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The Evolution of Russia's Strategic Nuclear Force

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Abstract

The majority of Russia's current strategic nuclear force will become obsolete shortly after the turn of the century. Hence, Russian strategic force modernization is essential if Russia is to remain a nuclear power on a par with the United States. Numerous uncertainties, especially financial uncertainties, prevent accurate estimates of Russia's future strategic force structure. Nevertheless, under the START I Treaty, Russia can probably maintain a force with slightly more than 4,000 strategic nuclear warheads over the next two decades—about half the number of the United States. Under START II, Russia is likely to maintain a strategic force of between 1,800 and 2,500 warheads, compared to 3,500 warheads for the United States. Therefore, Russia's main interest in ratifying the START II Treaty would be to pursue a START III Treaty that limits both sides to between 2,000 and 2,500 strategic nuclear warheads. This is the least expensive way to retain rough parity with the United States. Several reasons have been educed for why Russia should not ratify the START II Treaty, namely, because the Treaty allows a U.S. advantage in reconstitution capability and prompt hard-target-kill capability. However, these advantages are neither so great nor so consequential that Russia should reject the START II Treaty for these reasons alone. If Russia ratifies the START II Treaty, and presumably a follow-on START III Treaty, Russia's future strategic nuclear force will appear a lot different than its Soviet predecessor due to the reduced emphasis on land-based ICBMs. Nevertheless, the Russian force should remain a highly survivable, stable force—assuming Russian leaders allocate sufficient resources to ensure that their ballistic missile submarines, mobile ICBMs, and bombers can survive all plausible counterforce threats.

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I would like to thank Paul Podvig, Nikolai Sokov, and Steven Zaloga for providing advance copies of their excellent overviews of Russian strategic nuclear force modernization; Thomas Cochran, Joshua Handler, Nikolai Sokov, and Steven Zaloga for providing comments on an earlier draft; and the Center for International Security and Cooperation, at Stanford University, and the Carnegie Corporation, without whose support this work would not have been possible. The views expressed herein are solely the author's and do not reflect those of the Carnegie Corporation or any of the Center's other sponsors.

The Evolution of Russia's Strategic Nuclear Force

Introduction

Considerable uncertainty surrounds the future of Russia's strategic nuclear force because of political and economic turmoil within Russia, the uncertain outcome of Russia's current military reform, and uncertainties with respect to which arms control treaties will be in force over the next several decades.[1] Nevertheless, Russia will have to carry out substantial strategic force modernization over the next decade if it is to remain a major nuclear power on a par with the United States. The United States has less need to modernize its strategic forces at the current time because its strategic nuclear delivery vehicles are newer and last longer than their Russian counterparts.

Financial constraints likely will be the dominant factor in shaping the future of Russia's strategic nuclear force, forcing early retirement for some strategic systems, creating maintenance problems for others, and causing delays in strategic force modernization to replace existing systems—the majority of which will become obsolete soon after the turn of the century. Moreover, it is difficult to determine how long Russia's financial problems will last. Not only has the defense budget shrunk as a fraction of the Russian GNP (Russian defense spending in 1997 was 3.0 percent of its GNP, down from Cold War highs above 15 percent), but the Russian GNP, which initially equaled about 60 percent of the former Soviet GNP in 1992, has shrunk by 50 percent over the past six years. Hence, Russian defense spending is at best approximately one-tenth that of the former Soviet Union during the mid-1980s, and equals approximately 10–13 percent of the current U.S. defense budget.[2] Over the next decade Russian defense spending is expected to hover around 3.5 percent of GNP and the Russian GNP is expected to grow by several percent per year—although the latter is difficult to predict as indicated by the 1997 budget crisis and the impending collapse of the ruble.[3]

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[1] For a good discussion of Russia's military reform see Alexei G. Arbatov, "Military Reform in Russia: Dilemmas, Obstacles, and Prospects," *International Security*, Vol. 22, No. 4 (Spring 1998), 83–134.

[2] Ibid., 97.

[3] In 1997 the Russian government based its expected revenues on a predicted growth rate of 2 percent. The actual growth rate was 0.6 percent, which led to a severe budget crisis that required "sequestering"

Shrinking defense budgets are only part of the picture. In 1992 Russia inherited the bulk of the former Soviet armed forces and its military industrial complex. While attempts have been made to reduce the size of the armed forces, today they contain approximately 1.6 million military personnel and 900,000 civilian employees.[4] This is comparable in size to the U.S. military. Consequently, approximately 70 percent of the Russian defense budget is spent on personnel costs (i.e., salaries, wages, food, and supplies) and 30 percent on investment (i.e., military R&D, procurement, and military construction), which is the reverse of the situation in the 1980s when approximately 30 percent of the Soviet defense budget was spent on personnel costs and 70 percent on investment. Even with the increased fraction spent on personnel, the standard of living for troops still is deteriorating, wages are paid late (typically three months), food is of poor quality, a severe housing shortage exists (housing construction falls under military construction), and inadequate funds are available for training.[5]

With respect to Russia's large defense industrial base, inadequate procurement contracts, ineffective defense conversion, the legal requirement to maintain an oversized defense industrial mobilization base, and the lack of political will to decide which industries should survive and which should be closed and/or converted has left Russia's oversized defense industrial sector continuing to deteriorate in a haphazard and inefficient manner. The result is that Russia's shrinking defense investment budget is being squandered in an attempt to forestall the complete collapse of an oversized defense industrial complex, rather than being used to preserve the R&D and procurement infrastructure required to meet Russia's future defense needs.[6]

Although many issues are hotly debated in Russia's current military reform, there appears to be remarkable consensus that strategic nuclear force modernization will receive high priority relative to other pressing defense needs—despite the fact that conventional forces may be better suited to Russia's future security needs. Nuclear weapons, for example, have no role in conflicts of the sort that occurred in Chechnya and will have only a limited role in conflicts around the Russian periphery because threats emanating from the post-Soviet space are not likely to involve large-scale theater wars of the sort that might threaten Russia's vital interests. Nevertheless, the argument is made that with relatively weak conventional forces, Russia must place greater reliance on nuclear weapons for its security, just as the United States did in the 1950s. While this will involve an emphasis on tactical nuclear weapons, considerable emphasis will be placed on strategic nuclear forces as well. This is due, in part, to the fact that strategic nuclear forces are the sine qua non of great-power status and, in part, to their role as a deterrent to unforeseen threats that might develop in the future (e.g., more aggressive NATO expansion, etc.).[7]

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government funds so that government outlays were 20–30 percent below the authorized amount. This shortfall hit all government-funded programs, with the defense budget suffering a 21 percent reduction compared to the initial budget projection. See Alexei G. Arbatov, "Military Reform in Russia: Dilemmas, Obstacles, and Prospects," op cit., 96–97.

[4] Ibid., 98.

[5] Ibid., 103–105.

[6] Ibid., 108–112.

[7] For a good discussion of current Russian thinking on strategic nuclear force modernization, see Nikolai Sokov, *Modernization of Strategic Nuclear Weapons in Russia: The Emerging New Posture*, Working Paper no. 6, Program on New Approaches to Russian Security, Davis Center for Russian Studies, Harvard University, May 1998.

Obviously the size of the defense budget, the fraction allocated to procurement, and the priority assigned to strategic nuclear force procurement will determine the production rates and force levels for new strategic systems. Russia currently spends about 10 percent of its defense budget on strategic nuclear forces. This will have to increase probably by 100–150 percent to adequately fund Russia's future strategic force needs.[8]

Uncertainties regarding the fate of the START II Treaty, which the Russian Duma has yet to ratify, and a subsequent START III Treaty imply that Russian forces may not be limited by these arms control treaties in the future. While it is true that financial constraints will make it difficult for Russia to maintain forces much above the level set by the START II Treaty, the details of its force structure could be different, e.g., land-based intercontinental ballistic missiles (ICBMs) could carry multiple independently-targeted reentry vehicles (MIRVs) and more than 90 SS-18 silos could be converted to launchers for new ICBMs.

Projecting Russian strategic nuclear forces into the future is of interest for several reasons. First, the size of Russia's strategic (and tactical) nuclear arsenal relative to that of the United States and the medium nuclear powers will be of interest, if not importance, as long as nuclear weapons are a part of great-power politics. Second, Russia's projected strategic force posture allows one to determine whether the nuclear balance will be stable in the future. Third, Russian force projections in the absence of arms control constraints allow one to determine the potential impact of future arms control treaties. Finally, the size and character of Russia's future strategic force allows one to address such questions as whether U.S. ballistic missile defenses will pose a realistic threat to Russia's strategic nuclear force if or when such defenses may be fully deployed.

A Simple Model for Deployed Forces

This analysis uses a simple model to project Russian force levels over time. The model takes into account the date at which the delivery systems of a particular type first become operational (the Initial Operating Capability or IOC), the rate at which new systems are deployed, the date at which the systems are fully deployed (the Full Operational Capability or FOC), and the system's service life. The service life determines how long a particular system remains operational.[9] The first delivery system deployed is the first to be retired at the end of its service life and the last to be deployed is the last to be retired.

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[8] See Alexei G. Arbatov, "Military Reform in Russia: Dilemmas, Obstacles, and Prospects," op cit., 123–124.

[9] Strategic delivery vehicles eventually must be replaced because major components of the system that cannot easily be replaced reach the end of their useful life span (e.g., the rocket motors for ICBMs and SLBMs, airframes for bombers, and submarine hulls and nuclear propulsion systems for nuclear-powered SSBNs). Maintenance on major subsystems (e.g., missile guidance systems, aircraft engines, and the power plant aboard nuclear-powered submarines), as well as minor maintenance, is assumed to take place to keep the systems operational for the duration of their useful service life. One should note that data on service life for Russian systems frequently refer to a "warranty life," i.e., the duration for which the manufacturer guarantees the system will remain operational. The actual service life may exceed this "warranty life" for some systems, giving rise to discrepancies between the service life as stated in the production contract and the service life as determined by the length of time these systems remain operational in the field. Systems can remain operational beyond their expected service lives if additional tests and maintenance guarantee that the system will remain within specified tolerances for several additional years, or if these tolerances are relaxed. The latter approach obviously sacrifices operational effectiveness.

