties of travelling to them and access restrictions. However, the cities also offer world-class science and engineering capabilities, and large numbers of highly skilled and disciplined people are available for low cost. Because they are closed, the cities also have lower crime rates and less corruption than other areas of Russia. In some cases, as in Sarov, they have their own technical universities which could, as in the United States, become training grounds for high-tech entrepreneurs and business managers.

In the near term, the likeliest private-sector successes will be firms that can provide goods and services (not necessarily high-tech) to markets within Russia and science and engineering services such as software engineering to foreign clients. Achieving success will require a portfolio of tools, including tax incentives, training and technical assistance to new enterprises, loan and investment funds, and risk insurance for potential investors. Such efforts cannot achieve long-term success, however, if the Russian government does not in parallel take significant steps on macro-level issues such as tax reform and legal protection for investments.

NCI is already helping create some of the infrastructure for business development. It has financed the creation of business-development-assistance centers in Zheleznogorsk and Snezhinsk that provide potential entrepreneurs with access to the web, email, a library, and software plus advice on laws, taxes, business plans and customs. These centers also provide host services for international assistance efforts such as the EBRD micro-loan programs for business startups. They also plan to fund regional economic assessments in support of accelerated conversion plans.[36]

Radioactive clean-up R&D. The DOE spends more than $200 million dollars a year on R&D to develop improved radioactive cleanup technologies for its Defense Environmental Restoration and Waste Management Program.[37] Spending a small percentage of these funds in the closed cities could get some of this R&D done at much lower cost and lead to the development of technologies that could be used in both the US and Russian cleanup efforts.

The IPP program appears to be trying to catalyze such a connection by providing startup funding of $1.5 million for a new "[High-level Waste (HLW)] Tank Retrieval and Closure Demonstration Center" in Zheleznogorsk.[38] The DOE Environmental Management Program, which expects to spend tens of billions on HLW tank remediation over the next three decades, should provide program direction and follow-on funding for this effort.

Energy efficiency opportunities. Now that the prices of fossil fuels and electricity in Russia are rising, Russia is discovering – as the OECD countries did during the oil crises of the 1970s – that investments in energy-efficiency are cost effective. The Moscow Center for Energy Efficiency (CENEF), working with local and regional governments, carries out analyses of energy-efficiency opportunities that are annually resulting in over $100 million in investments in Russia. According to CENEF's count, as of 1998, there were 47 energy-efficiency centers throughout Russia – up from just two in 1992.[39] The establishment of energy-efficiency analysis centers in the nuclear cities should be a part of any conversion strategy. Energy costs have grown to become a major problem in the budgets of both the local governments and the facilities.

In fact, the NCI had planned to finance the startup of an energy-efficiency center in Snezhinsk before its FY2000 funding request was cut. In the meantime, CENEF, with startup financing from the W.Alton Jones Foundation, is working with the DOD's CTR program to assess the opportunities for cost-effective energy-efficiency investments in

---

[36] Jana Fankhauser, Pacific Northwest National Laboratory, "International Development Centers," presentation at the Princeton Conference.

[37] The total annual expenditure for the DOE Environmental Management program is about $6 billion per year (http://www.em.doe.gov/budget_docs.html).

[38] "US-Russian Cooperation in Closed Nuclear City Expanded" (US DOE press release, March 10, 2000). The initial funding for the Center, a joint project of the US Sandia National Laboratories and the Zheleznogorsk Mining and Chemical Combine, is $1.5 million.

[39] Meredydd Evans, "Energy Efficiency and Russia's Nuclear Cities," Princeton Conference.

Seversk and Zheleznogorsk that could reduce the amount of replacement heat required when the plutonium-production reactors are shut down.

Nonproliferation and arms-control R&D. The US government spends hundreds of millions of R&D dollars each year on nonproliferation R&D. Some of these funds already finance cooperative projects in the nuclear cities – especially in the two nuclear-weapon design laboratories in Sarov and Snezhinsk. The principal areas of focus thus far have been MPC&A, export controls, and nuclear-warhead dismantlement transparency.

The two nonproliferation analytical centers were established at Sarov and Snezhinsk with funding from the NCI and private US foundations[40] and should be used to carry out exploratory investigations of possible nonproliferation initiatives in additional areas. Their private-foundation funding makes it possible for them to examine initiatives in which the US and Russian governments are not yet officially interested. The Domenici legislative initiative would reinforce the collaborative effort on nonproliferation analysis by providing funds to encourage students in the United States and Russia to pursue careers in areas relating to nonproliferation.

