FOI-R--1588--SE
February 2005
ISSN 1650-1942
User report

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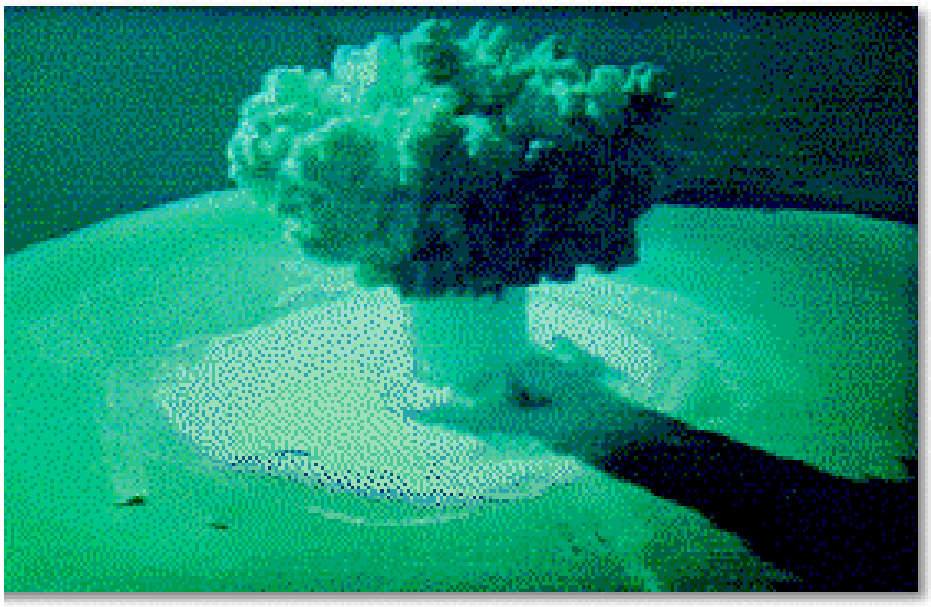
Russia's Tactical Nuclear Weapons

Part II: Technical Issues and Policy Recommendations



Systems Technology
SE-172 90 Stockholm

SWEDISH DEFENCE RESEARCH AGENCY
Systems Technology
SE-172 90 Stockholm

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The photograph on the front cover shows the test explosion of the Soviet Union's "First Tactical Nuclear Warhead" courtesy of the Nuclear Weapons Museum of the All-Russian Research Institute of Experimental Physics (VNIIEF), Sarov, Russia.

Issuing organization	Report number, ISRN	Report type
FOI – Swedish Defence Research Agency Systems Technology SE-172 90 Stockholm	FOI-R--1588--SE	User report
	Research area code 31 Nuclear Defence Research	
	Month year February 2005	**Project no.** A6123
	Sub area code 31 Nuclear Defence Research	
	Sub area code 2	

Author/s (editor/s)	Project manager
Gunnar Arbman, Charles Thornton	Mattias Waldenvik
	Approved by
	Sponsoring agency
	Scientifically and technically responsible Gunnar Arbman and Charles Thornton

Report title

Russia's Tactical Nuclear Weapons
Part II: Technical Issues and Policy Recommendations

Abstract (not more than 200 words)

This is the second part in a series of two reports on Russia's tactical nuclear weapons (TNW). Part II starts with a description of likely missions of Soviet TNWs during the Cold War era, followed by recent evidence on how Russia contemplates the use of its present nuclear weapons including command and control. The safety of Russia's TNWs is discussed together with the issue of possible pre-delegation of release authority of TNWs in a time of crisis.

Aspects on TNW warhead manufacturing and refurbishment are given and safety problems related to nuclear warhead storage sites and transportation are discussed. The report concludes that while there is a severe lack of transparency on TNW issues in Russia, its TNW warheads are probably more secure than analysts in the West commonly assert. It ends with a proposal that Russia would nevertheless do well to consolidate its tactical warheads into a smaller set of storage facilities in order to mitigate security as well as command and control concerns.

Keywords

Russia, tactical nuclear weapons, command and control, nuclear weapons storage site

Further bibliographic information	Language English
ISSN 1650-1942	**Pages** 78 p.
	Price acc. to pricelist

Utgivare	Rapportnummer, ISRN	Klassificering
Totalförsvarets Forskningsinstitut - FOI Systemteknik 172 90 Stockholm	FOI-R--1588--SE	Användarrapport
	Forskningsområde 3. Skydd mot NBC och andra farliga ämnen	
	Månad, år Februari 2005	**Projektnummer** A6123
	Delområde 31 N-forskning	
	Delområde 2	

Författare/redaktör	Projektledare
Gunnar Arbman, Charles Thornton	Mattias Waldenvik
	Godkänd av
	Uppdragsgivare/kundbeteckning
	Tekniskt och/eller vetenskapligt ansvarig Gunnar Arbman och Charles Thornton

Rapportens titel (i översättning)

Rysslands taktiska kärnvapen. Del II: Tekniska frågor och policyrekommendationer

Sammanfattning (högst 200 ord)

Föreliggande rapport är den andra av två som behandlar Rysslands taktiska kärnvapen. Rapporten ger en tillbakablick över hur Sovjetunionen sannolikt hade tänkt använda sina taktiska kärnvapen. Nyligen publicerade doktriner och genomförda militärövningar analyseras i syfte att hitta ledtrådar till hur man i dagens Ryssland skulle kunna tänka sig använda sina (taktiska) kärnvapen. Kontroll- och ledningsfrågor uppmärksammas med särskild betoning på eventuell delegering av beslutsrätten att använda taktiska kärnvapen vid en större väpnad konflikt.

Underhåll och nytillverkning av taktiska kärnvapen behandlas liksom skyddet vid transport och lagring. En slutsats är att säkerheten vid hantering, förvaring och transport av de taktiska kärnvapnen verkar vara större än många västliga bedömare anser vara fallet. En annan slutsats är att säkerheten trots detta kan förstärkas genom fortsatt centralisering - d.v.s. genom att antalet förråd och förvaringsplatser för stridsspetsarna ytterligare reduceras. Dessutom skulle sannolikt högsta ledningens kontroll och samband med underställda enheter påverkas i en gynsam riktning av detta.

Nyckelord

Ryssland, taktiska kärnvapen, ledning och samband, kärnvapenförråd

Övriga bibliografiska uppgifter	**Språk** Engelska
ISSN 1650-1942	**Antal sidor:** 78 s.
Distribution enligt missiv	**Pris: Enligt prislista**

Russia's Tactical/Non-Strategic Nuclear Weapons
Part II: Technical Issues and Policy Recommendations

Gunnar Arbman, Ph.D. (Swedish Defense Research Agency)
Charles L. Thornton (University of Maryland)

II-0.0 Introduction to Part II

In 1999 the Russian Security Council held a meeting that focused on Russia's tactical nuclear forces.[1] President Yeltsin opened the meeting by saying, "For half a century the nuclear forces have been one of the decisive factors in the stability of the situation in the world as a whole. That is precisely why maintaining the combat readiness of our nuclear potential at a high level is one of Russia's priority state interests."[2] According to one report, "Particular attention was devoted to the questions of extending the timetable for the storage and operation of tactical nuclear weapons ... Last year the Russian military stated that Asian tactical nuclear munitions had been placed in storage too. But NATO expansion and the war in Yugoslavia have forced the Russian military to keep their 'nuclear powder' dry."[3] Therefore, as Yeltsin stressed to the Council, "We must consider in detail the whole industrial cycle of the nuclear arms complex, including scientific research in the sphere of nuclear armaments; the carrying out of tests, the production, and the storage of such weapons; and guaranteeing their safe operation and recycling."[4]

At the meeting, Yeltsin reportedly signed three decrees. Most reports noted that two of the decrees contended with the future of Russia's tactical and strategic nuclear forces, while the third was too classified to publicize. One report, however, described the three decrees as follows: one decree would operationalize the newly developed *Iskander* short-range missile system with nuclear warheads; one decree was connected with improvements in the nuclear weapons testing and experimental facilities; and one decree called for the development of supercomputers in order to enhance the safety of Russia's nuclear arsenal.[5]

Russian military scholars have described the role of their TNW force this way:

> *"A two-level system of nuclear deterrence consisting of strategic and nonstrategic nuclear forces increases RF military security and enables a flexible reaction to changes in the military-strategic situation by maneuvering nuclear forces and weapons. Implementation of this system conforms fully to the laws of warfare, particularly to the law of subordination of the goals and nature of military operations of a lesser scale to operations at a higher level. Thus, capabilities of halting aggression in its early stages expand substantially."*[6]

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[1] The following paragraphs are derived in part from Gunnar O. Arbman and Charles L. Thornton, *Russia's Tactical Nuclear Weapons – Part I: Background and Policy Issues*, Defense Research Agency (Totalförsvarets Forskningsinstitut, FOI), Swedish Ministry of Defense, Report # FOI-R--1057--SE, ISSN 1650-1942, November 2003.

[2] Report by *Rossiyskaya Gazeta/ITAR-TASS*, "Flawless Nuclear Shield," 30 April 1999, p. 2 [FBIS Document MM3004141699].

[3] Ilya Bulavinov and Ivan Safronov, "Yeltsin orders nuclear shield to be patched up," *Kommersant*, 30 April 1999, provided by The British Broadcasting Corporation, 04 May 1999.

[4] Report by *Rossiyskaya Gazeta/ITAR-TASS*, "Flawless Nuclear Shield," 30 April 1999, p. 2 [FBIS Document MM3004141699].

[5] "Russian nuclear complex falling apart. Russian Federation Security Council outlines measures to revive it," *Nezavisimaya Gazeta*, 30 April 1999.

[6] Colonel V. V. Kruglov and Colonel M. Ye. Sosnovskiy, "On the Role of Nonstrategic Nuclear Weapons in Nuclear Deterrence," *Voyennaya Mysl*, No. 1, 01 September 1997, pp. 11-14 [FBIS Document FTS19971205000584].

This is Part II in a two-part series on Russia's tactical, or shorter range nuclear forces. In Part I of our report,[7] we analyzed the background and policy issues that led to the Russian Security Council's decisions in 1999, subsequent developments in this area, and possible policy implications for Russia and other interested states. In this second part of our report, we analyze the technical issues surrounding Russia's tactical nuclear weapons (TNWs) and offer a general policy recommendation.

As discussed in the next section of this report, hard evidence on these issues is difficult to come by in through open sources. Nonetheless, we have compiled and synthesized open data on the safety and security of Russia's TNWs, warhead and delivery system modernization, command and control, and the missions to which Russia may assign its tactical nuclear forces.

Our general assertions are as follows:

- Russia maintains a large TNW force that, in relation to the treaty-mandated strategic nuclear force reductions, constitutes a growing portion of its overall nuclear force structure.
- The lack of transparency into, and available hard evidence concerning Russia's TNWs suggests a deliberate effort to sustain this force in response to insufficient conventional capabilities.
- The TNWs retained obviously have a defensive as well as an offensive role. A large fraction of Russia's TNWs seem to have been developed to defend "the homeland" against NATO strategic strikes by destroying incoming bombers and cruise missiles as well as eliminating NATO's naval nuclear assets. The attempt to protect Moscow against incoming missiles could also be mentioned in this regard. Primarily offensive TNWs can be found within the Ground Forces and the Tactical Air Force.
- Russia's tactical warheads are more secure than analysts commonly assert, but that condition remains transitory.
- The political and military leadership maintains adequate command and control (C2) over the tactical forces during peacetime, but C2 during times of crisis is not as strict as for strategic systems, and may be susceptible to accidental or unauthorized TNW launches.
- The consolidation of Russia's entire tactical warhead stockpile into a smaller set of central storage facilities would mitigate both the security and C2 concerns, while minimally impacting Russia's operational capabilities.

To date, Russia has not concluded any treaties with foreign governments that cover the development and deployment of TNWs. The Conventional Armed Forces in Europe Treaty (CFE) of 1990 places some limits on the number of dual-capable delivery systems that may be deployed between the Atlantic Ocean and the Ural Mountains. However, these limits are high enough that they do not significantly impact the deployment of nuclear forces that may be deliverable by dual-capable systems.

The only political commitments Russia has made were in the form of unilateral declarations in 1991 and 1992. The Presidential Nuclear Initiatives (PNIs), as they are known, are not

[7] Gunnar O. Arbman and Charles L. Thornton, *Russia's Tactical Nuclear Weapons – Part I: Background and Policy Issues*, Defense Research Agency (Totalförsvarets Forskningsinstitut, FOI), Swedish Ministry of Defense, Report # FOI-R--1057--SE, ISSN 1650-1942, November 2003.

ratified treaties and thus are neither enforceable nor verifiable. Since the PNIs were not ratified as official treaties, they did not cause the Russian parliament to change Russian laws. In turn, the military is compelled to continue training for the possible future deployment of those warheads that were sent to storage facilities in accordance with the PNI commitments.

The balance of Russia's nuclear forces has shifted dramatically from strategic toward tactical. Assuming that Russia abides by its commitment to reduce its deployed strategic warheads to 1,700-2,200 by 2012 under the Strategic Arms Reductions Treaty (Moscow Treaty), Russia's tactical warheads may well become the majority of its deployed force in the next few years. This situation has been generated, from the Russian point of view, by an increase in the direct threat to its homeland:

> *"This new expansion of NATO into the East creates totally new realities in relations between the alliance and Russia ... It is necessary to bluntly state that today the Russian Army is in no condition to offer a real military demonstration. NATO's superiority in conventional weapons is so great that when calculating the ratios between forces and assets one can conclude that this superiority is absolute."*[8]

Given the nature of the dual-capable delivery systems and the rapidly transportable warheads, and the probability that military units continue to train as though they possessed the tactical nuclear warheads, Russia appears to have established a just-in-time delivery system. Warheads stored in regional or central depots may be sent to the operational military units on short notice and readied for use. Some may argue that once the warheads were removed from the units, those units and their delivery systems would be de-certified for nuclear operations, as would be the case in the United States. However, no evidence of such procedures exists, and anecdotal evidence suggests that the units continue to train with dummy warheads.

This discussion leads to the conclusion that Russia's tactical nuclear weapons pose a challenge for regional and international security. Russia's vast landmass brings it into contact with regions stretching from Northeast Asia to Central Asia to Europe. As recently as November 2004, Russian Defense Minister Sergei Ivanov admitted that the Russian military is not battle-worthy.[9] President Putin coincidentally asserted an active and priority nuclear modernization effort. Although his comments were widely attributed to developments in strategic missiles, his statement did not specify any particular category of weapon.[10] In any case, Russia clearly will rely on its nuclear arsenal generally, and its tactical nuclear forces specifically, for the foreseeable future in order to ensure its security. We therefore offer our assessments on the status, operations, and other technical issues surrounding Russia's stockpile of tactical nuclear weapons.

II-0.1 Methodological Approaches to Parts I and II

[8] Mikhail Khodarenok, "In Response to NATO Expansion: Russia Must Emphasize Tactical Nuclear Weapons," *Voyenno-Promyshlennyy Kuryer*, Moscow, 07 April 2004 [FBIS document # CEP20040408000291].
[9] Fedor Rumyantsev and Ilya Barabanov: "Army Not Yet Ready," *Gazeta.ru*, Moscow, 17 November 2004 [FBIS Document CEP20041118000250].
[10] Andrey Kolesnikov, "Father to Arbat. President Divulges Military Secrets to Generals," *Kommersant*, Moscow, 18 November 2004, p. 3 [FBIS Document CEP20041118000271].

We approached the research and analysis of Russia's tactical nuclear weapons with the anticipation that little direct and verifiable evidence would be available openly. We were partially correct. A large amount of information is available concerning doctrinal and policy issues. Russia openly publishes its national security strategies and military doctrines, and Russian and non-Russian experts have published volumes of material on Russia's nuclear policies.

Sources of information on related technical issues have been more difficult to acquire, but considerable data is available in specific areas. For example, due in large part to bilateral U.S.-Russian initiatives such as the Nunn-Lugar Cooperative Threat Reduction program, Russia's nuclear warhead security practices have become more familiar. Likewise, data on the general state of the Russian military and on the military-industrial sector increasingly has become available.

However, important aspects of Russia's TNW developments and operations remain well-guarded state secrets. Perhaps the most widely discussed gap in our understanding of this subject is the numbers of warheads and delivery systems in the inventory. Unlike the information that increasingly has become available on strategic command and control, the C2 technologies and procedures for Russia's TNWs remains virtually unknown. All published literature on these topics is speculative.

We therefore rely to a large extent on anecdotal information. For example, basic warhead design and development processes for nuclear warheads are well-known, and experts have analyzed extensively Russia's warhead production capabilities. Using this data as background, we can infer Russia's capabilities to manufacture and refurbish tactical warheads. Likewise, we surmise that security procedures for tactical warheads are similar to security procedures for strategic warheads.

We realize the pitfalls of this approach and have attempted to mitigate them. For example, wherever possible, we have confirmed the validity of data points with secondary sources. If this has not been possible, but we have determined that the data is important enough to include in our report, then we have softened the tone of our language to reflect the questionable validity.

Most importantly, we have used Russian sources as much as possible. Many of our non-Russian colleagues have published excellent analyses on these subjects that are well worth the reader's attention. We reiterated some of their work in both Part I and Part II of this report. However, we deemed the Russian point of view on these subjects to be useful and in many cases sufficient.

Many of the citations found in these two volumes points to Russian media sources. We approached the Russian media reports with some suspicion, but we frequently found them to be our best sources of information – particularly when the articles quote senior governmental officials or military officers. Again, we understand the pitfalls associated with this approach, especially the probability of deceptive information finding its way into the media. We did our best to cull out what appeared to be misinformation, whether by mistake or by design.

When deciding what subjects to include in this two-volume report, we considered the likely audience. A primary concern of countries like Sweden is the security of Russia's TNW. Even the slightest possibility that an unauthorized nuclear explosion might occur on the

territory of a country adjacent to Russia is enough to generate serious apprehensions among its population. There are several kinds of scenarios where such an event is not entirely unthinkable.

One type involves possible weak points in the command and control structure of Russia's TNW, weak points that might enable one or a few "crazy people" within the command and control chain to launch and explode a TNW unauthorized. Hence, the command and control procedure with regard to Russian TNW is an area of considerable interest in this report – an area where little authoritative information is available. While some information exists, the methodology involved in evaluating possible command and control related risks is a significant problem. In particular, this is the case in which pre-delegation of release authority of TNW is taken into account.

Other types of scenarios are based on the possibility that a TNW could be illegally obtained one way or another by some non-state actor, transferred to and then exploded on non-Russian territory. And even if an illegally obtained TNW cannot be exploded in an unauthorized way so that all of its nuclear energy is released, radioactive material such as plutonium could be extracted from such a weapon for subsequent use in a dirty bomb or, less likely, an improvised nuclear device of some type.

A low-intensity gamma-emitting substance such as weapon grade plutonium reduces the radiation risks for the perpetrators in making, handling, and exploding a dirty bomb compared to using some high intensity gamma-emitting radioactive material. Furthermore, some vitally important area (a major airport, an important communication center, etc.) contaminated with an alpha-emitting material such as plutonium will cause a severe economic drawback to any country, due to the high costs of shutting down vital facilities and decontaminating them to safe levels.

Evaluating the risks that a TNW can be illegally obtained in Russia presents a formidable methodological problem due to an absence of transparency.

While for obvious reasons it is rarely mentioned, a NW state can – if it chooses to do so – in principle impose its political will upon a non-NW state by employing some form of "nuclear blackmail." Generally speaking, this cannot be countered by a non-NW state without assistance from another, friendly NW state. The inherent deficiency in national security generated by this fact is, of course, a major driving force behind nuclear proliferation. To diminish this force, some NW states have extended a "nuclear umbrella" in that they have committed themselves to protect (allied) non-NW states by their NW (positive security assurances, or PSA) and/or issued negative security assurances (NSA). The latter assurances mean that a NW state declares its intent not to use NW against a non-NW state unless the latter state is part of a nuclear armed coalition or uses weapons of mass destruction other than nuclear in an armed conflict with the NW state in question.

In the case of Russia, its NW arsenal certainly provides sufficient means in a technical sense for the country to impose its will on virtually any non-NW state, should it choose to do so. For states adjacent to Russia, these means consist of Russia's TNW rather than its strategic NW, which by definition are reserved for a nuclear conflict with countries farther afield, such as the United States. Hence, for countries in the vicinity of Russia, assessments of the technical capabilities of Russia's TNW and their corresponding delivery systems are of higher national security concern than those of Russia's strategic NW. Again, an analysis of

these matters requires an indirect methodological approach, since only incomplete quantitative and qualitative information on its TNW arsenal can be obtained from authoritative Russian sources.

II-1.0 Current Operational Status of Russia's Tactical Nuclear Forces

In Part I of this report, we estimated that Russia maintains a total stockpile of 8,000 tactical nuclear warheads, including over 3,000 "operational" warheads (the remainder are in central storage depots). The term "operational" in this context may be misleading. Since tactical delivery systems are dual-capable for the most part – that is, they can carry both conventional and nuclear payloads – it may not make a lot of sense to differentiate between "operational" and "reserve" forces. Moreover, tactical nuclear warheads are uniquely characterized by their ability to be quickly transported to a military unit and mated to a delivery system, thus further blurring any attempt to designate the status of a warhead. Nonetheless, in the sub-sections that follow, we further assess the current capabilities of the TNW systems that Russia possesses.

II-1.1 Tactical Nuclear Weapon Systems and Their Categorizations

As discussed in Part I of this study, the concept of TNW eludes an unambiguous and generally accepted definition. One way of getting around the definitional problem might be to replace TNW with the concept of "NW usable for tactical purposes."[11] Another alternative is to discard the notion altogether and only talk about various kinds of NW systems. In Part I of this report, we utilized the definitions of non-strategic nuclear weapon systems offered by a senior Counselor in the Russian Ministry of Foreign Affairs (MFA), Vladimir Rybachenkov.[12]

For Part II of this report, we will utilize the terminology officially described under the NATO-Russia Council. An extensive glossary of nuclear terms and definitions was drawn up by NATO and Russian experts in order to "provide common, standardized specialist terms and definitions, related to nuclear issues, with a view to facilitating NATO-Russia nuclear consultations and cooperation through a better mutual understanding."[13] It defines TNWs with the following categories:

[11] N. Sokov, CNS, Monterey Institute of International Studies, private communication.
[12] Vladimir Rybachenkov, "Nuclear Strategy of Russia," Ministry of Foreign Affairs of the Russian Federation, *Lecture at the NATO school*, Oberammergau, 1 March 2001.
[13] Nuclear Experts, *NATO-Russia Glossary of Nuclear Terms and Definitions*, NATO-Russia Council, October 2002. Available at: http://www.nato.int/docu/glossary/eng-nuclear/index.htm.

Non-strategic nuclear weapons	Non-strategic nuclear weapons include all nuclear weapons which do not fall into the class of strategic nuclear weapons, that is, weapons with less than 5,500 km ranges, to include Tactical and Operational nuclear weapons.
Tactical nuclear weapons	Tactical nuclear weapons are designed to engage objects in the tactical depth of enemy deployment (up to 300 km) to accomplish a tactical mission. Under certain conditions, tactical nuclear weapons may be involved in operational and strategic missions.
Operational nuclear weapons	Operational nuclear weapons are designed to engage objects in the operational depth of the enemy deployment (up to 500 km) with the purpose of accomplishing an operational mission. Under certain conditions operational nuclear weapons may be involved in the accomplishment of strategic missions and, in exceptional cases, in the accomplishment of tactical missions.

In what follows, our notion of "TNW" essentially combines Russia's "tactical nuclear weapons" and "operational nuclear weapons" categories – that is, weapons with ranges of zero to 500 kilometers. To understand how the present situation with regard to Russia's TNW has evolved, it is useful to briefly recapitulate the history of NW, starting with its development in the U.S.

During the early years of the NW era there was a reluctance in the U.S. to regard NW in any other sense than "strategic." In 1949, Vannever Bush, for instance, wrote:

> *"The atomic bomb cannot be subdivided. This is inherent in the physics of the situation…There will be no shells for guns carrying atomic explosives, nor will they be carried by marine torpedoes or small rockets or in any other retail way. Atomic bombs will be used only against important targets to which it pays to devote a large effort."* [14]

In the middle of the 1950´s, however, the situation had changed in part due to technological advance, which enabled the construction of smaller, more lightweight and versatile nuclear warheads, and the concept of "atomic weapons for tactical purposes" was mentioned, for example, by U.S. Secretary of State John Foster Dulles in 1955, who proclaimed:

> "*The present policies will gradually involve the use of atomic weapons as conventional weapons for tactical purposes. If that occurs and there is a replacement of what is known as conventional weapons by a different type of weapon, they will, of course, be used."* [15]

By the end of the 1950s, there was a noticeable U.S. military interest in "the nuclear battlefield," and consequently in TNW, particularly in the army, in part reflecting an expansion of the original "massive retaliation" concept. The Soviet interest in TNW largely seems to have paralleled that of the U.S.

To proceed with the Soviet Union, some noticeable remarks on its history of TNW have recently been offered by A. Konovalov, who is the director of the Institute for Strategic Assessment in Moscow:

[14] Vannever Bush, *Modern Arms and Free Men*, New York: Simon and Schuster, 1949, pp. 106-107
[15] J.F. Dulles, "News Conference Statement by Secretary Dulles," Department of State Bulletin 32, 03 January 1955, p. 117.