The deployment rate is assumed to be constant over the buildup period and the service life is assumed to be a constant that characterizes all strategic delivery systems of a particular type.[10] The result is a trapezoidal profile for the number of strategic systems of a given type deployed over time, as depicted in Fig. 1.

Application of this model to the Russian ICBM force is complicated by the fact that several modifications of the same basic missile frequently were deployed. In this analysis, the model is applied to each ICBM modification (with a few exceptions).[11] In projecting the size of the Russian submarine-launched ballistic missile (SLBM) force, the model is applied to different ballistic missile submarine (SSBN) types. Thus, the service life pertains to the submarines as opposed to the SLBMs. It is assumed that Russia deploys enough SLBMs to fill each operational SSBN. In general, Russian submarines have service lives around 20 years, as opposed to 30 years for their American counterparts. Russian SLBMs have service lives of approximately 10 years, suggesting that two SLBM load outs occur during the life of the submarine. In the case of bombers, the model is applied to the bomber airframe and not the air-launched cruise missiles (ALCMs) it might carry. This model could be applied to individual SLBMs or ALCMs but insufficient data exist for this purpose. Finally, this model only approximates the real world because delivery systems are not deployed at a constant rate. Moreover, the size of the force may change if systems are accidentally destroyed or retired prematurely, the latter of which happened quite frequently during the collapse of the former Soviet Union between 1989 and 1991.

Notwithstanding the above qualifications, this simple model matches actual U.S. and Soviet/Russian strategic nuclear deployments quite well. The Appendix illustrates this for historical Soviet deployments of the SS-6, SS-7, SS-8, SS-9, SS-11, SS-13, and SS-17 ICBMs; the Golf, Hotel, and Yankee SSBNs; and the Bison and Bear A-G heavy bombers. Table 1 summarizes the model parameters that best fit the historical data and are believed to characterize future deployments for all Soviet/Russian strategic nuclear delivery systems

[10] Note the difference between production and deployment rates. For ballistic missiles, the number deployed is smaller than the number produced because extra missiles are produced for purposes of test and evaluation and for missile spares. For example, in 1997 Russia deployed a total of 360 SS-25 ICBMs. In addition, it possessed 57 non-deployed SS-25s. In addition, by October 1997 a total of 71 SS-25 test and training launches had been conducted from Plesetsk. Therefore, the total number of SS-25s produced must have been at least 488 missiles, implying that the SS-25 production rate must have been approximately 35 percent higher than the deployment rate. The difference between deployment and production rates for bombers is less pronounced because only a few aircraft are set aside for testing and training. Finally, the number of nuclear submarines produced is equal to the number deployed, although this is not true for SLBMs.

[11] This leads to relatively short estimated service lives for the early modifications of the SS-11, SS-17, SS-18, and SS-19 ICBMs because the deployment of later modifications forced the retirement of earlier missiles because the number of silos was fixed.

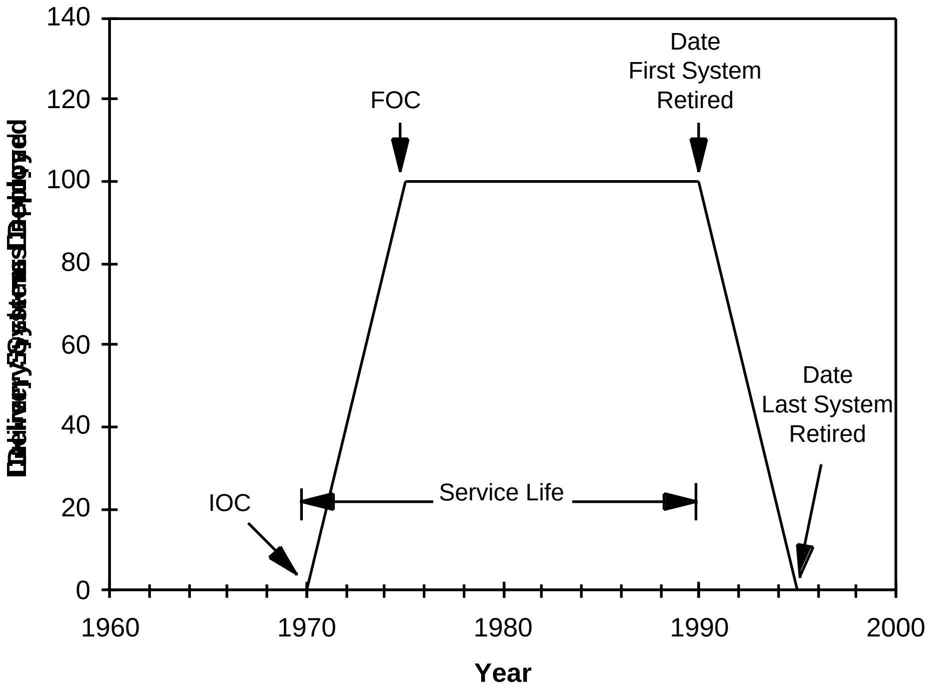

Fig. 1 - Model Deployment Profile

used in this analysis. In some cases the model IOC or FOC is different than the official dates because the model parameters have been picked to provide the best fit to the historical deployment profile.

Most of the historical data used in this analysis were compiled by the Natural Resources Defense Council (NRDC).[12] This is among the best publicly available data on past Soviet/Russian strategic force levels. Strategic forces are defined here to be those in the operational arsenal, regardless of whether they are in overhaul, repair, conversion, or modernization at a given date. Data for 1997 force levels come from the START I Memorandum of Understanding on Agreed Data Bases and, hence, represent START accountable, as opposed to operational, forces.[13]

Russian Strategic Force Modernization Options

Current Russian strategic force modernization plans include options for modernizing only

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[12] See Robert S. Norris and Thomas B. Cochran, *U.S.-USSR/Russian Strategic Offensive Nuclear Forces, 1945–1996*, Natural Resources Defense Council, Washington, D.C., January 1997.

[13] See *START Treaty Memorandum of Understanding Data for the Russian Federation*, U.S. Arms Control and Disarmament Agency, Washington, DC, January 1, 1998.

Table 1
Model Parameters for Soviet/Russian Strategic Delivery Vehicles

Delivery System	IOC (year)	FOC (year)	Deployment Rate (units/year)	Number Deployed	Service Life (years)
ICBMs					
SS-6	1960	1961	2.0	4	8
SS-7	1961	1965	39.4	197	14
SS-8	1963	1965	7.7	23	14
SS-9	1966	1971	46.7	280	10
SS-11 Mod 1	1965	1970	165.0	990	8
SS-11 Mod 2/3	1973	1976	105.0	420	17
SS-13	1969	1972	15.0	60	21
SS-17 Mod 1	1976	1979	32.5	130	7
SS-17 Mod 2	1978	1978	20.0	20	5
SS-17 Mod 3	1982	1983	75.0	150	8
SS-18 Mod 1 & 3	1975	1976	18.0	36	7
SS-18 Mod 2	1977	1979	54.0	162	5
SS-18 Mod 4	1979	1983	61.6	308	15/20
SS-18 Mod 5/6	1988	1991	22.5	90	15/20
SS-19 Mod 1	1975	1979	36.0	180	7
SS-19 Mod 2	1977	1978	20.0	40	5
SS-19 Mod 3	1980	1984	72.0	360	15/21/25
SS-24 (silo)	1988	1989	28.0	56	10
SS-24 (rail-mobile)	1987	1990	9.0	36	10
SS-25	1985	1990	48.0	288	12/15
	1991	1995	16.2	81	12/15
Topol M (silo)	1999	2011	7−15	90−195	20
Topol M (road-mobile)	2001	2010	11−35	110−350	15
Submarines					
Golf I Model 1	1958	1962	3.0	15	9
Golf I Model 2	1958	1962	1.4	7	18
Golf II	1966	1971	2.2	13	22
Golf III	1977	1977	1.0	1	10
Golf IV	1976	1976	1.0	1	5
Golf V	1978	1978	1.0	1	12
Hotel I/II	1962	1962	1.0	1	17
	1965	1968	1.5	6	17
Hotel III	1969	1969	1.0	1	21
Yankee I	1968	1973	5.0	30	17
Yankee II	1977	1977	1.0	1	14
Delta I	1974	1977	4.5	18	18
Delta II	1973	1976	1.0	4	21
Delta III	1977	1982	2.3	14	21
Delta IV	1985	1991	1.0	7	21
Typhoon	1981	1989	0.67	6	16
Borey	2004	2013	0.8−1.6	8−16	20
Strategic Bombers					
Bison	1956	1960	11.6	58	28
Bear A-G	1956	1964	11.7	105	32
Bear H6	1987	1990	7.8	31	32
Bear H16	1983	1989	8.1	57	32
Blackjack	1988	1992	5.0	25	30

the ICBM and SLBM legs of the Russian strategic triad. While new ALCMs may be built, no new heavy bombers are planned for at least a decade or more because the current Bear H heavy bomber force should remain operational until around 2015, assuming sufficient money is allocated to provide routine maintenance on these airframes.

Land-Based Intercontinental Ballistic Missiles

Russian ICBMs are the first systems undergoing modernization because the current ICBM force, consisting of the SS-18, SS-19, and SS-24 silo-based ICBMs and the SS-24 rail-mobile and SS-25 road-mobile ICBMs, are rapidly approaching obsolescence. In principle, three ICBM modernization options are available to Russian planners. First, they can extend the service lives for existing missiles with relatively small investments in maintenance. This may be achieved by cannibalizing parts from other missiles, deploying missiles that previously were in a “non-deployed” status, or remanufacturing those subsystems that are prone to failure. Second, Russia can continue production of existing missile types, provided the production facilities are located in Russia—which is the case for the SS-19 and SS-25 ICBMs. Finally, Russia can produce new missiles to replace obsolete types.