The Need for Increased Funding[41]

During the next five years, approximately $100 million per year in US and international funding will be required to have a major impact on the downsizing of Russia's nuclear-weapons complex and the development of alternative employment for its excess workers. Senator Domenici initially proposed increasing the funding for the Nuclear Cities Initiative to a level of $50 million for FY2001.[42] It appears that the actual appropriation for the first year will be less than this, but significantly more than the $17.5 million that DOE requested for NCI in this fiscal year. As has been demonstrated by both the CTR and MPC&A programs, such an effort, can be "sold" to skeptical legislatures if it is designed to offer demonstrable international-security benefits. Such security benefits could include the shutdown or conversion of specified facilities with which Russia has produced nuclear weapons. And contracting with Russian experts to get a modest amount of US R&D done at low cost would be an additional benefit.

Additional possible sources of funding have been suggested that would take advantage of the capabilities of the Russian nuclear complex. These include:

---

[40] The W. Alton Jones Foundation, the John Merck Fund, and the Ploughshares Fund.

[41] This section is based in large part on Matthew Bunn's presentation to the conference. For an in-depth discussion of the proposed ideas see: Matthew Bunn *The Next Wave: Urgently Needed New Steps to Control Warheads and Fissile Material*, March 2000, co-published by the Carnegie Endowment for International Peace (www.ceip.org/npp) and the Harvard Project on Managing the Atom (www.ksg.harvard.edu/bcsia/atom).

[42] "Nuclear Weapons Complex Conversion Act of 2000."

- **Storage of foreign spent nuclear fuel in Russia**. Commercial storage of spent fuel from foreign countries could generate billions of dollars in revenue, some of which could be directed toward conversion, cleanup, pensions for redundant nuclear-weapons workers, and MPC&A in the nuclear cities. While the environmental hazard posed by imported spent fuel in dry casks, if properly managed, would be small in comparison to the enormous environmental threats that could be addressed with the revenue from such a project, Russian environmental groups have thus far opposed such proposals, fearing that Russia could become the world's radioactive waste dump, and that MinAtom would somehow find a way to use the funds to finance projects that would create still more contamination. The authors of this report do not here take a position on this debate. Certainly the decision to accept foreign spent fuel is a matter that the Russians will have to determine for themselves, hopefully with the active participation of all who will be affected.

  However, if Russia determines to move forward with such a project, US support would be crucial since the United States has consent rights over most of the world's spent fuel, allowing it to veto shipment to Russia if it chooses. It would only be forthcoming if there were no reprocessing involved. Russia is already seeking international assistance to help it secure and dispose of 34 tons of excess weapons plutonium. In addition, it has a stockpile of 30 tons of civilian plutonium whose security the United States is helping upgrade. The United States and Russia are discussing a possible agreement on a 20-year reprocessing moratorium to prevent a further accumulation of plutonium in Russia.

- **Additional HEU purchases**. Russia now plans to maintain far fewer nuclear weapons than when the original HEU Purchase Agreement was signed in 1992. This should free up additional quantities of HEU beyond the 500 metric tons that Russia has already declared excess to military needs. Some combination of the United States, European Union and Japan could therefore propose to purchase additional blended-down Russian HEU under the condition that Russia use a portion of the proceeds for conversion and other nonproliferation activities in the closed cities. At $24 million per metric ton of weapon-grade uranium, only 4 additional tons per year would be required to generate almost $100 million per year.

- **A "debt-for-security swap."** The United States and other creditors could try to reach an agreement with Russia in which billions of dollars of foreign debt would be cancelled if Russia created an audited ruble fund to be used only for agreed nuclear security and conversion projects.

- **Lifting import limits on Russian exports of natural uranium and enrichment services.** If Russia agrees to spend a portion of the revenues on agreed nuclear security efforts, the United States should take the lead in working with the

European Union, Japan, and other countries to allow increased Russian exports of uranium, enrichment, and other fuel cycle services into their nuclear markets.

- **Extraction of U^{235} from and disposition of US depleted uranium**. Russia currently has surplus uranium-enrichment capacity and its gas-centrifuge uranium-enrichment technology uses only one tenth as much energy per separative work unit as the gas-diffusion technology used by the United States. It would therefore be economical for Russia to extract additional U^{235} from the depleted uranium stored at US enrichment plants. The US government could pay Russia an additional fee for dealing in this way with what would otherwise be a multi-billion-dollar US disposal problem.

CONCLUSION

Senator Domenici's proposal provides a realistic framework for a stronger and more focused US and multinational effort to help Russia downsize its nuclear complex. The proposal's requirement of milestones for that down-sizing in exchange for US conversion assistance is reasonable and necessary if the effort is to attract major funding. And its encouragement of the US Government to contract for cleanup, nonproliferation and other types of R&D in the nuclear cities reflects a realistic assessment that commercial ventures by themselves will not create new non-weapons jobs in the nuclear cities as rapidly as the planned drastic downsizing requires. Also important is the proposal's insistence that there be better interagency coordination of US assistance programs and a White House coordinator with real authority.

