Report

Conversion Challenges in Russian Nuclear Cities

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A decade after the end of the Cold War, an excess of nuclear weapons, fissile materials, production capacities, and nuclear weapon specialists remain in the world. About 95 percent of nuclear materials and capabilities are concentrated in Russia and the United States. While the end of the Cold War has made these excess capabilities militarily irrelevant, the terrorist attacks of September 11, 2001, and the fear that they could be repeated with weapons of mass destruction (WMD) have lent a new urgency to the problem of managing nuclear weapons and related infrastructure. Before 9/11, the challenge of terrorism was often considered a local one, primarily affecting particular regions or ethnic or political groups. Stable areas like the Urals region of Russia, home to a number of major nuclear facilities, were not viewed as likely targets of terrorist attack. But the 9/11 attacks made it obvious that the terrorism problem is global.

Since the 1990s, the effects of globalization have become increasingly visible, and military and terrorist challenges have begun to spread among regions of the world. The 9/11 attacks were just the latest culmination of this trend. It has become obvious that a global war has been declared by terrorists, and no countries can be considered immune from terrorist attack. Taking into consideration the size of its nuclear weapons complex, one can view Russia as a potentially dangerous place, especially considering the known aspirations of some terrorist groups to acquire a nuclear capability. The problem is not simply that Russian nuclear facilities could be vulnerable to terrorist attack. As has been widely documented and discussed, since the early 1990s these facilities have also faced a difficult economic situation, which if not properly addressed, will increase the risk that nuclear materials, technology, or know-how might leak out from them, with potentially catastrophic consequences. The current situation makes it increasingly important that the Russian nuclear complex be downsized to a level compatible with the current reduced nuclear forces fielded by Russia. It is also imperative that this process not increase the risk of proliferation from these facilities, but instead reduce it, by providing sustainable alternative uses for the human and material resources formerly devoted to nuclear weapons production.

This report examines the current state of the ten closed administrative territorial entities in Russia—also known as closed cities, or by their Russian acronym

ZATO—and provides an overview of the human and technological resources they possess. It then discusses efforts to date to convert excess defense nuclear capacities in these cities to civilian use. The report discusses conversion achievements, but also analyzes the reasons current programs have not been entirely successful at meeting the conversion challenge. The report argues that in order to downsize the nuclear ZATO without generating major social tensions and increasing proliferation risks, small and medium businesses must be developed that can absorb the workers who will be laid off from defense nuclear enterprises. It concludes that to facilitate the emergence of such businesses and help them find markets and partners, international development centers (IDCs) should be established in the regions of Russia where the ZATO are concentrated, such as the Urals region.

ZATO STRUCTURAL COMPOSITION AND THEIR CONVERSION

At a time when threats may be increasing, the Russian nuclear complex has found itself in a very complicated situation, as a lack of government funding has made it impossible to support the enormous infrastructure developed during the Cold War. As of 2003, the Russian Federation Ministry of Atomic Energy (Minatom) infrastructure includes the following types of facilities:

1. Research and development institutes
2. Chemical combines
3. Production plants
4. Nuclear power plants.

Ten closed cities have facilities of types 1-3 on their territory. A number of other Russian communities, which have type 4 facilities in their immediate vicinity, do not technically fall into the ZATO category, but nevertheless feel implicated by nuclear problems. The number of ZATO has remained unchanged since the Cold War era. Exactly half of these cities are located in the Urals, specifically in two of its regions, Chelyabinsk and Sverdlovsk (Ekaterinburg) Oblasts. Unfortunately there are no official statistics on ZATO available in Russian sources. In the authors' opinion, the most relevant data on the size and scope of the ZATO have been collected by the Nuclear Cities Initiative (NCI) of the U.S. Department of Energy, and are summarized in Table 1.

NCI and independent experts estimate that "75,000 workers are directly employed in nuclear-weapons facilities," while "150,000 have jobs in the nuclear facilities, about half in civilian activities, such as uranium enrichment for nuclear power reactor fuel, and half (60,000–67,000) in nuclear weapon-related projects."[1] Only rough estimates attempt to identify the number of these personnel with crucial nuclear weapons-related knowledge, however. Maurizio Martellini mentions that "roughly 20,000 nuclear scientists and workers are potential proliferation risks," and a Russian expert has estimated that "15–18 thousand people had crucial knowledge in particular fields (including missile specialists)."[2] Regarding the potential threat of "brain drain" from Russian nuclear facilities into "countries of proliferation concern," however, these estimates show that the ZATO are an area of particular risk.

Although the total number of employees working at ZATO nuclear facilities has been reduced by half since the beginning of the 1980s, the number of critical specialists, by contrast, has continued to grow.[3] A retired specialist—whether transferred to a civilian job, pensioned off, or self-employed—does not lose his or her specialized and sensitive knowledge. This category of retired ZATO specialist poses a significant proliferation risk, and is possibly a greater risk than current employees. First of all, despite some problems with unpaid wages, people working in nuclear production earn a high salary in comparison with that of the average Russian. According to the Russian Center for Welfare Standards at the Ministry of Labor, for the fourth quarter of 2002, the average minimum welfare standard in Russia was about $60 per month (for able-bodied citizens, $64). At the same time, the average per-person income (including "gray" or unofficial earnings) was $146. By comparison, in the nuclear field, the average monthly salary in the first 8 months of 2002 was $233 for industry (an increase of 129 percent compared with the same period in 2001) and $209 in nuclear research and development (R&D) institutions (137 percent more than the previous year).[4] The average salary at the Russian Federal Nuclear Center-All-Russian Scientific Research Institute of Technical Physics (VNIITF): Federal Nuclear Center (RFNC-VNIITF) in Snezhinsk in February 2003 was $262.[5] In the first eight months of 2002 the Russian consumer price index increased to 109.9 percent. Growth of actual salary if compared with the same period in 2001 came to 126.8 percent in industry and 134.3 percent in R&D institutions.[6] It should be mentioned that key specialists and top management (who have crucial knowledge) earn correspondingly higher salaries. Secondly, a tight regime of secrecy precludes almost all overseas trips for personal reasons by such specialists (not to mention their families).