Current Russian ICBM modernization plans involve the first and third options. Specifically, plans exist to extend the service life of the SS-19 and perhaps the SS-18 and SS-25 as well, although extending the SS-18 service life is unlikely if START II is ratified. In addition, a new ICBM, the Topol M or SS-27, was first deployed in December 1997 in former SS-19 silos, marking the initial operating capability of what will likely become the mainstay of the future Russian ICBM force. The Topol M eventually will be deployed in silos and in a road-mobile configuration. While a second new ICBM type might, in principle, be deployed, there is no indication that a follow-on to the SS-19 is being considered, probably because such a missile would violate the START II ban on MIRVed ICBMs.

SS-18

The SS-18 is the premier Russian heavy ICBM. It was designed by the Yuzhnoe Design Bureau and produced at the Yuzhmash Machine-Building Plant, both located in Ukraine. Six modifications of the SS-18 have been discussed in the Western literature. They appear to correspond to three different Russian missile types. The SS-18 Mod 1, first deployed in 1975, appears to be a single-warhead variant of the Russian R-36M missile, and the SS-18 Mod 2, first deployed in 1977, appears to be a variant of the R-36M with eight MIRVs. According to the NRDC data, the service lives for the SS-18 Mod1/3 and Mod 2 were 7 and 5 years, respectively, suggesting that these missiles either were retired early to make way for the deployment of Mod 4 SS-18s in 1979 or that the R-36M missile had technical problems that limited its service life. The SS-18 Mod 3, first deployed in 1978, and the SS-18 Mod 4, first deployed in 1979, were improved missiles carrying one and 10 MIRVs, respectively, and probably represent the Russian R-36MUTTH missile.[14] Finally, the SS-18 Mod 5, first deployed in 1988, carries 10 MIRVs and the SS-18 Mod 6, first deployed in 1990, carries a single warhead. Both are believed to be variants of the Russian R-36M2 missile. The SS-18

[14] See Steven J. Zaloga, *Russian Strategic Weapon Systems*, unpublished manuscript, June 1998.

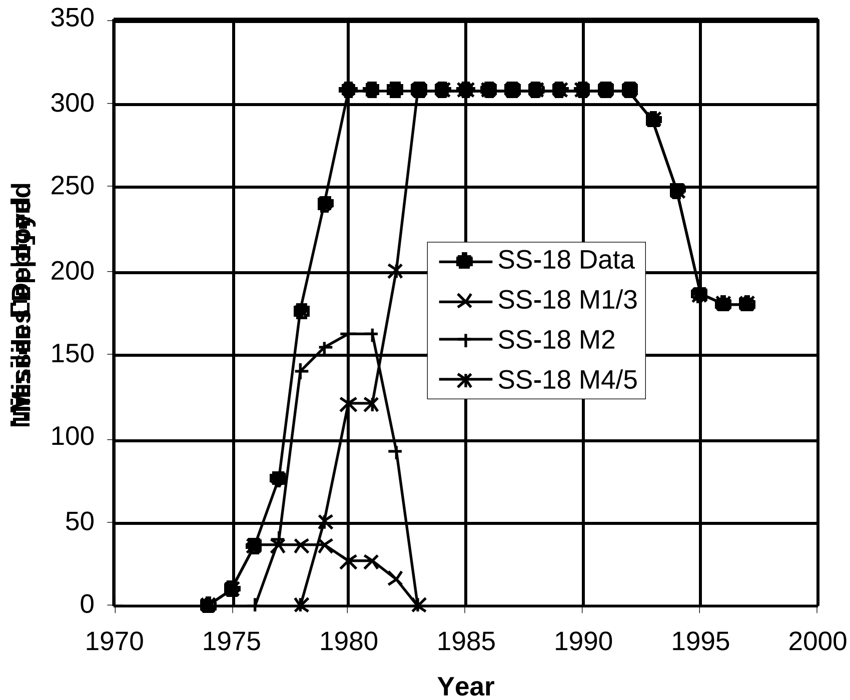

Fig. 2 - SS-18 Mod 1/3, 2, and 4/5 Deployment Profiles

Mod 4, Mod 5, and Mod 6 are still in the active inventory, although the SS-18 Mod 4 should be retired soon. The number of R-36M2 missiles actually deployed is not publicly known, nor is the split between Mod 5 and Mod 6 variants. One estimate places the number at 90 R-36M2 missiles. For the purposes of warhead counts, the Mod 6 has been ignored in this analysis. The Mod 4, Mod 5, and Mod 6 SS-18s reportedly have service lives of 15 years.[15]

Figure 2 shows the data for the number of SS-18 Mod1/3s, Mod 2s, and Mod 4/5s deployed through 1997. The Mod 6 was not included in the data. The drop in the SS-18 force from 1992 to 1995 represents the transition from Soviet to Russian SS-18 forces, with 104 SS-18s eliminated from Kazakstan. The missiles were transferred back to Russia. An additional 24 SS-18 launchers have been removed from ICBM bases located in Russia, leaving 180 silos loaded with Mod 4/5/6 SS-18s in the current Russian arsenal (52 of the original 64 SS-18 silos remain at Dombarovski, 52 of the original 64 SS-18 silos remain at Uzhur, 46 SS-18 silos are located at Kartaly, and 30 SS-18 silos are located at Aleysk).

Figure 3 illustrates three model projections for the total number of SS-18s deployed over time. The first simply projects the SS-18 deployment profile assuming 90 Mod 5/6 SS-18s, the remainder being Mod 4s, both with service lives of 15 years. The second

[15] See Paul Podvig, "The Russian Strategic Forces: Uncertain Future," *Breakthroughs* 7, no. 1 (Spring 1998): 12–13, Security Studies Program, Massachusetts Institute of Technology. For estimates regarding the number of MIRVs on each missile see Robert S. Norris and Thomas B. Cochran, *US-USSR/Russian Strategic Offensive Nuclear Forces: 1945–1996*, op cit., 20–21.

model

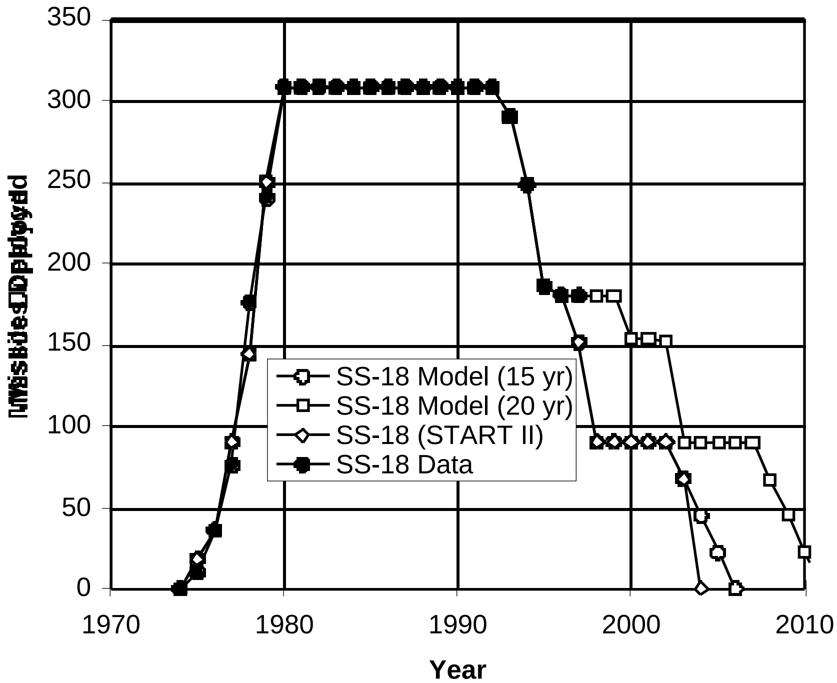

Fig. 3 - SS-18 Model Projections

projection illustrates a possible upper bound on SS-18 deployments by extending the service lives of the SS-18 Mod 4 and Mod 5/6 from 15 to 20 years, as has been suggested.[16] The third model projection assumes the START II Treaty is in force. These model projections assume that adjustments in the deployment of the different modifications are made so that no more than 308 missiles are deployed at any given time. They also assume that the missiles being removed are the oldest in the lot. The discrepancy between the data point for 1997 and the predicted number of Mod 4 SS-18s that should be remaining can either be explained by the fact that the 1997 START I MOU data point represents START accountable missile launchers (i.e., silos) and not operational missiles, the SS-18 Mod 4 service life is longer than 15 years, or a larger fraction of the remaining SS-18s are Mod 5/6 variants.

According to the START II Treaty only 65 SS-18s can remain by 2000 (Phase I limits) and they all must be destroyed by January 1, 2003. On September 26, 1997, the United States and Russia signed a Protocol to the START II Treaty extending the Phase I and Phase II implementation deadlines to December 31, 2004, and December 31, 2007, respectively, to give Russia extra time to dismantle non-treaty-compliant forces. However, as stated in the Albright-Primakov letters, all systems that eventually will be eliminated under START II must be deactivated by December 31, 2003, by removing the reentry vehicles from the missiles or by taking other jointly agreed steps. Therefore, all SS-18s must be deactivated by 2004, assuming the Duma ratifies the START II Treaty.

[16] See Paul Podvig, “The Russian Strategic Forces: Uncertain Future,” op cit., 13.