> "*... Soviet armed forces started massive deployment of tactical nuclear weapons in the 1950-60s. This approach resulted in one important technical consequence. Practically all the services required the industry to develop a dual-use combat payload compartment for different tactical systems (missiles, torpedoes, etc.), allowing the same delivery system to carry either conventional or nuclear warheads. As a result starting from the 1960s all Soviet tactical weapon systems (excluding gravity bombs) were simultaneously developed and produced in two modifications – conventional and nuclear. Gradually, all the services in the Soviet armed forces acquired and deployed tactical nuclear systems… Needless to say, very shortly the Soviet nuclear arsenal was saturated with an enormous variety of tactical nuclear warheads of different construction*." [16]

Similar observations can be found in the report written by Russian nuclear scientists describing the situation in the 1960s and 1970s:

> *"As for other types of the Armed Forces and branches, the following should be noted. The fact that the customer wished to equip with nuclear devices the weapons systems that were developed mainly for combat actions in ordinary military operations, that is using high explosives, also contributed into nuclear warhead range expansion… A large number of conventional weapons were in operation and under development (torpedoes, projectiles, cruise missiles, etc.); however, an additional arsenal of the same nuclear munitions appeared to execute a wide range of specific operational missions.*
>
> *Appearance of the similar-purpose weapons systems was also explained by the fact that various influential groups from the USSR military and industrial complex administration rendered strong support to design bureaus, which in practice often resulted in the following situation: there were as many types of weapons systems as there were design bureaus."* [17]

Much of this TNW arsenal no longer exists, since the warheads are dismantled in accordance with the unilateral presidential directives of 1991/1992 or stored away waiting for dismantlement. Still, a considerable number of these warheads are believed to remain either operational together with their delivery vehicles as discussed in Part I of this report or are in storage waiting for remanufacturing.

In what follows, we will discuss four categories of Russian TNWs:

- Ground forces weapons (tactical short-distance missiles, artillery, atomic demolition munitions),
- Missile and Air Defense weapons (ABM, SAM),[18]
- Air forces weapons (ASM, gravity bombs), and

[16] Alexander Konovalov, "Forgotten Nukes: Tactical Nuclear Weapons," Institute for Strategic Assessment, Moscow 2004.
[17] Yury A. Yudin, "Manuscript on the History of the Soviet Nuclear Weapons and Nuclear Infrastructure", Technical Report on Tasks A-1 and A-2, ISTC Project # 1763p.
[18] Note that we have separated out "missile and air defense weapons" from the category "general ground forces weapons" given in the tables in section I-2.0 in Part I of this report.

- General purpose Navy weapons (ASM, gravity bombs, SLCM, ASW, torpedoes, depth charges).

II-1.1.1 Missions During the Soviet Era

Virtually all Russian TNWs were designed and developed during the Soviet Union era. While there are similarities as to what existed in NATO during the 1970s and 1980s, the Soviet designs and deployments also display some noticeable dissimilarity, indicating that the military thinking and military requirements of the Soviet Union at the time differed from those of NATO.

First, the yields of the Soviet tactical nuclear warheads generally seem to have been significantly higher than their NATO equivalents. A high yield, of course, partly compensates for a lack of accuracy when the target to be destroyed is a hardened or super-hardened military object. It could also compensate for inabilities to pin-point accurately incoming enemy aircraft with counter electronic capabilities, stealthy aircraft or submerged SSBNs. Other factors motivating these high yields, such as a conviction that an ability to inflict severe damage over large areas increases the deterrence value of nuclear weapons, might have played a role as well.

Second, the USSR had more categories of TNW weapon systems than the U.S. – or, for that matter, all of NATO – during the latter part of the Cold War era. For instance, nuclear tipped "Missile and Air Defense weapons" disappeared from NATO's (the U.S.'s) TNW inventories during the 1970s but were retained by the Soviet Union and remain in the Russian arsenal up to this day.

Third, the Soviet Union seems to have produced more different types of TNWs within each category compared to the U.S. and, indeed, all of NATO. In particular, the Soviet Union developed and manufactured a plethora of TNW systems intended to combat naval and airborne targets – largely absent in the arsenals of NATO. It is hard to avoid the conclusion that substantial efforts were made in attempts to protect the territories of the members of the Warsaw Pact – in particular that of the Soviet Union itself – from nuclear explosions.

The seemingly vast number of TNWs in the "General purpose Navy weapon" category (ASM, gravity bombs, SLCM, ASW, torpedoes, depth charges) indicates that destruction of NATO's sea-based assets was of primary importance. Aircraft carrier battle groups and submarines equipped with nuclear weapons able to reach the territories of the Warsaw Pact were apparently high priority targets for these types of weapons, in part reflecting the naval force structure asymmetry between NATO and the Warsaw Pact.[19] (Disrupting NATO's sea lanes of communication might have been another task of vital importance had the war turned out to be protracted. It is, however, doubtful whether the Soviet military command believed much in the official U.S. perception of a protracted nuclear war as outlined by the end of 1970s in e.g. the Presidential Directive 59.)

[19] Alexander Konovalov, "Forgotten Nukes: Tactical Nuclear Weapons," Institute for Strategic Assessment, Moscow, 2004.

The Soviet missile and air defense weapons category (SAM, ABM) were clearly intended to defend against incoming NATO bombers and cruise missiles and – for Moscow – ballistic missiles.

Equipping their ground forces with nuclear artillery shells and short range surface-to-surface missiles as well as the frontal aviation with gravity bombs and tactical air-to-surface missiles seems to have been a decision made in response to NATO's efforts to compensate conventionally weaker ground forces with nuclear firepower capability.[20] In any case, such weapons were intended to aid ground forces by delivering strikes on the most valuable military units of the opponent (tank forces and TNW equipped units), important command and control sites (high command shelters), vital logistics facilities (railroad and road systems in the enemy rear at their most vulnerable points), air force bases, etc. Of course, tactical aircraft is quite versatile in its targeting ability and can be used for a variety of purposes to assist ground forces. And the Soviet nuclear demolition mines would apparently have been used for sabotage purposes and to delay advances of the opponent by creating craters and large areas contaminated with radioactive fallout.[21]

Minimizing collateral damage was a necessary prerequisite in order to achieve agreement within NATO regarding to the battlefield use of TNWs on European territory. The apparently higher yields of the corresponding Soviet TNWs[22] seem to indicate that there was less concern about collateral damage in the Soviet Union than there was in NATO. Since many remaining Russian TNWs continue to have these large yields, collateral damage is still of concern and will be discussed further in section II-1.2.1.

At what stage or stages during an armed conflict between NATO and the WP were these TNWs supposed to be used? To the extent that a nuclear war would have remained protracted and limited to attacking "significant military targets" only – i.e., had not rapidly escalated to the level of major strategic exchanges – NATO's doctrine was to employ TNWs in "the military theatre of action" for a period of time before resorting to a more comprehensive use of nuclear weapons. The purpose of this would be twofold: halting advancements of the Warsaw Pact forces and indicating that there was a "window of opportunity" to de-escalate the conflict before it had reached catastrophic, strategic levels.

A U.S. intelligence assessment[23] during the Soviet period described the allocation of warheads to various stages of a military operation, allowing for variations depending on the specific situation:

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[20] Yury A. Yudin, "Manuscript on the History of the Soviet Nuclear Weapons and Nuclear Infrastructure," Technical Report on Tasks A-1 and A-2, ISTC Project #1763

[21] Unattributed Article, "Russia´s Tactical Nuclear Weapons: Quantitative and Qualitative Parameters of the Grouping," 99R30025E, Voprosy Bezopasnosti (Internet Version), No 21, Moscow, 01 November 1998, [FBIS, Document FTS9990123000032].

[22] See e.g. Thomas B. Cochran, William M. Arkin, Robert S. Norris, and Jeffrey I. Sands, *Nuclear Weapons Databook, Volume IV, Soviet Nuclear Weapons*, p. 223.

[23] U.S. Defense Intelligence Agency, "Guide to Nuclear Weapons Available to the Soviet Front Commanders," Document #ST CS 02-18-73, p. xvi, formerly classified *secret*, released in 2004 under the Freedom of Information Act.

Stage of Operation	Mission	Assignment (%)
Initial Strike	Neutralize and destroy primary groups of enemy nuclear/missile weapons and troops	20 to 30
Intermediate tasks	Support breakthrough operations: destroy key rail and supply points, enemy reserves, strongpoints, and targets of opportunity	30 to 40
Subsequent task	Support exploitation forces	20 to 30
Front commander's reserve		10

This table depicts an order of battle for land warfare operations and is clearly designed for offensive rather than defensive purposes.

To conclude, in addition to being used on the battlefield, many of the Soviet TNW systems seem to have been developed to defend against NATO strategic strikes – augmenting whatever damage limitation to its assets the Soviet Union could achieve by attacking ICBM silos, strategic bomber air bases, command and control structures, etceteras in continental U.S. and – most likely – inside other NATO states from which nuclear weapons could be launched. A number of Soviet TNWs were obviously designed for usage against NW armed surface ships, SSBNs, and other types of submarines equipped with nuclear weapons. And evidently a primary mission of the Soviet nuclear SAM missiles was to defend against incoming bombers, i.e. against the airborne leg of the U.S. strategic triad, as well as nuclear armed cruise missiles.

II-1.1.2 The Current Operational Force

No official Russian information is given on what TNW systems are operational today. In the discussion in Part I of this report, we used Arbatov's assessment of 3,800 operational TNW[24] as a baseline to assess the Russian total TNW force level of 2004 including TNW set aside for dismantlement. Below, we give a slightly modified version of these estimates in view of the fact that some nuclear warheads for the Ground Forces weapon systems still seem to exist:[25]

[24] Alexi Arbatov, "Deep Cuts and De-alerting: A Russian Perspective," in Harold Feiveson, editor, *The NuclearTurning Point: A Blueprint for Deep Cuts and De-Alerting of Nuclear Weapons,* The Brookings Institutions, Washington, DC, 1999, p. 319.
[25] Oleg Falichev, Interview with Colonel-General V. N. Zaritskiy, November 2003, [FBIS Document CEP20031120000239].

Category of Weapon	Outside Central Storage	Warhead Inventory
	Ground Forces Weapons	
Rocket forces	0	0(?)
Artillery	0	0(?)
Corps of Engineers	0	0
	Missile and Air Defense Weapons	
Air Defense	unknown	1,500
	Air Forces Weapons	
Frontal Aviation	unknown	3,500
	Navy Weapons	
Ships and Submarines	0	2,000
Naval Aviation	0	1,000
Total		~8,000

A more detailed account of what TNW systems are operational in Russia is given in the following table, derived from combined reports:[26]

[26] Sources: (a) U.S. Department of Defense, *Soviet Military Power 1985, 1986, and 1987* U.S. Government Printing Office, Washington, DC; (b) Thomas B. Cochran, et al, *Nuclear Weapons Databook, Volume IV: Soviet Nuclear Weapons*, Natural Resources Defense Council, Inc. Harper & Row Publishers, New York, 1989; (c) John Pike, et al, "Russian Theater/Operational Missiles," Federation of American Scientists, http://www.fas.org/nuke/guide/russia/theater/, updated in 2000; (d) Center for Defense Information, "Nuclear Weapons Database," February 2003, http://www.cdi.org/issues/nukef&f/database/rusnukes.html; (e) Robert Norris and William Arkin, "NRDC Nuclear Notebook : Russian Nuclear Forces, 2001," *Bulletin of the Atomic Scientists*, Vol. 57, No. 3, May/June 2001, pp. 78-79; and, (f) Sergey Ivanov, Editor, *Oruzhie i tekhnologii Rossii: Entsiklopediia XXI vek, Tom 2: Raketno-artilleriiskoe vooruzhenie sukhoputnykh voisk / Russia's Arms and Technologies: The XXI Century Encyclopaedia, Volume 2: Rocket and Artillery Armament of Ground Forces*, Oruzhie i tekhnologii (OrTekh), Moscow, 2001.

Delivery Vehicle	Range	Yield of Munitions	Numbers Deployed
	Ground Forces Weapons		
Tochka (SS-21 Scarab)	70 km	n.a.	n.a.
Tochka-U	120 km	n.a.	n.a.
Iskander-E	280 km	n.a.	n.a.
Iskander-M	280 km	n.a.	n.a.
	Missile and Air Defense Weapons		
SH-08 Gazelle ABM	80 km	10 kt	64
SH-11 Gorgon ABM	350 km	1 mt	36
SA-5B Grammon SAM	150 km	25 kt	n.a.
SA-10 Grumble SAM	90 km	n.a.	n.a.
			1200 SAMs
	Frontal Aviation		
Tu-22M Backfire	n.a.	n.a.	70
Su-24 Fencer	n.a.	n.a.	70
AS-4 Kitchen ASM	400 km	1 mt	n.a
Gravity Bombs	n.a.	250 kt, 350 kt, 5-50 Mt	n.a.
			1700 ASWs
	Ships and Submarines		
SS-N-9 Siren SLCM	110 km	200 kt	n.a.
SS-N-12 Sandbox SCLM	550 km	350 kt	n.a.
SS-N-19 Shipwreck SLCM	550 km	500 kt	n.a.
SS-N-22 Sunburn SLCM	120 km	200 kt	n.a.
			320 SLCMs in all
	Naval Aviation		
SS-N-15 Starfish ASW	50 km	200 kt	n.a.
SS-N-16 Stallion ASW	50 km	n.a.	n.a.
			500 ASWs
	Other Delivery Vehicles		
Torpedoes	25 km	20 kt	n.a.
Depth Charges	n.a.	n.a.	n.a.
Total			~3,800 warheads

n.a. = not applicable; not available

The *Iskander*, the newest addition to the TNW force, is profiled more deeply in section II-4.2.3 of this report, but a short description is provided here:

> *"There is only one new missile in Russia, the ground-based Iskander-M, which has been recently put on combat duty in the armed forces. This unique missile is almost invisible to radars, can maneuver in flight and has a cruising speed of Mach 3, which allows it to avoid any of the modern ballistic defense systems. The missile is also a precision weapon. However, it is not a strategic but a tactical frontline missile with a range of 280 km."*[27]

With regard to Ground Forces TNWs, the Ministry for Foreign Affairs of the Russian Federation stated in 2002 that:

> *"Russia has practically implemented all the declared initiatives to reduce non-strategic NW with the exception of elimination of nuclear weapons of the Army."*[28]

[27] Russian Information Agency Novosti, "What New Nuclear Missile Systems Does Russia Have?" Moscow, 19 November 2004.

[28] Ministry of Foreign Affairs of the Russian Federation, "Statement of the delegation of the Russian Federation at the first Session of the Preparatory Committee for the 2005 NPT Review Conference under Article VI of the

In other words, some Ground Forces weapons obviously existed in 2002. No clues are given as to the status of these weapons. However, in a 2001 book published under the supervision of the Russian Defense Ministry, the FROG short range missile system (in Russian LUNA and a modified version, LUNA-M) is described as having a nuclear warhead. The more modern successor to FROG – the SS-21 (*Tochka*) with a range of 15-120 kilometers – on the other hand is portrayed to have warheads with high explosives only.[29]

In comparison, the warhead weights and cylindrical missile tube dimensions of the two systems are quite similar implying that warheads designed for the FROG system probably could be mated to the *Tochka* system without major modifications. In addition, the future short-range missile *Iskander* – which can carry a warhead of the same weight as *Tochka* (480 kg) and has a range of 50-280 kilometers[30] – might well be able to deliver existing or slightly modified nuclear munitions.

Some active-duty nuclear artillery shells seem to have existed in the year 2000 according to a Russian source.[31] Furthermore, no announcement from Russia regarding the completion of their elimination has been made. On the contrary, there are indications that the nuclear version is retained for 152 millimeter and 203 millimeter artillery, 240 millimeter *Tyulpan* mortars as well as nuclear land mines.[32] Finally, the existence of nuclear land mines is also mentioned in a current Russian article on TNWs. [33]

To conclude, recent statements by Colonel General Zaritskiy, chief of the RF Armed Forces Missile Troops and Artillery, indicate that nuclear warheads for short-range tactical missile, possibly nuclear artillery shells, and – perhaps less likely – nuclear land mines, still remain operational in the Russian TNW arsenal.

> *"At the present time, the Missile Troops and Artillery has the primary means for the employment of non-strategic nuclear weapons that are in the Ground Troops inventory ... They were, are, and will remain adequately reliable."*[34]

In fact, Russia continues to train its artillery troops to deploy nuclear shells, as described on Russian television:

> *"The army had acquired the Msta-B towed howitzer in 1987. According to experts, it was the best model in its class in the world at the time. The main quality of the new cannon was its maximum range of fire: the predatory long*

Treaty," in New York, 11 April 2002, Information and Press Department, Daily News Bulletin, 24 April 24 2002.

[29] Sergey Ivanov, Editor, *Oruzhie i tekhnologii Rossii: Entsiklopediia XXI vek, Tom 2: Raketno-artilleriiskoe vooruzhenie sukhoputnykh voisk / Russia's Arms and Technologies: The XXI Century Encyclopaedia, Volume 2: Rocket and Artillery Armament of Ground Forces*, Oruzhie i tekhnologii (OrTekh) Moscow, 2001, p. 92.

[30] Oleg Falichev, Interview with Colonel-General V. N. Zaritskiy, November 2003, [FBIS Document CEP20031120000239].

[31] Sr-Lt Andrey Lamkin, "The Diamond Eye and Precision Munitions," Samara Soldat Otechestva, 22 March 2000, [FBIS Document CEP20040629000378].

[32] Mikhail Khodoryonok, "V Otvet na Rasshirenie Nato Rossiya Dolzhna Sdelat´ Stavku na Takticheskoe Yadernoe Oruzhie" (In Response to NATO Enlargement, Russia Should Stake on Tactical Nuclear Weapons), *Voenno-Promyshlenny Kur´er*, No. 13, 07 April, 2004.

[33] Nikolai Poroskov, "A Nuclear Outpost," Vremya Novostei, 07 July 2004, p. 6.

[34] Oleg Falichev, Interview with Colonel-General V. N. Zaritskiy, November 2003, [FBIS Document CEP20031120000239].

and thin barrel of Msta makes it possible to fire up to 24 km with high-explosive fragmentation shells and up to 29 km with rocket-assisted projectiles. Msta is a multipurpose weapon – it can fire any types of shells, moreover, new types of shells had been designed especially for it: canister shells with 42 antipersonnel and armour-piercing grenades and jamming shells which scatter tiny radio transmitters to jam the enemy's communications ... In addition, the howitzer was designed so that it could be used to fire low-yield nuclear bombs.

Being a seven-tonne weapon, Msta-B has got quite high mobility. A team of eight people can deploy and roll it during as little as two - two-and-a-half minutes. When towed, it can be moved with a speed of up to 80 km/h along an asphalt road and up to 20 km/h along a dirt road ... The 152-mm division howitzer Msta-B is still quite an up-to-date weapon at the moment. It is actively being promoted in the world market now [and] has been seriously upgraded to achieve commercial success."[35]

A general discussion of the potential military utilities of different types of TNW is given in section II-2.2 of this report.

II-1.2 Recent Evidence on How Russia Contemplates the Use of Its (Tactical) Nuclear Weapons

Typical targets for non-strategic NW are generally presumed to be the nuclear non-strategic forces of an adversary,[36] air bases and high command posts, as well as elite armed units and other military assets of high value. Disrupting logistics by creating bottlenecks and denying an opponent communication by the use of low-altitude EMP-effects are other objectives to be achieved by the use of non-strategic NW.

These weapons can, of course, always be used in a strategic, counter-value mode (urban areas, societal infrastructure and military industrial facilities) on targets of these types within their reach. It should perhaps be mentioned here that exploding a NW for the purpose of demonstration, i.e. an explosion intended as a severe warning to an adversary without inflicting any noticeable damage, could be performed either with a strategic or a non-strategic NW. (A high altitude explosion might be easier to accomplish with a strategic NW than with a non-strategic NW, though, due to the different nature of their delivery systems.)

[35] Moscow NTV, 0725 GMT, 11 April 2004 [FBIS Document CEP20040411000049]. Artillery exercises carried out in Spring 2004 in Russia's Orenburg Oblast were described in an article by Sr-Lt Andrey Lamkin, "The Diamond Eye and Precision Munitions," *Samara Soldat Otechestva*, 22 March 2000 [FBIS Document CEP20040629000378].

[36] It seems as if the present operational non-strategic Russian NW – specified, developed, and manufactured during the Cold War period – to a large extent were designed to defend the Soviet Union against NATO's (in essence the U.S.'s) nuclear weapons by attacking and sinking SSBNs and SSNs, large nuclear capable surface ships such as carriers, or by shooting down nuclear armed cruise missiles and bombers of various types, flying towards the Soviet Union (perhaps capable of hiding from pin-point radar detection), defending Moscow against incoming strategic nuclear missiles, etc. Nuclear artillery shells, mines and short range missiles, mainly intended for land combat, seem to have been largely dismantled. The latest official statement is that these types of weapons will be eliminated by the year 2004 (written statement at the UN NPT Prep Com Conference in April 2002).

Russian military officers explained that the nuclear engagement method will depend on the following:

- goals of employing nuclear weapons,
- scope and importance of missions being accomplished,
- desired degree of destruction of enemy targets,
- availability and readiness of nuclear munitions,
- number of missile and artillery formations (units),
- time of mission execution,
- procedure for delivering nuclear strikes, and
- conditions for coordination and exercise of command and control.[37]

Most significantly, the fundamental military purpose of Russia's tactical nuclear arsenal has changed since the Soviet period. During that previous era, it was believed that Warsaw Pact forces would utilize its TNWs for offensive military operations. The order of battle for a typical land war is outlined in section II-1.1.1 of this report and depicts the utilization of tactical nuclear strikes to support the capture of territory. Today, Russia's TNW force appears to have the opposite mission: to defend the homeland from attack or invasion. The evidence for this assessment comes both from doctrine, as discussed in Part I of this report, and from the use of tactical strikes during recent Russian military exercises.

II-1.2.1 Evidence from Recent Military Exercises

A variety of Russian military exercises conducted since 1999 have revealed the following categories of potential targets for nuclear weapon with regard to NATO and the U.S.:

- airbases world-wide, from which U.S. and NATO aircraft might be flying sorties against Russia;
- surface ships and submarines that serve as platforms for attacks against Russia (aircraft carriers in particular); and
- command, communication, and support centers.

For example, U.S. bases outside NATO such as Guam, together with aircraft carrier battle groups, seem to have been targeted in military exercises during the spring maneuvers of 2003. Most of the targets listed above can be attacked by strategic as well as tactical nuclear weapons, and in the exercises aircraft (heavy or medium bombers) with ALCMs have often been used.

Far less can be inferred from military exercises about the role of TNWs in a hypothetical large conflict between Russia and China.

In view of the fact that most of the TNWs Russia has retained from the Soviet Union era seem to have quite high yields, questions can be raised regarding the Russian concern – or

[37] Lieutenant General (Retired) P. I. Dubok, candidate of military sciences, and Colonel (Retired) N. A. Zakaldayev, candidate of military sciences, "On Some Issues of Command and Control of Missile Troops and Artillery in Accomplishing Regional Nuclear Deterrence," *Voyennaya Mysl*, Moscow, No. 6, November-December 1999, pp. 72-74 [FBIS Document CEP19991210000001].

lack of concern – towards inflicting collateral damage associated with the use of these weapons.

II-1.2.2 The Issue of Collateral Damage

Despite Russian claims, such as the following statement by two Russian military scholars, that its operational planning is intended to minimize the collateral damage that may be caused by TNW detonations, the discussion below will demonstrate that this objective is a low priority:

> *"It should be noted that nuclear deterrence is realized by demonstrating real capabilities and the resolve to inflict sufficiently powerful strikes on the enemy leading to such damage where he cannot gain any advantages as a result of an attack on (or a continuation of aggression against) the Russian Federation and its allies. The scale of use of nonstrategic nuclear weapons must conform to the missions to be accomplished that stem above all from the degree of threat and the expected enemy reaction, with minimization of collateral damage."*[38]

In what follows, we will indicate a few collateral damage radii related to the yields of the Russian TNWs. This will be done by giving estimates of the shortest distance from a nuclear explosion at which unprotected people are expected to be essentially unharmed from the immediate effects of the explosion.[39]

As an example, the distance at which an unprotected person will receive negligible injuries from an air burst of 100 kiloton amounts to about 8 kilometers (5 miles) during clear visibility conditions. (Almost all the damage at large distances from air burst yields above 20-30 kiloton is caused by thermal radiation). This distance is increased to approximately 17 kilometers (11 miles) for a yield of about 1 megaton. Ensuing fires, and – depending on weather conditions, type of weapon, and height of burst – radioactive debris over large areas might complicate the situation immensely for survivors. However, such secondary effects cannot be predicted except in very broad terms without a detailed knowledge of meteorological, topological, demographical, and biotope data of the region adjacent to the explosion.

Ground bursts will reduce the maximum distances of collateral damage somewhat, to about 6.5 kilometers (4 miles) for 100 kiloton and about 16 kilometers (10 miles) for 1 megaton yields. (Because of the large dimension of the fireball, screening effects due to the vicinity of the ground will be largely absent for these high yields.) Unlike the case of an air burst where the radioactive particles will move upwards with the hot cloud, disperse, and stay for a long time while their radiation is harmlessly absorbed by the atmosphere, ground bursts with these large yields will produce considerable amounts of heavy, highly radioactive fallout particles over large areas in the direction of the winds, rendering rapid response rescue operations difficult or even impossible to perform.