Improving the energy efficiency of the nuclear cities will be critical to their economic future. Energy efficiency could also be a source of many technical jobs that would pay for themselves through savings in energy costs. Many such jobs have been created elsewhere in Russia with loans from the World Bank and other organizations.

Other potential sources worth considering for new funding for conversion projects in the nuclear cities include: storage of foreign spent fuel (but only if objections by local communities and public interest groups are met), additional or accelerated sales of blended-down highly-enriched uranium, raised limits on sales of Russian natural uranium and enrichment work in the United States, European Union and Japanese markets; production of low-enriched uranium from the stripping of additional U^{235} from US depleted uranium, and a "debt-for-security" swap.

APPENDIX 1: DOWNSIZING PROJECTIONS ON A CITY-BY-CITY BASIS[43]

During the Cold War, the Soviet nuclear weapons complex consisted of over twenty research institutes, design bureaus, fissile material production centers, and warhead production facilities. Eleven of these facilities were located in ten closed nuclear cities. The complex continued to grow until the late 1980s, when the Soviet government began reducing its nuclear-weapons stockpile and phasing out production of fissile materials for weapons, and initiated a program of defense conversion.

The production of HEU for weapons ceased in 1988. Ten out of thirteen plutonium-production reactors were shut down between 1987 and 1992. The three reactors still in operation produce heat and electricity for local populations and cannot be shut down until replacement energy sources become available. Since October 1994, freshly-produced plutonium has been placed in storage and is no longer used in nuclear weapons.

The termination of defense orders for new fissile materials effectively cut the uranium-enrichment and plutonium-production plants out of the weapons program. As a result, no nuclear weapons activities presently take place in three of the closed nuclear cities: two that specialize in uranium enrichment (Novouralsk and Zelenogorsk) and one in plutonium production (Zheleznogorsk). However, they remain critical to the mission of storing and managing hundreds of tons of fissile material recovered from nuclear weapons, some of which may remain a part of Russia's strategic reserves.[44]

The uranium-enrichment facilities seem to have made a relatively successful transition to providing fuel-cycle services and blending down HEU. Post-Soviet economic and social dislocations have weakened the remainder of the complex, however. Most defense conversion efforts have failed because of insufficient investments, the collapse of Russia's domestic markets, lack of entrepreneurial and market skills, secrecy, inflexible institutional bureaucracies, and high production costs. The technical infrastructure of the complex has deteriorated and many workers from facilities (particularly in open cities) have left for commercial jobs.

MinAtom's 1998 Program

[43] The discussion is based on Oleg Bukharin *Downsizing of Russia's Nuclear Warhead Production Infrastructure*, PU/CEES Report No. 323, May 2000.

[44] According to MinAtom officials, the Zheleznogorsk plutonium complex remains a part of the weapons complex.

Today, MinAtom's nuclear-weapons-production complex is already much smaller than its Cold-War size and consists of 17 facilities (Table A2-1). However, it remains oversized for its post-Cold War missions and cannot be supported by the Russian economy. In 1998, therefore, MinAtom launched a restructuring and downsizing effort to reduce facility duplication and to separate the defense part of the complex from the parts that have become excess to defense requirements. An integral part of the plan is to create civilian jobs for excess workers.

MinAtom's plans were formalized in a program, "On Restructuring and Conversion of the Nuclear Weapons Complex in 1998-2000," adopted by the Russian government in June 1998 as a part of a broader plan to restructure Russia's defense industries. This program and associated planning documents call on MinAtom to:[45]

- Stop warhead assembly in Sarov and Zarechny by 2000.
- Stop warhead dismantlement in Sarov and Zarechny in 2003.
- Phase out nuclear-weapon work at one of the two fissile material processing plants (subsequently determined to be Seversk) in 2003.
- Cut the number of defense program personnel from 75,000 to 40,000 by 2005.

After the implementation of the 1998 downsizing program, nuclear weapons activities will be concentrated in five closed cities (Sarov, Snezhinsk, Lesnoy, Trekhgorny, and Ozersk), along with several supporting and non-nuclear component manufacturing facilities in open cities.

In April 1999, MinAtom established the Department for Conversion of Nuclear Industry, which has the responsibility for defense conversion and complex restructuring.[46] All weapons-complex research institutes and production plants have developed and are working to implement facility-level restructuring programs. Warhead assembly work has ended at the Avangard plant in Sarov and its primary weapons work is now warhead dismantlement.[47] The Zarechny facility reportedly has no defense work and the closed city is on the verge of becoming open.[48] Seversk has also essentially become a civilian nuclear technology center.

Tables A1-2 contain estimates, based on public information, of the current and projected workforce levels (including nuclear-weapons program employment levels) for each of the ten closed nuclear cities. Also listed are the principal (including former)

---

[45] L.Ryabev, presentation to the Princeton Conference (March 14-15, 2000).