TABLE 1
DEMOGRAPHICS OF RUSSIAN NUCLEAR CITIES

ZATO Name	Population (thousands)	Population Density (percent)	Number of Workers of Minatom RF Town-Planning Enterprises (thousands)	Proportion of Minatom System Workers (percent)	Proportion of Minatom System Workers versus the Total Number of ZATO Residents (percent)
Europe	**147.00**	**19.44**	**31.50**	**26.76**	**21.43**
Sarov (Arzamas-16)	83.00	10.98	21.50	18.27	25.90
Zarechny (Penza-19)	64.00	8.47	10.00	8.50	15.63
Siberia	**286.00**	**37.83**	**33.30**	**28.29**	**11.64**
Zheleznogorsk (Kransnoyarsk-26)	100.00	13.23	8.30	7.05	8.30
Zelenogorsk (Kransnoyarsk-45)	67.00	8.86	10.00	8.50	14.93
Seversk (Tomsk-7)	119.00	15.74	15.00	12.74	12.61
Urals	**323.00**	**42.72**	**52.90**	**44.94**	**16.38**
Snezhinsk (Chelyabinsk-70)	48.00	6.35	9.50	8.07	19.79
Ozersk (Chelyabinsk-65)	88.00	11.64	12.00	10.20	13.64
Trekhgorny (Zlatoust-36)	33.00	4.37	6.40	5.44	19.39
Novouralsk (Sverdlovsk-44)	96.00	12.70	15.00	12.74	15.63
Lesnoy (Sverdlovsk-45)	58.00	7.67	10.00	8.50	17.24
Total	**756.00**	**100.00**	**117.70**	**100.00**	**15.57**

Source: Nuclear Cities Initiative, U.S. Department of Energy, "Program Plan," Washington, DC, October 2000.

Nevertheless, the threat of technology and know-how leaks from the Russian nuclear sector could worsen as a result of the ongoing restructuring of the nuclear industry, assuming substantial reduction of staff. Those who have become redundant in the post-Cold War era include specialists with crucial knowledge (mainly pensioners). In the 1990s, the populations in the nuclear ZATO rose sharply (increasing almost 4 1/2 times) compared with the 1980s.[7] As a result, local labor resources increased, although the demand for labor has not kept pace. The situation is worsened by the fact that the existing ZATO infrastructure is not ready to employ a lot of people, thus causing social strain and affecting the families of both current specialists as well as retired employees. The lack of alternative employment will create an additional incentive for specialists to move from the nuclear ZATO,

increasing the risk of technology leakage. In many cases, specialists are dismissed from their jobs and then leave the ZATO. For example, all the experts of the NeurOK private company (former Russian Federal Nuclear Center staff from Snezhinsk) offered and accepted employment in Moscow with compensation packages superior to their former government salaries. While this may represent a form of economic conversion of these workers' skills to civilian use, some proliferation risks remain. As long as a specialist remains employed in a ZATO, a commission decides for how long he or she is prohibited to travel abroad. That is why it is impossible to obtain a foreign passport until this term expires. However, this level of control is impossible to maintain outside ZATO, and a former specialist can leave the country if he or she manages to get a foreign passport illegally or travels through other countries of the former Soviet Union (for which a foreign passport is not necessary).

Can we predict the likely outcome of such unmanaged downsizing of the Russian nuclear complex? One way to answer this question is to examine the actual experience of the city of Visaginas (Lithuania), which is the location of the Ignalina Nuclear Power Plant (INPS).[8] Its population is 30,000, mainly Russian-speaking migrants who came from different parts of the Soviet Union. Until the mid-1990s, the city led an isolated life. In 1994, however, Lithuania bowed to European Union (EU) pressure to shut down INPS. The first reactor will be closed in 2005 and the second in 2009. By 1999 employees of the facility realized that its closure was inevitable. A number of unanticipated consequences followed. First there was a disastrous collapse of local residential real estate prices—the cost of three-room apartment fell to $3,000—as employees rushed to sell their property. This provoked a flood of "immigrants" from the nearby capital, Vilnius, and according to some reports, caused social degradation, growth of criminal activity, increased drug addiction, and alcohol abuse. Secondly, surveys revealed that 30 percent of the population of Visaginas (mainly high-qualified specialists) intended to leave Lithuania. While one-third of the current staff is participating in the shut-down and decommissioning of the facility, the remaining 9,000 people will lose their jobs (1,000 people in 2005, and 8,000 people in 2009). Lithuania will spend only $140 million to retrain these 9,000 staff (the EU pledged these funds). The consequences of staff reduction at Russian ZATOs would likely be similar, but on a larger scale, due to the broader scope of restructuring, higher risk of technology leakage, and lack of adequate economic support to manage the transition.

In accordance with post-Cold War reality and intergovernmental agreements between Russia (the USSR) and the United States regarding nuclear threat reduction, a decision to restructure Minatom was made more than 10 years ago. This restructuring assumes the reduction of the nuclear complex to the level required for Russian Federation (RF) security by concentrating defense work in a limited number of facilities. Based on this approach, surplus facilities are supposed to close and existing capacities at remaining facilities to increase.

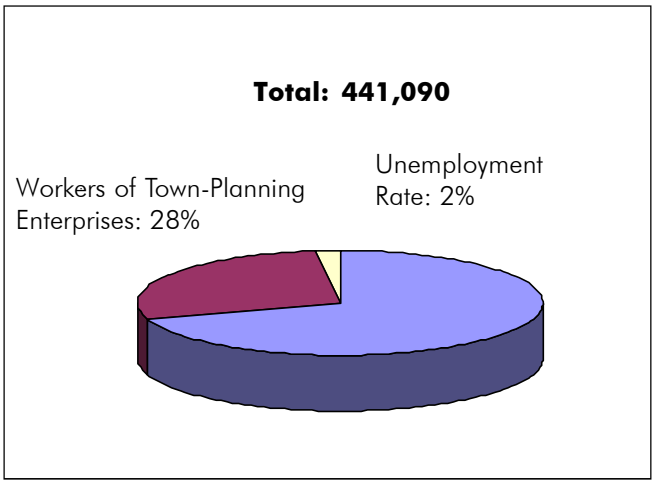
One of the main problems in implementing this restructuring plan is the fate of employees who will lose their jobs with the downsizing of the facilities. The restructuring cannot be implemented without making decisions about the employment of these people and/or providing attractive conditions for their retirement, since the existing economic and social structure of the "closed cities" does not fit and is not ready for making such a decision.

At the end of year 2000, the size of the economically active population of the ZATOs was 417,090 people; the number of registered unemployed was 9,180 people (see Figure 1).