As one can see from Fig. 3, the START II Treaty has relatively little impact on the number of SS-18s in the Russian force, assuming the SS-18 Mod 4/5/6 service life is 15 years, since they are projected to be retired by 2006. Put another way, if Russia ratifies the START II Treaty, extending the service life of the SS-18 beyond 15 years makes little sense. Note that the START I Treaty constraint that only 154 SS-18s can remain by 2000 is satisfied automatically if the SS-18 Mod 4/5/6 have service lives of 15 years (unless more than 154 Mod 5/6 SS-18s were deployed) and this Treaty constraint only has a slight impact if the service life is extended to 20 years.

SS-19

The SS-19 ICBM was designed at the TsKBM Design Bureau located near Moscow and was built at the Khrunichev Machine-Building Plant in Moscow. The SS-19 Mod 1, first deployed in 1975 with six warheads, and the SS-19 Mod 2, first deployed in 1977 with a single warhead, are believed to be variants of the Russian UR-100N missile.[17] Model fits to the deployment profiles for these systems give service lives of 7 and 5 years for the SS-19 Mod 1 and Mod 2, respectively. Most likely these missiles were retired prematurely to allow deployment of the SS-19 Mod 3, carrying six warheads, beginning in 1980—a pattern similar to that for the SS-18. The SS-19 Mod 3 is reputed to be the Russian UR-100NUTTH missile with an estimated service life of 15 years.[18]

Figure 4 shows historical data for the deployment profile of the different modifications of the SS-19. Of the 360 SS-19s deployed by the Soviet Union, 120 were deployed at Tatishchevo and 60 at Kozelsk in Russia, and 90 each were deployed at Khmelnitski and Pervomaysk in Ukraine.[19] Sixty SS-19s were retired in the late 1980s, presumably to accommodate the 54 silo-based SS-24 missiles deployed in former SS-19 silos (46 at Pervomaysk and 10 at Tatishchevo). From 1991 to 1994 an additional 130 SS-19s were retired, including all SS-19s in Ukraine, leaving Russia with 170 Mod 3 SS-19s in 1994. In 1996 an additional 10 SS-19s were dismantled, leaving Russia with 160 deployed SS-19 missiles, although 170 SS-19 silos are still START accountable.

Figure 5 illustrates model projections for the SS-19, assuming 15, 21, and 25 year service lives for the Mod 3 SS-19. With a 15-year service life—the original service life of the missile—the Mod 3 SS-19s would be undergoing retirement today. Thus, reports that a decision was made in the early 1990s to extend the service life to 21 years appearreasonable.[20] If the START II Treaty is ratified by the Russian Duma, 105 SS-19s can be downloaded to single-warhead missiles after December 31, 2007. However, unless the SS-19 service life is extended beyond 24 years, the missile would have to be retired by then anyway. Hence, extending the SS-19 service life to 25 years, an option Russian planners apparently are considering, allows the SS-19 to carry six MIRVs through 2007, after which

[17] Ibid., 13–14.

[18] Ibid., 14.

[19] See the Memorandum of Understanding on the Establishment of the Data Base in *Arms Control and Disarmament Agreements: START Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms,* U.S. Arms Control and Disarmament Agency, Washington, DC, 1991, 150–182.

[20] See Paul Podvig, "The Russian Strategic Forces: Uncertain Future," op cit, 14.

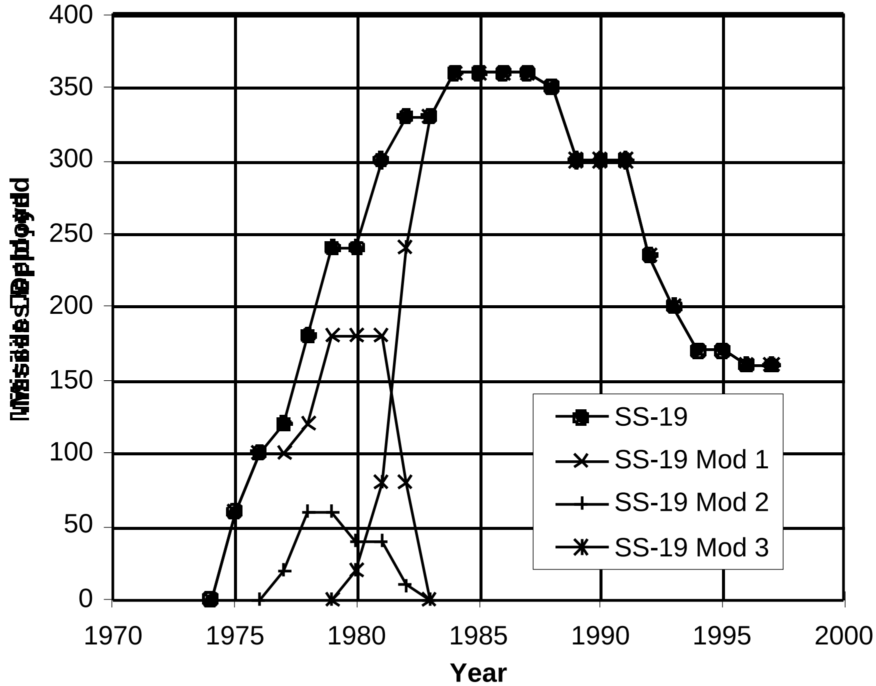

Fig. 4 - SS-19 Mod 1, 2, and 3 Deployments

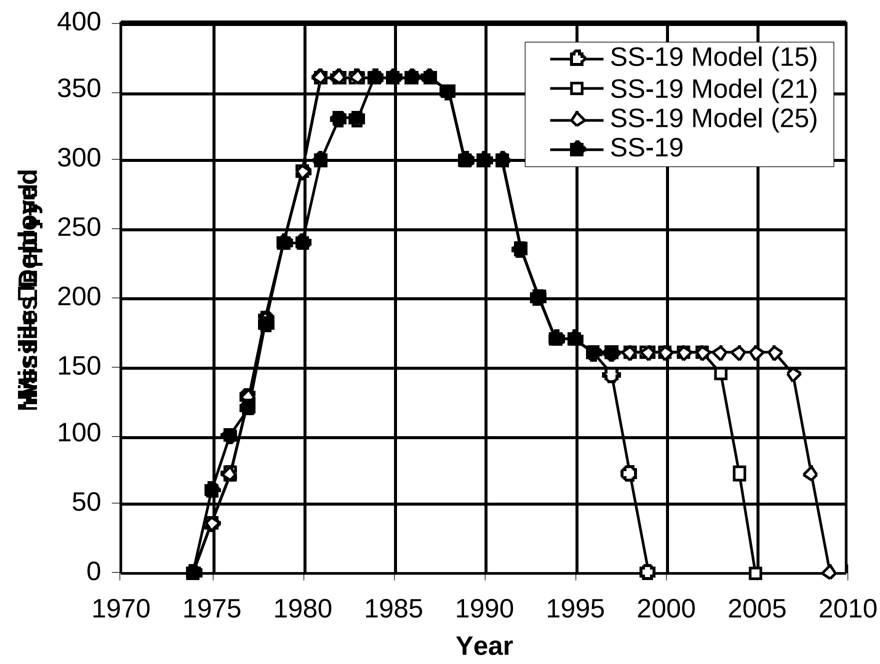

Fig. 5 - SS-19 Model Projections

the 72 missiles still remaining in 2008 will carry a single warhead.[21] All SS-19s are assumed to be retired by 2009. Extending the SS-19 service life to 25 years may be possible because the SS-19 missile was originally designed and built in Russia. Note that delaying the implementation of START II allows Russia to take full advantage of the SS-19 as a MIRVed missile before it must be retired.

SS-24

Figure 6 shows the deployment history for silo-based and mobile versions of the ten-warhead SS-24 (i.e., the Russian RT-23UTTH ICBM). The RT-23UTTH missile was developed at the Yuzhmash Design Bureau and built at the Pavlograd Mechanical Plant, both located in Ukraine.[22] All 36 rail-mobile SS-24s are located in Russia (at bases near Bershet, Kostroma, and Krasnoyarsk). However, of the original 56 silo-based SS-24s, only 10 were deployed at Tatishchevo in Russia. The remainder were deployed at Pervomaysk in Ukraine. The silo-based SS-24s in Ukraine were removed between 1992 and 1994. The service life for both versions of the SS-24 is reported to be 10 years.[23] Since the missile was produced in Ukraine and the production line was shut down in 1995, there is little opportunity to extend the service life of this missile.[24] In addition, there have been reports that the rail-mobile SS-24 has experienced safety problems and may be decommissioned early.[25] Hence, it is quite likely that the SS-24 will be retired shortly. Note that the model prediction for the road-mobile SS-24 does not fit the data point for 1997. This data point, however, refers to START accountable systems and not operational systems. The START II Treaty will have little impact on the SS-24 because, according to this model, all SS-24s will be retired by 2000. Put another way, the SS-24 service life would have to exceed 13 years before the START II Treaty would affect the SS-24 deployment.

SS-25

The SS-25 (RT-2PM Topol), first deployed in 1985, is the most modern ICBM in the current Russian arsenal. It was designed by the Moscow Institute of Thermal Technology and produced at the Votkinsk Machine-Building Plant in Russia.[26] It is a single-warhead, solid propellant ICBM based in a road-mobile configuration. The deployment history of the SS-25 is shown in Fig. 7. The model fit assumes that the SS-25 was deployed at two

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[21] Ibid., 14.

[22] See Steven J. Zaloga, "Molodets: symbol of the Soviet swan song," *Jane's Intelligence Review*, Vol. 8, No. 8 (August 1996), 347–348.

[23] See Joshua Handler, "The Future of Russian Strategic Forces," *Jane's Intelligence Review*, Vol. 7, No. 4 (April 1995), 163. The SS-24 guidance system, built by AiP NPO in Kharkov, Ukraine, reportedly has a service life of approximately 3.4 years. See Steven J. Zaloga, "Molodets: symbol of the Soviet swan song," op cit., 347–349.

[24] There is some possibility that Ukraine may open the production line to produce the Space Clipper, a space-launch vehicle based on the SS-24 rocket. However, this option has not moved beyond the proposal stage. See Steven J. Zaloga, "Molodets: symbol of the Soviet swan song," op cit., 349.