[46] See, for example, "Conversion: Interview with A.Antonov," *Atompressa*, No. 1 (378) January 2000, pp. 1-2.

[47] The assembly of the last warhead at the Avangard Plant was finished on December 30, 1997. Yu.Zavalishin *"Avangard" Atomic*, Krasny Oktyabr': Saransk, 1999, p. 292.

[48] L.Saratova "How do You Live, the Weapons Plant?" *Gorodskoy Kuryer*, No. 3, January 23, 1999.

weapons-related activities, commercial and government-funded nuclear activities, and major non-nuclear conversion projects (including proposed).

Table A1-1. Russia's Nuclear-Weapon Production Complex[49]
(including facilities in open cities)

	Fissile Material and Component Production	**Weapons R&D**	**Production of Warheads and Components**	**Complex Total**
Number of Facilities	3	6	8	17
Locations	Zheleznogorsk Seversk Ozersk	Sarov Snezhinsk Nizhni Novgorod Moscow	Sarov Zarechny Trekhgorny Lesnoy Novosibirsk Yekaterinburg Moscow	
Defense orders (% total)	41.5	80	68	
Employment	36,000	40,800	49,000	125,800
Defense Program Employment	14,900	27,600	33,300	75,800

[49] L.Ryabev, presentation to the Princeton Conference.

Tables A1-2. Nuclear Facilities and Employment Before and After Downsizing and Major Activities on a City-By-City Basis[50] (* indicates proposed activities and projects)

A project or activity is defined as "proposed" if it is yet not active because of the lack of the required technical infrastructure and/or technologies, or because of unfavorable market conditions or underdeveloped business approaches. For many projects (particularly for those classified as "commercial non-nuclear") adequate information to ascertain their status is not available. Such projects are presumed active.

SAROV (ARZAMAS-16)

POPULATION: 83,000
PRINCIPAL NUCLEAR ORGANIZATIONS:

- VNIIEF (Federal Nuclear Center – Institute of Experimental Physics)
- Electro-Mechanical Plant "AVANGARD"

VNIIEF: WORKFORCE

	1980s	**2000**	**2005** (projected)
TOTAL	25,000	18,000	16,000
WEAPONS PROGRAMS	25,000	16,000	12,000

[50] This set of tables was created by Oleg Bukharin. Unless indicated otherwise, the information is based on the author's estimates and compilation of data from a variety of sources that are too numerous to list individually. These sources include Western and Russian publications, presentations, and interviews. Current and projected defense-program workforces are estimated on the basis of the published current and projected total levels, reported data for some individual facilities, and employment levels at comparable US facilities. The data vary in quality from relatively reliable (as in the case of Sarov) to "guesstimates."

VNIIEF: MAJOR ACTIVITIES

Nuclear-Weapon Missions	**Non-Commercial**	**Commercial Nuclear**	**Commercial Non-nuclear**
Nuclear-weapons R&D Stockpile stewardship Component manufacturing	Basic research Emergency response NP/AC EM (Integrated Treatment Center*)	Nuclear-power-plant (NPP) safety projects Stable-isotope separation	Oil and gas industry projects Diamond cutting Production of SF_6 electrical power switches Software development Production of NPP instrumentation and controls* Production of auto electronics* Production of high-voltage generators* Conventional weapons R&D*

AVANGARD: WORKFORCE

	1980s	**2000**	**2005** (projected)
TOTAL	4,800	3,500	3,500
WEAPON PROGRAMS	4,800	2,700	900 (mostly working on conventional weapons)

AVANGARD: MAJOR ACTIVITIES

Nuclear-Weapon Missions	**Non-Commercial**	**Commercial Nuclear**	**Commercial Non-nuclear**
Warhead assembly [PAST] Warhead disassembly [TO END IN 2003] Component manufacturing?	Environmental cleanup (Integrated Treatment Center*)	Polonium isotope production Radioisotope Thermal Generator production	Production of - MPC&A equipment - anti-terrorist equipment - radio transmitters - consumer goods - medical equipment - conventional weapons

SNEZHINSK (CHELYABINSK-70)

POPULATION: 48,000
PRINCIPAL NUCLEAR ORGANIZATION: VNIITF (Federal Nuclear Center -- Institute of Technical Physics)

VNIITF: WORKFORCE

	1980s	**2000**	**2005** (projected)
TOTAL	15,000	9,500	9,000?
WEAPON PROGRAMS	15,000?	9,000?	7,000?