According to current Minatom restructuring plans, 35,000–40,000 nuclear ZATO workers will be laid off by 2010.[9] Only two of the four plants currently assembling nuclear weapons, and only one of two producing plutonium and uranium parts, will remain in operation.[10] First of all, the Mining and Chemical Combine, a plutonium production facility in Zheleznogorsk, and the Avangard Plant, a weapons assembly and disassembly facility in Sarov, will be closed. The Siberian Chemical Combine in Seversk and the Electrochemical Plant in Zelenogorsk will remain open, whereas the Urals Electrochemical Combine in Novouralsk and the Start Production Association in Zarechnyy will be significantly reduced in size. Under these plans, about 10,000 people will be laid off in Sarov (3,500 from Avangard and 6,000 from VNIIEF).[11] According to a recent report by Minister of Atomic Energy Aleksandr Rumyantsev, plans also call for ending the ZATO status of Novouralsk, Snezhinsk, Angarsk, Arzamas (possibly Sarov), Zelenogorsk, and a number of other scientific centers in the Urals and Siberia.[12]

The problem of nuclear specialist reorientation to civilian work appeared in the USSR in the late 1980s, with planned reductions in Soviet nuclear forces. From this point on, facilities have focused conversion efforts on compensating for a decrease in the scope of government contractual work with the production of civil products using existing capacities. During this era, a relatively favorable condition for financing conversion projects

FIGURE 1
ECONOMICALLY ACTIVE POPULATION IN ZATO



occurred. But at the beginning of the 1990s, when the Soviet Union collapsed and Russia undertook an abrupt transition to a market economy, the nuclear industry was thrust into "survival mode," as government defense contract work dropped precipitously and conversion projects were put on starvation diets. For example, from 1996 to 1997, conversion projects were funded only by the revenues raised through the U.S.-Russian highly enriched uranium (HEU) deal. Under these conditions, the attempt of the military nuclear complex to adapt to the emerging market conditions in Russia failed.[13] The main causes of this failure include the following:

- The general economic situation in Russia was not favorable for development of high technologies, overall production was down, generally only speculative business was prosperous, and there were few real possibilities for industrial development.
- The lack of funding for conversion did not allow completion of commercialization development and bringing developed products to production. Most of the products that were eventually introduced to the market found few buyers owing to insufficient research of market trends prior to project investment planning.
- Lack of adaptability of nuclear facility structures to market conditions (including a lack of qualified managers, inadequate resource separation for military and civil production, huge overhead costs, and a budgetary approach to investment development that excludes aiming at consumers) made products and services noncompetitive.[14]

Social and political conditions should also be taken into consideration. During the 1990s, the nuclear industry seemed to be under strong political pressure. This substantially slowed the development of the nuclear power industry, one of the main potential civil customers of the nuclear complex. One such example is the freezing of construction at the South Urals Nuclear Power Plant (SU NPP) in Chelyabinsk oblast. Construction was stopped as a result of the protests of local residents, although putting the SU NPP into operation would help resolve three sets of related problems:

1. Economic. The Chelyabinsk region is experiencing a power shortage, power rates are higher than the overall Russian average, and the average depreciation of the equipment of the regional energy company Chelyabenergo by the beginning of 2001 was already 53.5 percent—while one-fifth of this equipment had already exceeded its planned service life.[15]
2. Ecological. Design features of the SU NPP would help manage the Techa cascade, a group of reservoirs which are currently storing water contaminated with low-level radioactive waste from the Mayak Production Association. The cost of alternative activities to mitigate this Techa cascade situation is comparable to the cost of SU NPP construction.[16]
3. Social. This dimension includes nonproliferation goals, such as the utilization of weapons-grade plutonium in the nuclear fuel cycle (the SU NPP will have fast breeder reactors that use plutonium as fuel), and the creation of alternative civilian employment for nuclear specialists.

As a result of the 1998 financial crisis, however, the situation in Russia has changed and some preconditions for the development of new civilian production have taken hold. During the same year, a subprogram of the Federal Target Program (Government Resolution #625, dated June 24, 1998), "Restructuring and Conversion of Nuclear Industry Facilities (Nuclear Weapons Complex) in 1998-2000," was adopted (later its term was extended to 2001). A separate program, "Target Program of Minatom ZATO Public Employment Support for 1998 - 2000," was separately chosen from this program. The funds allocated for this program are shown in Table 2.

However, it was obvious from the start that this level of funding was inadequate to achieve good results. Owing to this problem, the program goals were not fully achieved. Only 8,173 jobs were created out of a planned 15,000. For

TABLE 2
FUNDS ALLOCATED FOR TARGET PROGRAM OF MINATOM ZATO PUBLIC EMPLOYMENT SUPPORT, 1998–2000 (MILLIONS OF RUBLES, 2001 PRICES)

	Federal Budget	Task Budget Fund of Minatom	Centralized Conversion Fund	Facility Funds	Total: Minatom	Grand Total
Planned	3,802.21				3,355.05	7,157.26
Actual	0	5,106.03	661.47	83.66	5,106.03	5,851.16

Source: Ministry of Atomic Energy of the Russian Federation, "Primary Results of the Subprogram 'Restructuring and Conversion of Nuclear Industry Facilities (Nuclear Weapons Complex) in 1998-2001," <http://www.minatom.ru/activity/conversion/14.html>.

example, for successful implementation of the core conversion project for the Electrochemical Plant in Zelenogorsk at the beginning of the 1990s, $215 million was spent just for equipment for production of magnetic medium (used to produce audio and video tapes).[17] This sum, however, exceeded the money spent from 1998 through 2001 for the entire nuclear industry under the program. In addition, all the obstacles to conversion noted above continued to have an adverse affect. As a result, the only facilities that have successfully converted to civilian production have turned out to be those that changed their production capacity as little as possible for general delivery to western countries (for example, Mayak), or those that are participating in the U.S.-Russian HEU deal.

The unemployment problem in the nuclear ZATO, however, is not limited to the creation of jobs for former weapons specialists. As was mentioned above, weapons specialists make up 28 percent of the whole economically active population of ZATO. ZATO social stability cannot be achieved without resolving the job problem for the remaining categories, especially when jobless specialists leaving municipal enterprises replenish the ZATO "unemployed" category. Some government programs have attempted to address this problem. Under the Public Employment Support Program, 13,300 jobs were created or retained in the ZATO by 2000. More than 1,250 people participated in public works programs through placement services and 1,200 people were sent for occupational training.[18] The public works programs were intended to provide services and support for organizations performing jobs of temporary or seasonal nature and tasks under the federal and regional programs of social and economic development. Many of these programs, however, were underfinanced.