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[38] Colonel V. V. Kruglov and Colonel M. Ye. Sosnovskiy, "On the Role of Nonstrategic Nuclear Weapons in Nuclear Deterrence," *Voyennaya Mysl*, No. 1, 01 September 1997, pp. 11-14 [FBIS Document FTS19971205000584].

[39] L. Wigg, *Manual for Effects of Nuclear Weapons*, Swedish Defence Research Agency, FOI-R-96-00378-4.1—SE, December 1996, ISSN 1104-9154.

Assuming adequate protection from the thermal radiation and blast effects, such as being inside an ordinary brick building well away from windows and subsequent whirling glass splinters etc., distances of negligible immediate injuries to human beings will be reduced to about half of the distances mentioned above. Fires and radioactive debris might, of course, eventually constitute severe hazards in some areas, depending on weather conditions and on the amount of combustible material present.

One could mention that an unprotected person being outdoors at a distance of 1.2 kilometers (0.75 miles) from a one kiloton air or ground burst - a typical yield for a nuclear artillery shell - will receive no immediate injuries from the effects of this explosion. For yields in the low kiloton range, human injuries at "large" distances from the explosion are essentially caused by the initial ionizing radiation emitted within the first few seconds of the burst. Immediate injuries to people without any protection inflicted by blast and thermal radiation will occur at distances well below one kilometer (approximately 0.6 miles) for a yield of one kiloton.

To summarize, nuclear weapons used on targets located on or beneath the ground with yields between 100 kiloton and one megaton and – typical yields of Russian TNWs according to open sources – will cause collateral damage up to at least a distance of 5 kilometers (3 miles) from ground zero if the yield is 100 kiloton, and well above 10 kilometers (6 miles) if the yield is in the 1 megaton range. For such weapons, the major damage mechanisms will be fires and, for surface bursts, radioactive fallout in the directions of the wind.

At sea, high yield nuclear explosions not too far below the surface can be expected to form a "spray dome" cloud followed by a radioactive cloud of condensed water. The latter is usually called the "base surge" and will initially expand rapidly from the point of explosion followed by a drift in the downwind direction. Radioactive particles from the fission debris within the cloud will be the main hazard, with a potential to move over large areas. Flooding of nearby costal areas by huge water waves might cause additional collateral (or intended) damage.

We conclude this section by noting that, for most military targets, the shockwave propagated by air, ground, or water and – occasionally – by thermal effects, are generally the main nuclear weapon effects expected to destroy the target. Hence, from the point of view of an aggressor, radii of assured destruction often are only fractions of the radii at which collateral damage will result.

II-2.0 Current Issues in Russia's Tactical Nuclear Force Policy

In the National Security Concept[40] (January 2000) and Military Doctrine[41] (April 2000), four types of warfare are discussed:[42]

- armed conflict (primarily ethnic or religious in origin, waged inside the country; other states might be involved indirectly);

[40] *National Security Concept of the Russian Federation*, Decree No. 24 of the President of the Russian Federation, 10 January 2000.
[41] *Russian Federation Military Doctrine*, Decree No. (unknown), 21 April 2000, provided by *Nezavisimaya Gazeta*, "Russian Federation Military Doctrine, Approved by Russian Federation Presidential Edict of 21 April 2000," 22 April 2000, pp. 5-6 [FBIS Document CEP20000424000171].
[42] N. Sokov, CNS, Monterey Institute of International Studies, private communication.

- local war (one or several other states as opponents; the scope and goals of the conflict are limited);
- regional war (attack by a state or a coalition of states pursuing significant political goals); and
- global war (attack by a coalition of states; survival and sovereignty of Russia are at stake).

According to the security concept, nuclear weapons will only be considered in the last two types of conflict. In these types of conflict, nuclear weapons are considered to have a de-escalatory role, in addition to upholding deterrence.

As will be discussed in more detail below, the "White Paper,"[43] published in October 2003, amplified the Military Doctrine of April 2000 but did not change it.

II-2.1 The Role of Tactical Nuclear Forces in the 2000/2003 Russian Military Doctrines

While the purposes and tasks of strategic NW and the forces in charge of these weapons are frequently referred to in official Russian military doctrinal publications, few if any explicit allusions are made to the role of non-strategic nuclear weapons in the current and future military planning in these documents.

At the presentation of the "White Paper" by the Minister of Defense Sergei Ivanov in October 2003, President Putin, who attended the meeting, stated that:

> *"The main foundation of national security in Russia remains, and will remain for a long time to come, nuclear deterrence forces. They are in a very good state, there are plans to develop them, and the plans are realized."*[44]

President Putin then proceeded by referring to the capabilities of the SS-19 ICBMs.

The "White Paper" can be seen as an updated version of the 2000 Military Doctrine; it is more detailed than this latter document. Since some of the information given is relevant for Russian TNWs in spite of the absence of explicit references to these types of weapons, a few excerpts from the "White Paper" are quoted below:

> "*…global nuclear war and large-scale wars, using of conventional weapons, with NATO or another U.S.-led coalition [has been] excluded from among the most probable conflicts for which the country's Armed Forces [should be] prepared. That provided the opportunity to resort to a substantial reduction of the nuclear potential and the conventional weapons potential without damage to the country's security."*

All the same, the paper's authors issued a warning to NATO:

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[43] Russian Federation Ministry of Defense Brochure: Urgent Tasks of the Development of the Russian Federation Armed Force, RIA-Novosti, 03 October 2003.
[44] Russian Federation President, "President Putin Delivers Opening Speech at 2 October Armed Forces Leadership Meeting," Moscow, 03 October 2003 [FBIS Document CEP20031008000267].

"…if NATO is preserved as a military alliance with the offensive military doctrine that exists today, that will require a radical restructuring of Russian military planning…including a change of the Russian nuclear strategy."

In the "White Paper," attempts to restore nuclear weapons to the category of permissible military instruments – presumably by the U.S. – are noted. This is believed to lower the threshold for nuclear weapon employment, which in turn:

"... [would] require from Russia the restructuring of the troop command and control system and the approaches to the deterrence of threats of various levels."

Nuclear deterrence in modern warfare has changed and has to be more integrated with the conventional operations of the general-purpose forces (which allows for possible missions for TNWs):

"... nuclear deterrence, especially with regard to the deterrence of threats that are associated with the employment of conventional weapons by the enemy can be effectively carried out under contemporary conditions only if highly equipped and combat ready general-purpose forces are available. Only in that case will the threat of using nuclear weapons in response to an attack with the use of conventional weapons appear convincing."

Another change in modern warfare is identified in that the role of long-distance weapon systems will be enhanced:

"The increasing significance of the range of a weapons engagement will be a characteristic feature of tactical actions in the future. Troops will acquire the ability to inflict significant damage to the enemy long before direct contact with him using firing weapons."

An air defense system capable of conducting effective combat with all enemy aircraft including "Stealth" is described as being structured at three levels, the highest of which is:

"... strategic air defense with elements of protection from cruise missiles and ballistic missiles."

Deterrence of military and military-political threats to Russia is emphasized, which among other things includes:

"--maintenance of the composition, status, combat and mobilization readiness and training of the strategic nuclear forces, the men and equipment that support their functioning and employment, and also the command and control systems at a level that guarantees inflicting a given level of damage to the aggressor under any condition."

The "White Paper" proceeds to describe essentially the same types of warfare, which can be found in, for example, the Military Doctrine of April 2000 [emphases added]:[45]

> *1. **Armed conflict** as one of the methods of resolving political, national-ethnic, religious, territorial, and other contradictions with the use of the weapons warfare… [It can] become the consequence of an escalation of an armed incident, a border conflict, an armed action, or other armed clashes of a limited scale,.. and can have an international or a domestic nature.*
>
> *2. **A local war** is a war between two or more states, limited in political goals… as a rule, within the borders of the opposing states and affects primarily the interests of only those states. [It can] be conducted by troop (force) groupings that are deployed in the conflict area with their possible reinforcement by transporting additional men and equipment from other sectors and a partial strategic deployment of the armed forces.*
>
> *3. **A regional war** is a war with participation of two or more states (groups of states) of a region using national or coalition armed forces with employment of both conventional and also nuclear weapons on territory that is limited by the borders of one region with the water area of the oceans, sea, airspace and space that are adjacent to it; during the course of which the sides pursue important military-political goals. … **In the event that the participating states or their allies possess nuclear weapons, a regional war will be characterized as the threat of the transition to the employment of nuclear weapon**s.*
>
> *4. **A large scale war** is a war between coalitions of states or the largest states of the world community. It could become the result of the escalation of an armed conflict, or a local or regional war through the involvement in it of a significant number of states of various regions of the world. In a large-scale war, the sides pursue radical military-political goals. It requires **mobilization of all existing material resources** and spiritual forces of the participating states.*

Contemporary Russian military planning is based fundamentally on the objective of deterring and repelling an attack on the Russian homeland. This mission includes scenarios in which potential adversaries possess conventional high-precision and mass destruction munitions. In this context, the RF Armed Forces must be capable of:

> *"In peacetime and in emergency situations, while preserving the strategic deterrence potential and accomplishing combat readiness maintenance tasks, successfully accomplishing missions simultaneously in two armed conflicts of any type, and also peacemaking operations both independently, and as part of multinational contingents using permanent readiness troops (forces) without additional mobilization measures.*
>
> *"In the event of the deterioration of the military-political and military-strategic situation – ensuring the strategic deployment of the RF Armed*

[45] *Russian Federation Military Doctrin*e, Decree No. (unknown), 21 April 2000, provided by *Nezavisimaya Gazet*a," Russian Federation Military Doctrine, Approved by Russian Federation Presidential Edict of 21 April 2000," 22 April 2000, pp. 5-6 [FBIS Document CEP20000424000171].

Forces and deterring the escalation of the situation using the strategic deterrence forces and maneuver by permanent readiness forces.

*"In wartime – using the forces at hand, repelling an enemy aerospace attack and, after a full-scale strategic deployment – accomplishing missions simultaneously in two local war*s."

Maintenance of the potential of the Strategic (Nuclear) Deterrent Forces is said to be of primary importance in order to guarantee their capability to carry out strategic deterrence. This deterrence is to be achieved with the goal:

"In peacetime – Prevention of forceful pressure and aggression against Russia or its allies;

In wartime – De-escalation of aggression; cessation of military operations under conditions that are acceptable for Russia; and, inflicting the prescribed damage on the enemy."

"Prescribed damage" is defined as follows:

"Prescribed damage – Damage, subjectively unacceptable to the enemy, exceeding that benefit, which the aggressor expected to receive as a result of the use of his military forces."[46]

Probably the most important new concept presented was the right of Russia to use its forces pre-emptively as is implied by the statement that Russia "can no longer completely rule out preventive use of force if demanded by the interest of Russia or its alliance commitments."[47] It has been observed by N. Sokov,[48] that even if this statement did not specifically refer to nuclear weapons, given their overall role in Russia's defense policy it might nevertheless imply a threat with nuclear weapons.

The "White Paper" confirms the declaration in the Military Doctrine of 2000 that nuclear weapons will only be considered in two types of conflict: *a regional war* and *a large-scale war.* It can be noted, however, that a likely escalation path is believed to exist from an encounter of the first type: an *armed conflict* as one of the methods of resolving political, national-ethnic, religious, etc. contradictions to *a regional war.* Most probably this reflects Russian concerns that foreign interference in Chechnya-type operations are – or at the time of this writing were – not inconceivable.

Nuclear weapons are regarded as having a de-escalatory role in addition to upholding deterrence. Similar considerations, although in quite a different context, were present in NATO's nuclear doctrine during the latter part of the Cold War era. Ever since December 1993, the Russians have proclaimed that a first use of nuclear weapons is not ruled out – for instance, if in a conventional conflict, Russian forces are unable to repel it in any other way.

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[46] All of the above-referenced "White Paper" citations are from the following: "Russian Federation Ministry of Defense Brochure: Urgent Tasks of the Development of the Russian Federation Armed Forces," RIA-Novosti 03 October 2003

[47] Statement by Sergei Ivanov, available at http://www.rian.ru.

[48] Nikolai Sokov, *"Russian Ministry of Defense's New Policy Paper; The Nuclear Angle*," CNS Report, Monterey Institute of International Studies, Monterey, October 2003.

To conclude, the "White Paper" implies that limited and regional wars associated with nuclear weapons will have the following characteristic features:

- future limited conflicts will be fought over large territories unlike earlier traditional conflicts or some Cold War scenarios;
- the ability to strike targets at large distances will play a central role, as will defense against such strikes;
- secure and survivable command, control, communications, and intelligence capabilities will be important;
- ready reserves that can be called up and deployed after the war begins will play a vital role in all types of conflicts; and
- nuclear weapons can be an effective deterrence tool only if supported by modern and effective conventional forces.

II-2.2 How Consistent are the Operation Tactical Nuclear Forces with the 2000/2003 Russian Military Doctrines?

The Military Doctrine of April 2000, the "White Paper" of October 2003, as well as various analyzes of these documents, indicate likely or possible missions for all categories of the Russian TNWs. It can be deduced from the "White Paper," that these missions do not seem to have changed in any major way from those of the latter Soviet period described in section II-1.1.1 of this report, possibly indicating that TNW systems designed to combat certain categories of military targets are not that easy to use for new military purposes necessitated by a new military environment.

Declarations to the effect that the deterrence value of nuclear weapons are believed to depend strongly on support by conventional forces indicate a role for the nuclear component of the ***ground forces weapon arsenal,*** i.e. for short-distance missiles, perhaps nuclear artillery shells, and possibly nuclear land mines. This is the classical "battlefield use" of TNW, where there is little or no room for strategic NW.

Retaining TNWs in this category is, of course, in disagreement with the unilateral PNI declarations of President Gorbachev in 1991, where he promised, "The USSR will eliminate its entire inventory of ground launched short-range nuclear weapons, including nuclear artillery shells, short-range ballistic missile warheads, and nuclear land mines." (This was followed by President Yeltsin´s proposal in 1992 that "production for ground-based tactical missile and nuclear artillery shells and mines had ceased.") A recent official Russian statement on the state of reductions of these types of TNWs was issued at the First Session of the Preparatory Committee for the 2005 NPT Review Conference, held in April 2002 in New York, when it was declared, "Production of nuclear munitions for tactical ground-launched missiles, nuclear artillery shells and nuclear mines has been completely stopped; the destruction of nuclear reentry vehicles for tactical missiles and nuclear artillery shells, as well as nuclear mines continues."[49]

[49] Ministry of Foreign Affairs of the Russian Federation, "Statement of the delegation of the Russian Federation at the First Session of the Preparatory Committee for the 2005 NPT Review Conference under Article VI of the Treaty (New York, 11 April 2002)," Information and Press Department, Daily News Bulletin, 24 April 2002.

There are indications that some amount of these types of TNWs are – and will continue to be – kept in the arsenals. One such indication was provided by Colonel-General Zaritskiy´s recent assertion that "the Missile Troops and Artillery are responsible for the employment of those non-strategic nuclear weapons that are in the Ground Troops inventory" and that "these weapons were, are, and will be adequately reliable."[50] Maintaining weapons in this category is at any rate consistent with the general ideas presented in the Military Doctrine of 2000 and the "White Paper" concerning the credibility of the nuclear deterrence. In case they were to be used, collateral damage is likely to be far less than if weapons of much higher yields – such as AS-4 Kitchen ASMs or gravity bombs – were delivered. Last but not least, short-range missiles and artillery are known to be reliable as well as accurate weapons.

The contribution of TNWs associated with the Ground Troops to overall deterrence was outlined by two Russian military scholars in 1997:

> *"Ground Troops mobile missile complexes ... possess higher promptness of effect on the enemy and concealment of use as well as lesser in-flight vulnerability of missiles compared with aircraft ... Therefore it appears advisable to have a certain number of operational-tactical missile complexes with a launch range to 400-450 km and capable of employing nuclear-armed missiles as part of missile and artillery troops of fronts (or of armed forces in a TVD). This will increase substantially the capabilities of operational-strategic (strategic) formations for delivering nuclear strikes under any situation conditions, and this will become an additional weighty factor in deterring potential aggressors."*[51]

This assessment was confirmed more recently with respect to Russia's European area of operations:

> *"Today, unfortunately, the only effective method for putting military pressure on the North Atlantic alliance is Russia's use of tactical nuclear weapons. The systems possessing such weapons within the Russian Federation Armed Forces include 152 and 203 mm caliber barreled artillery pieces; the* Tyulpan *240 mm caliber mortars;* Tochka-U *tactical missile systems; and the* Iskander *that is being introduced in 2004. There are also frontal and long-range aviation aircraft."*[52]

The second category of Russian TNWs discussed here is ***missile and air defense weapons***. Again, it is difficult to see how strategic NW can be used for these types of defensive purposes. A number of surface-to air missiles such as SA-5B *Grammon* and SA-10 *Grumble* intended to combat aircraft and cruise missiles - as well as anti-ballistic missiles such as SH-08 *Gazelle* and SH-11 *Grumble* meant to be used against incoming ballistic missiles over the Moscow region - will be maintained according to the PNIs of 1991/92. (Reportedly,

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[50] Oleg Falichev, Interview with Colonel-General V. N. Zaritskiy, Chief of the RF Armed Forces Missile Troops and Artillery, November 2003 [FBIS Document CEP20031120000239].
[51] Colonel V. V. Kruglov and Colonel M. Ye. Sosnovskiy, "On the Role of Nonstrategic Nuclear Weapons in Nuclear Deterrence," *Voyennaya Mysl*, No. 1, 01 September 1997, pp. 11-14 [FBIS Document FTS19971205000584].
[52] Mikhail Khodarenok, "In Response to NATO Expansion: Russia Must Emphasize Tactical Nuclear Weapons," *Voyenno-Promyshlennyy Kuryer*, Moscow, 07 April 2004 [FBIS Document CEP20040408000291].

approximately 50% of the warheads in the SAM category that existed in 1990 have been eliminated.[53])

The need for a strategic air defense is explicitly stated in the "White Paper," and all indications are that this category of TNWs will be maintained during the foreseeable future. By and large, these weapons seem to be intended for the defense of Russian territory against major attacks involving aircraft, cruise missiles and – in the case of Moscow – ballistic missiles. We note in passing that the SAMs might be of limited use against low flying objects, however, since nuclear explosions at low or medium heights will cause considerable collateral damage – in this case, presumably on Russian territory. Still, Russian experts frequently express an opinion that in conditions of potential massive hostile air attack with conventional high-precision weapons (i.e. capable of saturating air defenses), the use of nuclear surface-to-air missiles would be more effective.[54]

The third category of TNWs, ***tactical air force weapons*** (ASMs and gravity bombs*)* are similar to what the U.S. has maintained as operational TNWs, except that they seem to have considerably larger yields according to open sources. In 2002, it was declared by the Ministry of Foreign Affairs of the Russian Federation that "50% of nuclear air bombs ... have been destroyed."[55]

There is no mention of ASMs, either in the PNIs or any subsequent official statements of dismantlement of TNWs. One has to assume that most, if not all, of the AS-4s are maintained as operational weapons and/or in reserve, waiting for remanufacturing. The importance assigned to the ability to strike distant targets in the "White Paper" indicates that there might be a considerable interest in aircraft delivered nuclear weapons. This conjecture is further corroborated by the Zapad-99 exercise, as well as by subsequent military exercises, where strategic bombers were used to deliver nuclear strikes for de-escalatory purposes. For targets within reach of tactical aircraft, TNWs such as AS-4s could probably be used for similar purposes as well, implying an overlap in use between strategic NW and TNW of this category.

For the fourth category of Russian TNWs, ***general purpose naval weapons*** (SLCMs such as SS-N- 9 *Siren*, SS-N-12 *Sandbox*, SS-N-19 *Shipwreck*, SS-N-21 *Sampson*, and SS-N-22 *Sunburn*, naval aircraft delivered gravity bombs and ASMs, torpedoes and depth charges), little if any explicit information can be found in recent doctrinal documents. Pavel Podvig notes that:

> *"... equipping [the navy] with nuclear weapons was originally viewed solely as a means of enhancing the effectiveness of naval operations in actions against large ships and groups of ships and against naval bases."*[56]

Podvig proceeds by making the more detailed observation that:

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[53] Vladimir Rybachenkov, "Nuclear Strategy of Russia," Ministry of Foreign Affairs of the Russian Federation, *Lecture at the NATO Schoo*l, Oberammergau, 01 March 2001.

[54] Anatoli Diakov, Eugene Miasnikov, and Timur Kadyshev, "Non-Strategic Nuclear Weapons: Problems of Control and Reduction," Center for Arms Control, Energy and Environmental Studies, Moscow Institute of Physics and Technology, Dolgoprudny, 2004, p.14, http:/www.armscontrol.ru/.

[55] Ministry of Foreign Affairs of the Russian Federation, "Statement of the Delegation of the Russian Federation at the First Session of the Preparatory Committee for the 2005 NPT Review Conference under Article VI of the Treaty (New York, 11 April 2002)," Information and Press Department, Daily News Bulletin, 24 April 2002.

[56] Pavel Podvig, *Russian Strategic Nuclear Forces,* The MIT Press, Cambridge, MA, 2001, p. 235.

"In a crisis the Russian Naval Forces would be expected to perform several offensive operations to debilitate the enemy: in particular, threats to the enemy's aircraft carrier groups, maritime communication lines, shore facilities, and strategic submarines. Attack submarines would be expected to play a central role in the performance of these functions. Such actions, which would be taken simultaneously in various parts of the world's oceans, would be intended to divert the antisubmarine forces and weapons of the adversary and thereby reduce the threat to Russian strategic missile-armed cruiser."[57]

The PNI declarations of 1991/92 seem to have been fulfilled for these kinds of TNW. The 1991 PNI stated that "the USSR would remove all naval tactical nuclear weapons, including sea-launched cruise missiles from its surface ships, multi-purpose submarines, and land-based naval aircraft. A portion of these warheads would be destroyed, while the remainder would be centrally stored and available if necessary." (President Yeltsin made the additional announcement 1992 that "Russia would eliminate one-third of its sea-based tactical warheads.") In 2002, Russia declared that "all non-strategic nuclear weapons have been dismantled from surface ships and multipurpose submarines, as well as from ground-based naval air force and placed for central storage; more than 30% of nuclear munitions of the total number designed for tactical sea-launched missiles and naval air force has been eliminated."

Still, a fairly large amount of these weapons apparently remain in storage, some apparently with quite high yields. (When these weapons were designed, collateral damage at sea was probably not regarded as a major problem compared to the importance of having large radii of assured destruction of ships and other naval assets.) There is no information available as to how many of these weapons could be deployed with short notice, the time required for such a deployment, or how many are in need of remanufacturing. The fact that they were never intended to be completely eliminated, nor have been, indicates that they are regarded as an important contribution to Russia's defense structure – presumably against NATO's SSBNs, aircraft carrier battle groups, sea lines of communications, and major naval bases – since it is difficult to identify any sea-based forces besides those of NATO that could possibly constitute a major threat to Russia. While there seems to be some interchangeability between a few of these TNW and strategic NW regarding their uses, especially if coastal strategic targets were to be attacked, it must be presumed that the basic role of this category of TNW is to assist in tactical naval warfare rather than to be used for strategic missions.

II-3.0 Command and Control in the Tactical Nuclear Forces Context

In 1999, two Russian military officers published an article that called for enhancements to the command and control systems for tactical nuclear weapons. Their primary concern was not the prevention of unauthorized use, but rather the timely transition from peacetime to combat operations. Their analysis discussed the need to build a modern C2 system that could manage conventional military operations in conjunction with limited or wide use of tactical nuclear strikes by the Russian artillery and missile forces.

This analysis by the Russians spends surprisingly little narrative on the automation of firing controls and the centralization of use authority, in favor of considerable narrative on

[57] Pavel Podvig, *Russian Strategic Nuclear Forces,* The MIT Press, Cambridge, MA, 2001, p. 255-256.

coordinating combat operations and intra- and inter-unit communications. The authors implied that C2 upgrades were underway and that this article was their contribution to the debate. Such a system, according to the officers, should meet the following basic requirements:

- correspond to the organizational structure of combined-arms, large, strategic formations;
- possess structural and functional redundancy ensuring its stability and consequently also ensuring continuous command and control of subordinate troops under conditions of the use of nuclear weapons;
- if necessary, permit massing the strikes of all or the bulk of RViA [Missile Troops and Artillery] of the large strategic formation for reliable destruction of enemy targets in the shortest possible time;
- possess adaptiveness and flexibility permitting its realignment without complicated reorganizations under conditions of a swiftly changing situation and swiftly changing missions for nuclear deterrence of aggression; and,
- possess necessary standardization and reserves of technical means for rapid restoration of disrupted command and control.[58]

The following sub-sections compare the command and control of strategic nuclear forces to the available evidence on the C2 of tactical forces..

II.3.1 C2 for Strategic Nuclear Systems: How Relevant?