VNIITF: MAJOR ACTIVITIES

Nuclear-Weapon Missions	**Non-commercial**	**Commercial Nuclear**	**Commercial Non-nuclear**
Nuclear weapons R&D Stockpile stewardship Component manufacturing	Basic research Nonproliferation and arms control R&D Emergency response Environmental research	Development of container for spent fuel storage and transport	Oil and gas industry projects Conventional weapons R&D Production of oil-well-liner perforators* Production of fiber-optic cable* Super-plastic forming* Software development* R&D/production of medical equipment*

OZERSK (CHELYABINSK-65)

POPULATION: 88,000
PRINCIPAL NUCLEAR ORGANIZATION: Production Association Mayak

MAYAK: WORKFORCE

	1980s	**2000**	**2005** (projected)
TOTAL	12,000?	12,000?	?
WEAPONS PROGRAMS	12,000?	6,000?	4,000?

MAYAK: MAJOR ACTIVITIES

Nuclear-Weapon Missions	**Non-commercial**	**Commercial Nuclear**	**Commercial Non-nuclear**
Plutonium production for weapons [PAST] Fabrication of HEU and plutonium components Tritium production, purification and reservoir loading Fissile material storage and management?	Environmental cleanup and waste management Facility decommissioning Fissile material storage and management Plutonium disposition*	Reprocessing of spent power-reactor fuel HEU processing for downblending Production of medical and industrial isotopes Production of Pu-238 and radioisotope thermal generators Nuclear power plant construction and operation* Spent fuel storage*	Production of Consumer goods Instrumentation and control equipment for nuclear, chemical, and oil/gas industries Vessels for food-processing and chemical industries Ion-exchange membranes for fuel cells Personal dosimeters Printed circuits Strong rare-earth metal magnets Precision electrical motors Thermoelastic tubes and films TV sets Polished silicon wafers* Fiber-optic cable*

SEVERSK (TOMSK-7)

POPULATION: 119,000
PRINCIPAL NUCLEAR ORGANIZATION: Siberian Chemical Combine (SKhK)

SKhK: WORKFORCE

	1980s	**2000**	**2005** (projected)
TOTAL	20,000	15,000	?
WEAPON PROGRAMS	?	5,000? (including plutonium production workers)	None ?

SKhK: MAJOR ACTIVITIES

Nuclear-Weapon Missions	**Non-commercial**	**Commercial Nuclear**	**Commercial Non-nuclear**
HEU production [PAST] Plutonium production for weapons [PAST] Fabrication of HEU and plutonium components [PAST] Fissile material storage and management?	Still operating two plutonium-production reactors to produce heat and power Environmental cleanup and management Facility decommissioning Disposition of enrichment tails Fissile material storage and management	HEU downblending Uranium (including RepU) processing and enrichment Uranium conversion Stable-isotope (B-10*) separation Nuclear power plant construction and operation*	Oil refinery operation (Tomsk Oil and Chemical Combine) Electricity/ heat production Production of consumer goods Production of high-purity materials* Production of dispersed powders* Production of chemical power sources*

ZHELEZNOGORSK (KRASNOYARSK-26)

POPULATION: 100,000
PRINCIPAL NUCLEAR ORGANIZATION: Mining and Chemical Combine (MCC)
OTHER SIGNIFICANT INDUSTRIAL ORGANIZATIONS: Production Association of Applied Mechanics (Satellite development and production, 11,000 employees?)

MCC: WORKFORCE

	1980s	**2000**	**2005** (projected)
TOTAL	11,000	8,300	?
WEAPONS PROGRAMS	?	4,000? (including plutonium-production workers)	None ?

MCC: MAJOR ACTIVITIES

Nuclear-Weapon Missions	**Non-commercial**	**Commercial Nuclear**	**Commercial Non-nuclear**[51]
Plutonium production [PAST] Plutonium storage and management?	Still operates one plutonium-production reactor to produce heat and power Environmental cleanup and waste management Facility decommissioning Fissile material storage and management Plutonium disposition*	Spent fuel storage (wet) International spent fuel storage (dry)* Spent fuel reprocessing*	Production of: - semiconductor silicon (Silicon of Siberia)* - rare-earth metals - pure aluminum - medical bandages - pharmaceutical products - equipment for aluminum industry - asbestos-silicate materials - mercury lamp recycle

[51] In part based on communication with Anatoli Diakov, March 2000.

NOVOURALSK (SVERDLOVSK-44)

POPULATION: 96,000
PRINCIPAL NUCLEAR ORGANIZATION: Urals Electro-Chemical Combine (UEKhK)

UEKhK: WORKFORCE

	1980s	**2000**	**2005** (projected)
TOTAL	15,000	15,000?	?
WEAPONS PROGRAMS	?	None	none

UEKhK MAJOR: ACTIVITIES

Nuclear-Weapon Missions	**Non-commercial**	**Commercial Nuclear**	**Commercial Non-nuclear**
HEU production [PAST] CURRENTLY NO DEFENSE MISSION	Environmental cleanup and waste management Disposition of enrichment tails Uranium storage	HEU downblending Uranium enrichment	Production of - fuel cells - instrumentation and control equipment - car batteries - compressors and power equipment - electrical equipment - farm products