At the beginning of the 1990s, an additional source of employment support appeared in the ZATO—small- and medium-size private businesses. At this time, the economic and social infrastructure of the ZATO was transferred from the Minatom enterprises to the local city administrations. Article 5 of the Russian Federal Law "About ZATO" allowed the implementation of an incentive taxation zone in ZATO that attracted investment to the closed cities, including investment for business development. Unfortunately, even when social and economic infrastructure responsibilities were given to local authorities, Minatom enterprises still couldn't solve their problems under the complicated transitional conditions. For instance, in 1997 in Sarov, the city budget received 82 billion rubles, when by comparison the external businesses registered there received 246 billion rubles. At the same time, the employees of the Russian Federal Nuclear Center located in Sarov were not paid their wages on time, and the center's wage arrears totaled 100 billion rubles.[19]

Since the new Russian tax code was passed in 1999 and the federal laws on the budget for 2000 and 2001 came into force, however, the privileged taxation regime for ZATO was cancelled. For financial resource accumulation and allocation, extrabudgetary funds were created, which provided financing for business projects in the ZATO. However, these efforts turned out to be ineffective. The majority of jobs were created at municipal enterprises or remained only on paper. The main problem was the underdeveloped infrastructure in the ZATO—for example, lack of sufficient commercial building space, absence of a favorable business environment for supporting commercial projects due to ZATO isolation, lack of qualified management, a low level of entrepreneurial abili-

ties of project participants, and inefficient management of the municipal share of newly organized enterprises.[20]

Mutual efforts by the federal program and city administrations have led to a decrease in the total number of unemployed (see Table 3).[21] Nevertheless, the trend toward enhancing labor market conditions in the ZATO cannot be called a steady one. While many job openings are available on the labor market, these jobs often remain unfilled for the following reasons: The majority of available jobs for men offer salaries that are too low, with frequent wage payment delays; the share of women and young people among the unemployed has increased; and the number of people asking for job placement, or psychological, legal, and guidance services increased by 37 percent from 1994 to 2000.[22]

The improvement in the Russian economy since 2000 has not been reflected in the ZATO labor market. Although the rate of growth of the Russian gross domestic product was 8.3 percent in 2000 and 5.3 percent in 2001, the economic situation in the ZATO has not radically changed.[23] On the contrary, the withdrawal of tax privileges from the closed nuclear cities in 2000 and the transfer of local budgets onto subsidy levels caused the ZATO to lose attractiveness in the eyes of investors. These changes resulted in an outflow of investment and a caused a budget deficit for the cities.

TABLE 3
LEVEL OF MINATOM ZATO REGISTERED UNEMPLOYMENT, 1994–2000
(PERCENT OF LABOR FORCE)

ZATO	1994	1995	1996	1997	1998	1999	2000
European Russia							
Sarov (Arzamas-16)	0.5	1.5	2.3	1.7	2.4	2.0	1.2
Zarechny (Penza-19)	6.2	8.8	8.2	6.8	7.9	5.8	3.1
Siberia							
Zheleznogorsk (Kransnoyarsk-26)	2.0	6.0	6.0	5.8	3.1	1.5	1.1
Zelenogorsk (Kransnoyarsk-45)	2.6	2.3	3.1	2.0	2.9	2.7	2.7
Seversk (Tomsk-7)	3.7	6.3	7.3	5.9	5.1	3.6	2.0
Urals							
Snezhinsk (Chelyabinsk-70)	1.8	2.2	2.8	1.8	2.7	1.4	0.8
Ozersk (Chelyabinsk-65)	1.0	1.9	3.6	4.6	5.8	3.2	2.3
Trekhgorny (Zlatoust-36)	3.4	6.0	5.4	6.9	5.8	4.5	2.7
Novouralsk (Sverdlovsk-44)	0.5	2.6	4.7	4.7	6.3	4.2	2.9
Lesnoy (Sverdlovsk-45)	2.7	3.7	4.0	2.9	5.5	3.8	3.6

Source: I.V. Yefimkova, "Analysis of Results of Performance of the Target Program on RF Population Employment Support in 1998-2000," paper delivered to the seminar, Small Innovative Firms in Russian Nuclear Cities, Obninsk, Russia, September 10-14, 2001.

Another source of alternative job creation is international nonproliferation programs that have principally been funded by the United States. Currently, more than 30 mutual U.S.-Russian programs on threat reduction are ongoing. Several U.S. programs, some funded by the Department of State, others by the Department of Energy, aim at creating civilian jobs for former nuclear weapons specialists. The International Science and Technology Center (ISTC), Initiatives for Proliferation Prevention (IPP), and Nuclear Cities Initiative (NCI, involving three ZATO—Sarov, Snezhinsk, and Zheleznogorsk) are in operation. Recently a private U.S. foundation, the Nuclear Threat Initiative (NTI), started working on this issue as well.

A five-year agreement on NCI was signed on September 22, 1998. In July 2003, however, U.S. Secretary of Energy Spencer Abraham informed Minister of Atomic Energy Rumiantsev that the United States would not extend the NCI Agreement until the Russian government adopts legal regulations protecting American employees and companies working in Russia under the projects. Nevertheless, considering the positive experience of cooperation under the NCI program, the parties of the Joint Steering Committee Meeting held in Moscow on September 19, 2003, decided to continue working on 69 projects.[24] During 1999-2003, Russian participants in ZATO received about $14.5 million in U.S. funding under the NCI program: That represents about 20 percent of the total NCI budget.[25] The U.S. General Accounting Office (GAO) analyzed these programs in 2001 and reached the conclusion that they are not a great success.[26] In the opinion of the GAO, the main problems of the programs are insufficient financial support for Russian projects, insufficient efforts to achieve commercially viable products, incorrect selection of projects, and unnecessary duplication of programs with similar goals.[27] Regarding NCI, Minatom's official position is that

> the Agreement has not reached its initial goals, but it has laid a foundation for further Russian-American cooperation and it can provide the backgrounds for elaboration of a new legal basis of such cooperation between Russia and the USA, as well as between other countries under the Global partnership.[28]

Minatom concluded that under NCI, "The parties have undertaken an attempt to implement particular projects under a framework agreement having no precise application mechanisms. That is the main disadvantage and the most important lesson from our cooperation that should be taken into account in the future."[29]

ZATO Restructuring Plans and Potential Approaches to their Implementation

The ZATO labor market will be heavily affected by the federal target program, "Reorganization of Nuclear Industry Enterprises (Nuclear Weapons Complex) in 2001–2005 and up to 2010." This program calls for releasing 30,000–35,000 workers from nuclear weapons complex enterprises during its implementation.[30] The main program goals for mitigating the impact of these large-scale layoffs on the social situation in the ZATO are:

- Reorientation of released personnel to development and production of civilian products
- Support and development of private enterprises and self-employment
- Organization of temporary and public works projects.