[25] Ibid., 349

[26] The transporter erector launcher for the SS-25 was assembled by the Barrikady Plant in Volgograd and the SS-25 guidance system was built by Signal NII in St. Petersburg. See Steven J. Zaloga, "The Topol (SS-25) Intercontinental Ballistic Missile," *Jane's Intelligence Review*, Vol. 7, No. 5, May 1995, 195–200.

different rates:

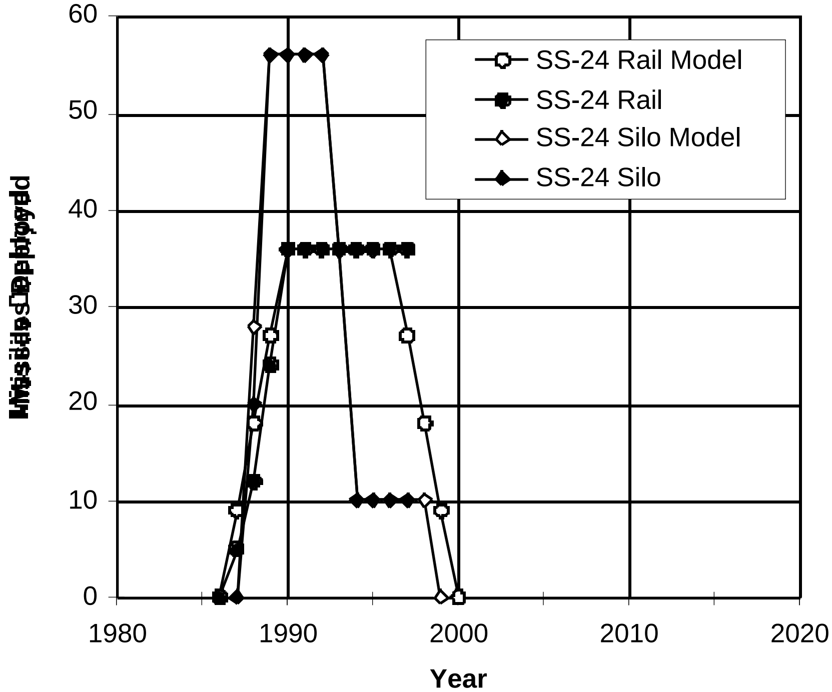

Fig. 6 - SS-24 Deployment and Model Projections

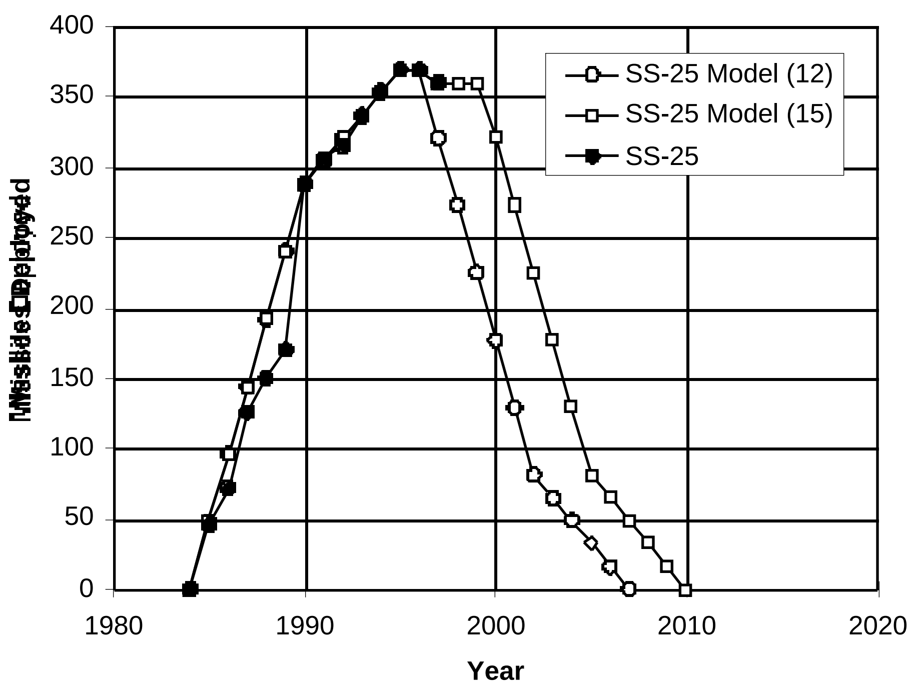

Fig. 7 - SS-25 Deployment and Model Projection

an average rate of 48 missiles per year between 1985 and 1990 and an average rate of 16.2 missiles per year between 1991 and 1995.[27] The service life that best fits the data is 12 years, although the original service life for the SS-25 was supposed to be 10 years.[28] Even with a 12-year service life the model does not fit the 1997 data point. However, the 1997 data point is for START accountable SS-25s and not operational missiles.

The only viable modernization option for the SS-25 is to extend its service life by several years. The second model profile in Fig. 7 assumes a service life of 15 years, as has been suggested in the literature.[29] This may be accomplished by maintaining low peacetime alert rates to avoid exposing missiles to the rigors of deployment in the field, as Russia appears to be doing, and producing spare parts to replace SS-25 subsystems that are aging. Production of the SS-25 ceased around 1995. Continued production of the SS-25 is not a viable option because the new SS-27 (Topol M), which is a follow-on to the SS-25, is being produced at the same plant. Hence, the SS-25 should begin to be retired from the force this year unless a service life extension program can extend its life by several years. The missiles will begin to be retired by 2000 in any case.

SS-27 (Topol M)

Russia's main ICBM modernization program is the Topol M, being designed by the Moscow Institute of Thermal Technology and produced at the Votkinsk Machine-Building Plant in Russia. The Topol M is a solid-fuel ICBM similar in design to the SS-25, although somewhat larger in size and with a slightly heavier throw weight (1.2 metric tons instead of 1.0 metric tons).[30] Although the current plan calls for a single-warhead missile, the Topol M can probably accommodate up to three MIRVs, like the SS-25. Unlike the SS-25, silo-based and road-mobile versions are expected. The first two SS-27s were deployed in former SS-19 silos at Tatishchevo in December 1997 after an unusually small number of flight tests (only four compared to the more typical range of 15–20 for new ICBMs).[31] The road-mobile version is expected to be deployed by 2000 or 2001.[32] The silo-based Topol M is supposed to have a service life of 20 years and the road-mobile Topol M reportedly will have a service life of 15 years (compared to 12 years for the road-mobile SS-25 and 10 years for the rail-mobile SS-24).[33]

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[27] Joshua Handler gives a deployment rate of 11 SS-25s per year from 1991 to 1994 in "The Future of Russian Strategic Forces," op cit., 163.

[28] See Steven J. Zaloga, "The Topol (SS-25) Intercontinental Ballistic Missile," *Jane's Intelligence Review*, Vol. 7, No. 5, May 1995, 200.

[29] See Paul Podvig, "The Russian Strategic Forces: Uncertain Future," op cit., 15.

[30] See Stephen J. Zaloga, "The Topol (SS-25) Intercontinental Ballistic Missile," op cit., 195–200; and Nikolai Sokov, *Modernization of Strategic Nuclear Weapons in Russia: The Emerging New Posture*, op cit., 33.

[31] See Nikolai Sokov, *Modernization of Strategic Nuclear Weapons in Russia: The Emerging New Posture*, op cit., 31.

[32] See Nikolai Novichkov, "Russia will field Topol M ICBM by end of this year," *Jane's Defence Weekly*, July 16, 1997, 3.

[33] See Stephen J. Zaloga, "The Topol (SS-25) Intercontinental Ballistic Missile," op cit., 200.

The Topol M deployment rate depends on the level of funding and the production capacity at the Votkinsk Machine-Building Plant. This plant reportedly has a maximum

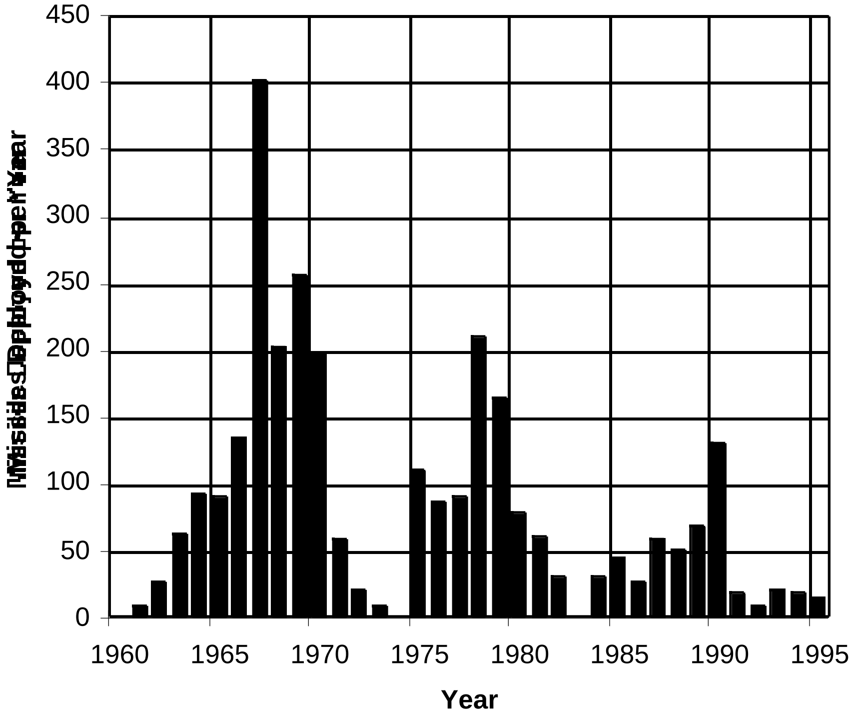

Fig. 8 - Historical Soviet/Russian ICBM Deployment Rate

production capacity of up to 80 missiles per year, with a production rate around 30 missiles per year being optimal. A production rate between 12 and 15 missiles per year is the minimum required to sustain the network of approximately 200 subcontractors on the project.[34] Of course, the production rate and the deployment rate are not the same because extra missiles must be produced for test and evaluation and for “non-deployed” missile spares. Using the SS-25 as a guide, approximately 75 percent of the missiles produced were deployed.[35] Hence, the maximum deployment rate ought to be around 60 Topol M missiles per year, assuming adequate funding. For comparison, Fig. 8 shows the deployment rate for ICBMs of all types by year in the former Soviet Union. Note that funding for deployment rates above 60 ICBMs per year was common during the massive ICBM buildups in the late 1960s and late 1970s, although the rate stayed around 45 missiles per year during the Soviet ICBM buildup in the late 1980s.