Since almost no material is available on Russian command and control in the tactical nuclear forces context, we will start with what is published in the West on the command and control of Russia´s strategic nuclear forces.Valery E. Yarnich, formerly a Russian SRF and General Staff officer, states in a recently published book that:

> *"The Russian president has the right to authorize the use of nuclear weapons. The highest level of command , control and communication (C3) includes, in addition to the president, the minister of defense, the General Staff, and the commanders in chiefs of the SRF, Navy and Air Force …*
>
> *"In order to provide for continous command and control of the troops in general, and especially of the nuclear forces, a system of command posts has been deployed and is operational. The highest level command posts include:*
>
> - *underground, super hardened command posts in the city of Moscow, and the Moscow region (Chekhov);*
> - *airborne command and control posts for the General Staff, the SRF, the Navy, and the Air Force, based near Moscow;*
> - *railroad and mobile ground (truck-mounted) command posts.*

[58] Lieutenant General (Retired) P. I. Dubok, candidate of military sciences, and Colonel (Retired) N. A. Zakaldayev, candidate of military sciences, "On Some Issues of Command and Control of Missile Troops and Artillery in Accomplishing Regional Nuclear Deterrence," *Voyennaya Mysl*, Moscow, No. 6, November-December 1999, pp. 72-74 [FBIS Document CEP19991210000001].

"These command posts are connected by two-way communications channels, and are equipped to receive an ESW signal of a nuclear attack ...

Individuals and agencies included in the higher level of SNF C3 are continuosly connected to each other by a special communication system, Kazbek. This system includes:

- *portable equipment (Cheget) used by the president to prepare and issue authorization for the use of nuclear weapons (the 'nuclear briefcase');*
- *terminal equipment (Baksan) installed at command posts of the General Staff, SRF, Air Force, and Navy to receive the president´s authorization;*
- *the special communication system Kavkaz (radio, radio relay and satellite communication channels). This system connects the 'nuclear briefcase' to the Kazbek network from wherever the president happens to be...*

"How many 'briefcases' were used in the Soviet SNF command and control is unknown. Some believe that three were used for preparation and release of nuclear authorization; one belonged to the general secretary of the Communist Party´s Central Committee, one to the minister of defense, and one to the chief of the General Staff. A clear, official description of this complex and crucially important process does not exist."[59]

Yarnich describes the technical means for command and control as basically consisting of the two-way communication system *Signal-A* with its subsystem *V´yuga.* These systems are backed up by an emergency system called *Perimetr.*

The *Signal-A* system is said to be characterized by a high degree of redundancy, reliability and combat readiness. The reliability of the system is assured by several communication tracks, each track having different physical communication channels such as radio, cable, satellite, tropospheric, etc. *V´yuga* adds to this redundancy by using HF, VLF, and satellite communication links. All command posts, including regimental ones, are said to be equipped also with *V´yuga* receivers. Furthermore, *Signal-A* and *V´yuga* seem to be interfaced electronically and algorithmically and can be used simultaneously with a high security of all communication channels involved.

The existence of a backup system, *Perimetr* has been known outside Russia for some time but was officially recognized by Russia in 1999.[60] It is designed to withstand the extreme conditions of a nuclear war. It is intended to maximize the probability to achieve a second strike after Russia has absorbed a first strike (launch under attack or LUA). A summary relevant for SRF is given by Yarnich:

"The crucial characteristic of Perimetr is its ability to transmit an order from the General Staff directly to the ICBM launchers, physically bypassing (in contrast to Signal-A*) all immediate command posts of the SRF."*[61]

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[59] Valery E. Yarnich, *C3: Nuclear Command, Control Cooperation*, Center for Defense Information, Washington, DC, May 2003, pp. x-y.
[60] Karpenko, Utkin, Popov, *Otechestvennye strategicheksie Raketnye kompleksy*.
[61] Valery E. Yarnich, *C3: Nuclear Command, Control Cooperation*, Center for Defense Information, Washington, DC, May 2003.

The command, control and communication system designed for strategic submarines (SSBNs) is similar to the SRF *Signal-A* system. The modifications are, of course, related to the limited radio communication possibilites beneath the surfaces of the oceans, since in this case only LF, VLF, or ELF communication can be used. Neverthelesss, SSBNs patrolling submerged in peacetime are continously in VLF-type contact with the General Staff, the main naval staff, and subordinate staffs. Apparently, a special kind of the *Perimetr* system exists also for SSBNs, although for physical reasons the signals from the highest command short-cutting intermediate staffs are not coming directly to the (submerged) SSBNs but are transmitted to them by LF, VLF, or ELF signals received by some sea-based strategic nuclear forces C3. Consequently, SSBNs are believed to be equipped with *Perimetr*-type logic receivers.

It should perhaps be noted here that Russian SSBNs are furthermore believed to have safety devices blocking accidental or unauthorized launches of SLBMs,[62] which can only be unblocked after a special code is received from the chain of command.

The bombers of the Russian strategic triad maintain communication in flight by way of HF and satellite channels transmitted from ground bases. Normally, the crews are believed to receive necessary orders for accomplishing a mission (such as the target destination and the codes for unlocking the nuclear weapons) before taking off, since jamming can be a problem when airborne.

II-3.2 C2 for Tactical Nuclear Forces

As noted previously, very little is known regarding command, control, and communication for Russia´s TNWs. It is likely, though, that strong similarities exist between the command, control, and communication structure for the strategic nuclear forces and the tactical nuclear forces – all the more so since the distinction between TNWs and strategic NWs does not seem to be very clear-cut in Russia. A major problem with command and control of TNWs that essentially is missing for strategic NWs is predelegation. Technically, there are no problems with predelegation, since authorizing codes and information necessary to unlock a nuclear weapon can be released at any time.

The problem arises because centralization of command and control is counter to the necessity of a commander in field to make the decisions when and where to use his tactical nuclear weapons according to how a particular theatre situation evolves. However, predelegation of TNW release authority is a very serious matter for the leadership of any NW state considering the stakes involved. As will be discused more in detail in section II-3.2.2, some modified version of the *Perimetr* system might in principle be used to enhance centralized command, while still allowing the field commander a rapid use of TNWs if necessary. Any clear indication in the open literature that such a system exists, however, has not been found by the present authors.

It is unclear how relevant the command and control systems utilized during the Soviet period are to today's Russian military. Some of the available evidence from the Soviet period is

[62] Valery E. Yarnich, *C3: Nuclear Command, Control Cooperation*, Center for Defense Information, Washington, DC, May 2003.

presented first here to highlight the differences between strategic and tactical command and control and second, to provide a baseline for what has evolved into the current system.

Ivan Safranchuk offers two perspectives on who controls the TNWs: (1) the central political elites controlling the entire NW system, including strategic and tactical weapons; or (2) a less centralized command structure for the tactical systems, with the possibility of use authority being delegated to the local military districts.[63] We find little evidence to support either proposition, but we believe that Russia maintains adequate command and control over its TNW systems, at least under normal circumstances.

II-3.2.1 Dilemmas of Vulnerability and Command and Control[64]

Russian analysis is as frequently contradictory as non-Russian perspectives. One Russian report contends with the problems involved in control of the strategic nuclear forces, and notes that such an examination must be placed in a context of the general system combat employment of the armed forces. It first suggests that TNWs are only entangled in the centralized nuclear C2 systems occasionally:

> *"Rational strategic planning must be unified with a calculation of the possibilities of both conventional and nuclear war and its sudden transformation from one form to another. For example, a local war may require only the limited use of nuclear weapons, primarily tactical weapons. In repulsing large-scale aggression, massive use of strategic and tactical nuclear forces [may be required]. Depending on the nature of the armed conflicts and wars the scope of involvement of the general purpose forces and the formations and units of other power agencies with military capabilities may be different.*
>
> *"In the United States, by virtue of their strategy, the main general purpose forces with their tactical nuclear weapons have been dispatched to and deployed in remote theaters of military operations (TVD). Under these conditions the actions of the command in the TVD have a relatively independent character. The [American] Joint Chiefs of Staff concentrate their main efforts on general strategic planning and administrative activity, because there is no need for such close and constant coordination of the actions of the SYaS [strategic nuclear forces] and the general purpose forces as under Russian conditions. Accordingly, the organization of the strategic leadership of the armed forces in the United States and Russia cannot be the same."*[65]

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[63] Ivan Safranchuk, "Tactical Nuclear Weapons in the Modern World: A Russian Perspective," in Brian Alexander and Alistair Millar, *Tactical Nuclear Weapons: Emergent Threats in an Evolving Security Environment,*" Brassey's, Inc., Dulles, VA, 2003, pp. 58-59.

[64] The following section is adapted from Michael Krepon, Ziad Haider, and Charles Thornton, "Are Tactical Nuclear Weapons Needed in South Asia?," in Michael Krepon, Rodney W. Jones, and Ziad Haider, Editors, *Escalation Control and the Nuclear Option in South Asia*, The Henry L. Simson Center, Washington, DC, Chapter 6, 2004.

[65] Makhmut Gareyev, "Integration – Not a Goal in and of Itself: The Command and Control of the Strategic Forces Must Become More Effective and Economical," Nezavisimoye Voyennoye Obozreniye, Moscow, No. 1, 15 January 1999, p. 4 [FBIS Document FTS19990122001305]. The author is a General of the Army and Doctor of Military Sciences.

The more tactical nuclear weapons are ready for use, the greater the potential for a breakdown of command and control. The more controls are placed over these weapons, the less ready they might be for use when needed. These dilemmas increase in proportion to the seriousness of a crisis or a military engagement. Increased readiness or dispersal of tactical nuclear weapons during a crisis also increases the possibility that something unexpected or unwanted could happen. In addition, the predelegation of authority to use tactical nuclear weapons in the event of combat conditions could improve military responsiveness at the risk of uncontrolled escalation. As Glenn Snyder noted:

> *"Tactical nuclear warfare is much more likely than conventional warfare to give rise to accidents leading to the inadvertent explosion of full-scale war. Even if NATO planned to fight a conventional war, and the war started at the conventional level, the possession of atomic weapons by the troops on each side would create possibilities of their accidental firing. The chance of accidental firing becomes greater as smaller weapons are developed, because the smaller the weapon, the lower the level of command to which it is likely to be assigned and the larger the number of fingers that will be on atomic 'triggers.'".*[66]

Forward basing of tactical nuclear weapons demonstrates resolve and deterrence, but at the risk of increasing the vulnerability of deployed nuclear weapons upon the outbreak of hostilities. During the Cold War, American political and military leaders rightly worried that Soviet forces would attempt to attack NATO nuclear sites in Western Europe. Soviet war planners had good reason to worry about similar tactics, since U.S. Army manuals on tactical nuclear weapons emphasized attacks against known or suspected enemy atomic missile storage and launching sites.[67]

Mutual vulnerability of forward-deployed tactical nuclear weapons was an enduring concern throughout the Cold War, and remains so today. A report by the United Nations Institute for Disarmament Research highlights this dilemma while alluding to the risks for escalation control:

> *"In a fast moving battle, the risk of being overrun is particularly great for troops with short-range weapons that are necessarily deployed close to the front line…The vulnerability of TNWs [tactical nuclear weapons], thus, contains an inherent imperative to employ them early in warfare… The shortest-range TNWs especially are thus a factor of grave instability."*[68]

If, as is the present case in Russia, TNWs are considered to be a compensating factor for relative conventional military weakness, an absence of predelegation might well deprive a field commander from taking advantage of the military effectiveness usually connected with the use of TNWs.

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[66] Glenn Snyder, *Deterrence and Defense: Toward a Theory of National Security*, Princeton University Press, Princeton, NJ, 1961, p. 140.
[67] John P. Rose, *The Evolution of U.S. Army Nuclear Doctrine, 1945-1980*, Westview Press, Boulder, CO, 1980, p. 86.
[68] *Tactical Nuclear Weapons: Options for Control, A UNIDIR Report,* United Nations Publications, Geneva, 2000, p. 27.

II-3.2.2 Authorizing the Use of Tactical Nuclear Weapons

Scholarly work by Bruce Blair in 1993 of Soviet-era C2 informs our current discussion, since we surmise that use authority and release procedures in Russia have not changed drastically.[69] Just as in the U.S., the President of Russia has the sole responsibility to authorize the use of any type of NW. If the President is no longer alive or is no longer in a position to decide, this authority is transferred to other high-ranking people such as the Minister of Defence and/or the chief officer of the General Staff and most likely others in a descending order. In any case, each one of the three office holders mentioned above carries a "suitcase" containing information necessary for releasing NW. One Russian media report described the "nuclear suitcases" this way:

> *"There are three of them in our country: the President's, the Minister of Defense's, and a backup in the General Staff. The 'suitcase' and its case are a unified, instantaneous response system that lets the president receive information in a moment's notice on where and how soon enemy warheads will hit, where they can be intercepted, and what responsive actions have been taken. In addition, the system provides operational communications with all elements responsible for the nation's defense and security. The decision to use nuclear weapons can be made only by the joint agreement of the President, the Minister of Defense, and the Chief of the General Staff. The cases, which are usually referred to as 'suitcases,' were manufactured by Samsonite; they are ten centimeters in width and weigh several kilograms. They are carried by specialists well versed in electronics and experienced in combat watch operations. They remain close to the President at all times, twenty-four hours a day."*[70]

As mentioned in section II-3.2, shortcuts or an "automatic mode" (*Perimetr)* in the system seems to have existed during the Soviet period in order to guarantee that a second strike could be delivered also after an exposure to a massive first strike in accordance with the logic of the MAD (Mutually Assured Destruction) doctrine.[71] Since the "automatic" mode may be intended for the strategic part of the NW arsenals, it is a moot point if it also applies to the non-strategic arsenals. In any event, we will restrict our discussion to the normal "manual mode" in what follows.

After a high command (presidential and highest defence authority) decision to use non-strategic NW has been reached, details of the actual execution of a nuclear strike can apparently be delegated to lower levels. It seems likely, however, that the first decision to use nuclear weapons, i.e. the first breaking of the "nuclear taboo", would also include operational details to be decided at the highest level, since this would be an unprecedented event for Russia.

However, if such an event were to be followed by a protracted nuclear war including the use of non-strategic NW, lower command levels would most likely be authorized to decide upon the actual use of TNW within limitations given by the highest command. Once that top-level decision is made, the authority to use TNWs appears to filter to the *front* commanders. A

[69] Bruce G. Blair, *The Logic of Accidental Nuclear War*, The Brookings Institution, Washington, DC, 1993.
[70] Sofya Ryzhova, "Everyday Life of the Kremlin," *Simbirsk Simbirskiy Kuryer*, commentary on exerpts from a book by President Yeltsin's Protocol Chief Vladimir Shevchenko, 02 November 2004 [FBIS Document CEP20041102000414].
[71] Bruce G. Blair, *The Logic of Accidental Nuclear War*, The Brookings Institution, Washington, DC, 1993.

Soviet/Russian *front* is the largest wartime command unit, varying widely in size but containing several armies, air armies, and combat support units – at the time, it was equivalent to a NATO army group commander. The U.S. intelligence community described the Soviet TNW control procedures this way:

> "*Nuclear operations are characterized by overall control at the* front *level [emphasis in the original]. The* front *commander assigns all warheads and missiles; moreover, he must agree to all targets engaged in the initial strike and to many of the targets subsequently engaged. Adequate communications nets for proper command and control of nuclear operations exist within the* front.
>
> *"The* front *commander has many means of gaining battlefield intelligence, but the effectiveness of his nuclear weapons employment is still limited by his target acquisition capability. Combat intelligence is acquired using air reconnaissance, ground patrols, and a variety of electronic means such as direction finders and radars.*
>
> *"Nuclear operations within the* front *are characterized by wide dispersion and continual movement of launchers. Attention is paid to concealment as well as deception. Not all launchers will be available at any given time owing to movement requirements, and reaction and refire times. The reliability of the Soviet systems ranges from 70% to 80%. Nuclear fires will be employed in conjunction with conventional and chemical munitions."*[72]

It is likely that these practices and procedures have been, to a large extent, retained under by Russia military. Although the U.S. intelligence analysis is premised on Soviet military operations that no longer appear relevant modern tactical systems have enhanced their target acquisition, reaction and refire, and concealment capabilities. Moreover, as we have assessed throughout this report, *front* commanders appear to have retained considerable use authority once the command structure has decided to utilize nuclear weapons and the warheads have been deployed.

Communication of authorities and combat orders between and among the units becomes critical during a crisis period. Two former Russian military officers offered the following description:

> *"Another important element in organizing command and control of the RViA* [Missile Troops and Artillery] *during nuclear deterrence is the creation of a communications system. Staffs of the RViA of large strategic formations usually are allocated the communications channels and equipment which go to form such a system in combination with forces and assets of missile, artillery and technical units. Special channels are provided in it for command and control of missile and artillery units employing tactical nuclear weapons in support of nuclear deterrence missions so that*

[72] U.S. Defense Intelligence Agency, "Guide to Nuclear Weapons Available to the Soviet Front Commanders," Document #ST CS 02-18-73, p. xvi, formerly classified *secret*, released in 2004 under the Freedom of Information Act.

appropriate RViA staffs can promptly communicate missions to subordinates across one or two echelons right down to the launch (firing) battery."[73]

One significant difference in the procedures to authorize the use of TNWs between strategic and tactical weapons in the Russian system is an apparent requirement to authorize both the tactical warhead *and* the tactical delivery system:

> *"All tactical warheads, including those in the Navy, are equipped with code-preventive devices. In order to activate the nuclear device a permissive code should be installed first. A similar code should be installed into the command system of the delivery vehicle ... The sanctioning codes should be inserted into both the nuclear warhead and the tactical missile to make it possible to mate the nuclear device with the delivery vehicle. In other words, it is impossible to install the nuclear warhead on the tactical delivery vehicle without activation of two code systems."*[74]

Again, there is considerable speculation and little available direct evidence as to how the Russian leadership authorizes the use of tactical nuclear forces, communicates the authorizations, and controls the operations. We believe that Russia has discarded the practice of using sealed envelopes stored with military district commanders with modern electronic systems. But it may well be, as many have argued, that many authorizations are pre-delegated to the local level.

II-3.2.3 Concerns About Pre-Delegating Use Authority

The practice of delegating the authority to use nuclear weapons down to the battlefield commander's level remains a concern in the Russian TNW context. This issue does not apply during times of peace and stability, given that Russia stores the nuclear warhead triggers separately from the explosives packages. However, if functional warheads are mated to delivery systems during times of crisis, many observers suspect that they may be fired without central authorization, or fired on warning.

As described by Stephen Lambert, a U.S. Air Force officer who spent time in Russia researching these issues and interviewing Russian officials and military personnel:

> *"The operational philosophy of pre-delegation ... extends to Russia's tactical weapons. In order to increase the survivability of the tactical nuclear systems (which are more widely dispersed and suffer from a shortage of communications links), launch authorization codes are pre-delegated to local commanders during times of increased tension. Thus, the potential for local use is significantly increased during times of conflict ... Russian strategists have explicitly sought to extend the threshold for escalation downward, thereby increasing the likelihood of tactical nuclear release in the face of hostilities. Thus there are two distinct concepts at work: (1) the procedure*

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[73] Lieutenant General (Retired) P. I. Dubok, candidate of military sciences, and Colonel (Retired) N. A. Zakaldayev, candidate of military sciences, "On Some Issues of Command and Control of Missile Troops and Artillery in Accomplishing Regional Nuclear Deterrence," *Voyennaya Mysl*, Moscow, No. 6, November-December 1999, pp. 72-74 [FBIS Document CEP19991210000001].

[74] Sergei Rogov and Alexander Konovalov, Editors, *The Soviet Nuclear Legacy Inside and Outside Russia: Problems of Non-Proliferation, Safety and Security*, Institute of the USA and Canada, Moscow, 1993.

of pre-delegating the launch codes; and (2) the operational doctrine of lowering the nuclear threshold."[75]

During the Soviet period, pre-delegation was managed by *front* commanders:

> *"The* front *commander has several means of controlling the nuclear firepower within the* front *[emphasis in the original]. He assigns some missile units to the armies and retains others under* front *command. He assigns all nuclear warheads within the* front*. He must agree to all targets engaged in the first mass strike and to subsequent strikes involving more than one army. He also retains the right to approve targets for* front *weapons, targets in depth, or targets crossing interarmy boundaries. All nuclear strikes by army or divisional weapons require the approval of the army commander although the authority to engage enemy nuclear weapons may be delegated to artillery commanders."*[76]

This analysis implies that most use authority is not pre-delegated to the combat troops on the line, except in very specific circumstances. This would suggest a system and procedures that would be prepared to act in a time of crisis but that would be less susceptible to impulsive battlefield decisions than is commonly thought.

Russia has managed its nuclear operations responsibly since 1991. It has maintained a relatively stable political system, with clear chains of command and strong central leadership. These are all critical background factors for the control of nuclear weapons. Nonetheless, the possibility of pre-delegating use authority during times of international or regional instability increases the danger of TNW release based on judgments made by battlefield commanders.

II-3.2.4 "Permissive Action Links" for Russian Tactical Nuclear Warheads

All American nuclear warheads are built with devices that would permanently disable them and disallow any detonation if their physical security were circumvented but proper electronic codes were not entered. There is some debate as to whether Russia's tactical nuclear warheads contain such devices. As Oleg Bukharin notes:

> *"Tactical weapons...are easy to hide and transport and, under certain circumstances, are directly usable. Indeed, although tactical weapons are protected by mechanical locks and special equipment is required to use them, a state, or even a group of terrorists, can overcome such difficulties given time and resources."*[77]

The physical security of Russia's warheads is discussed in detail elsewhere in this report. Although we assess warhead security to be adequate, theft and diversion cannot be ruled out.

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[75] Stephen P. Lambert and David A. Miller, "Russia's Crumbling Tactical Nuclear Weapons Complex: An Opportunity for Arms Control," INSS Occasional Paper 12, Regional Series, USAF Institute for National Security Studies, U.S. Air Force Academy, Colorado, April 1997.

[76] U.S. Defense Intelligence Agency, "Guide to Nuclear Weapons Available to the Soviet Front Commanders," Document #ST CS 02-18-73, p. 38, formerly classified *secret*, released in 2004 under the Freedom of Information Act.

[77] Oleg Bukharin, "Technical Aspects of Proliferation and Non-Proliferation," in George Quester, Editor, *The Nuclear Challenges in Russia and the New States of Eurasia*, M.E. Sharpe, Armonk, NY, 1995.

It therefore becomes essential to assess the possibility that a stolen or diverted warhead could be caused to detonate. Lambert categorizes the relative vulnerabilities of different warhead types:

> *"Experts familiar with Russian locks on tactical systems indicate that the technical safeguards found on gravity bombs and cruise missiles deployed with Russian bomber divisions are the weakest. Locks on the gravity bombs are not sophisticated, and cruise missiles lack adequate technical protection to inhibit unauthorized use. In fact, Russian sources indicate that a captured cruise missile armed with a nuclear warhead could readily be launched from a variety of aircraft and would produce a nuclear detonation ... Indeed, an acknowledged expert in Russian nuclear weapons control indicates that the blocking devices are really 'just gimmicks designed to buy time.' In all probability, the Russian ministries in charge of nuclear weapons are still relying on old Soviet security methods ... In Russia [PAL-level] protection is limited to Russian strategic systems."*[78]

If a PAL-type system has been implemented, it would function approximately as follows: After a decision on which non-strategic NW one should use, what the targets will be, which time the strike should be executed, which units will be involved etc., a preliminary coded order prepare for combat is sent by the General Staff to the individual units selected to carry out an intended NW strike. The same order is sent in parallel by the staff of the Navy or Air Force, depending on who will be responsible for the strike. Not until such a "preliminary order" has been given and received can additional orders reach the combat crew responsible for executing the strike. The actual warheads seem to be in custody of officers from the Twelfth Main Directorate up to the point of launch.[79] The final order is – or at least was – apparently divided into two steps: one order of "permission" and one "direct" order.

The "direct" order, issued after the "permission" order and in a sense the executive order, is sent encoded over some appropriate secure line of communication depending on what units are involved. It supposedly contains information about targets, timetables, and similar attack details as well as the codes necessary to unlock the warhead triggers. During the Soviet period the communications links functioned as follows:

> *"Nuclear operations are characterized by overall control at the* front *level [emphasis in the original]. Since firing units as well as target acquisition units are assigned to* front*, army, and division, communication means between levels become most important. Adequate communication nets do exist, linking* front *headquarters to the firing and target acquisition units. Minimizing the net traffic loadings is emphasized. Special communication modes and procedures are likely when nuclear warheads are used. The messages are brief code word and number sequences which are associated with encoded target, launcher, and meteorological data. Adequate backup of these nets enables them to handle any reasonable contingency."*[80]

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[78] Lambert, Stephen P. and David A. Miller, "Russia's Crumbling Tactical Nuclear Weapons Complex: An Opportunity for Arms Control," INSS Occasional Paper 12, Regional Series, USAF Institute for National Security Studies, U.S. Air Force Academy, Colorado, April 1997.
[79] Bruce G. Blair, *The Logic of Accidental Nuclear War*, The Brookings Institution, Washington DC, 1993.
[80] U.S. Defense Intelligence Agency, "Guide to Nuclear Weapons Available to the Soviet Front Commanders," Document #ST CS 02-18-73, p. 45, formerly classified *secret*, released in 2004 under the Freedom of Information Act.

These procedures are likely to continue to exist today. The last procedure of unlocking the weapon seems to be performed by the same Twelfth Main Directorate officers which accompany the warheads. Essentially, the Russian "manual mode" command authority system seems to allow for a substantial degree of flexibility in the choice of targets and timing as well making unauthorized use exceedingly difficult. While it is impossible for outsiders to have an opinion as to possible discrepancies between "rules and reality," there are no indications of any lack of discipline or responsibility within the military units involved, at least none that have surfaced so far.