The largest and most extensive conversion in the nuclear weapons complex is planned for the first phase of the reorganization program (2002–2005) and will require substantial government support. During this phase, the program aims to create 17,800 new jobs for personnel released from the nuclear weapons complex. To mitigate the social stress generated by these layoffs, the program stipulates that temporary employment will be provided for all ZATO population categories by organizing public works for 44,900 people and providing retraining and training in new occupations for 185,300 people.[31]

During 2002–2010, the program will generally use two methods for creating 30,000 jobs in the nuclear ZATO: the establishment of conversion enterprises and the development of small and medium businesses. The main means of funding conversion is supposed to be conversion credits to nuclear industrial enterprises, which will be granted on a competitive basis. The program assumes that financing will be provided on a contribution basis, taking into account the involvement of extrabudgetary sources (the enterprise's own funds). It also assumes that payback will take two to three years (however, this is probably unrealistic for conversion projects). Local government is supposed to be another source of jobs. For ensuring stable social and economic development and public employment, local governments will implement investment projects for developing small and medium businesses, using local budgets and also attracting outside investors. However, as was mentioned earlier, in order to attract investors to closed cities, it is necessary to create the proper environment, which does not currently exist. Reorgani-

zation of defense enterprises will also affect the cities since implementation of new goals will require changes and upgrades in ZATO city infrastructures (new personnel, lines of communication, power, roads, etc.).

Each side involved in the ZATO employment problem is using its own approach. Minatom is generally financing industry projects based on state-owned enterprises. Local administrations prefer so-called MPEs (enterprises with a share of municipal property). International programs are also dealing mostly with state-owned industrial enterprises and, to a lesser extent, with municipal enterprises and private businesses. Experience, however, including that of international assistance programs, has shown that government enterprises (as well as municipal ones) are not highly motivated to participate in commercially successful projects since they are primarily interested in getting budgetary financing.[32] Part-time personnel invited to develop a particular project during sponsor financing, for example, at the NCI-supported Open Computer Center in Sarov, often fill newly created jobs.[33] Thus, there is a threat that newly created jobs will continue to exist only while outside financing is still available.

In making decisions concerning public employment, local authorities often ignore city planning facilities. In spite of the fact that mass production projects generate a large number of jobs and promote employment, the goal of nonproliferation would not be totally achieved. For example, enterprises that locate their production capacities in Snezhinsk, a city currently dominated by a nuclear weapons design bureau, face a serious problem when hiring workers, which can only be resolved by hiring workers from neighboring areas.[34] On the other hand, new production facilities in Snezhinsk might not require the highly qualified engineering and scientific staff and other specialists released from the nuclear weapons complex.

However, investing in enterprises with a high share of government or municipal property would make sense. It provides support to the city administration or city planning enterprise. This approach reduces risks, since statistics indicate that only one to three enterprises out of 10 newly established ones are successful. However, using these organizational and legal forms does not necessarily result in the creation of an effective self-sustained business, one that is capable of surviving in the absence of continued financial support. For example, the State Unitary Enterprise Spektr was established in Snezhinsk in 1999. This is a conversion daughter enterprise of the Russian Federal Nuclear Center VNIITF (RFNC-VNIITF) that existed for only one and one-half years. Conversion developmental designs and 357 people were transferred to this enterprise.[35] The goal was to bring the designs into commercial development. The enterprise was supposed to be financed by the money of the city planning enterprise RFNC-VNIITF, the Snezhinsk city administration, and international programs. However, RFNC-VNIITF remained the only source of financing. The city administration did not support an organization with public ownership. A one-and-a-half-year "battle" to implement a cooperation initiative with the University of New Mexico was completed without any substantial results from the Russian side. No response for any single mutual project was discussed.[36] The first NCI contracts (Â507085/Â507086) for development of graded-index optical fiber production were placed with Spektr only in March 2000, but in August Spektr stopped working and was eventually closed because RFNC-VNIITF financing was terminated. The main part of the staff returned to VNIITF, although 60 people moved to another new enterprise, Spektr-Conversion Ltd. (with 98 percent municipal ownership), and some parts moved to other organizations.[37] The causes of this failed conversion project are clear: insufficient financing, ineffective structure (practically copying the parent enterprise), and weak management.

At the moment, Spekter-Conversion Ltd. has substantial support from the Snezhinsk city administration as well as the NCI and IPP programs. To render a fair appraisal of this case, it should be noted that the activities of private companies formed in Snezhinsk that tried to perform development and subsequent commercialization on their own also turned out to be unsuccessful.[38] But the scope of resources of those companies was incommensurably small in comparison with budgetary and governmental sources of financing. The lack of business skills of private enterprise founders also provided a negative impact since the majority of founders and managers of those enterprises were former nuclear scientists.

SITUATION IN THE ZATO OF THE URALS REGION

The downsizing of the Russian nuclear weapons complex will affect some regions of the country more heavily than others. Under existing conditions, the closed cities of the Urals region, where half of Minatom's industrial capacity is concentrated, could find themselves in an especially critical situation. In the absence of restructuring plans for

the ZATO in the Urals region (according to presentations by First Deputy Minister of Minatom L.D. Ryabev at a March 2001 conference, a number of the planned changes will principally affect Sarov, Zheleznogorsk, Zarechny, and partially Novouralsk),[39] Minatom is directing the main part of the financial resources allocated for defense conversion to enterprises located in the European part of Russia (see Table 4).[40] A similar situation exists in the area of federal subsidies for ZATO budget workers (see Table 5).