The Topol M force level that can be achieved depends on the length of the production run (which also depends on funding), and on the availability of silos and mobile ICBM garrisons. To bracket these uncertainties, three Topol M force structures have been constructed for this analysis. The first assumes that 90 silo-based Topol Ms are deployed

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[34] See Nikolai Sokov, *Modernization of Strategic Nuclear Weapons in Russia: The Emerging New Posture*, op cit., 32–33.

[35] See footnote 10.

over a 13-year period starting in 1999 and 110 road-mobile Topol Ms are deployed over a 10-year period starting in 2001. These production runs are relatively long compared to previous ICBM production runs. This force requires a deployment rate of approximately 18 missiles per year, a rate close to the minimum required production rate and close to the deployment rate for the SS-25 during the early 1990s—a time when Russia was undergoing considerable political and economic turmoil. The second force assumes 195 silo-based and 205 road-mobile Topol Ms are deployed over the same time periods for a maximum deployment rate of approximately 35 missiles per year. The final Topol M force assumes 195 silo-based and 350 road-mobile missiles are deployed over the same time periods for a maximum deployment rate of 50 missiles per year—a rate similar to the deployment rate for the SS-25 during the late 1980s. The production rates, of course, may be about 35 percent higher. Figures 9, 10, and 11 show the silo-based, road-mobile, and total Topol M deployment options, respectively. The road-mobile SS-25 force (with its service life extended to 15 years) has been added to the road-mobile Topol M deployments in Fig. 10 to illustrate the fact that a large drop in the number of road-mobile missiles will occur shortly after the turn of the century because deployment of the road-mobile Topol M cannot keep up with SS-25 retirement.

The 400-missile Topol M force (middle projection in Fig. 11) is consistent with current Russian plans (a production rate of 30–40 Topol Ms per year), which seems realistic if modest economic growth occurs in Russia over the next decade as the government predicts.[36] The 200 and 545 Topol M projections provide low and high estimates for possible future Topol M forces that also are plausible, depending on the assumptions one makes about funding. Obviously, different silo-based and road-mobile Topol M mixes could also be considered. It is even possible to consider larger silo-based Topol M forces because 334 high-quality ICBM silos (154 SS-18 silos, 170 SS-19 silos, and 10 SS-24 silos) will exist in Russia by 2000. Using more than 90 SS-18 silos for single-warhead missiles would require renegotiating (or not ratifying) the START II Treaty. However, such options might be attractive to Russian planners because silo-based ICBMs are less expensive, safer, and more secure than road-mobile ICBMs—considerations that have become increasingly important since the dissolution of the Soviet Union.[37] The SS-27 deployed in former SS-18 and SS-19 silos may be quite survivable because these silos are among the hardest ever built by the former Soviet Union and the added room with a small missile deployed in these silos suggests that the SS-27 could have greater shock resistance and hence could be more difficult to destroy than the SS-18 and SS-19 ICBMs deployed in these silos.

Modernized ICBM Force

Figure 12 shows the historical deployment profile for Soviet/Russian ICBMs, along with the aggregate model fit.[38] Two model projections are shown for the expected life of the

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[36] See Nikolai Sokov, *Modernization of Strategic Nuclear Weapons in Russia: The Emerging New Posture*, op cit., 33.

[37] Road-mobile ICBM basing requires approximately five to six times the number of personnel compared to silo basing, thereby raising the operating and support costs. See Stephen J. Zaloga, “The Topol (SS-25) Intercontinental Ballistic Missile,” op cit., 199.

[38] The model projection underestimates the historical data for the number of ICBMs deployed between 1975 and 1985 because the SS-11 Mod 1 model underestimates the number of SS-11s deployed during this period (see Fig. A.2) and it overestimates the number of ICBMs deployed between 1986 and 1990 because the model overestimates the number of SS-17s (see Fig. A4) and SS-25s deployed during this period.

current

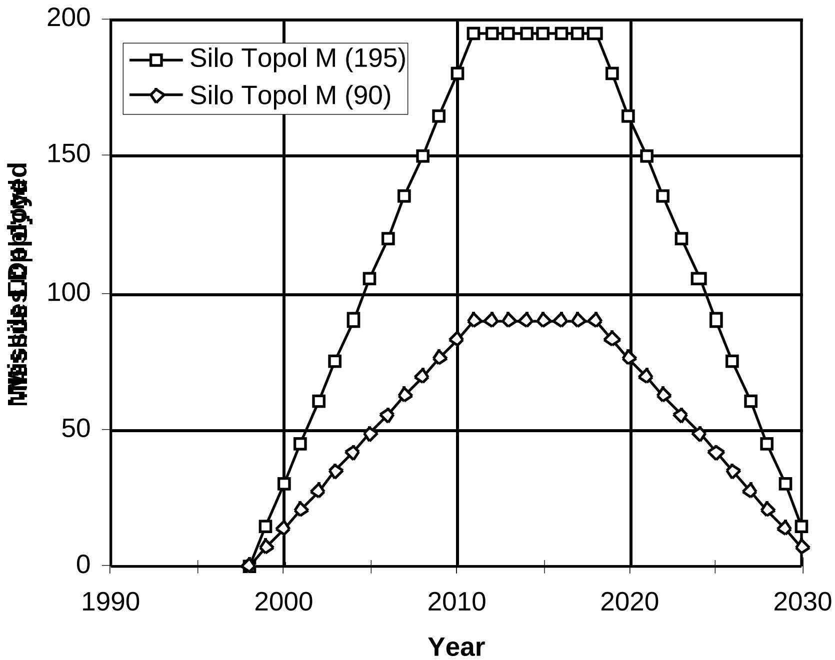

Fig. 9 - Topol M Silo Deployments

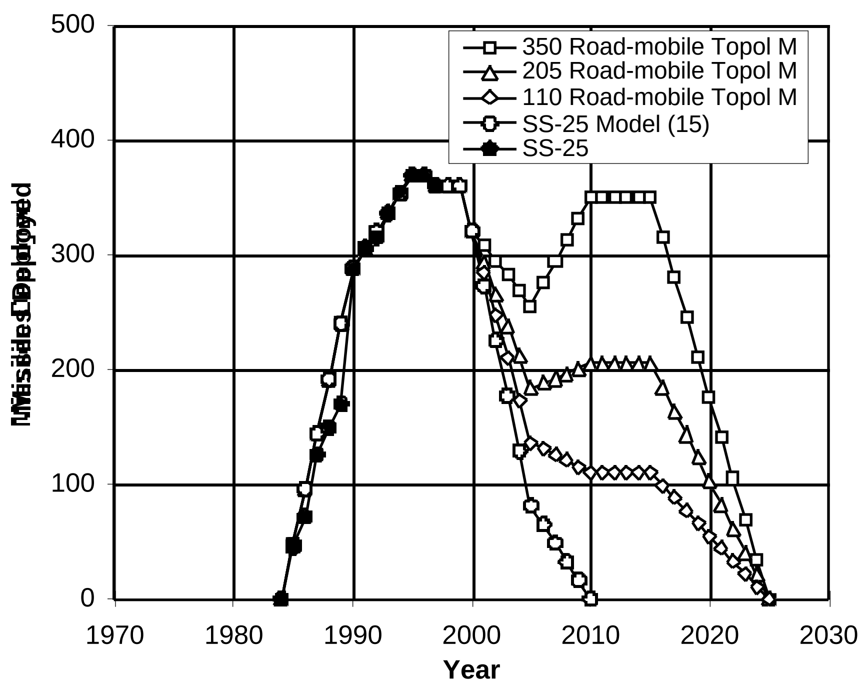

Fig. 10 - Topol M Road-Mobile Deployments (Including the SS-25)

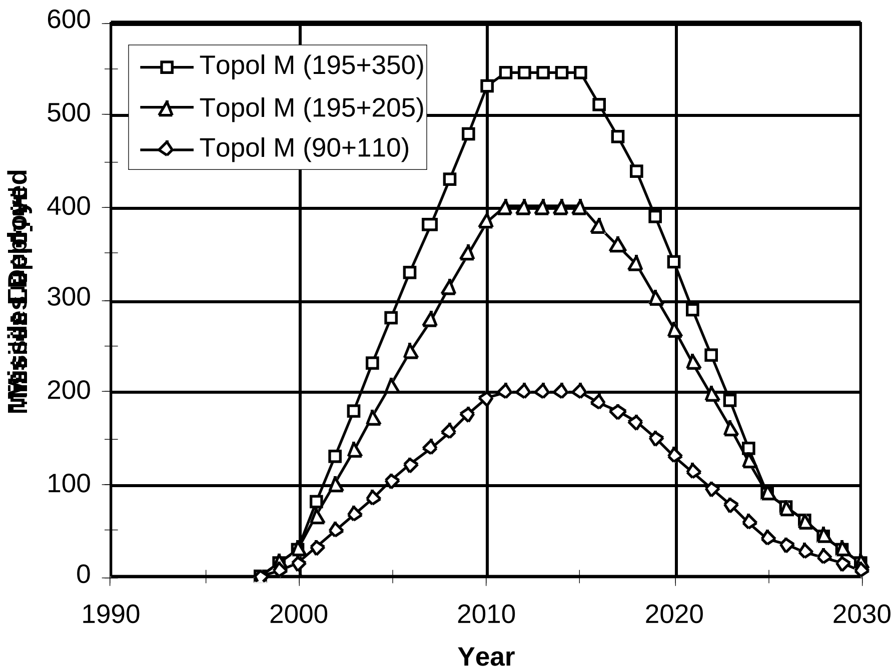

Fig. 11 - Total Topol M Deployments

Russian ICBM force without modernization depending on whether the START I or START II Treaty is in force. The large decrease in ICBMs deployed between 1990 and 1995 reflects the breakup of the former Soviet Union. However, the drop expected after 1997 is due to the obsolescence of the remaining force. By 2005, the current Russian ICBM force will be largely obsolete. This is consistent with one Russian report which stated that Russian fixed and mobile missiles "will have exhausted their service life by the years 2000–2003."[39] Note that the START II Treaty does not alter the number of deployed ICBMs appreciably because most of these systems reach the end of their service life before START II takes effect. Hence, the START II Treaty, if it is ratified by the Duma, will not have much impact on existing ICBMs but rather will constrain the modernization options Russia might pursue.