While not ruled out, we can find no direct evidence to suggest that Russia TNW systems have ever been fitted with any PAL-type devices. Our concern, therefore, lies in the small and infrequent window of opportunity during the deployment of a live warhead. One official analysis during the Soviet period describes security of the warheads during this window this way:

> *"Nuclear warheads cannot be released initially without authority from the highest political level. Once they are within the front, the security for the warheads is probably the responsibility of the preparation unit until they are turned over to the launch units. No information on mechanical or physical means used to guarantee the proper use of the warheads in the field is available."*[81]

Very little additional information has become available under the Russian system. However, since the triggers are separated from the warheads in storage, and since the military units would be on higher alert during times of crisis, it is unlikely that a fully functional tactical warhead could be stolen or diverted. However, if such a warhead were to be obtained by a technically savvy foreign state, it cannot be entirely ruled out that it might be caused to detonate. At a minimum, the fissile material could always be extracted for subsequent, possibly devastating, use.

In general, we believe that Russia is concerned about the command and control of its tactical nuclear forces and maintains strict command and control over those assets. We believe this to be particularly true during peacetime. Although C2 during times of high international tension may be more concerning, such a scenario has not been tested empirically. We are inclined, therefore, to believe that Russia is *more* concerned about such a scenario and has solved the problems associated with TNW C2. As noted at the outset of this section, upgrades to Russia's TNW command and control systems may well be underway.

II-4.0 Technical Aspects of Russia's Tactical Nuclear Weapons

The safety of Russia's tactical warheads, Russia's warhead and delivery system manufacturing capabilities, and the personnel who manage and handle the nuclear warheads constitutes an important but little understood element of the Russian TNW complex. These

[81] U.S. Defense Intelligence Agency, "Guide to Nuclear Weapons Available to the Soviet Front Commanders," Document #ST CS 02-18-73, p. 47, formerly classified *secret*, released in 2004 under the Freedom of Information Act.

seeming disparate issues are not only linked to each other; they are also linked to the broader conditions of the Russian military and the domestic economy.

While the issues of command and control, security, and force deployments may be of greatest concern to the international community, it is likely that the issues discussed in the following sub-sections are of paramount interest to the Russian political and military leadership. If Russia expects itself to rely on its TNWs to ensure national security, safety, manufacturing, and personnel will be the limiting factors.

II-4.1 Safety of Tactical Nuclear Warheads

In terms of safety, the possibility of causing a warhead to detonate without authorization is the most concerning to the international community. If an organized crime group, terrorist or insurgent organization, or dedicated insiders were to acquire a weapon through theft or diversion, they would obviously be able to access to weapons-grade fissile material and obtain some warhead design information. But would they be able to cause the warhead to detonate? These and related issues are discussed in the following subsections.

II-4.1.1 The Possibility of Causing an Unauthorized Detonation?

To use a NW unauthorized, one first has to acquire such a weapon. Issues related to the security of Russian warheads are discussed in section II-5.0. In addition, a number of publications have been released addressing possible illegal ways to obtain Russian NW. For extensive treatments of the security subject, we refer to recent work by M. Dunn and A. Wier[82] and M. Bremer Maerli.[83]

Let us assume that a nuclear weapon has been illegally obtained one way or another. First, a necessary – though certainly not sufficient – condition to achieve a nuclear explosion with the acquired weapon, is to have access to an expert with sufficient knowledge about the particular type of weapon acquired. This would have to be a technically trained person, well acquainted with the physical, mechanical and electronic specifics of the warhead. Some acquaintance of the operational procedures involved in exploding it is yet another necessary requirement.

Second, as elaborated in some detail in section II-3.1.4 of this report, these weapons invariably have locks that must be unlocked, in principle presenting a formidable barrier against unauthorized use. The question how easy or difficult it is to break or circumvent these locks without access to the codes necessary to unlock a particular weapon is difficult to assess. As discussed in more detail in section II-3.2.3 of this report, we note that there is a common belief in the international community that some of the older Russian TNW lack sufficiently sophisticated locks to prevent them from being used in an unauthorized way. Notes one expert:

[82] Matthew Bunn and Anthony Wier, "Securing the Bomb – An Agenda for Action," John F. Kennedy School of Government, Harvard University, May 2004.
[83] Morten Bremer Maerli, "Crude Nukes on the Loose? Preventing Nuclear Terrorism by Means of Optimum Nuclear Husbandry, Transparency, and Non-Intrusive Fissile Material Verification," Faculty of Mathematics and Natural Sciences, University of Oslo, 2004.

"Due to the lack of technical safeguards, especially on air-delivered weapons (cruise missiles and gravity bombs), individual attempts to acquire these weapons even during times of peace are possible. Moreover, the lack of adequate locking mechanisms on these weapons would then make them deliverable, with a full nuclear yield, even without launch authorization."[84]

Third, there is a problem of aging of NW, discussed more in detail in section II-4.1.3. It is generally believed that Russian NW have a shelf lifetime of approximately eight to twelve years[85] before a major remanufacturing is required, something that is generally performed by the establishments where these weapons were manufactured. For some non-strategic NW, such as the alleged "suitcase weapons" mentioned by Lebedev and others, the service time interval seemed to be as short as six months according to a recent study.[86] For additional information on refurbishment of aged warheads, we refer to section II-4.2 of this report.

Fourth, and perhaps the most significant step Russia has taken, initiated during the Soviet period, is to separate a warhead's triggering fuse from the warhead itself during storage. One retired senior military officer stated recently:

"As far as storage facilities are concerned, the protection levels [for TNWs] are the same as it is for strategic nuclear weapons. The security systems, the control systems are all the same. Moreover, I will tell you a small secret. Marshall Sergeyev, when he was Minister of Defense, instituted certain technical measures for these small tactical nuclear weapons. These measures were implemented. The idea is that the hardware is kept separate from the actual nuclear weapon – they are separated in distance from each other."[87]

This was clarified to mean that the warheads and mechanical fuses are kept in separate storages.[88] However, it is not clear whether this practice covers all TNW warheads. One report states that this practice is not used by the Navy (or strategic warheads, incidentally):

"The problem of preserving safety of nuclear weapons at the launching sites is related only to strategic nuclear weapons (ICMBs and SLBMs) and to naval tactical nuclear weapons. The reason is that according to the procedures adopted in the former Soviet Union the nuclear devices for (non-naval) tactical weapons were kept separately from their delivery means (aircraft of the tactical aviation, short range missiles and nuclear capable artillery) ... It is worth noticing that the only exception from this pattern ... have been the tactical nuclear warheads of the Navy. Combat ships while being on patrol or

[84] Lambert, Stephen P. and David A. Miller, "Russia's Crumbling Tactical Nuclear Weapons Complex: An Opportunity for Arms Control," INSS Occasional Paper 12, Regional Series, USAF Institute for National Security Studies, U.S. Air Force Academy, Colorado, April 1997.
[85] Bruce Blair, CDI, Washington, DC, private communication.
[86] Nikolai Sokov, CNS, Monterey, CA, private communication.
[87] General Victor Yesin, Department Head of the National Security Council of the Russian Federation, Presentation and Roundtable Discussion on "U.S.-Russian Strategic Cooperation," hosted by the Program on Transatlantic Relations at The Atlantic Council of the United States, Washington, DC, 23 January 2002.
[88] This practice appears to be on-going. Unsolicited comments to this effect were made to co-author Charles Thornton during personal conversations in Moscow with former Duma Defense Committee Deputy Alexei Arbatov on 30 March 2004 and with retired General (Retired) Pavel Semenovich Zolotarev on 30 March 2004.

in combat-ready condition usually used to have their nuclear weapons on board."[89]

This practice appears to have been solved with the PNIs, since all naval tactical nuclear warheads were withdrawn from ships and placed in direct support storage facilities by late 1992. Still, some non-Russian analysts believe that the naval vessels remain nuclear-certified and therefore believe that the crews continue to train with dummy warheads in order to maintain their proficiencies.

Of course, a stolen or diverted TNW would provide the perpetrator with fissile material that might be removed and possibly used in some type of crude device. How difficult – or easy – this could be achieved is beyond our knowledge. However, old weapons-grade plutonium seems to be more difficult to use for this purpose than newly (re)processed plutonium, due to the ageing basically caused by radioactive processes in this material.

II-4.1.2 One-Point Safety

One-point safety refers to the design of some NW of implosion type. Such weapons can be made for which an ignition at a single point of the conventional high-explosives surrounding the nuclear pit produces a non-symmetric compression of the pit resulting in no or negligible nuclear yield. One way to achieve one-point-safety is by boosting. O.R. Coté, Jr, describing the early one-point-safety difficulties experienced by U.S. NW scientists, infers that:

"Concerns about accidental detonation were a major issue for weapon designers early in the Cold War… Prior to the widespread adoption of tritium boosting, single-stage implosion weapons or primaries of a multi-stage weapon were designed with two-piece cores, one piece of which was stored separately and inserted just prior to use. In the event of an accident causing detonation of the high-explosive assembly mechanism, core detonation would be impossible due to the missing piece of the pit. With boosting, sealed pit weapons were developed with less fissile material in the core. These weapons depended on tritium-deuterium gas injection to produce an appreciable yield even if the assembly mechanism worked perfectly. In an accident, when the high explosive would detonate unevenly, and without gas boosting, such a device would produce no appreciable nuclear yield."[90]

Whether all Russian TNWs are one-point safe or not, remains an unanswered question. The fact that these weapons, unlike those in the U.S., are transported by trains, trucks, etc. but not by aircraft, could indicate a lack of guaranteed one-point safety. On the other hand, it could also be attributed to extensive general safety precautions regarding the transport of Russian NW.

[89] Sergei Rogov and Alexander Konovalov, Editors, *The Soviet Nuclear Legacy Inside and Outside Russia: Problems of Non-Proliferation, Safety and Security*, Institute of the USA and Canada, Moscow, 1993.
[90] G. T. Allison, O. R. Coté, Jr, R. A. Falkenrath, and S.E. Miller, *Avoiding Nuclear Anarchy*, The MIT Press, Cambridge, MA, 1996, p.211.

Reports suggest that Russia formal audits the condition of each warhead every six months.[91] Each time a warhead is refurbished, the designers at the manufacturing facilities take the opportunity to upgrade individual components. It appears, though, that even through this periodic modernization, Russia never achieved the one-point safety standard, especially in its tactical warheads. As one group of Russian experts noted:

> *"As the modern generation of the nuclear weapons in the Soviet Union was created, the requirement was put forward to exclude (to the maximum degree) the possibility of a nuclear explosion even of limited yield as the result of accidents or mistakes of personnel. Nevertheless, this requirement leaves space for the possibility of an explosion that can not be excluded totally ... A great number of old 1950-1960s designs with unsophisticated systems of detonation (that can be regarded from the point of view of today's technological level as obsolete in their design) were kept and still remain in service. Sometimes the weapons designers demanded the withdrawal of some types of the weapons from service for reasons of safety, but their recommendations were not implemented."*[92]

A senior officer of the Twelfth Main Directorate, in charge of the safety, field maintenance, and security of all Russian nuclear warheads, testified before the State Duma that the particular status of a warhead may not indicate its relative state of safety:

> *"In speaking about which poses a greater threat – the nuclear munitions in storage facilities or those which are in combat duty, the situation in question must be considered. One cannot unambiguously say where they are more dangerous. One charge can be transported, but then there is still the same situation in terms of coming under fire from bullets or a grenade thrower, or the charge falling during re-loading – all of these factors constitute a considerable danger.* ***Our explosives do not match their American counterparts in terms of fire-resistance and detonation, so if dropped or exposed to fire, they may explode****."* [emphasis added][93]

Thus, there is substantial anecdotal evidence to suggest that Russia's tactical nuclear warheads are not designed with one-point safety features, and there is no direct evidence to suggest otherwise. Russia has taken steps to mitigate this design shortcoming, especially in times of relative peace and stability. During times of increased tensions, however, when the triggering fuses may be installed in the warheads and the warheads deployed with the military units, the available evidence suggests an increased risk of accidental or unauthorized detonation.

II-4.1.3 Ageing of Tactical Nuclear Warheads

[91] See, for example, Sergei Rogov and Alexander Konovalov, Editors, *The Soviet Nuclear Legacy Inside and Outside Russia: Problems of Non-Proliferation, Safety and Security*, Institute of the USA and Canada, Moscow, 1993.

[92] Sergei Rogov and Alexander Konovalov, Editors, *The Soviet Nuclear Legacy Inside and Outside Russia: Problems of Non-Proliferation, Safety and Security*, Institute of the USA and Canada, Moscow, 1993.

[93] Comments by General Igor Valynkin, First Deputy Head of the Twelfth Main Directorate before the Duma Committee on Security, "Stenographic Record of the Parliamentary Hearings on the Topic: Issues Concerning the Security of Hazardous Nuclear Facilities," *Yaderny Kontrol Digest*, No. 5, Fall 1997. The hearings were held on 25 November 1996.

Just as concerning as the lack of one-point safety is the apparent fact that Russia's tactical warheads may be far beyond their designed service lives. This is reportedly the case for Russia's strategic weapons, and there is no evidence to suggest different conditions for the tactical warheads. It is unclear whether strategic or tactical warheads are given priority in the refurbishment queues at the Russian Federal Atomic Energy Agency, or Rosatom (formerly MinAtom), plants. In any case, there are no reports of new warhead design introductions in the last decade, and the pace of refurbishment is not known. Therefore, the consequences of aging must be considered.

There are a number of potential aging mechanisms at work inside a nuclear warhead. First, to the extent that the explosion mechanisms rely on the presence of tritium, this material has to be replaced from time to time, since it has a half-life of only about 12.3 years.

Second, all components inside a warhead are exposed to the heat generated from the radioactive processes inside the fissile material as well as to the ionising radiation from this material, which negatively effect some aging processes.

Third, the conventional high-explosives surrounding the pit, like all chemical explosives, are in a high-energy, quasi-stable state above its energetic ground state, intrinsically unstable and hence susceptible to aging. This aging is further accelerated by the heat and radiation emitted by the fissile material in the core.

Fourth, and foremost, fissile material in general and plutonium in particular age from the inside out as well as from the outside in. As noticed by S.S. Hecker (former director of Los Alamos National Laboratory) and J.C. Martz (program manager for Enhanced Surveillance and Weapon Materials in the Nuclear Weapons Stockpile Systems program office at Los Alamos National Laboratory):

> *"Like other reactive materials, plutonium ages with time. In moist air, it 'rusts' much more profusely than iron, and when exposed to other atmospheric environments, it will react to form several surface-corrosion products. In other words, plutonium ages from the outside in. What makes plutonium really special, however, is that it also ages from the inside out. As a result of its radioactive nature, it relentlessly undergoes self-irradiation damage throughout its volume. Consequently, nature's most unusual element becomes even more complex as it ages."*

As a result:

> *"... every plutonium atom [is] being displaced, on the average, once every 10 years."*

In addition, Hecker and Martzmake note that:

> *"The combination of irradiation-induced lattice damage and presence of helium atoms [created from α-particles emitted by Pu-239 and other Pu-isotopes] can cause void growth and bulk swelling without the presence of*

helium bubbles… The swelling rate will be approximately 1-2 percent per 10-year lifetime for plutonium 239." [94]

The principal mechanism for the heating of plutonium is the transformation of the kinetic energy of the emitted α-particles from Pu -238, Pu-239, and Pu-240 to thermal energy.

Finally, plutonium-241 decays by β-emission into americium-241, which in turn decays to neptunium-237 by α-decay. Thus, the ever-increasing amount of americium requires the weapons-grade plutonium to be "cleaned out" periodically.

Highly enriched uranium is a far more benign material than plutonium – both from a chemical and irradiation-related perspective. Hence, aging problems for warheads based entirely on HEU are considerably less than for plutonium-based warheads.

The three first mentioned ageing mechanisms of warheads could probably be taken care of at military bases and at storage sites. However, most likely this is not the case for the fourth mechanism – the aging of the plutonium components. Hence, we believe this to be the basic reason for bringing Russian TNWs back to their facilities of manufacture for refurbishment at regular intervals. While the general properties of the aging plutonium are well known, no information exists on how this aging in turn affects the safety and reliability of Russian TNW warheads.

II-4.2 Manufacturing, Refurbishment, and Modernization Capabilities

Russia's increasing reliance on its nuclear forces to ensure its national security has been discussed extensively in this series of reports as well as in many others. The modernization of Russia's strategic nuclear systems has also been well publicized. Strategic modernization in Russia primarily has been in the form of the *Topol-M* (SS-27) ICBM. Russia has fielded 40 of the silo-based *Topol-M* systems since 1997, each carrying a single warhead, at the Tatishchevo SRF base.

In accordance with the START-II requirement to eliminate missile systems carrying multiple, independently targeted re-entry vehicles, Russia had developed the *Topol-M* to replace its ageing fleet of SS-18s, which carry ten warheads each. Since the U.S. withdrawal from the Anti-Ballistic Missile Treaty and the Russian withdrawal from START-II, however, Russia has reconsidered its plans to dismantle the SS-18s. It has also accelerated development of a road-mobile version of the *Topol-M*, which it may begin deploying in 2006.

Russia has also stepped up development of other strategic systems. For example, the *Bulava* (SS-N-30) SLBM began test flights in 2004. Its characteristics are said to mimic the *Topol-M*. In November 2004, President Putin caused a stir in both the domestic Russian and international communities when he publicly claimed that Russia was developing a new and unique weapon that could defeat any ballistic missile defenses. He did not elaborate, and considerable speculation followed. Some experts suggested Putin was announcing a previously unknown system, while others believed he was talking about either the *Bulava* strategic system or the *Iskander* tactical system.

[94] Siegfrid S. Hecker and Joseph C. Martz, "Ageing of Plutonium and Its Alloys," Los Alamos Science Number 26, 2000.

In any case, the preceding discussion is intended to point out the historical perspective. As we reported in Part I of this report, a debate took place within Russian military and political circles in the late 1990s and early 2000s. The debate centered on the choice between modernizing and enhancing the strategic versus the conventional forces.

Minister of Defense Igor Rodionov had suggested that NATO expansion might force Russia to increase tactical nuclear forces along its western borders. He was later replaced by the former chief of the Strategic Rocket Forces, Marshal Igor Sergeyev. Whereas Rodionov had concentrated on conventional force issues, Sergeyev brought nuclear weapons back to prominence. Sergeyev subsequently conflicted with Chief of the General Staff, General Anatoliy Kvashnin, who argued for a reduction in Russia's reliance on nuclear deterrence in favor of investments in conventional forces. Ultimately, a kind of bureaucratic compromise was reached that added funding to the defense budget for the conventional forces, but not before Sergeyev had protected his strategic force developments.

As we noted in the introduction to this report, the Russian Security Council met in 1999 to discuss the revitalization and modernization Russia's tactical nuclear forces. The participants devoted much of their time to the problem of extending the timetable for the storage and operation of tactical nuclear weapons. President Yeltsin called on the Council to assess the industrial cycle of the nuclear arms complex and the research, testing, production, and operationalization of new tactical forces.

It appears that this debate continues to remain unsolved. According to one Russian analyst, "The Kremlin administration, government and defense ministry cannot agree on top military planning priorities."[95] Russia has continued to increase its defense budget on an annual basis, but there is clearly limited funding available to modernize its strategic nuclear forces, its tactical nuclear forces, and its conventional forces. Given the dual-use nature of the tactical nuclear delivery systems, an emphasis on conventional force modernization would benefit the tactical nuclear forces. At least publicly, however, President Putin appears to be spending considerable time and energy on the strategic systems.

II-4.2.1 Tactical Nuclear Warhead Manufacturing and Refurbishment

Due to the lack of evidence, it is nearly impossible to disaggregate Russia's tactical nuclear warhead manufacturing capability from its overall capabilities in that area. Indeed, official information regarding Russia's general nuclear warhead manufacturing, disassembly, and refurbishment capabilities is not openly available. Therefore, the evidence utilized in this section is largely anecdotal and must be considered within the context of Russia's overall nuclear weapons stockpile and Rosatom's overall capabilities, and specific assessments concerning the tactical force must be intuited from what is understood about Russia's warhead designs.

Currently, Rosatom manages two serial production complexes:

- Electrokhimpribor at Lesnoy (Sverdlovsk-45), and

[95] Viktor Litovkin, "Modernization of Russian Army Does Not Threaten the West," Russian Information Agency Novosti, Moscow, 18 November 2004.

- Device-Building Plant at Trekhgorny (Zlatoust-36)

Until 2003, Rosatom managed two additional serial production complexes at:

- Electromechanical Plant Avangard at Sarov (Arzamas-16), and
- Production Association Start at Zarechny (Penza-19)..

It is not clear what has become of the two facilities that have discontinued assembly/disassembly operations. When all for plants were functioning, each one specialized in particular types of warheads and warhead components, and warheads were returned to their plants of origin for refurbishment or disassembly. For example, Bukharin speculates that the Sverdlovsk-45 complex specializes in warheads certain tactical weapons systems.[96]

Russian warheads are designed differently from their American counterparts. Whereas the U.S. has not manufactured new nuclear warheads for over a decade, until 2003 Russia's production lines had remained continually operational. This was explained by several factors. First, as explained above, Russia continues to modernize its nuclear delivery systems, and new warheads are required for those systems. Second, and more significantly, the design of Russia's warheads requires them to be maintained more frequently and completely rebuilt approximately every decade.

Therefore, Russia had maintained a large capacity to manufacture and refurbish nuclear warheads. Russia's warhead production facilities perform the full range of services: that is, during any given period they may be building new warheads, performing maintenance on the existing stockpile, rebuilding and refurbishing warheads, or dismantling warheads. Naturally, these activities may be re-prioritized periodically, factoring in the state defense order, requests by the Twelfth Main Directorate to remove aging warheads from the stockpile, and the general international security environment.

It is therefore necessary to estimate the total throughput of the warhead production complex. Oleg Bukharin analyzes Russia's capabilities as follows:

- Russia has a total warhead manufacturing capacity of 7,000 per year (note: this should be considered a theoretical upper limit).
- However, Russia is only able to produce 2,000 plutonium pits per year.
- Therefore, Russia may only be able to produce 2,000 new warheads annually.[97]

These estimates reflect a surge capacity, and Russia's plants are assumed to be functioning at a much lower levels. Moreover, since the end of the Cold War, Russia has drastically reduced the number of personnel working in the production facilities[98] and has reduced the

[96] Oleg Bukharin, "Downsizing Russia's Nuclear Warhead Production Infrastructure," *The Nonproliferation Review*, Volume VIII, Number 1, Spring 2001.
[97] Oleg Bukharin, "A Breakdown of Breakout: U.S. and Russian Warhead Production Capabilities," *Arms Control Today*, Volume 32, Number 8, October 2002.
[98] Ministry of Foreign Affairs of the Russian Federation, "Statement of the Delegation of the Russian Federation at the First Session of the Preparatory Committee for the 2005 NPT Review Conference under Article VI of the Treaty (New York, 11 April 2002)," Information and Press Department, Daily News Bulletin, 24 April 2002.

number of operating plants from four to two – and plans to discontinue the manufacture of nuclear weapons components at one of the two remaining facilities by 2005. [99]

The reconfiguration of Russia's military requirements and international commitments has caused the warhead production complex to realign its capabilities. Research and development, along with manufacturing and refurbishment requirements, are forcing many adjustments:

> *"The end of nuclear testing in 1990 and Russia's ratification of the CTBT in 2000 have changed the nature of warhead R&D activities. The development of more advanced warhead designs has lost priority. Activities are largely limited to maintaining nuclear warhead design skills and preventing surprise breakthroughs in nuclear weapons technology by foreign countries. As of March 2000, for example, no work on new warhead designs was taking place at Chelyabinsk-70. Stockpile reductions have presumably allowed Russia to keep newer warheads thereby temporarily scaling down warhead remanufacturing activities. The priority of stockpile surveillance and warhead life extension has correspondingly increased."*[100]

The following table outlines *notional* warhead manufacturing and remanufacturing requirements to sustain the current stockpile. The numbers are hypothetical for several reasons. First, although the deployed strategic warhead numbers are known due to START reporting requirements, the number of warheads in storage and the number of deployed tactical warheads is not known. Second, the life spans of the warheads are commonly used estimates, but the actual life spans are not known. Moreover, Russia has been working toward life span extensions. Third, Russia may not be sending its warheads to be remanufactured in a timely manner; many reports suggest that large portions of the stockpile are well beyond their life cycle guarantees. Finally, the number of new strategic delivery systems that come on line annually is known due to START reporting requirements, but the number of new strategic and tactical warheads manufactured is not known. Russia may, for example, be keeping certainly production lines operational in order to maintain their core technical competencies.

	Total Strategic Warheads*	**Total Tactical Warheads**	**New Strategic Warheads**	**New Tactical Warheads**
Total Number	10,000	8,000	10	10
Annual Throughput Rate	6-10%	8-12%	100%	100%
Annual Throughput Requirement	600-1,000	640-960	10-20	10-20
Total Warhead Throughput Requirements		Low Estimate: 1,250 High Estimate: 2,000		

**Deployed and stockpiled.*

[99] Vladimir Rybachenkov, "Nuclear Strategy of Russia," Ministry of Foreign Affairs of the Russian Federation, *Lecture at the NATO School*, Oberammergau, 01 March 2001.
[100] Oleg Bukharin, "Downsizing Russia's Nuclear Warhead Production Infrastructure," *The Nonproliferation Review*, Volume VIII, Number 1, Spring 2001.