Based on the data presented in Tables 1 and 4, conversion investment per worker in the Urals ZATO is half that in European Russia or Siberia. At the same time, based on Tables 3 and 5, the average unemployment level in the Urals ZATO is higher, with a lower level of subsidies. The situation is the same with international assistance programs, which are mostly aimed at Sarov. The lion's share of NCI financing for the three cities currently participating in the programs goes to Sarov—about 50 percent. European Nuclear City Initiative (ENCI) projects show a similar pattern.[41] And the privately funded NTI program is also focused on Sarov. The first project list for this program included only $1 million in financing for the Conversion Company Development Foundation of Sarov.[42]

This unbalanced distribution of conversion resources could increase the proliferation threat from the Urals ZATO. The region has a high concentration of nuclear weapons facilities, personnel, technologies, and materials on the one hand, and a relatively low level of financing nonproliferation, restructuring, and conversion activities on the other. Terminating the closed city status of the ZATO while keeping nuclear facilities open would worsen the problem, creating easier access by criminals or terrorists to these facilities and their personnel. In addition, the current law enforcement infrastructure of these cities would be unable to withstand the inrush of criminals that could take place after their "opening." Under these circumstances, the Urals region could become more vulnerable to terrorist organizations. Recent events suggest that this possibility is not just theoretical. In March 2002, three Chechen arms dealers were arrested in Lesnoy, a Urals region ZATO which houses a weapons assembly and disassembly facility. A search of one of the suspect's houses revealed a stockpile of weapons, including explosives and remote-control detonators. One of the suspects also had a pass allowing access to the closed city, which was originally thought to be a forgery, but later turned out to be genuine, as he was a former resident of Lesnoy.[43]

Concerning criminal activity in the region more generally, one should not forget that Chelyabinsk and Sverdlovsk oblasts rank third among Russian regions in the rate of grave crime (20–25 murders per 100,000 people).[44]

RECOMMENDATIONS FOR IMPROVING CONVERSION EFFICIENCY

Innovative ways to address the conversion problem do exist. An important way to achieve successful commercialization is to take advantage of existing specializations in the ZATO. For example, using its experience in production of radioisotopes, exports from Mayak provide 97 percent of the hard currency budget of the Chelyabinsk oblast.[45] On the other hand, branch institutes, as a rule, are not intended for mass production, and a realistic method for their commercialization is to market designs. But in Russia, because of industrial and financial complications, designs are still not in great demand. In this situation, some international programs are mainly playing the roles of clients. For example, the ISTC program turned out to be fairly effective in the case of the Russian Federal Nuclear Centers. This program provides scientists and specialists with work in the area of applied, not military, topics (however, not on a stable basis and only part-time). Approximately 14 percent of the ISTC money is spent for "closed cities." A major drawback, however, is that the commercial output resulting from ISTC grants is not high.[46]

Another approach is to use cooperation among the closed cities, which is a strong resource for stable development, to enhance conversion efficiency. Each city would perform its tasks in cooperation with the others, and all would work toward common results. To date, such cooperation was mainly a feature of defense projects managed by Minatom. When conversion was considered, each closed city was assumed to "survive" in its own way. But cooperation between the cities still remains an underused resource, which could help enhance the efficiency of commercial development projects and decrease program expenses by allowing more effective utilization of existing equipment, premises, and specialists and the elimination of duplication.

Reasons to push for increased cooperation among the closed cities include:

- Existing business contacts. Many in the nuclear industry have preserved the traditional links and cooperate with their old partners rather than other enterprises. ZATO enterprise managers have the same way

TABLE 4
MINATOM RF EXPENSES FOR CONVERSION IN 1998–2000 FOR FIVE PROGRAMS
(MILLIONS OF RUBLES, 2000 PRICES)

ZATO	Silicon of Minatom RF	Minatom for Fuel and Energy Complex	Micro-electronics	Electrical Equip-ment	Medical Equip-ment	Other Tasks	Total for Five Programs
European Russia							
Rubles	**0**	**0**	**57.60**	**32.50**	**61.70**	**180.00**	**331.80**
(Percent)	**(0)**	**(0)**	**(20.95)**	**(25)**	**(33.33)**	**(16.67)**	**(13.49)**
Sarov	0	0	57.60	32.50	61.70	180.00	331.80
(Arzamas-16)	(0)	(0)	(20.95)	(25)	(33.33)	(16.67)	(13.49)
Zarechny	0	0	0	0	0	0	0
(Penza-19)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Siberia							
Rubles	**300.00**	**0**	**0**	**0**	**61.70**	**0**	**361.70**
(Percent)	**(47.62)**	**(0)**	**(0)**	**(0)**	**(33.33)**	**(0)**	**(14.70)**
Zheleznogorsk	300.00	0	0	0	61.70	0	361.70
(Krasnoyarsk-26)	(47.62)	(0)	(0)	(0)	(33.33)	(0)	(14.70)
Zelenogorsk	0	0	0	0	0	0	0
(Krasnoyarsk-45)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Seversk	0	0	0	0	0	0	0
(Tomsk-7)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Urals							
Rubles	**0**	**150.00**	**0**	**65.00**	**61.70**	**0**	**276.70**
(Percent)	**(0)**	**(93.75)**	**(0)**	**(50)**	**(33.33)**	**(0)**	**(11.25)**
Snezhinsk	0	50.00	0	0	0	0	50.00
(Chelybinsk-70)	(0)	(31.25)	(0)	(0)	(0)	(0)	(2.03)
Ozersk	0	0	0	0	0	0	0
(Chelybinsk-65)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Trekhgorny	0	50.00	0	32.50	0	0	82.50
(Zlatoust-36)	(0)	(31.25)	(0)	(25)	(0)	(0)	(3.35)
Novouralsk	0	0	0	0	0	0	0
(Sverdlovsk-44)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Lesnoy	0	50.00	0	32.50	61.70	0	144.20
(Sverdlovsk-45)	(0)	(31.25)	(0)	(25)	(33.33)	(0)	(5.86)
Moscow							
Rubles	**330.00**	**10.00**	**217.40**	**32.50**	**0**	**900.00**	**1,489.90**
(Percent)	**(52.38)**	**(6.25)**	**(79.05)**	**(25)**	**(0)**	**(83.33)**	**(60.56)**
Total							
Rubles	**630.00**	**160.00**	**275.00**	**130.00**	**185.10**	**1,080.00**	**2 ,460.10**
(Percent)	**(100)**	**(100)**	**(100)**	**(100)**	**(100)**	**(100)**	**(100)**

Source: The following site was used when preparing the table: <http://www.minatom.ru>. Since reports for the programs contained only total money and lists of performers, contributions of financial resources allocated for each project participant were aasumed to be equal.