ZELENOGORSK (KRASNOYARSK-45)

POPULATION: 67,000
PRINCIPAL NUCLEAR ORGANIZATION: Electro-Chemical Combine (EKhK)

EkhK: WORKFORCE

	1980s	**2000**	**2005** (projected)
TOTAL	10,000	10,000?	?
WEAPONS PROGRAMS	?	None	None

EKhK MAJOR ACTIVITIES

Nuclear-Weapon Missions	**Non-commercial**	**Commercial Nuclear**	**Commercial Non-nuclear**
HEU production [PAST] CURRENTLY NO DEFENSE MISSION	Environmental cleanup and waste management Disposition of enrichment tails	HEU downblending Uranium enrichment Separation of stable isotopes	Production of - VCR and audio tapes - TV sets and consumer electronics - synthetic cotton (SibKhimVolokno)

LESNOY (SVERDLOVSK-45)

POPULATION: 58,000
PRIMARY FACILITY: Combine Electrokhimpribor

ELECTROKHIMPRIBOR: WORKFORCE

	1980s	**2000**	**2005** (projected)
TOTAL	10,000	10,000?	?
WEAPONS PROGRAMS	?	7,000-10,000?	5,000?

ELECTROKHIMPRIBOR: MAJOR ACTIVITIES

Nuclear-Weapon Missions	**Non-commercial**	**Commercial Nuclear**	**Commercial Non-nuclear**
HEU production [PAST] Lithium-6 separation [PAST] Warhead assembly and disassembly Fissile material storage?	Environmental cleanup and waste management	Separation of stable isotopes	Production of - neutron generators for oil/gas industries - consumer goods (bicycles etc) - valves for oil/gas industries - SF_6 power-switches - aluminum rims for car wheels - cutting tools coated with diamond-chromium powder - ultra-dispersed diamond powders - Gold Star TV sets (jointly with S.Korea)

TREKHGORNY (ZLATOUST-36)

POPULATION: 33,000
PRINCIPAL NUCLEAR ORGANIZATION: Device-Building Plant (PSZ)

PSZ: WORKFORCE

	1980s	**2000**	**2005** (projected)
TOTAL	6,400?	6,400	5,000
WEAPONS PROGRAMS	6,400?	3,600	2,800

PSZ: MAJOR ACTIVITIES

Nuclear-Weapon Missions	**Non-commercial**	**Commercial Nuclear**	**Commercial Non-nuclear**
Warhead assembly and disassembly Fissile material storage?	Environmental cleanup and waste management	DU processing and fabrication of DU products	Production of nuclear power plant instrumentation and control equipment Production of phone switching stations ATS-400 Production of footwear Production of bathroom equipment Production of polyethylene pipes Reconditioning of electrical tram-cars Construction of a ski-resort*

ZARECHNY (PENZA-19)

POPULATION: 64,000
PRINCIPAL NUCLEAR ORGANIZATION: PO START
OTHER SIGNIFICANT ORGANIZATION: NIKIRET (branch of Eleron's, physical security equipment designer)

START: WORKFORCE

	1980s	**2000**	**2005** (projected)
TOTAL	11,000?	10,000	?
WEAPONS PROGRAMS	?	7,000-10,000	Several hundreds?

START: MAJOR ACTIVITIES

Nuclear-Weapon Missions	**Non-commercial**	**Commercial Nuclear**	**Commercial Non-nuclear**[52]
Warhead assembly [PAST] Warhead dismantlement [TO END IN 2003] Non-nuclear nuclear-weapon component manufacturing?			Production of - security equipment - car components (for GAZ plant) - lathe machines - instrumentation and control equipment for gas pipelines - communication equipment - energy-efficiency equipment - medical equipment - food - road construction

[52] In part based on communication with Anatoli Diakov, March 2000.

APPENDIX 2. CONFERENCE AGENDA AND LIST OF PARTICIPANTS

AGENDA

TUESDAY, MARCH 14

8:30-9:00 AM **REGISTRATION** and Continental Breakfast
Dodd's Auditorium, Woodrow Wilson School of Public and International Affairs, Robertson Hall

9:00-9:30 AM **GREETINGS AND CONFERENCE OVERVIEW**

Greetings
Michael Doyle
Director of the Center of International Studies, Princeton University

Conference Overview
Frank von Hippel
Professor of Public and International Affairs, Princeton University

9:30-11:00 AM RUSSIAN AND U.S. STRATEGIC APPROACHES
Chair: *Frank von Hippel*

Downsizing of the Nuclear Complex and Defense Conversion Programs
Lev Ryabev
Deputy Minister, Russian Ministry of Atomic Energy