This table does not depict annual warhead dismantlement rates, but merely the throughput required to sustain and modernize the existing stockpile. Any additional warheads undergoing disassembly would constitute additional throughput requirements. In any case, it appears that Russia is well within its capability to meet both its stockpile maintenance and dismantlement requirements. Indeed, this is the judgment of most expert analyses.

II-4.2.2 Tactical Warhead Testing and Modernization

Full-scale nuclear warhead testing was more or less a standard practice throughout most of the Cold War years for the NW states recognized by the Nuclear Non-Proliferation Treaty (NPT).

Following the Partial Test Ban Treaty (PTBT) of 1963, the Soviet Union and the U.S. brought atmospheric testings to an end, limiting full-scale testing to underground explosions. After signing – and, in the case of Soviet Union and subsequently Russia, also ratifying – the Comprehensive Test Ban Treaty (CTBT), both states have complied with this treaty, which prohibits testings of NWs that result in prompt nuclear criticality of an explosively assembled device. The last full-scale test of Russia – or more precisely the Soviet Union – took place underground in October 1990, and the last corresponding U.S. test was carried out in September 1992.

The other NW states parties to the NPT (Nuclear Non-Proliferation Treaty), which have signed and ratified the CTBT, are France and the U.K. As is the case with the U.S., the People's Republic of China has signed but not ratified it. Both states have, however, declared a moratorium in accordance with the CTBT for the time being.

Development and design of new types of NW have traditionally required full-scale verification tests before the warheads have entered the production stage. (The only known exceptions are simple gun devices based on HEU.) The majority of test explosions have, in fact, been carried out to guarantee that yield and other properties impossible to certify without full release of nuclear energy, meet specifications.

Some tests in the past were designed to assess the effects of nuclear explosions on different types of targets at various distances from ground zero, various heights of bursts, etc. (NW Effects Tests), and a few tests each year were made on randomly selected warheads deployed in the arsenal in order to verify that no malfunction had been introduced due to aging etc.

While some aspects related to effects of nuclear air or underwater explosions on different targets cannot be ascertained by underground explosions, most other objectives discussed above can. In particular, underground testing is fully sufficient to verify that the anticipated explosive yield of a new nuclear warhead design has been achieved. This fact is likely to have facilitated the agreement on the PTBT during the Cold War years between the U.S. and the Soviet Union.

The closest approximation to the initial phase of a nuclear weapon explosion (i.e., the phase when the fissile material is explosively compressed to and beyond criticality) is hydrodynamic testing. These tests are performed on material that will not attain critical mass by compression, yet display as closely as possible the same behaviour under compression as the fissile material inside some specific warhead. Hydrodynamic testing and “simulated

testing" (simulation of nuclear explosions with the aid of sophisticated three-dimensional mathematical models of a particular warhead design, performed by a series of numerical computations on supercomputers) are, of course, allowed under the CTBT.

Little is known to what extent Russia is in need to resume full scale testing and to what extent hydrodynamic testing, simulated testing and other allowed test methods can now be substituted with sufficient degree of confidence. We surmise that adequate performance evaluations of deployed warheads could perhaps be made – or soon will be made – without any release of nuclear energy but that it will be more difficult to develop entirely new types of sophisticated NWs without tests involving a release of nuclear energy. For Russia to resume full-scale testing will either require a withdrawal from the CTBT – a six-month process after notification – or result in a violation of the treaty.

Nonetheless, Russia presumably takes every opportunity to upgrade at least the components of its tactical nuclear warheads, if not their design. As assessed by Russian experts:

> *"During the whole lifetime of nuclear warheads, beginning with final assembly and ending with the total dismantlement of the warheads, the designers have supervision over their products. Over the life-time warheads are also being modernized. During the maintenance periods, different elements of the warheads become subject for modernization which – in addition to other purposes – are aimed at increasing reliability and safety during for [sic] the period in which they are deployed. Over the past years such activities were conducted in course of practically each review of the condition of the warheads which takes place every 6 months."*[101]

We finally note that the testing ground at Novya Zemlya is being used continually for sub-critical NW testing (testing that can involve fissile material without attaining critical mass at any stage of the test phases) and that this ground would most likely be used again if Russia were to resume full-scale testing. Nonetheless, it appears that a dedicated tactical nuclear warhead modernization program has not existed in Russia since the Soviet period, and the capability for such a program remains limited.

II-4.2.3 Tactical Nuclear Delivery Systems

According to the U.S. intelligence community, "Russia has the most technologically evolved and best-equipped, maintained, and trained theater ballistic missile force in the world today. The SS-21 and SS-26 SRBMs [short-range ballistic missiles] provide Russian general-purpose ground forces with a rapid, precision-guided, theater deep-strike capability."[102] Although delivery systems have become a principle bottleneck for the deployment of modern strategic warheads, this may not be the case for tactical systems. Given the dual-use nature of the tactical delivery systems, their development, deployment, and maintenance is more susceptible to the general state of the Russian military.

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[101] Sergei Rogov and Alexander Konovalov, Editors, *The Soviet Nuclear Legacy Inside and Outside Russia: Problems of Non-Proliferation, Safety and Security*, Institute of the USA and Canada, Moscow, 1993.
[102] United States National Intelligence Council, *Foreign Missile Developments and the Ballistic Missile Threat Through 2015*, Unclassified Summary of a National Intelligence Estimate, December 2001.

To begin with a comparison, relatively high priority has been placed on the development of modern strategic delivery systems. Despite the direct attention of the senior Russian political and military leadership, the newest strategic delivery systems have not fared well recently. For example, in February 2004 President Putin witnessed the failure of two Navy ballistic missile launches during the Bezonpasnost [Security]-2004 exercises in the Arctic (although more successful tests were performed subsequently).

Production of new systems has also been stymied. For example, the new *Bulava* SLBM was originally scheduled to enter the fleet in 2000. However, a successful test launch occurred only in October 2004 and it may not be ready for deployment until 2008.[103] The designer and manufacturer of the *Bulava* and *Topol-M* recently claimed that the production lines have become so slow as to threaten the defense industry's ability to continue production. Moscow has ordered only six *Topol-Ms* annually, which is insufficient to sustain production. Moreover, payments to the industries often lags, causing intermittent halts to the production lines – ultimately making the missiles more expensive to manufacture.

These two missile systems are produced by the Moscow Scientific Research Institute of Thermal Technology and supported by over 600 enterprises. It is not clear whether or not similar conditions afflict the industries that provide the tactical delivery systems, but undoubtedly there is overlap.

In 1999, President Yeltsin reportedly signed a decree that would operationalize the newly developed *Iskander* short-range missile system with nuclear warheads. The Russian military establishment prioritized a number of features for the design of these new systems:

- precise accuracy of fire;
- control throughout the entire flight path;
- broad range of effective warheads;
- availability of battle management automation and information support systems;
- integration into global satellite navigation systems;
- ability to engage hardened targets;
- increase in the number of engaged targets per unit of time;
- ability to penetrate air and missile defenses; and,
- capability to engage moving targets.

The *Iskander* is the one new tactical missile system currently in serial production in Russia. Early production models were named the *Iskander-E*, the "E" designating it for export. The most recent version is named the *Iskander-M*, the "M" indicating modernized. Although the *Iskander-M* has been considerably modified, it is based on the "E" version.

According to the manufacturer, "The *Iskander-E* high-precision missile system of the Ground Forces is intended for concealed preparation and delivery of effective missile strikes at critical pinpoint and area targets." Several Russian firms have joined to develop this missile system, whose particular features include: high accuracy of fire, a short time of readiness for launch, independence of combat assets, a high degree of pre-launch preparation automation, and sufficiently high effectiveness of warhead deliveries.

[103] Vladimir Vinokurov, "The Yuriy Dolgorukiy is to remain without the *Bulava*," *Russkiy Kuryer*, Moscow, 19 March 2004 [FBIS Document CEP20040319000351].

The *Iskander-E* was developed as a result of joint work of a number of research institutes, design bureaus, and plants under the supervision of the KBM Engineering Design Bureau, which previously developed the *Tochka* (SS-21), *Oka* (SS-23), and *Tochka-U* missile systems.[104] Although less is known openly about the "M" variant, the designers provided the following comparisons:

> *"The principle of operation is a single-stage missile, aeroballistic, but the 'brains' are different and the design variations of many assemblies are also different. The 'M' variant significantly surpasses the export version. Take just the number of missiles – by two times. The flight trajectories are different."*[105]

Various Russian reports have touted the stealthiness of this new system:

> *"The warhead of the* Iskander *missiles may be both conventional (cluster, penetration, or high explosive-fragmentation) and nuclear ... The system is practically impossible to plot. Targets for the missile system may be determined here by satellite in space orbit or from an airplane, and, if necessary, this may be done by a conventional reconnaissance team or even a single reconnaissance officer."*[106]

> *"Its flight trajectory is not ballistic which makes it difficult for the enemy to predict. The missile is guided throughout the flight trajectory. During the initial stage [it is guided] by gas-dynamic fins, then after acceleration, aerodynamically. Right after launch and immediately on approach to the target, the missile maneuvers vigorously, changing the guidance plane that complicates monitoring it from space. A large part of the flight trajectory of the missile, which incorporates 'stealth' technology and has minimal surface dispersion, passes at an altitude of 50 kilometers, reducing the probability of its destruction both from below and from above. The "invisibility" effect is achieved by to a set of design features, in particular, a special covering over the framework, which discards all projecting parts right after launch and by other features."*[107]

Russia placed funding in the 2004 Defense Order to procure the Iskander,[108] but it is currently scheduled to enter serial production in 2005. The manufacturer is skeptical, naturally, that the Defense Ministry will provide sufficient funding for large-scale procurements.[109] In any case, it appears that there are extensive plans to utilize this new system:

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[104] Milparad.ru, No. 34. Available at http://www.milparade.com/1999/34/010.htm.
[105] Oleg Klochkov, "The Secrets of the New *'Iskander'*: There Are No Equivalents in the World to This Precision-Guided Operational-Tactical Complex, Thinks Chief Designer Oleg Mamalyga," Nezavisimoye Voyennoye Obozreniye, Moscow, 5 November 2004 [FBIS Document CEP20041105000367].
[106] Vladislav Kulikov, "Ivanov Is Purchasing a Missile Brigade: the Army Will Be Getting a New Stealth System," Rossiyskaya Gazeta, Moscow, 28 August 2004, p. 4 [FBIS Document CEP20040830000064].
[107] *Krasnaya Zvezda*, "Don't Enrage the *Iskander*," Moscow, 09 December 2004 [FBIS Document CEP20041209000415].
[108] Ivan Safronov, "Mikhail Kasyanov Fulfills Defense Ministry Order. Arms Purchases Will Increase 50 Percent," Kommersant, Moscow, 14 August 2003 [FBIS Document CEP20030814000206].
[109] Ivan Safronov, "Mikhail Kasyanov Fulfills Defense Ministry Order. Arms Purchases Will Increase 50 Percent," Kommersant, Moscow, 14 August 2003 [FBIS Document CEP20030814000206].

> *"In particular, only by equipping the Leningrad Military District's brigades with* Iskander *(for which, in seems likely, there is a special combat section) operational-tactical missiles will it be possible, should the need arise, to deliver a crushing strike against air bases in Tala, Tartu, Pyarnu, Arikyula, Liyelvarde, and Shyaulyai. Deploying this promising system in Kaliningrad Oblast will make it possible to target all Polish ports and naval bases along the Baltic coastline of Poland to Shchetsin inclusively, and when necessary to deliver a strike against the capital of Warsaw."*[110]

In the long run, it may make more sense for Russia to develop, procure, and deploy tactical nuclear missiles as opposed to strategic systems. Strategic offensive arms are more difficult and expensive to produce and require longer lead times. Moreover, strategic systems are covered by international arms control agreements and thus are subject to close inspection and scrutiny. Tactical systems, on the other hand, are dual-capable and not subject to international examination.[111] Finally, Russia is more likely to require deterrence at the regional level than at the intercontinental level for the foreseeable future. None of these developments, of course, would be welcome by the international community.

II-4.3 Russian Tactical Nuclear Force Personnel

The personnel who operate Russia's tactical nuclear forces are regular members of the military services. That is, they are not generally considered to be an elite corps, and nor are they separated units with unique functions and dedicated chains of command. Therefore, they have been subjected to all of the tribulations generally associated with the Russian armed forces since the late 1980s.

Several high-profile incidents were reported in the 1990s that had some association with nuclear weapons. These included disgruntled and even psychotic military personnel at silo-based and road-mobile ICBM bases and aboard naval vessels. As noted by one American military expert, "Taken as a whole, there seems to be substantial opportunity for security breaches, theft, and system compromise in the nuclear weapons complex of the Russian Federation today."[112]

Moreover, the combat readiness of the TNW-associated troops repeatedly has been called into question by the Russians themselves:

> *"Unfortunately, the sharp decline in combat and operational training in the RF Armed Forces has seriously affected issues having to do with the use of tactical nuclear weapons. The quality of the training of specialists and troops at almost all levels has dropped to a critical stage. In some units they are*

[110] Mikhail Khodarenok, "In Response to NATO Expansion: Russia Must Emphasize Tactical Nuclear Weapons," *Voyenno-Promyshlennyy Kuryer*, Moscow, 07 April 2004 [FBIS Document CEP20040408000291].
[111] Except, under certain circumstances, under the Conventional Armed Forces in Europe (CFE) Treaty.
[112] Stephen P.Lambert and David A. Miller, "Russia's Crumbling Tactical Nuclear Weapons Complex: An Opportunity for Arms Control," INSS Occasional Paper 12, Regional Series, USAF Institute for National Security Studies, U.S. Air Force Academy, Colorado, April 1997.

talking about the complete loss of experience in working with combat units."[113]

In November 2004, the Russian Defense Minister Sergey Ivanov reported that 932 servicemen had died in Russia's Armed Forces in 2004. According to Ivanov, the main reason, 24.6 percent, for the deaths is suicide.[114] Corruption and social discontent increased throughout the 1990s and does not appear to have regained a positive trajectory:

"After 2000, world oil prices skyrocketed and Russia was saturated with billions of petrodollars. Since 2000, the defense budget, in terms of U.S. dollars, increased threefold. Government propaganda insists that the condition of our military has drastically improved also. But despite some $15 billion spent since 2000 on procurement, practically no new weapons were acquired and conditions of service also have not improved significantly. Social tension and discontent are growing within the ranks. Most middle-ranking officers believe the high brass to be a band of thieves, who will steal anything they can put their hands on. Inside the closed military professional community it is impossible to hide one's expenses and lifestyle from subordinates and colleagues, especially if someone's spending is tens or hundreds of times in excess of official pay."[115]

Russian military enlistment rates have steadily decline. Defense Minister warned in October 2004 that the military stood on the verge of collapse because people were avoiding the draft and less than 10 percent – down from over 30 percent a decade ago – of those eligible were showing up at enlistment stations.[116] All Russian men are obligated to serve in the armed forces for at least two years after age 18. However, low morale and persistent reports of hazing recruits have caused the youth to try anything possible to avoid service.

In 1997, the Twelfth Main Directorate acknowledged that:

"We can invest as much as we like into elements of physical protection, technical security resources, equipment, etc. But the threat may come from within, from an officer working directly with the nuclear weapons or nuclear munitions, which are totally exposed to him, without even any casing around the nuclear charge ... At the present time, every third young officer is leaving the military. It takes years to train a nuclear specialist, since working with these weapons requires patience and knowledge. This trend of staff deterioration will inevitably lead to major accidents."[117]

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[113] Mikhail Khodarenok, "In Response to NATO Expansion: Russia Must Emphasize Tactical Nuclear Weapons," *Voyenno-Promyshlennyy Kuryer*, Moscow, 07 April 2004 [FBIS Document CEP20040408000291].
[114] RosBusinessConsulting, "Suicide among major reasons for deaths in Russia's Armed Forces," Moscow, November 17, 2004.
[115] Pavel Felgenhauer, "Degradation of the Russian Military: General Anatoli Kvashnin," *Perspective*, Volume XV, No. 1, Institute for the Study of Conflict, Ideology, and Policy, October-November 2004.
[116] Agence France-Presse, "Russia's Armed Forces on Verge of Collapse: Defense Minister," Moscow, 01 October 2004.
[117] Comments by General V. N. Verkhovtsev and General Igor Valynkin, First Deputy Head of the Twelfth Main Directorate before the Duma Committee on Security, "Stenographic Record of the Parliamentary Hearings on the Topic: Issues Concerning the Security of Hazardous Nuclear Facilities," *Yaderny Kontrol Digest*, No. 5, Fall 1997. The hearings were held on 25 November 1996.

Despite these negative trends, those personnel assigned to conduct nuclear operations appear to be receiving an increase in training opportunities. The Zapad-99 military exercises, discussed extensively in Part I of this report, involved at least five military districts, the command and control centers of the Northern, Baltic, and Black Sea Fleets, and the Caspian Flotilla, the Strategic Rocket Forces and Strategic Aviation, troops from the Ministry of Internal Affairs, Federal Border Service, Federal Security Service, Ministry of Emergencies, and Ministry of Railways, plus units from Belarus and observers from Kazakhstan. Approximately 6,000 service members were involved. This exercise involved the use of a battlefield nuclear strike and tested the military's ability to respond to an invasion from the northwest.

Since that event, the Russian military has undertaken a number of other key exercises. President Putin provided the political impetus for increased training in a May 2003 speech:

> *"The reinforcement and modernization of the nuclear deterrent forces will be a serious component of reform in the Armed Forces ... I repeat once again that the country needs a combat-capable army. An army with an intellectual officer corps, with a highly professional junior command corps, and finally, with soldiers who truly want and are prepared to serve their Motherland."*[118]

In March 2003, a Moscow Military District brigade carried out strikes against an "enemy" that was getting ready to deliver a strike with nuclear weapons:

> *"During a tactical exercise at the Kapustin Yar State Range, Col Vladimir Ozherelev's missile brigade successfully carried out a missile strike with two Tochka systems. The three-day training contained 14 exercises (9 types of combat support each), hundreds of kilometers of the steppe's expanses, and the exertion of all the strength of 400 servicemen. The actions of the missile brigade in the front repair-technical base received a rating of 'Good' ... Two Tochka missile complexes [were] on the snow-covered steppe, threateningly frozen in readiness to strike. Ignoring the freezing wind, the combat teams, the training center's specialists, and the umpires 'practice their witchcraft.' Everyone is agitated. They want so much to show '100 percent' that the missile system, which was accepted for service in 1975, is still effective and in reliable hands."*[119]

In August 2003, the Russian military conducted its largest exercises in 15 years. Under the context of conducting naval rescue operations, the exercises involved 70,000 troops and civilian specialists, around 60 war ships, and more than 70 planes and helicopters. While the event did not involve NW strikes, presumably many dual-use systems and dual-trained personnel were involved.

Most recently, with NATO observers on site, the Russian military undertook Avaria [Accident]-2004, which focused on protecting and defending nuclear weapons convoys and responding to terrorist attacks. The exercise, part of the NATO-Russia Council work program, was held at a testing ground near the town of Olenegorsk in the Murmansk region.

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[118] Vladimir Putin, Message of President of the Russian Federation to the Federal Assembly of the Russian Federation, 16 May 2003.
[119] A. Khrolenko, "Precision Missile Strike," *Krasnyy Voin*, Moscow, 22 March 2003, [FBIS Document CEP20030409000383].

It simulated a terrorist attack on a truck or rail convoy with the aim of capturing the transported nuclear weapon. The convoy guards repelled the terrorist attack before arrival of main response force, a team of helicopters and armored vehicles to assist the guards.[120]

Still, these exercises may not be sufficient to build and retain a capable TNW operational force.

> *"Unfortunately, the sharp decline in combat and operational training in the RF Armed Forces has seriously affected issues having to do with the use of tactical nuclear weapons. The quality of the training of specialists and troops at almost all levels has dropped to a critical stage. In some units they are talking about the complete loss of experience in working with combat units ... For this reason, one of the first practical steps in the RF Armed Forces must be to reestablish the 'pre-reform' training of combat crews and the ability of the troops as needed to use the special munitions with existing weapons ... In addition, the use of tactical nuclear weapons will force a reexamination of the existing system for establishing the commands and signals that are now in use in the strategic nuclear forces. The Russian state simply does not have any other method for guaranteeing the inviolability of its borders. The readiness to use tactical nuclear weapons is the only possible and effective military-political resource."*[121]

II-5.0 Security of Russia's Tactical Nuclear Forces

One of the most important issues surrounding Russia's tactical nuclear weapons is the security of the warheads. Analysts of proliferation problems frequently cite the small size and relatively easy transportability of the warheads. Analysts have also suggested that those tactical nuclear warheads stored outside of central depots are less secure and therefore more vulnerable to theft of diversion.

For the purposes of this report, a nuclear warhead storage "site" shall be considered any individually-secured nuclear warhead storage structure. That is, the term "site" will include individual bunkers, vaults, shelters, and temporary locations (railheads). In this context, the terms "site" and "warhead/weapon storage area (WSA)" may be used interchangeably.

A "facility," on the other hand, shall refer to a more comprehensive area. Each "facility" includes at least one "site", and probably multiple "sites." A "facility" also includes support structures, such as guard force buildings, administrative buildings, housing, and social infrastructure. An entire base may or may not be considered part of the "facility," since some "facilities" are located within larger Air Force and Navy bases and are co-located with Ministry of Atomic Energy facilities.

Finally, a "complex" will be used to describe the entire system of sites and facilities owned and operated by each organization. Therefore, this report may refer, for example, to a

[120] NATO Update, "Nuclear weapons accident response exercise held in Murmansk region," 11 August 2004.
[121] Mikhail Khodarenok, "In Response to NATO Expansion: Russia Must Emphasize Tactical Nuclear Weapons," *Voyenno-Promyshlennyy Kuryer*, 07 April 2004 [FBIS Document CEP20040408000291].

Ministry of Defense complex, a Twelfth Main Directorate complex, a Russian Navy complex, or a Russian Artillery and Missile Troops complex.

Although many of the numbers reported below will refer to individual sites, the analysis in this report is constructed around facilities as the prime units of geographic location. As noted in section II-6 below, a reduction in the number and scope of storage facilities – not necessarily a consolidation in the number of individual bunkers – may inherently increase the security of Russia's nuclear warheads.

The following are examples of site and facility types:

- National stockpile sites, owned and operated by the Twelfth Main Directorate.
- National stockpile sites, collocated with Rosatom's (formerly MinAtom) warhead assembly/disassembly facilities, but owned and operated by the Twelfth Main Directorate.
- Service-level "direct support" sites, collocated with Air Force bases, but "controlled" by the Twelfth Main Directorate as of 1998.
- Service-level "direct support" sites, collocated with Navy bases, but "controlled" by the Twelfth Main Directorate as of 1998.
- Service-level "direct support" sites, collocated with SRF bases, but "controlled" by the Twelfth Main Directorate as of 2002.
- Other "direct support" sites, possibly collocated at Artillery and Missile Troops bases.
- Temporary storage sites (ownership unspecified).

II-5.1 The Nature of the Tactical Nuclear Warhead Security Problem

The nature of the security problem for tactical warheads has several dimensions and differs somewhat from strategic warheads. The first issue is one of geographic location. There is no official data and little unofficial evidence of where Russia's stockpiles of tactical warheads are located. Several points are, however, clear:

- The warheads are widely dispersed. Russia is geographically immense, and its stockpile system is scattered throughout the country. This system is designed to support operational requirements, which means that storage facilities must be proximate to their locations of use. Moreover, the Soviets/Russians chose to store their warhead assets in fewer numbers at more locations in order to decrease their vulnerability to pre-emptive strikes or capture. By structuring the storage system this way, the designers inherently sacrificed security, which is more efficiently achieved through consolidation.

- The warheads are stored in an unknown number of sites. According to Russian policy statements, warheads owned by the Ministry of Defense are stored both in national stockpile sites (central depots) controlled by the General Staff and with operational units controlled by the military. It is also probable that warheads are stored for varying lengths of time at assembly/disassembly plants controlled by the Federal Agency for Atomic Energy (formerly the Ministry of Atomic Energy).

- The warheads have traditionally been stored in regions of concern. Russia has closed some of its nuclear warhead storage sites due to political and social unrest. However, as discussed in Part I of this report, Russia has contemplated re-opening, or has actually re-opened, storage sites in regions that are more vulnerable to terrorist, insurgent, or other foreign threats.

A second issue with the nature of the security problem is the status of any given warhead in the system. Depending on a warhead's status, it is relatively more or less secure than its peers. Interestingly, the order of relative security differs somewhat from strategic warheads. Strategic warheads are actually in their most secure state when they are mated to delivery systems and deployed. In such a state, the warheads are continually monitored electronically; are enclosed in highly secure silos, submarines at sea, or bombers in hangars or in the air; and are surrounded by external security systems. Such warheads are the least susceptible to theft or diversion.

Due to the highly mobile and dual-use nature of the tactical delivery systems, the warheads may be relatively less secure when mated and deployed. A relative order of states of security, from most to least, for tactical warheads may be the following:

- Stored in a national stockpile site,
- Stored in a deployed, operational "direct support" level bunker,
- Mated to delivery system and deployed,
- Deployed, operational "direct support" level temporary location (for example, in a mating-/de-mating facility),
- In transit, or
- In temporary storage in transit (for example, at a railhead or rail transfer station).