TABLE 5
DISTRIBUTION OF SUBSIDIES AND SUBVENTIONS TO ZATO BUDGETS, 2001
(THOUSANDS OF RUBLES)

ZATO Name	Subsidies	Resettlement	Subventions for Capital Outlays	Development Programs
Europe				
Sarov	386,309	-	253,366	20,000
Zarechny	438,268	4,300	142,568	40,000
Total	**824,577**	**4,300**	**395,934**	**60,000**
Siberia				
Zheleznogorsk	671,587	-	219,679	100,000
Zelenogorsk	236,821	-	207,665	20,000
Seversk	489,667	1,100	256,610	33,000
Total	**1,398,075**	**1,100**	**683,954**	**153,000**
Urals				
Novouralsk	-	359,079	20,000	-
Lesnoy	135,964	9,000	112,676	30,000
Ozersk	391,932	-	208,576	90,300
Trekhgorny	-	20,000	-	-
Snezhinsk	-	-	100,000	-
Total	**527,896**	**388,079**	**421,252**	**120,000**

Source: Russian Federal Assembly, "On the Federal Budget in 2002," Federal Law FZ-194, Attachment 15, December 30, 2001.

of thinking; they can easily come to mutual understanding, and personnel from one ZATO have access to other ZATO, facilitating cooperation.

- Deep specialization. Each ZATO carried out a precise task as part of the nuclear weapons complex. Such narrow specialization can be an obstacle for efficient work in the commercial market where diversification and flexibility are needed. Under these conditions, however, joint efforts can produce excellent results. For instance, R&D and pilot production could be conducted in Snezhinsk (which has specialized in design) while large-scale production could be done in Ozyorsk or Tryokhgornyy.

In such a cooperative project, the client could be, for example, a ZATO enterprise operating under the project and performing the final phase of implementation, while experts from an external organization could provide project management.

In contrast to Minatom's approach—to fund conversion projects at existing nuclear enterprises—international programs have started to apply another approach—establishing new enterprises on a commercial basis. And their success is guaranteed if an existing successful business is involved (such partners are often located outside the ZATO). On the one hand this approach provides needed management, and on the other access to financial support for the project. Effective results can be achieved by energetically using this approach to attract private businesses and create favorable conditions for their development in the ZATO. For example, in the U.S. Defense Authorization Act for FY 2001, a condition for allocation of money to nuclear industry conversion projects from the NCI program is the preliminary evaluation that any "scientific, technical, or commercial project" funded by the NCI will:

- Not enhance Russia's military capabilities
- Be "carried out in conjunction with an appropriate commercial, industrial, or non-profit entity as partner"
- Be "commercially viable" within three years.[47]

But in themselves, these conditions do not resolve the need to link private business with the conversion process. For businesses, the commercial success of a project is determined by profit, company value, etc., whereas from the point of view of nonproliferation, the number of jobs is the primary criteria of success. These two goals are not always compatible. The process of developing an NCI project is often characterized by a long period of numerous discussions, concurrence with various authorities,

correspondence, etc. Take the case of the Spektr conversion project mentioned above, for which NCI funding became available too late to have a practical impact.

The terms under which these NCI projects operate are thus unacceptable for private business when market conditions change faster than the time it takes to agree on projects. For the time being, the milestones of a project for the program are construction of a plant, delivery of equipment, operation, etc. However, an equally important stage in successful conversion to commercial production is the achievement by an enterprise of at least the break-even stage. For that, resources should also be considered in the planning stage. For a private business, issues of city infrastructure, favorable business environment, and possibilities of attracting needed future personnel are very important. From this perspective, the nuclear ZATO, with their restrictive regulations and undeveloped conditions for entrepreneurial activities, are far from being attractive for external investors. The main problem for an investor, especially a foreign one, is the limited access to ZATO. This issue can be resolved only at the level of Minatom and supervising federal authorities.[48]

A related challenge is the shortage of qualified managers in the nuclear ZATO. This shortage is due primarily to the inability of human resources and managers to migrate to the ZATO, owing to administrative restrictions. One proposal for improving this situation involves the Russian government creating five to seven special economic areas in the next two to three years, in order to create "science-intensive" production and the same number of technical-practical areas to develop the most advanced technologies. The enterprises and companies operating in these areas would be freed from customer fees, and they would have privileged rates for utilities, rent of land, and facilities, and they would receive budget subsidies and "cheap" state credits.[49] However, in order to avoid negative consequences of "privileged areas" in the ZATO, trilateral agreements should be signed between the new enterprise, Minatom, and the local authorities. In any case, such a privileged regime is needed not for all industry in or near the nuclear ZATO, but only for particularly promising science-intensive projects.[50]

Besides large projects with city planning enterprises and city administrations, a large contribution to the creation of alternative employment for former employees of the nuclear weapons complex should be made by small and medium businesses, which are taking on an increasingly significant role. For example, in 2001, 3,500 private businessmen and dozens of small private enterprises were registered in Snezhinsk.[51] Whereas previous small businesses in ZATO were mostly involved in sales and intermediary activities, which are not very attractive for nuclear specialists, a reorientation has taken place in the small business sector toward the development of manufacturing facilities. This shift is producing demand for engineering and design specialists. The rapid creation of software development and mathematical modeling companies in ZATO, which are direct employers for researchers, is very noteworthy. Currently, Snezhinsk is successfully applying a strategy in which development and production are being performed by small firms inside the ZATO, while management is provided by external companies. It is possible to cite several examples of such links in Snezhinsk: The Snezhinsk Plant of Paintwork Materials, Ltd., is partnering with NVN-Market, Ltd., of Ekaterinburg in the manufacture of commercial equipment, woodworking, and retail trade; Rastr-Technology, Ltd., (Snezhinsk) is partnering with Rastr-Technology (Moscow) in the manufacture of punch tooling, packaging, and printing materials; Home Closed Corporation is working with ZapSibGasprom Holding (Tyumen); Ekstraproduct-Urals and UralsTravers-Pack are working with Holding Park-Group (Moscow) in the production of packaged coffee; and Snezhinsk Pharmaceutical Company, Ltd., is collaborating with CogalymFinanceService Public Corporation (Tyumen), an oil company. Enterprises from outside the ZATO can offer the management skills needed to make such partnerships work. They know market conditions much better and have larger resources than the small firms located inside the ZATO. The outside partners sometimes purchase ownership shares of small Snezhinsk enterprises; Snezhinsk enterprises also are operated as subdivisions of external business entities. Nevertheless, small business in the ZATO still face the same challenges of underdeveloped infrastructure and geographical isolation, which remains a substantial challenge to additional investments.[52]