Multiplying the number of ICBMs of each type by the number of warheads each carries provides a profile of the total expected ICBM warhead inventory without modernization, as shown in Fig. 13.[40] Figures 12 and 13 illustrate not only the remarkable Soviet ICBM buildup during the 1960s and the MIRV programs of the 1970s, but the equally remarkable drop expected in the Russian ICBM force as Russia enters the twenty-first century—a drop all the more amazing because ICBMs were the premier delivery system in the Soviet strategic nuclear arsenal.

[39] See Joshua Handler, "The Future of Russian Strategic Forces," op cit., 163.

[40] Again, the model overestimates the number of ICBM warheads deployed between 1986 and 1990 because the SS-17 carried up to four MIRVs. The underestimate of the number of SS-11s deployed between 1975 and 1985 disappears in this plot because the SS-11 carried a single warhead.

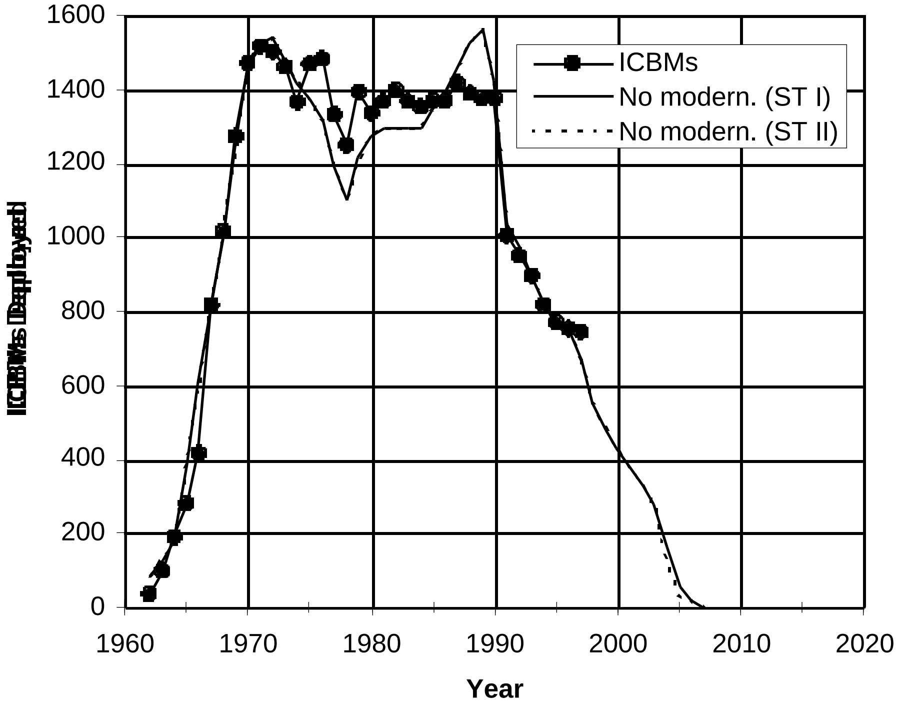

Fig. 12 - Total Soviet/Russian ICBMs (w/o Modernization)

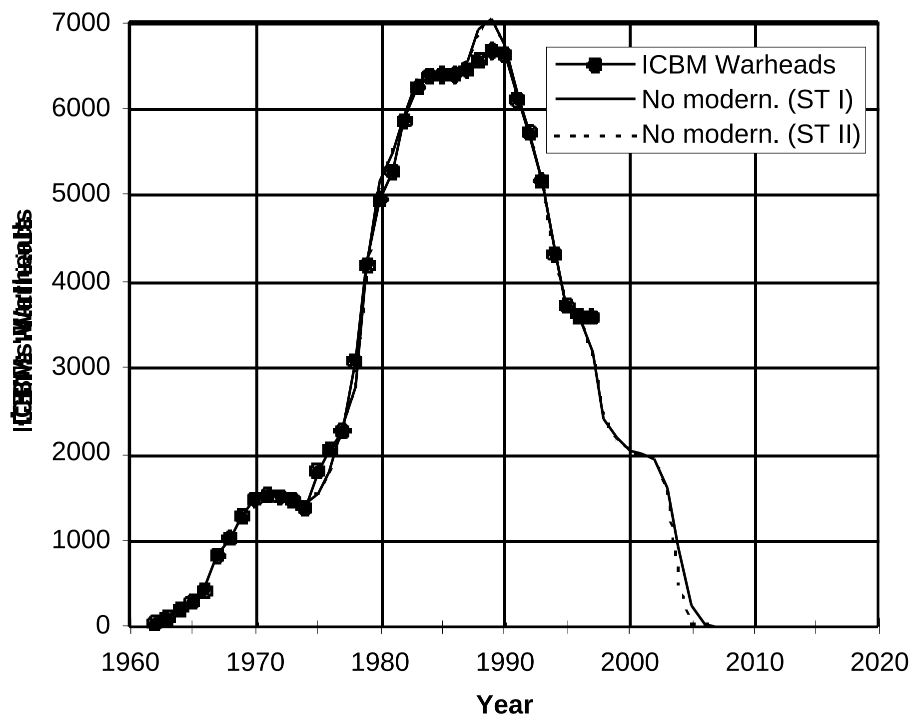

Fig. 13 - Total Soviet/Russian ICBM Warheads (w/o Modernization)

Finally, Figs. 14 and 15 show the projected future Russian ICBM force in missiles and warheads, respectively. The projected START I force assumes that the service life of the remaining 154 SS-18s is extended from 15 to 20 years, that the SS-19 service life is extended from 21 to 25 years, that all SS-19s remain MIRVed until 2008, that the SS-25 service life is extended from 12 to 15 years, and that 545 Topol M missiles carrying three MIRVs each are deployed in silo-based and road-mobile configurations, with the majority of the Topol M silo deployment occurring after the SS-18s and SS-19s are retired. This projection is not intended to represent a likely future Russian force, but rather provides a plausible upper bound on the size of Russia's future ICBM force if the START II Treaty is not ratified.[41] Therefore, Russia could, in principle, maintain an ICBM force with between 1,500 and 3,000 warheads for the first 15 years of the twenty-first century.

The other three modernization options assume that START II is in effect, that the SS-18 service life is 15 years, the SS-19 service life is extended from 21 to 25 years with no more than 105 single-warhead SS-19s deployed after 2007, the SS-25 service life is extended from 12 to 15 years, and that 200, 400, or 545 single-warhead Topol M missiles are deployed in silo-based and road-mobile configurations. These three START II options illustrate the fact that the START II Treaty may not have much impact on the number of ICBMs deployed but it will have a substantial impact on the number of ICBM warheads deployed.

Submarine-Launched Ballistic Missiles

Russian SSBN and SLBM modernization is the next highest priority behind ICBM modernization because these systems will become obsolete next. Russian submarine modernization is occurring against a backdrop of a decaying submarine fleet. Amidst stories of officers and sailors that go months without pay, submarines rusting in port, maintenance delays, and low operational readiness, one wonders how Russia can afford to build new submarines at all. Its strategy is straightforward. The severe budget crunch has forced the Russian Navy to retire older attack and ballistic missile submarines prematurely and to concentrate its limited resources on maintaining only the most modern assets, i.e., the Oscar and Akula attack submarines and the Delta IV SSBN. Less frequent deployments at sea help extend the service lives of these systems.[42] Within this context,

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[41] One can generate larger ICBM forces if a new ICBM in the 90-ton class (i.e., similar to the SS-19 or SS-24) is deployed. Such an ICBM, if liquid fueled, could be produced at the former SS-19 production plant and, if solid fueled, could in principle be built at the plant that makes the solid-propellant SS-N-20 SLBM. These options have been considered in Russia, especially if START II is not ratified and Russia returns to its traditional emphasis on MIRVed ICBMs, but are not included here because they do not appear to be in the current plan. Commitment to the Topol M modernization plan, the lack of sufficient ICBM silos, and the expectation that MIRVed ICBMs will be banned under START II may be among the reasons why these options are not being pursued. See Alexei G. Arbatov, *Implications of the START II Treaty for US-Russian Relations*, Stimson Center Report No. 9, The Henry L. Stimson Center, Washington, DC, October 1993, 20.

[42] Typically, only one or two SSBNs are on patrol from the Northern Fleet and probably fewer from the Pacific Fleet—a rate that is four to five times lower than the Soviet peacetime patrol rate during the Cold War. See Joshua Handler, "Russia seeks to refloat a decaying fleet," *Jane's International Defence Review*, January 1997, 44.