With respect to this order of relative security, however, it is important to note that warheads are generally considered to be most vulnerable to theft or diversion while in the transportation system. Transportation rates for tactical warheads were high in the late 1980s when the Soviets withdrew their TNWs from Eastern Europe and early 1990s when the Russians withdrew the TNWs from the newly independent states of the former Soviet Union.[122] In recent years, Russian official statements that it is nearing completion of its unilateral Presidential Nuclear Initiatives,[123] or that it will discontinue its TNW reductions, suggest that transportation rates for tactical warheads have declined.

This contemporary background to Russia's tactical warhead security – including the withdrawals in the 1980s and 1990s and the PNIs – constitutes a third issue in the nature of the security problem. The Soviet Union had built a storage system consisting of approximately 500 sites by the mid 1980s. Many of those sites were outside of the Russian Federation. Several trends converged at the end of the Cold War that placed tremendous stress on the storage system:

[122] For a lengthy discussion of this history, see Gunnar O. Arbman and Charles L. Thornton, *Russia's Tactical Nuclear Weapons – Part I: Background and Policy Issues*, Defense Research Agency (Totalförsvarets Forskningsinstitut, FOI), Swedish Ministry of Defense, Report # FOI-R--1057--SE, ISSN 1650-1942, November 2003.
[123] Ibid.

- First, as documented in Part I of this report, thousands of warheads were withdrawn from Eastern Europe to Soviet territory in the 1980s and the storage sites for those warheads were either closed or became unavailable as the Warsaw Pact collapsed.

- Second, additional thousands of warheads – both strategic and tactical – were removed from the former Soviet republics in the 1980s and 1990s and placed on Russian territory. As will be discussed below, the storage sites in Russia were filled beyond capacity by this time.

- Third, for various reasons, Russia began to consolidate the number of storage sites on its own territory. It is not openly known why some of those sites were shut down. Some were closed due to social unrest proximate to the sites, while others were closed to remove the warheads from dangerous neighborhoods such as Chechnya. Many of the operational level sites were shut down as the delivery systems were dismantled in accordance with the START and INF treaties and the military bases were removed.

This confluence of decreasing storage capacity and increasing storage requirements forced the stockpile system into an overflow situation. General Colonel Igor Nikolaievich Valynkin, currently chief of the Twelfth Main Directorate, has argued for years to the Russian Duma and to U.S. officials that his storage facilities are filled beyond capacity. He has noted that the bottleneck is due to a lack of storage space for the fissile material from dismantled warheads. In any case, since the Twelfth Main Directorate is unable to deliver warheads to disassembly plants as quickly as they are entering its system due to arms control and unilateral reduction initiatives, the storage crunch will continue. The following statements, in chronological order, describe the possible storage crunch conditions:

> "There isn't a single storage facility that hasn't been filled to capacity."[124]
> *General Sergei Zelentsov, then chief of the Russian Twelfth Main Directorate, 1992*

> "We were removing warheads from their prepared storage areas to other sites. The weapons were sited at bases built long ago and, furthermore, ones not designed to take additional warheads."[125]
> *Gennady Novikov, Chief of the Sector Special Security Laboratory at Chelyabinsk-70, 1992*

> Russian analysts estimated overloading to be at 135% - 220%.[126]
> *Dr. Sergei Rogov and Dr. Alexander Konovalov, 1993*

> "A matter of substantial concern is the fact that they are overloaded with nuclear munitions with expired service life periods, and even with weapons subject to being disassembled in accordance with international agreements concluded by Russia."[127]

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[124] Quoted in Andrew Higgins, "Deadly secrets for sale," *The Independent*, United Kingdon, 19 April 1992.
[125] Interview with Gennady Novikov, Chief of the Sector Special Security Laboratory at Chelyabinsk-70, by V. Umnov, "Few Bombs Will Survive Till the Year 2000: In the Past Year the Safety of Our Nuclear Weapons Has Declined Sharply," *Komsomolskaya Pravda*, 12 March 1992, (FBIS-SOV-92-051, 16 March 1992, p. 7).
[126] Sergei Rogov and Alexander Konovalov, Editors, *The Soviet Nuclear Legacy Inside and Outside Russia: Problems of Non-Proliferation, Safety and Security*, Institute of the USA and Canada, Moscow, 1993.
[127] Comments by General Igor Valynkin, First Deputy Head of the Twelfth Main Directorate before the Duma Committee on Security, "Stenographic Record of the Parliamentary Hearings on the Topic: Issues Concerning the Security of Hazardous Nuclear Facilities," *Yaderny Kontrol Digest*, No. 5, Fall 1997. The hearings were held on 25 November 1996.

General Lieutenant (currently General Colonel) Igor Valynkin, 1996

"Russia is believed to be dismantling warheads, but Moscow has not divulged specific information on warhead reductions. The economic situation in the country probably has slowed the reduction effort; many retired warheads slated for elimination are awaiting dismantlement ... The logistic system supporting the nuclear weapons stockpile has changed considerably since 1991. With the consolidation of tactical nuclear warheads and the transfer of strategic warheads, the number of storage sites holding warheads has been reduced from over 500 facilities to fewer than 100. This consolidation has improved nuclear warhead security. However, the current resource shortages in Russia have subjected the nuclear security system to new stresses and risks."[128]
U.S. Department of Defense, 1997

"At the same time it is necessary to note that the nuclear weapons available in Russia are under reliable control. Higher effectiveness of this control is made through the adoption of organizational and technical measures. In particular, during the period from 1991 to 2001 the overall stockpiles of the available nuclear weapons has been reduced more than 5 times and the number of nuclear munitions storage sites - 4 times. All non-strategic nuclear munitions have been transferred to the central storage facilities of the Ministry of the Defense. It allowed to concentrate all the financial resources on providing for nuclear safety and secured safeguarding of nuclear munitions storage sites by using modem technical means of protection."[129]
Ministry of Foreign Affairs of the Russian Federation, 2002

One of the measures taken to contend with the storage overflow problem was implemented at the regulatory level by the Russian Ministry of Defense (MOD) Twelfth Main Directorate. The chief of the Twelfth Main Directorate, General Valynkin, reported to U.S. Defense Department officials in 2000 that his department had to reduce the normal footprint for each stored weapon from six square meters to four square meters.[130] He did not elaborate on the technical impact of this decision, nor did he distinguish between tactical and strategic warheads. Nonetheless, Valynkin's disclosure indicates the seriousness of his predicament.

The nature of the security problem is further compounded by Russia's "traditional" approach, using human-based, manpower-intensive procedures. Through assistance programs from the U.S. government, various departments of the Russian Defense Ministry have started to employ high-technology systems at their storage sites. However, those security enhancement assistance programs are being implemented slowly and may take another decade to complete.

Russia's "traditional" approach does not appear to have changed considerably since the 1960s. The key concepts include remoteness, secrecy, and obfuscation. Storage facilities were typically built far from large population centers. These remote locations kept the facilities

[128] Office of the Secretary of Defense, *Proliferation: Threat and Response*, U.S. Department of Defense, April 1997.
[129] Ministry of Foreign Affairs of the Russian Federation, "Statement of the delegation of the Russian Federation at the First Session of the Preparatory Committee for the 2005 NPT Review Conference under Article VI of the Treaty (New York, 11 April 2002)," Information and Press Department, Daily News Bulletin, 24 April 2002.
[130] Originally reported in Charles Thornton, "The Nunn-Lugar Weapons Protection, Control, and Accounting Program: Securing Russia's Nuclear Warheads," 43rd Annual Meeting of the Institute for Nuclear Materials Management, 26 June 2002, Orlando, Florida.

outside of the public eye. Just as the Russian Ministry of Atomic Energy maintained a complex of secret cities around Russia for the design and manufacture of nuclear warheads, the Russian Ministry of Defense kept the names and locations of the storage facilities a closely held state secret. Access to the regions surrounding the facilities is tightly controlled. And even if the general public does happen to get within sight of a storage facility, the structures themselves are typically obfuscated from view by forests, walls, and fences.

In 1998, the commander of the U.S. Strategic Command, General Eugene Habiger, visited a national stockpile site managed by the Twelfth Main Directorate. He described the site as follows:

> *We went to Saratov, a national nuclear weapons storage site, where I saw not only strategic weapons, but tactical weapons ... And they took me into the side of a mountain, a hill, where we went behind two doors that were each several thousands of ton in weight. And you had to open up one door at a time, these sliding, massive doors, in order to get into the inner sanctum. In the inner sanctum, there were five nuclear weapon storage bays. They took me into one of those bays and we had interesting discussion.*
>
> *... it's a closed cantonment area. There are about 3,500 people who live in this area. About 1,200 or so are military. The rest are dependents and children. It is closed. The commander, a colonel, is the one who gives permission for people to go off the facility. Completely self-contained schools, hospitals."*[131]

The security procedures themselves rely on a decades-old, manpower-intensive approach. First and foremost, Russia heavily relies on human guards. There are few technological security systems, and those that are in place are not integrated. Typically, there is no automated access control system and a lack of an intrusion detection system. The security perimeters around most facilities are obstructed, and the fences themselves are degraded. Minimal supporting infrastructure exists around most facilities, including power, lighting, and guard force training and operating facilities. Moreover, there exists minimal inter- and intra-site communications capabilities.

Perhaps most concerning is the Russian practice of a paper-based warhead inventory control system. Each warhead is assigned to the responsibility of a single officer. Attached to each warhead is a "passport," a set of records that contains the entire history of that individual warhead: production; maintenance records; transfer records; deployment assignments; storage conditions; etc. Warheads are inventoried on paper, and then aggregated through a series of regional commands up to the headquarters level. General Valynkin asserts that his organization can conduct a complete warhead audit in 72 hours.

It is unlikely that MOD could physically count all of its warheads accurately in that 72 hour period, and therefore the audit is likely to be merely a paper exercise. MOD would certainly find it difficult to inventory physically those warheads that are in transit during that period. Russia's warhead transportation system was constructed to supply the vast and dispersed

[131] DoD News Briefing, General Eugene Habiger, Commander of U.S. Strategic Command, The Pentagon, Tuesday, June 16, 1998, 2:15 p.m.

storage and deployment system described above. It was also constructed to take advantage of the existing ground transportation system and to maximize safety.

Unlike in the United States, which utilizes both air and truck transport for long distance nuclear warhead transportation, Russia relies on its extensive railroad network. Whether over short or long distances, warheads are often shrouded with bullet-proof blankets and placed inside large metal containers, which provide ballistic and thermal protection. Many of the so-called "supercontainers" currently in use throughout Russia were provided by the United States, France, and Britain.

Over shorter distances – for example, from a bunker to be mated to a delivery system, or from a bunker to a railhead – warheads are transported in specially designed trucks. Over longer distances, most warhead transport is conducted by train. Guard cars are dispersed along a line of cargo cars, with each cargo car typically carrying between two and four warheads, depending on the size and configuration of the containers.[132]

For certain geographic locations, warheads must be transported over water by ship or submarine. For example, strategic warheads may be delivered by submarine to the Rybachiy naval base on the Kamchatka peninsula in the Far East. The most publicized tactical nuclear warhead transport by ship took place in 2000. Russia reportedly moved nearly 100 warheads for the SS-21 *Scarab* to the Russian exclave of Kaliningrad.[133]

According to both U.S. Government and Russian analyses, nuclear weapons and weapon components are exposed to increased vulnerability during transit. Whenever a tactical nuclear warhead is outside of its storage bunker, the risks of accident and diversion escalate. For rail transport, the Twelfth Main Directorate coordinates with the Ministry of Railways to plan routes and clear the tracks. When the cars are moving, therefore, warheads may be considered relatively secure.

However, Russian warheads are often stored for short periods in areas other than highly secure bunker complexes. During their transit, tactical warheads may be temporarily stored in warship and submarine docking areas, maintenance facilities, delivery system mating/de-mating areas, rail trans-shipment areas and railheads, and weapon transportation vehicles. It is during these periods that the warheads may be at highest risk of attack, theft, or diversion.

II-5.2 Current Status of Russian Tactical Nuclear Warhead Security

The U.S. government has been providing security enhancements since the early 1990s, in the form of transportation security equipment, emergency response systems, physical storage site security enhancements, automated inventory control computers, and personnel reliability programs. The transportation security enhancements, in the form of supercontainers, kevlar blankets, and emergency response modules have been successfully implemented. In fact, the U.S. government has funded the movement of over 100 nuclear warhead transportation trains from deployment sites and central storage depots to dismantlement facilities – many of them undoubtedly carrying tactical warheads.

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[132] For more information, see Igor Sergeev, Editor, *Oruzhie i tekhnologii Rossii: Entsiklopediia XXI vek, Tom 1: Strategicheskie iadernye sily / Russia's Arms and Technologies: The XXI Century Encyclopedia, Volume 1: Strategic Nuclear Forces*, Oruzhie i tekhnologii (OrTekh), Moscow, 2000.

[133] For more details, see Part I of this report.

Although it is the most extensive in the world, the rail transportation system is neither the safest nor the most secure. The dissolution of the Soviet Union subdivided the rail network and split many of its vital warhead transportation lines. Russia has overcome this particular hurdle, but its track infrastructure is long overdue for upgrades and replacements. It was anticipated in the early 1990s that Russia would experience a serious transportation accident involving nuclear weapons once every two to three years.[134] This has not occurred, to our knowledge, but the conditions have not improved.

Transportation security, although enhanced by U.S. assistance, remains a concern. According to one Russian analysis:

> *"Analyzing the conditions of transportation of nuclear munitions, the military also recognized that the weapons could be attacked and fired at with bullets and grenades, or the munitions could fall down because of overloading ... It would be enough to say that the trains carrying nuclear munitions had no communication line between the engine driver and the locomotive brigade."*[135]

U.S. assistance provided train upgrades to solve the latter problem on 100 cargo and 15 guard cars. However, Russia's rolling stock is much larger than that, and it is aging. Moreover, the transportation routes, once highly classified, have become common knowledge:

> *"The most dangerous phase in the [dismantlement process] of nuclear munitions is transport, whether by motor vehicle or by railcar ... Repair of the rolling stock at the repair facilities of the Railroad Ministry is done with delays in connection with the untimely payment of invoices for the repair of special railcars and locomotives.*
>
> *In the past, the situation was different: people did not know the specific rail line along which nuclear weapons were being transported. But now practically everyone in the area around our city knows that nuclear weapons are being transported along these rail lines, essentially without protected corridors."*[136]

Unfortunately, implementation of the U.S.-funded storage site security enhancements has been slow. The U.S. provided perimeter security systems to the Twelfth Main Directorate in 1997 and 2000, but it did not have the funding to install most of the equipment. The U.S. has been willing to fund the installation of the systems, if it has access to the sites in order to inspect the work for which it pays. However, Russia has been reluctant to provide such access. Furthermore, the U.S. and Russia have jointly designed a comprehensive suite of

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[134] Analysis by Sandia National Laboratories.

[135] Vladimir Orlov, Roland Timerbaev, and Anton Khlopkov, *Nuclear Nonproliferation in U.S.-Russian Relations: Challenges and Opportunities*, PIR Library Series, PIR Center, Moscow, 2002, p. 36.

[136] Comments by General Igor Valynkin, First Deputy Head of the Twelfth Main Directorate, and Sarov Afanasiyev, VNIIEF All-Union Scientific Research Institute of Experimental Physics, Arzamas-16, before the Duma Committee on Security, "Stenographic Record of the Parliamentary Hearings on the Topic: Issues Concerning the Security of Hazardous Nuclear Facilities," *Yaderny Kontrol Digest*, No. 5, Fall 1997. The hearings were held on 25 November 1996.

security equipment that could be installed at all storage sites, but none of the comprehensive systems has even been procured.

The security of Russia's warheads appears to vary widely from facility to facility and from region to region.[137] There exist 13-15 national stockpile facilities throughout Russia, and we can assume that all of them contain a mix of strategic and tactical warheads. There is at least one storage site co-located with each START-associated strategic nuclear facility, and an unknown number of bunkers for storing tactical warheads that directly support front-line military units.

According the U.S. National Intelligence Council:

> *"To secure their weapons, the Russians employ a multi-layered approach that includes physical, procedural, and technical measures. The security system was designed in the Soviet era to protect weapons primarily against a threat from outside the country and may not be sufficient to meet today's challenge of a knowledgeable insider collaborating with a criminal or terrorist group."*[138]

In October 2001, the Russian Ministry of Defense revealed to the public that "terrorists" had conducted reconnaissance operations on MOD's nuclear weapon storage sites twice during the previous eight months. General Colonel Igor N. Valynkin, chief of MOD's Twelfth Main Directorate, further admitted that a ground attack on his storage sites might succeed.[139] Concurrently, Osama bin Laden was making public statements that his al Qaida network had obtained nuclear and other weapons of mass destruction. Although most analysts dismissed bin Laden's claims, Russia's vast nuclear warhead storage and transportation system remains an enticing and vulnerable target for any terrorist organization attempting to acquire nuclear capabilities.

II-6.0 Policy Recommendation: Consolidate Russia's Nuclear Weapon Storage Sites

A number of policy options have been put forward to address the perceived threats stemming from Russia's tactical nuclear forces. Several of those recommendations are surveyed below. Given the perceived proliferation concerns, and given the changing balance of Russia's nuclear arsenal that is increasingly weighted towards tactical weapons, it may seem curious that the United States and Russia, or Europe and Russia, have not chosen to limit formally or reduce TNWs beyond the informal 1991/1992 PNIs. Many factors play into these calculations, including the political symbolism NATO members place on the U.S. tactical

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[137] For more information, see Michael Jasinski and Charles Thornton, "The Implementation of U.S. Nonproliferation Assistance Programs in Russia's Regions," in James Clay Moltz, Vladimir A. Orlov, and Adam N. Stulberg, Editors, *Preventing Nuclear Meltdown: Managing Decentralization of Russia's Nuclear Complex*, Ashgate Publishing, Ltd, United Kingdom, 2004.

[138] United States National Intelligence Council, "Annual Report to Congress on the Safety and Security of Russian Nuclear Facilities and Military Forces," February 2002. Available at http://www.cia.gov/nic/pubs/other_products/icarussiansecurity.htm.

[139] Originally reported in Charles Thornton, "The Nunn-Lugar Weapons Protection, Control, and Accounting Program: Securing Russia's Nuclear Warheads," 43rd Annual Meeting of the Institute for Nuclear Materials Management, 26 June 2002, Orlando, Florida.

warheads remaining in Europe and Russia's growing reliance on its TNWs to offset its conventional vulnerabilities.

Nonetheless, the expert community has continued to call for better controls and enhanced transparency concerning Russia's TNWs. Government legislators and executives also periodically express concerns. The U.S. Congress recently passed the Nuclear Security Initiative Act of 2003, which states:

> *(a) SENSE OF CONGRESS.—It is the sense of Congress that the United States should, to the extent the President considers prudent, seek to work with the Russian Federation to develop a comprehensive inventory of Russian tactical nuclear weapons.*
> *(b) REPORT.—Not later than 12 months after the date of the enactment of this Act, the President shall submit to Congress a report, in both classified and unclassified form as necessary, describing the progress that has been made toward creating such an inventory.*[140]

More recently, U.S. Assistant Secretary of State for Arms Control Stephen Rademaker commented in Moscow that Washington is concerned about Russia's fulfillment of the 1991/1992 PNIs. According to a Russian media report, "The European community is concerned about the large quantity of Russian tactical warheads in the region and about the countries, at which those nukes are aimed."[141] The Russian government responded this way:

> *"In the first place, the word 'commitments' in this context is incorrect. The question is one of the unilateral 1991-1992 initiatives, that is a goodwill gesture on the part of Russia ... Russia has practically carried out in full all of the TNW reduction initiatives that had been put forward. All those weapons, unlike the situation with the United States, are located solely within our national territory. They are under reliable control. They are effectively secured. So there are no reasons for the concern Mr. Rademaker voiced."*[142]

The following is a sample of policy options recommended by the arms control community to contend with Russia TNWs:

- A U.S. Congressional Research Service specialist summarized several options. (1) Status Quo: Russian nonstrategic nuclear weapons pose no military threat to the U.S. or its allies and friends. (2) Reduce reliance on nuclear weapons: removing U.S. weapons from NATO would relieve Russia of its deterrence burden. (3) Cooperative Responses: increase transparency; expand threat reduction assistance; and/or negotiate a formal treaty.[143]

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[140] United States Public Law 108–136, "Nuclear Security Initiative Act of 2003," *National Defense Authorization Act for Fiscal Year 2004*, Title XXXVI, Section 3621: Comprehensive Inventory of Russian Tactical Nuclear Weapons, adopted 24 November 2003.
[141] Dmitry Litovkin, "The U.S. administration is seriously concerned with Russia's failure to reduce tactical nuclear arms," Pravda, Moscow, 07 October 2004.
[142] Alexander Yakovenko, Spokesman of Russia's Ministry of Foreign Affairs, Answers a Russian Media Question at Press Conference at RIA Novosti Concerning Russia's Initiatives for Reducing Tactical Nuclear Weapons, Moscow, 07 October 2004.
[143] Amy F. Woolf, "Nonstrategic Nuclear Weapons," Report RL32572, CRS Report for Congress, U.S. Congressional Research Service, 09 September 2004.

- Experts at the Moscow Institute of Physics and Technology assess that formal negotiations are not attractive to any interested state party, and therefore unilateral actions are the only viable option. New unilateral initiatives would be aimed at developing transparency first by exchanging data on numbers and locations and second by permitting site visits to build confidence.[144]

- Two experts from U.S. industry propose that the Western states "buy" the weapons. Such an initiative would build on the Nunn-Lugar Cooperative Threat Reduction Program and the Kilotons for Kilowatts Program. Under their proposal, a Western consortium would negotiate a price-per-kiloton of yield and then would turn the warheads over to the International Atomic Energy Agency for storage and dismantlement at facilities in Russia.[145]

- Two experts from a U.S. nongovernmental organization presented several "practical, incremental steps" for controlling TNWs. (1) Reaffirm the PNIs: a presidential joint statement. (2) Complete PNI implementation and exchange data on the actions taken. (3) Increase transparency: improve predictability and reduce misperceptions. (4) Enhance security: possibly involving international assistance. (5) Reduce alert levels: reduce the operational status of the weapons. (6) Codify the 1991/1992 PNIs: establish a legally binding treaty. (7) Adopt a global ban on selected TNWs: focus on those weapon types of least use to the U.S. and Russia. (8) Agree to further reductions: eliminate the large excesses. (9) Pursue a comprehensive verification approach: this would necessarily cover both strategic and tactical warheads.[146]

While all of these proposals are valid and deserve attention, none has received positive official response from Russia. However, Russia itself has essentially opened the door for assistance directly related to meeting its 1991/1992 unilateral Presidential Nuclear Initiatives. In April 2002 at a Nuclear Nonproliferation Treaty preparatory meeting, Russia stated the following:

> *"Russia has practically implemented all the declared initiatives to reduce NSNW with the exception of elimination of nuclear weapons of the Army ... Russia plans to complete implementation of the initiatives in the sphere of NSNW by 2004 on condition of adequate financing."*[147]

It is not clear what the Russian Foreign Ministry meant by "adequate financing." Certainly, its preference would be for internal, domestic resources. But, the statement was presented at an international forum and was thus intended for international consideration.

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[144] Anatoli Diakov, Eugene Miasnikov and Timur Kadyshev, "Non-Strategic Nuclear Weapons: Problems of Control and Reduction," Publication of the Center for Arms Control, Energy and Environmental Studies, Moscow Institute of Physics and Technology, Dolgoprudny, 2004.

[145] Timothy D. Miller and Jeffrey A. Larsen, "Dealing with Russian Tactical Nuclear Weapons: Cash for Kilotons," *Naval War College Review*, Vol. LVII, No. 2, Spring 2004.

[146] William C. Potter and Nikolai Sokov, "Practical Measures to Reduce the Risks Presented by Non-Strategic Nuclear Weapons," Report No. 8, The Weapons of Mass Destruction Commission (Blix Commission), Stockholm, 2004.

[147] Ministry of Foreign Affairs of the Russian Federation, "Statement of the delegation of the Russian Federation at the First Session of the Preparatory Committee for the 2005 NPT Review Conference under Article VI of the Treaty (New York, 11 April 2002)," Information and Press Department, Daily News Bulletin, 24 April 2002.

The U.S. is already heavily involved in the enhancement of Russian TNW security. Both the U.S. Department of Defense and U.S. Department of Energy are providing security upgrades for a wide range of Russian nuclear warhead storage facilities and the U.S. Defense Department has provided security enhancements for warhead transportation and has even funded the movement of warheads from deployment and storage sites to dismantlement facilities.

However, U.S. Nunn-Lugar assistance has not explicitly covered TNWs, and its scope has been limited. Since Russia's central nuclear warhead storage facilities, managed by the Twelfth Main Directorate, contain all types of weapons, and since trains departing those facilities are likely to have carried all types of weapons, it has always been assumed that Nunn-Lugar assistance has addressed the security of both strategic and tactical warheads.