Thus, one of the main challenges of business development and establishment of commercially successful companies in the nuclear ZATO is the creation and development of business infrastructure that would facilitate running businesses; allow effective interaction between businesses, city authorities, and the city planning company; and support integration of businesses in the ZATO with "open" areas. According to Russian statistics, approximately 50 percent of newly established enterprises go out of business during the first two years. That means that the starting phase is the time when such enterprises require

qualified support. Hence, the obvious way of enhancing the effectiveness of mutual nonproliferation programs is the investment of money not only in establishing companies (job creation) but also in developing the business infrastructure in the nuclear ZATO through the development and support of organizations (agencies) that provide services on commercialization, economic consulting, selection and training of managers, assistance in the search for customers, financial analysis and accounting, and intellectual property protection. The goal of these agencies should be self-sustainability and the stable development of businesses.

CONCLUSION: THE CRITICAL ROLE OF INTERNATIONAL DEVELOPMENT CENTERS

Already, the first steps in this direction have already been taken. Within the framework of the NCI program, the International Development Center (IDC) program has been functioning in some nuclear ZATO for three years. To date, two IDCs have been established: one in Zheleznogorsk (1999) and the other in Snezhinsk (2000). The IDCs aim to resolve three principal problems that prevent the development of business activities in nuclear cities:

- Isolation from information about foreign markets
- Inadequate practical skills in running businesses in free-market conditions
- Lack of capital.

One of the tasks of the Snezhinsk IDC is to attract investment to Snezhinsk. To achieve this goal, the IDC has established a range of contacts with private investors, banks, foundations, and other entities. The main challenge is to propose viable projects that meet the interests and conditions of the investor.

Unfortunately the ZATO no longer offer any tax privileges for investors, making fundraising quite difficult. The existence of U.S. assistance programs like NCI is one of the incentives for potential investors in the ZATO, both from the point of view of cofunding and also because of the high political status of projects. In some past cases, the Snezhinsk city administration has also supported investment projects from its budgetary and nonbudgetary funds.

In the last two years, however, the situation has changed drastically, and the city faces a budget deficit, reducing the support it can offer. The IDC continues with the search, selection, and preparation of investment projects, but opportunities for successful development are beyond our control. Many projects are run jointly with the NCI program. Unfortunately, the termination of the NCI program will have a heavy impact on the attractiveness of Snezhinsk for private investors, especially under conditions of the city budget deficit. Another challenge is the resolution of legal, staffing, and accounting issues facing new businesses in Snezhinsk. For instance, the IDC is arranging the purchase of the building where the city printing house was located for the Moscow company RASTER-Technology, Ltd. The acquisition of this building is part of a joint project with British Nuclear Cities Partnership aimed at setting up an enterprise manufacturing up-to-date package in Snezhinsk.[53]

The experience of the IDC shows convincingly that this approach is an effective way to help with conversion of the ZATO workforce. The success of the IDC program is obvious. The IDCs render effective support to ZATO businesses through training, provision of equipment, information, consulting and other business-related services, and a search for partners and investors, etc. Both the business itself and officials recognize this positive role. In addition to supporting business development, the IDCs have also played a significant role in enhancing the effectiveness of cooperative nonproliferation programs like NCI. Until now, Minatom and the international programs have not had as close a relationship with the IDCs as would be optimal. The IDC could be involved in the development of project business plans, the review of projects, the evaluation of resources and qualifications of a selected project team or the search for an appropriate team, as well as the independent tracking of project implementation, the comparison with established design performance characteristics, and the identification of problems and corrective actions to resolve these problems. The optimal scheme, which began under the NCI, is including in the project cost expenses for management by a professional organization during the implementation of the project. This step increases project cost by 7 to 10 percent, but enhances its prospects greatly, provides investors a more accurate interpretation of the situation, and helps to keep a project under control.

Presently, the Snezhinsk IDC is the only organization capable of providing comprehensive support to commercialization projects at Urals ZATO. Until now, the activity of the Snezhinsk IDC has been limited to Snezhinsk. However, the Urals ZATO system is unique in that it includes practically all components of the nuclear cycle and, thus, the entire spectrum of resources (materials, equipment, personnel, etc.) that are needed for successful imple-

mentation of conversion projects. This is exactly the situation in which cooperation among ZATO on conversion may be the most effective. Within the framework of conversion projects, labor among ZATO companies can be divided according to their specialization to achieve the best results. Expanding IDC activities to other cities would improve cooperation and allow the experience accumulated in Snezhinsk over the past two years to be used in other Urals ZATO. The result would be a reduction in expenses and the elimination of the information vacuum that sometimes insulates the ZATO from each other. In addition, both cooperative nonproliferation programs and Minatom would benefit from a constantly operating structure in Urals ZATO, conducting independent online monitoring of the conversion situation. This is especially important for international assistance programs, since it would at least partially resolve the issue of control in the case of limited access to ZATO areas.

In our view, an optimal approach would transform the two existing IDCs into a regional ZATO Center for the Urals region. The regional status would increase the influence of the IDCs, but to be effective, it would also have to be followed by a substantial acceleration of problem resolution at the regional level, including receiving grants and financing from federal regional budgets—one of current main thrusts of future development in the NCI program, a vision elaborated at the initiative's joint steering committee meeting in September 2003. The committee said that in order "not to lose an opportunity of making the projects (which are being elaborated) for grow, both patties should provide a mechanism preserving and developing the capabilities that are of interest for Russian and foreign investors by means of various alternative programs besides the NCI."[54] On the Russian side, for instance, its Conversion Department Minatom could involve the IDC in training and instruction, search for funding, and business planning to assist redundant weapons specialists in other nuclear ZATO such as Seversk, Zarechnyi, Ozyorsk, and Novouralsk that are not covered by the NCI."[55] The IDCs can help in this role and help overcome the obstacles that to date have hindered the conversion of nuclear ZATO, but must be resolved if the Russian nuclear sector is to be successfully downsized without creating significant proliferation risks.

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