The Nuclear Cities Initiative and Its Synergisms with Other DOE Efforts
Ernest J. Moniz
Undersecretary, U.S. Department of Energy

U.S. Assistance to Russia
William Taylor
Coordinator of United States Assistance to the New Independent States, U.S. Department of State

11:00-11:15 AM COFFEE/TEA BREAK

11:15 AM-1:00 PM **CURRENT CONDITIONS IN RUSSIA'S CLOSED NUCLEAR CITIES**
Chair: *Frank von Hippel*

Snezinsk (Chelyabinsk-70)
Evgeny Avrorin
Scientific Director, All Russian Institute of Technical Physics

Sarov (Arzamas-16)
Vassili P. Neznamov
First Deputy Director, All-Russia Institute of Experimental Physics

The Eight Other Closed Nuclear Cities

Anatoli Diakov
Director, Center for Arms Control, Energy And Environment, Moscow Institute of Physics and Technology

1:00-2:30 PM **LUNCH**, Shultz Dining Room, Robertson Hall (no speaker)

2:45-4:00 PM **PERSPECTIVES ON PROGRAMS AND POSSIBLE PATHS FORWARD (Part 1)**
Chair: *Ken Luongo*

Background on U.S. Cooperative Activities in Russia's Nuclear Cities
Sharon Weiner
Research Associate, Center for Energy & Environmental Studies, Princeton University

The Nuclear Cities Initiative
Rose Gottemoeller
Assistant Secretary of Energy for Nonproliferation and National Security, U.S. Department of Energy

The Moscow International Science & Technology Center
Steven Aoki
Director, Office of Proliferation Threat Reduction, U.S. Department of State

4:00-4:15 PM **COFFEE/TEA BREAK**

4:15-5:30 PM **PERSPECTIVES ON PROGRAMS AND POSSIBLE PATHS FORWARD (PART 2)**
Chair: *Ken Luongo*

On Progress of and Prospects for the Implementation of the Nuclear Cities Initiative Agreement
Victor Belkin
Main Specialist, Russian Ministry of Atomic Energy

Accelerated Conversion Proposal for Sarov
Siegfried Hecker
Former Director, Los Alamos National Laboratory

Congressional Interest and Concern for the Nuclear Cities
Peter Lyons
Science Advisor to U.S. Senator Pete Domenici

6:30 PM **RECEPTION, Prospect House**

7:30 PM **DINNER, Prospect House**

After-Dinner Speaker *Andrei Kortunov*
President, Moscow Public Science Foundation

WEDNESDAY, MARCH 15

8:30-10:15 AM CHALLENGES AND OPPORTUNITIES I
Chair: *Matthew Bunn*

Re-Structuring the U.S. Nuclear Complex
Victor Reis
Science Applications International Corporation (SAIC)

On Some Aspects of Defense Conversion of the Nuclear Weapons Complex in Closed Cities
Vladimir Starosotnikov
Deputy Director, Department of Conversion, Russian Ministry of Atomic Energy

Down-Sizing of Russia's Nuclear-Weapons Production Infrastructure
Oleg Bukharin
Research Staff, Center for Energy & Environmental Studies, Princeton University

Opportunities from Nuclear Disarmament
Thomas Neff
Research Affiliate, Center for International Studies, Massachusetts Institute of Technology

10:15-10:30 AM COFFEE/TEA BREAK

10:30 AM-12:00 PM CHALLENGES AND OPPORTUNITIES II
Chair: *Matthew Bunn*

Business
Jana Fankhauser
Pacific Northwest National Laboratory; and
David Bernstein
Research Associate, Center for International Security and Cooperation, Stanford University

Energy Efficiency
Meredydd Evans
Pacific Northwest National Laboratory

European Nuclear Cities Initiative
Maurizio Martellini
Secretary General, Laudau Network Coordination Center

12:00-1:30 PM LUNCH, Shultz Dining Room, Robertson Hall, (no speaker)

1:30-3:30 PM **EXPANDING AND REFOCUSING THE EFFORT**
Chair: *Frank von Hippel*

Ken Luongo
Executive Director, RANSAC

Matthew Bunn
Assistant Director, Science, Technology and Public Policy Program, Kennedy School of Government, Harvard University

Vladimir Rybachenkov
Councilor, Department for Security, Affairs and Disarmament, Ministry of Foreign Affairs of The Russian Federation

Discussion

LIST OF PARTICIPANTS

Gene Aloise
Assistant Director, Resources, Community and Economic Development Division, US General Accounting Office

Steven Aoki
US Department of State

Evgeny Avrorin
All Russian Institute of Technical Physics, Snezhinsk

Victor Belkin
Ministry of the Russian Federation on Atomic Energy, Department of International Relations

David Bernstein
Center for International Security and Cooperation, Stanford University