In a press conference on 3 February 1999 with the Chief of the Defense Ministry's Twelfth Main Directorate, General Colonel Igor Valynkin stated that he was in favor of "joint control" and "monitoring" of tactical nuclear weapons, as long as the measures were reciprocal. However, he believed that the sides would not reach a sufficient stage of transparency until the next millennium.[148]

In fact, the U.S. National Security Council issued guidelines in 2003 that precluded the U.S. from providing security assistance to "operational sites." In this context, operational storage sites provide direct support to the operational military units. According to the U.S. General Accounting Office (now the General Accountability Office), "The guidelines allow the [U.S.] departments to improve security at [Russian] storage sites and rail transfer points that support warhead storage, consolidation, dismantlement, or force reductions, where security assistance it less likely to enhance operational capability. The guidelines do not support assistance to operational sites where mated or unmated warheads may be handled in the course of training or deployment."[149]

In effect, this precludes the U.S. from enhancing the security of tactical nuclear warheads that are co-located with operational military units. Although most of Russia's TNW stockpile should be stored in central depots, we assume that a significant number are outside of this system. Given that a terrorist or other potential proliferator does not care whether a warhead is destined for deployment or dismantlement, our primary recommendation is for the further consolidation of Russia's warheads into fewer, centralized storage facilities.

II-6.1 Background on the Framework for Consolidation

Consolidating Russia's non-deployed nuclear warheads into fewer suitably enhanced storage facilities would be inherently more secure than maintaining a widely dispersed complex. Russia, perhaps with foreign assistance, could provide a higher level of security if it were

[148] "Press conference with Colonel General Igor Valynkin, Chief of the Defense Ministry Main Directorate, on Nuclear Safety," Official Kremlin International News Broadcast, Federal Information Systems Corporation, 03 February 1999.

[149] United States General Accounting Office, "Additional Russian Cooperation Needed to Facilitate U.S. Efforts to Improve Security at Russian Sites," GAO-03-482, Report to the Ranking Minority Member, Subcommittee on Financial Management, the Budget, and International Security, Committee on Governmental Affairs, U.S. Senate, March 2003.

required to address fewer sites. In addition, the warheads would be another level removed from potential operational theaters, further raising the nuclear threshold.

On its own initiative and for various reasons, Russia actually had begun the process of site consolidation prior to the end of the Cold War. However, those site reductions occurred at a time of tremendous change in Russia, including the demise of the Warsaw Pact, the dissolution of the Soviet Union, accelerations in the reductions of strategic and non-strategic warhead delivery systems, and social upheaval. It is probable, therefore, that the resulting warhead storage complex is incommensurate with Russia's warhead storage requirements.

To illustrate this notion, specific examples are provided here. These examples are derived from the bilateral U.S.-Russian Nunn-Lugar Cooperative Threat Reduction Program, under which both sides have been working to enhance the security of Russia's existing warhead storage complex.

In 2000, the Russian MOD requested that the U.S. government fund the installation of perimeter security systems around two nuclear weapon storage sites, one at the Aleysk Strategic Rocket Forces (SRF) base in the south-central part of Russia and one near the town of Novorossisk on the Black Sea coast. The security systems to be installed – each set consisting of a layer of sensored fencing, microwave detectors, two layers of engineering fencing to establish clear zones, and associated cabling – were provided by the U.S. through the CTR Program in 1997 and 2000. The U.S. met MOD's request for the Aleysk SRF security upgrades but chose not to proceed with the Novorossisk facility. For a variety of reasons, most of which are described below, it would have been more effective in the long run to persuade the Russian MOD to close those facilities in order to consolidate the complex.

The Novorossisk facility was, and remains, small and in general disrepair. General Colonel Valynkin confirmed that Novorossisk only came under the Twelfth Main Directorate's control from the Russian Navy in 1998. Since Novorossisk is a regional, service level site, it likely includes few bunkers and minimal storage capacity intended only to support spare warheads or weapon maintenance. Furthermore, MOD noted in technical discussions with the U.S. that the security at Novorossisk was not up to Twelfth Main Directorate standards and therefore insufficient to support nuclear weapons. Consequently, MOD had removed all of the weapons from Novorossisk.

There are no START-related facilities in the Novorossisk area. START data exchanges do not identify any strategic weapons associated with the Novorossisk area, regarding Navy or any other assets. Warheads that would be stored in that facility would likely support the Black Sea Fleet, but given the lack of START-associated assets, they would likely be tactical in nature.

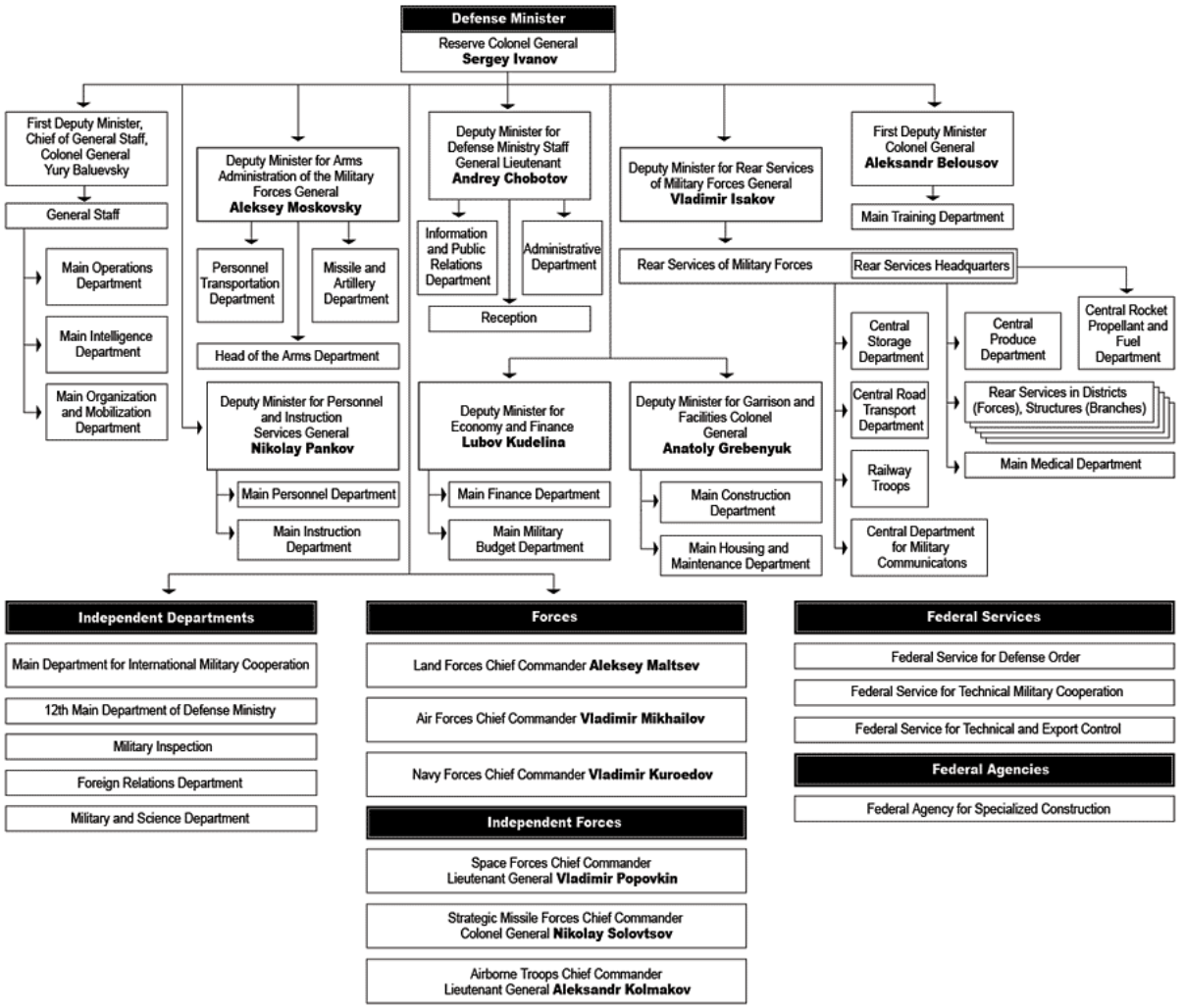
The geo-political situation surrounding Novorossisk is a further concern, regarding its proximity to the Black Sea and to volatile areas. During the first conflict in Chechnya, press reporting on rebel claims to have seized two nuclear devices could not be adequately disputed by the Russian government. General Valynkin himself has repeatedly stressed MOD's concerns with the terrorist threat. Reconstituting the Novorossisk storage site would place weapons back into that unstable region.

The Aleysk SRF base, like Novorossisk, is a service level, direct support facility. Therefore, it too comprises few bunkers and minimal storage capacity intended only to support spare

warheads or weapon maintenance. While associated with strategic assets, the Aleysk SRF base was closed under START counting rules at the end of 2001. The U.S. and Russia installed the security systems around that facility since the final period of drawdown placed the warheads at higher risk as they were removed from the delivery systems.

These two sites represent many more service level, direct military support facilities dispersed throughout Russia. All of them are relatively small, and most of them are considered to possess inadequate physical security.

New Structure of Russian Defense Ministry



Source: U.S. Government

II-6.2 Consolidation Proposal

Instead of securing Aleysk, Novorossisk, or similar-type sites, Russia – probably with foreign assistance – should re-activate one or more national level nuclear weapons storage sites recently closed by MOD. Currently, the Twelfth Main Directorate is operating 13-15 national stockpile facilities. This number is down from the 18-20 it operated at the end of the Cold War. The re-activation of a single stockpile site could allow MOD to close several less secure, less remote service level, direct support sites. Thus, aggregate consolidation could be achieved.

MOD claimed that, since Aleysk and Novorossisk are Twelfth Main Directorate facilities, it wanted to use the storage space to relieve the overloading pressure at its other sites (described in section II-5.1 of this report). This may indicate that MOD is willing to use any Twelfth Main Directorate facility to relieve the overloading problem.

A comparison of costs indicates that closing three service level sites in favor of re-activating one national level facilities requires roughly equal funding. The U.S., under CTR, is currently planning to spend hundreds of millions of dollars to enhance the security of over 100 individual sites. Although the costs of procuring and installing the security equipment at a service level site is relatively known due to previous CTR activities, and the costs of procuring and installing the equipment and additional infrastructure improvements necessary to re-activate a national level site is relatively unknown as it has never been attempted, the additional costs that may be incurred with the latter would be worth the overall improvement in security.

The most accessible national level stockpile site may be the facility near the town of Tula, south of Moscow. As a recently de-activated site, Tula should be in decent shape and contain the necessary infrastructure. As a national level site, Tula may have sufficient capacity to relieve the overloading problem. Tula is located in a relatively internal and stable part of the country, alleviating some of the geo-political concerns. Importantly, U.S. government technical teams have already visited Tula.

As noted above, re-activating a national level site might allow for the closure of multiple regional, service level sites. Part of any agreement for foreign funding to assist in this process could be to insist that such closures occur as the larger sites are re-opened. For example, Russia could agree to swap one national level site for multiple regional sites.

Perhaps most important in a political sense is that a large, national level site storing weapons downloaded from dismantled strategic and tactical delivery systems would alleviate the military posture concerns with respect to a site like Novorossisk. Since the PNIs are not constituted in a treaty, the international community has no way to verify or to dismiss its concerns over violations of the commitments. Moreover, as it appears that Russia may be using the Novorossisk port to base its Black Sea Fleet as it withdraws from the bases in Ukraine, any proximate nuclear weapon storage site would likely support this operational function.

Moreover, allowing for the full closure of sites like the Aleysk facility would alleviate any lingering concerns over the possible reconstitution of that site as a strategic base. By removing the warheads along with the delivery systems, the international community would be further assured of its removal from operation.

Obviously, we have little idea what it would really take, practically and financially, to re-activate a national level site. Ultimately, however, fewer sites requiring security enhancements means a higher overall level of security and less foreign funding required to provide enhancements. A number of compelling arguments can be made that might persuade Russia that additional facility consolidations are warranted, achievable, and desirable.

II-6.3 Incentives for Russian Acceptance of Nuclear Warhead Storage Facility Consolidation[150]

Convincing the Russian government of the merits of this proposal will not be trivial. Many organizations, each with their own bureaucratic priorities, are stakeholders in the nuclear warhead storage complex. These organizations include the Ministries of Defense, Industry and Economics (of which the former Ministry of Atomic Energy is now a part), and Foreign Affairs; the Strategic Rocket Forces, Navy, Air Force, and Artillery and Missile Troops; and the Duma.

Russia must be convinced that consolidation will maintain or expand current aggregate storage capacity, especially if the scarcity of adequate storage space persists. It must also be convinced that the improvement in warhead security produced by consolidation will be measurable but at the same time that any negative effects on operational military readiness will be negligible and mitigated.

In this context, we offer the following incentives that may help induce Russia to implement a process of consolidation:

1. Security: Consolidation would mitigate against warhead theft or diversion by groups and states inimical to Russia's interests.
    a. Consolidate into storage sites that are significantly upgraded with respect to security systems.
    b. Calculate tradeoffs between diffusion versus consolidation: Diffusion of troops, bases, weapons, factories, and so forth has long been one of Russia's methods for enhancing security. In order to convince the Russians of the enhanced security that would come from consolidation, we must select measures of effectiveness and that demonstrate that consolidation in well-managed and well-equipped sites is more secure than diffusion among less secure sites.
    c. Consider the political and social stability of each region: Fewer sites mean less chance of an unstable, uncontrolled environment.
    d. Although the consolidation process entails risks during transport to central storage, given the inherent risks of the transport process, once the warheads are in place transportation occurrences and distances should be minimized. Warheads in diffuse sites, in contrast, may be subject to multiple moves over longer distances as sites become untenable for storage for various reasons.

2. International politics/economics: Foster good will *vis-à-vis* Russia's G8 partners, with political and economic benefits to follow.
    a. The G8 supports enhanced security for Russian warheads and fissile materials (*The G8 Global Partnership against the Spread of Weapons and Materials of Mass Destruction*, Kananaskis, Canada, 27 June 2002). In principle, this includes efforts to consolidate warhead storage, if it can be demonstrated that consolidation will make the warheads less subject to theft, diversion, or unauthorized use.
    b. Use approach in #1 to establish this linkage between consolidation and security in presenting proposals to the entire G8.

[150] Co-author Charles Thornton thanks, Dr. Richard Soll, a colleague at Science Applications International Corporation, for contributing his ideas to this section of this report.

c. A prominent non-governmental report issued in 2003 recommends that the United States, United Kingdom, and France assist Russia's efforts to enhance nuclear security, explicitly including "accelerating the consolidation its strategic and tactical nuclear weapons at a reduced number of secure storage sites."[151]
d. Therefore, the United States and other advanced industrial nations should develop and promise concrete assistance programs for Russia and ensure consequential economic benefits.

3. Domestic economics: Reduce warhead storage and transport costs.
   It can be demonstrated in real, quantitative terms that over time, consolidation will be less costly than diffusion. Large consolidated sites benefit from economies of scale, since infrastructure, command and control, access monitoring and security, and other aspects do not have to be duplicated at as many sites.

4. Infrastructure: Consolidate warheads in areas of Russia where infrastructure (especially rail, roads, electricity, and government services) is least eroded.
   a. Original locations for nuclear facilities were selected largely on basis of availability of infrastructure, primarily rail.
   b. The Russian rail and road systems have eroded considerably over the last decade, and will be allowed to erode further; for example, along the Trans-Siberian route now that (1) many ICBM complexes along that route have been taken out of service and (2) the Russian Far East has established extensive economic and trade relations with the countries of the Pacific Rim and, therefore, is much less dependent on European Russia than was the case under the Soviet regime.
   c. Warhead storage facilities should also be available to emergency response and consequence management capabilities in case of an incident or accident. This can only be assured in limited cases – i.e., consolidated sites with adequate infrastructure – in Russia. Diffuse sites not only are more likely to have incidents or accidents but also are less likely to be available to adequate response capability if these contingencies occur.

5. Military readiness: Consolidation can be accomplished while retaining a high state of military readiness. Also, consolidation must not be allowed to impact negatively on Russia's perceived ability to deploy warheads in case of operational necessity.
   a. Russia will be reluctant to allow further consolidation if consolidation appears to lower readiness level by moving warheads farther away from national borders and, thus, farther from a likely theater.
   b. On the other hand, proximity to a likely theater (e.g., along southern or southwestern tier and in Russian Far East) poses increased security risks, with regard to direct theft or sabotage and attack by short- or mid-range ballistic missiles.
   c. A solution may be for Russia to ensure that the infrastructure (especially transportation) at the consolidated facilities (presumably in interior of country) is adequate for moving warheads to a theater.

6. Local political and social situation: Store warheads in regions that are most stable politically and socially.

[151] Robert Einhorn, and Michèle Flournoy, "Volume 1: Agenda for Action," in *Protecting Against the Spread of Nuclear, Biological, and Chemical Weapons: An Action Agenda for the Global Partnership*, Securing the Global Partnership Project, Center for Strategic and International Studies, Washington, DC, 2003.

a. Although stability is largely driven by ethnic composition of a region, there may be other factors (such as degree of control by local officials, penetration by organized crime, degree and nature of local corruption, nature of local police and military presence) that must be considered.
b. Each potential site must be evaluated on its own merits, and all factors bearing on stability and security must be identified and calculated.
c. These evaluations should consider whether factors for stability are likely to be enduring.

Finally, David Cortright and Andrea Gabbitas offer six external incentives that would augment the six we provide above:

- Removal of U.S. TNWs from Europe,
- Forming a single cap on tactical and strategic nuclear weapons,
- Guarantees on nondeployment to new NATO members,
- Giving Russia a lead role in the NATO-Russia Partnership,
- Expediting Russian World Trade Organization membership on favorable terms, and
- Debt forgiveness and/or debt swap.[152]

The U.S.-funded CTR program is already heavily involved in the transportation and storage security of Russia's tactical nuclear warheads. The likeliest roadblock to implementing this proposal is the military readiness problem. Whereas strategic nuclear weapons require long lead times to prepare, deliver, and mate to their delivery systems, tactical warheads may function in a just-in-time capacity. That is, assuming the military units are trained and certified to handle nuclear munitions, the dual-use nature of the tactical delivery systems would allow for the nuclear warheads to be delivered readily from long distances. During times of relative peace and stability, therefore, Russia may be persuaded to reduce dramatically the number of locations where it stores those warheads.

II-7.0 Conclusions to Part II

> *"We do not plan to remove tactical nuclear weapons from Russia's arsenal."*[153]

This comment, by General Yuriy Baluyevskiy, who is now the Chief of the General Staff of the Russian Armed Forces, sets the tone for this report. We assess that Russia's reliance on its tactical nuclear forces for national security has increased in a major way, and anticipate this situation to remain constant for the foreseeable future even if Russia is presently boosting its overall defence spending. Whereas the American TNWs in Europe have evolved over the last decade into uniquely political symbols, Russia's during the same period have become the cornerstone of its warfighting capability and national security insurance.

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[152] David Cortright and Andrea Gabbitas, "Incentives for Nuclear Restraint: The Role of Inducement Strategies in Controlling Russian Tactical Nuclear Weapons," in Brian Alexander and Alistair Millar, *Tactical Nuclear Weapons: Emergent Threats in an Evolving Security Environment*," Brassey's, Inc., Washington, DC, 2003.
[153] Interfax, "General says Russia won't destroy tactical nuclear weapons," 26 November 2003 [provided by Johnson's Russia List #284, 27 November 2003].

Since the late 1980s, Moscow has dramatically and systematically reduced the quantity, location, and deployments of its tactical nuclear forces. Withdrawals from Eastern Europe were concluded prior to the dissolution of the Soviet Union, and withdrawals from the former Soviet Republics were concluded by 1992. Consolidations within Russia have occurred in accordance with the 1991/1992 unilateral Presidential Nuclear Initiatives, although Russia appears not to have completed the pledged reductions.

The U.S. intelligence community provided the following assessment in 2002:

> *"Moscow is significantly reducing its nonstrategic nuclear stockpile. In October 1991, then-Soviet President Gorbachev, responding to a U.S. presidential initiative, announced that the Soviet Union would unilaterally consolidate most of its nonstrategic nuclear warheads in central depots and would eliminate a major portion of them. In January 1992, President Yeltsin publicly reaffirmed Gorbachev's announcement. Although Russia has taken some actions to fulfill these pledges, Moscow—because of concerns over deteriorating conventional capabilities—probably will retain several thousand nonstrategic nuclear warheads through at least 2015."*[154]

A Russian military analysis agrees:

> *"... preservation (along with the Strategic Nuclear Forces, general-purpose naval forces and front aviation) of a sufficient nuclear potential of Ground Troops Missile Troops and Artillery, including a certain number of operational-tactical missile complexes capable of employing conventionally-armed and nuclear-armed missiles, is in our view one of the reliable, simple-to-realize, and militarily and economically effective ways to ensure RF military security for the next 10-15 years. In the authors' opinion, an increase in capabilities of nonstrategic nuclear weapons will narrow the gap in the contribution made by general-purpose forces and Strategic Nuclear Forces to deterring potential aggressors."*[155]

Although Russia's TNW footprint may be much smaller than it was at the end of the Cold War, the size and capabilities of the force remain significant. Therefore, despite constant assurances from the Russian government, foreign officials and experts continue to raise concerns about the safety, security, and control of Russia's TNWs. We have concluded in this report that, although there remains substantial cause for concern, Russia has implemented adequate procedural and technical measures to control its tactical warheads.

It is significant to note in this context that the fundamental purpose of Russia's tactical nuclear forces has shifted from an offensive role to a more defensive one. Whether arrayed against NATO, China, or a future threat to Russia's southern region, Moscow's conventional forces do not possess the capability for territorial aggression. In fact, Russia's conventional forces may be insufficient to stop a concerted attack into Russian territory in any of these

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[154] National Intelligence Officer for Strategic and Nuclear Programs, "Annual Report to Congress on the Safety and Security of Russian Nuclear Facilities and Military Forces," U.S. National Intelligence Council, February 2002.

[155] Colonel V. V. Kruglov and Colonel M. Ye. Sosnovskiy, "On the Role of Nonstrategic Nuclear Weapons in Nuclear Deterrence," *Voyennaya Mysl No*, 01 September 1997, pp. 11-14 [FBIS Document FTS19971205000584].

regions. Therefore, Russia has displayed the capability, both in its official doctrine and during military exercises, to utilize tactical nuclear strikes to halt an invasion.

What, then, would it take for Russia to seriously engage in TNW reductions? One often-cited Russian requirement would be the removal of U.S. nuclear weapons from Europe. For example, as an official Russian statement affirmed:

> *"On our part we believe that removal of the tactical nuclear weapons, for example, from Europe and elimination of respective infrastructure there would become an important practical step to ultimately overcome the remnants of the Cold War period."*[156]

However, this step would seem to be insufficient. First, the number of gravity bombs that the U.S. has stored in NATO countries is relatively small compared to the estimated Russian arsenal. Although the Russians consider the U.S. weapons in Europe to be strategic in nature, this would be a highly asymmetrical equation. At the very least, Russia would want to include French and British nuclear forces into such an equation. But this would probably still be insufficient, given the relative superiority of NATO's conventional forces.

Limiting the discussion to Europe's current nuclear force posture would also seem to be insufficient. An adjustment to the CFE Treaty may result in a less threatening front toward Russia, but Russia would certainly want assurances that NATO would not place nuclear assets in former Warsaw Pact states and former Soviet republics. Moreover, even with these added incentives such an equation would not address the threats along Russia's southern and eastern borders.

If possible, Russia may have further lowered its nuclear threshold, perhaps even compared to Soviet policy during the Cold War. The simple doctrinal statement that Russia will be a first user of nuclear weapons if its conventional forces are found to be inadequate in an armed conflict of some magnitude essentially guarantees an early use of (T)NWs in a conflict with any sizable opponent, and all the more so if this opponent is equipped with more modern conventional arms than Russia. As noted by General Makhmut Gareyev, president of the Academy of Military Sciences in Moscow, "In the current situation the role of nuclear weapons for Russia is hard to overestimate. Basically it is the only factor which can still ensure our country's safety."[157]

Finally, Russia does not appear to be receptive to any formal agreement that would allow for the exchange of data on the quantities and locations of nuclear warheads. Many experts have noted that, due to the dual-use nature of tactical delivery systems, any treaty that covered TNWs and included a verification regime would necessarily require direct warhead counting. This seems unlikely: as a Russian Defense Ministry spokesman summed up his country's foreign policy concerning the implementation of the 1991/1992 unilateral initiatives to reduce and consolidate its tactical nuclear forces:

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[156] Permanent Mission of the Russian Federation to the United Nations and Other International Organizations in Geneva, "Statement by the Delegation of the Russian Federation at the Second Session of the Preparatory Committee for the 2005 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons," 28 April 2003.

[157] David Holley, "Russia Seeks Safety in Nuclear Arms," Los Angeles Times, 06 December 2004.

> *"If you want, take our word for it. If you don't want to, then don't. But we are not going to report back to anybody with figures in our hands about how many and what kind of specific tactical nuclear arms we have reduced."*[158]

Thus, we are confronted with the most likely scenario: Russia will retain a sizeable and capable tactical nuclear force, dispersed throughout the country and prepared for military operations. Given this scenario, we believe that the leverage foreign governments can assert comes in the form of *nonproliferation* and not *arms control*. That is, programs like the U.S. Cooperative Threat Reduction program and the G-8 Global Partnership should be utilized to enhance the security of Russia's tactical nuclear arsenal in a way acceptable to Moscow. By decreasing the number of locations where warheads are stored and by allowing the security at those fewer facilities to be enhanced, Russia would take a major step towards assuring the international community that its tactical nuclear forces are well controlled.

[158] ITAR-TASS, "Russian Defense Official Says Kept Promises to Reduce Nuclear Weapons," Moscow, 07 October 2004 [FBIS Document CEP20041007000187].