Naila Bolus
Executive Director, Ploughshares Fund

Jennifer Brush
NP/PTR, US Department of State

Oleg Bukharin
CEES, Princeton University

Matthew Bunn
BCSIA, Harvard University

Ronald W. Cochran
Lawrence Livermore National Laboratory

Tom Cochran
Natural Resources Defense Council

Paolo Cotta-Ramusino
Dipartimento di Fisica, Milano, Italy

Renee de Nevers
Program on Global Security and Sustainability, John D. and Catherine T. MacArthur Foundation

William J. Desmond
Director, IPP-NCI, US Department of Energy

Marco Di Capua
Lawrence Livermore National Laboratory

Anatoli S. Diakov
Director, Center for Arms Control, Energy and Environmental Studies
Moscow Institute of Physics and Technology

Michael Dobbs
Washington Post

Michael Doyle
Director of the Center of International Studies, Princeton University

William Dunlop
Lawrence Livermore National Laboratory

Will Englund
Baltimore Sun

Meredydd Evans
Associate Director, Advanced International Studies Unit, Pacific Northwest National Laboratory

Jana Fankhauser
Battelle Seattle Research Center

Hal Feiveson
CEES, Princeton University

Wayne Glass
Senior Defense Policy Advisor, Office of Senator Jeff Bingaman

Rose Gottemoeller
Assistant Secretary for Nonproliferation, US Department of Energy

Joshua Handler
CEES, Princeton University

Janet Hauber
US Department of Energy

Mary Alice Hayward
Senate Armed Services Committee

Siegfried Hecker
Materials Science and Technology Division, Los Alamos National Laboratory

Ann Heywood
Lawrence Livermore National Laboratory

Bill Hoehn
Washington Office Director, RANSAC

Igor Khripunov
CITS, University of Georgia

Michael Knapik
McGraw-Hill

Andrei Kortunov
President, Moscow Public Science Foundation

Edward Levine
Committee on Foreign Relations, US Senate

Ken Luongo
Executive Director, Russian American Nuclear Security Advisory Council (RANSAC)

Corbin Lyday
Senior Policy Analyst, Office of Democracy & Governance, Bureau for Europe and Eurasia, US Department of State

Peter Lyons
Office of Senator Pete Domenici

Maurizio Martellini
Secretary General, Landau Network Coordination Center, Milan, Italy

Matt Martin
Office of Senator Kerrey

Alan McCurry
Military Legislative Assistant, Office of Senator Pat Roberts

Margot Mininni
Director, Community Development Projects and Outreach, Nuclear Cities Initiative, US Department of Energy

Stephen V. Mladineo
Program Manager, Pacific Northwest Laboratory

Ernest J. Moniz
Under Secretary, US Department of Energy

Inta Morris
CRDF

Thomas Neff
Center for International Studies, MIT

Vassili P. Neznamov
First Deputy Director, Russian Federal Nuclear Center – VNIIEF, Sarov

Patricia Moore Nicholas
Carnegie Corporation of New York

Noboru Oi
Senior Consultant, Japan Atomic Industrial Forum

Sonia Ben Ouagrham
Senior Research Associate, Monterey Institute of International Studies, Center for Nonproliferation Studies

William Potter
Director, Center for Nonproliferation Studies, Monterey Institute of International Studies

George Pomeroy
Nuclear Cities Initiative, US Department of Energy

Thomas C. Reed
Chairman, Quaker Hill Development Corporation

Victor Reis
SAIC

Lev Ryabev
First Deputy Minister, Ministry of the Russian Federation on Atomic Energy

Vladimir Rybachenkov
Counsellor, Ministry of Foreign Affairs of the Russian Federation

Diane Snyder
Director, Special Programs, Sarnoff Corporation

Peggie Spanel, Princeton, NJ

David Speedie
Chair, International Peace and Security, Carnegie Corporation of New York

Vladimir Starosotnikov
Ministry of the Russian Federation on Atomic Energy, Deputy Head, Department for Defense Conversion

Kristen Suokko
W. Alton Jones Foundation

William Taylor
Office of the Coordinator of US Assistance to the New Independent States, US Department of State

James W. Toevs
Russian Nonproliferation Program, Los Alamos National Laboratory

Elizabeth Turpen
Office of Senator Pete V. Domenici

Frank von Hippel
Princeton University

Sharon K. Weiner
CEES, Princeton University

David M. Wolfe
Department of Physics & Astronomy, University of New Mexico

Fumhiko Yoshida
Deputy Editor, Foreign News Section, Asahi Shimbun

Yuri Yudin
Director, Analytical Center for Non-Proliferation at the RFNC-VNIIEF, Sarov

Yury K. Zavalishin
Director General, Electromechanical Plant Avangard

David Zigelman
Westinghouse Savannah River Company

Peter D. Zimmerman
Science Advisor, Bureau of Arms Control, Department of State