Russian SSBN modernization will go forward, although at a slower pace than before the collapse of the Soviet Union.

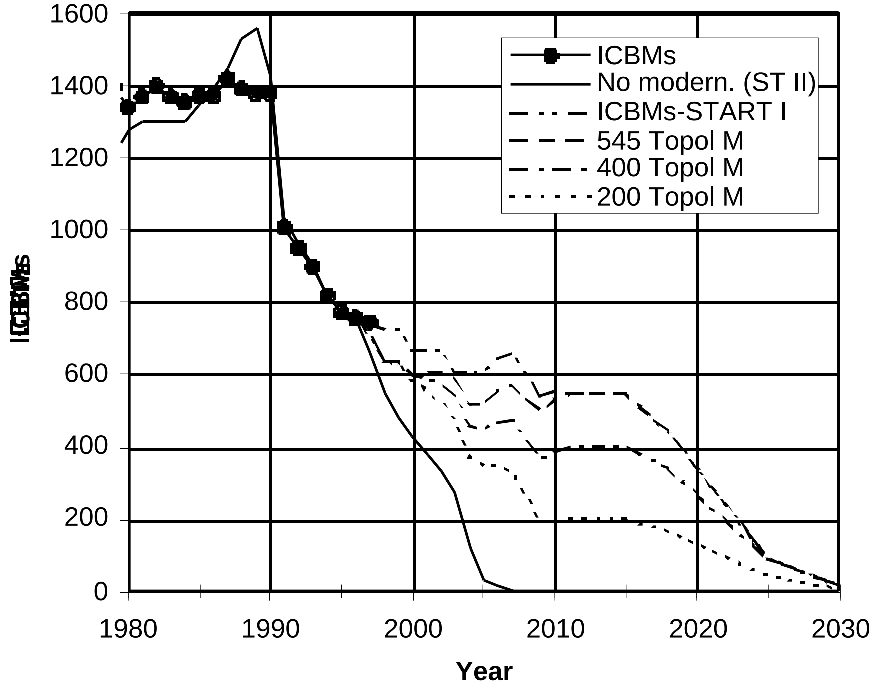

Fig. 14 - Projected Russian ICBM Force

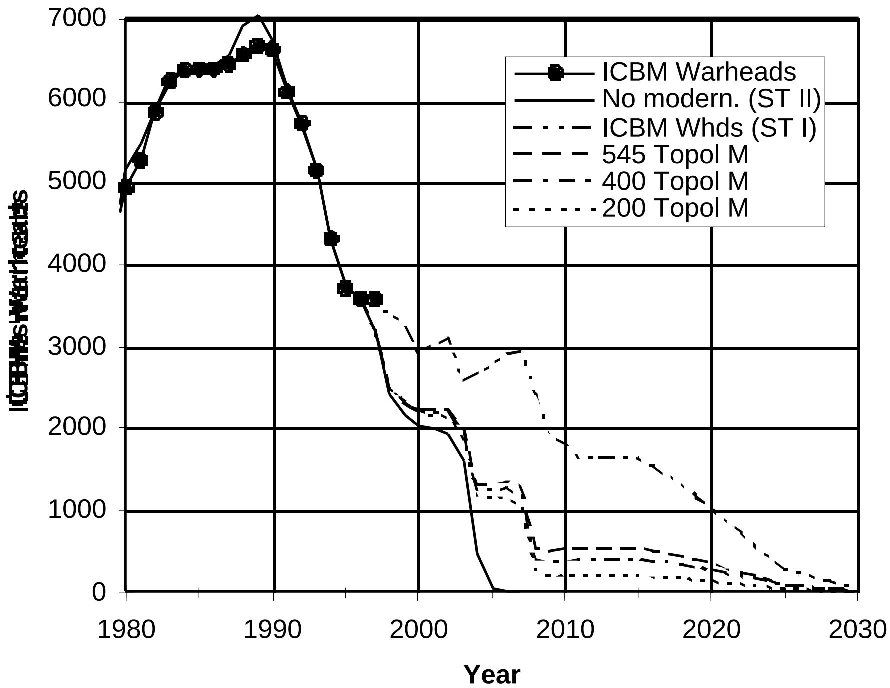

Fig. 15 - Projected Russian ICBM Warheads

Russia currently has three operational SSBN types, the Delta III, Delta IV, and Typhoon submarines, carrying SS-N-18, SS-N-23, and SS-N-20 SLBMs, respectively. In November 1996, Russia laid the keel for the *Yuri Dolgoruki*, the first of the new Borey-class SSBNs. This SSBN is similar in design to the Delta-class SSBNs. In fact, it is sometimes referred to as the Delta V. In addition, there is evidence that Russia has two SLBM modernization programs under way, one of which is a modernized version of the solid-fuel SS-N-20 (i.e., the SS-NX-28), presumably for deployment on Typhoon submarines and possibly the new Borey SSBN as well, and the other a modernized version of the liquid-fuel SS-N-23, which also may be the missile that will be deployed on the new Borey SSBN.[43] One of the biggest decisions facing the Russian Navy is whether enough Borey-class submarines will be deployed to maintain boats with the Northern and Pacific Fleets. If not, the Russian Navy will have to consolidate its SSBN operations with the Northern Fleet. The Delta III is the only SSBN currently deployed with the Pacific Fleet.

Delta-Class SSBNs

The Delta-class SSBNs were built at the Severodvinsk shipyard in Russia from 1972 to 1991. The SLBMs deployed on these boats, as with almost all Soviet/Russian SLBMs, were designed by the Makeev Design Bureau in Miass, Russia, and built at the Krasnoyarsk Machine Building Plant in Russia. Figure 16 shows the deployment history of the Delta-class SSBNs, along with future projections. The Delta I (Project 667B) carried 12 SS-N-8 SLBMs and the Delta II (Project 667BD) carried 16 SS-N-8 SLBMs, each with a single warhead. The Delta III (Project 667BDR) carries 16 SS-N-18 (R-29R) SLBMs. The warhead count for the SS-N-18 SLBMs is complicated by the fact that three modifications were deployed: the Mod 1 with up to three MIRVs, the Mod 2 with a single warhead, and the Mod 3 with up to seven MIRVs.[44] Three warheads are associated with each SS-N-18 in this analysis because this is the number attributed to each missile in the START I Treaty. Finally, the Delta IV (Project 667BDRM) carries 16 SS-N-23 (R-29M) SLBMs, each with four MIRVs.

The average production rates for the Delta I, II, III, and IV were 3.6, 1.0, 2.3, and 1.0 boats per year, respectively. The service lives that fit the deployment data for the Delta I, II, and III SSBNs are 19, 21, and 21 years, respectively. From the data it appears that the Delta I and II boats were retired more rapidly than one would expect based on their service lives. The Delta III should be retired shortly, with one boat having been retired in 1995.[45] The Delta IV is the only Delta-class boat that will remain operational in the next decade. The projected deployment for the Delta IV in Fig. 16 assumes a service life of 21 years.

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[43] See Nikolai Sokov, *Modernization of Strategic Nuclear Weapons in Russia: The Emerging New Posture*, op cit., 39.

[44] See Robert S. Norris and Thomas B. Cochran, *US-USSR/Russian Strategic Offensive Nuclear Forces: 1945–1996*, op cit., 30.

[45] A Russian missile specialist has warned that many of the SS-N-18 missiles carried aboard the Delta III SSBNs may be reaching the end of their service life. See David Hoffman, “Russian Warns of Missile Danger,” *Washington Post*, May 14, 1998, 25.

Typhoon SSBN

The Typhoon (Project 941) SSBN also was built at the Severodvinsk shipyard during the 1980s. Figure 17 illustrates the deployment history for the Typhoon, along with a model

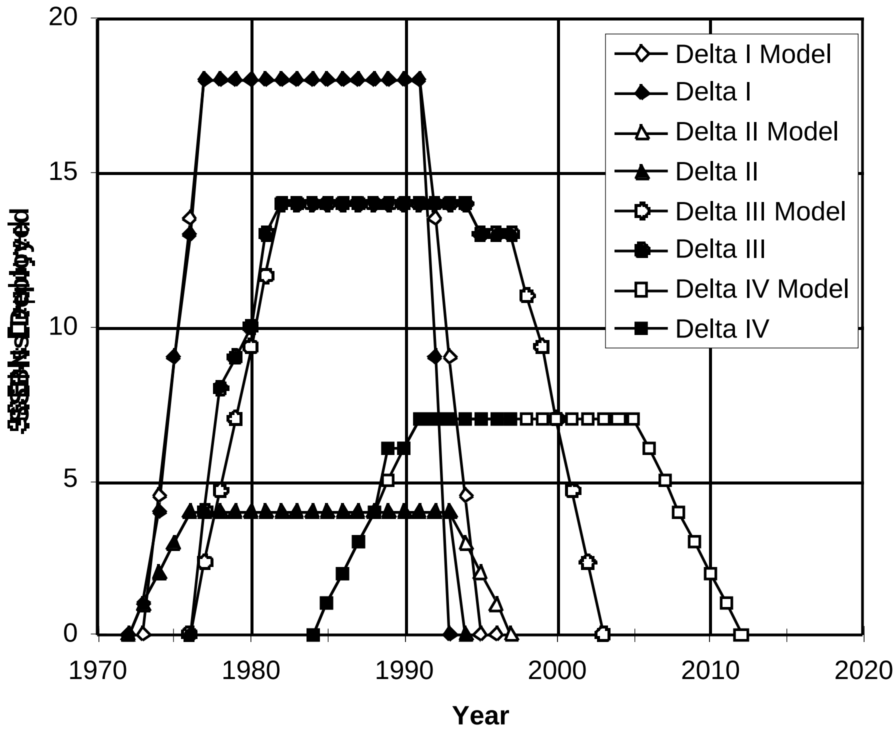

Fig. 16 - Delta I, II, III, & IV Deployment

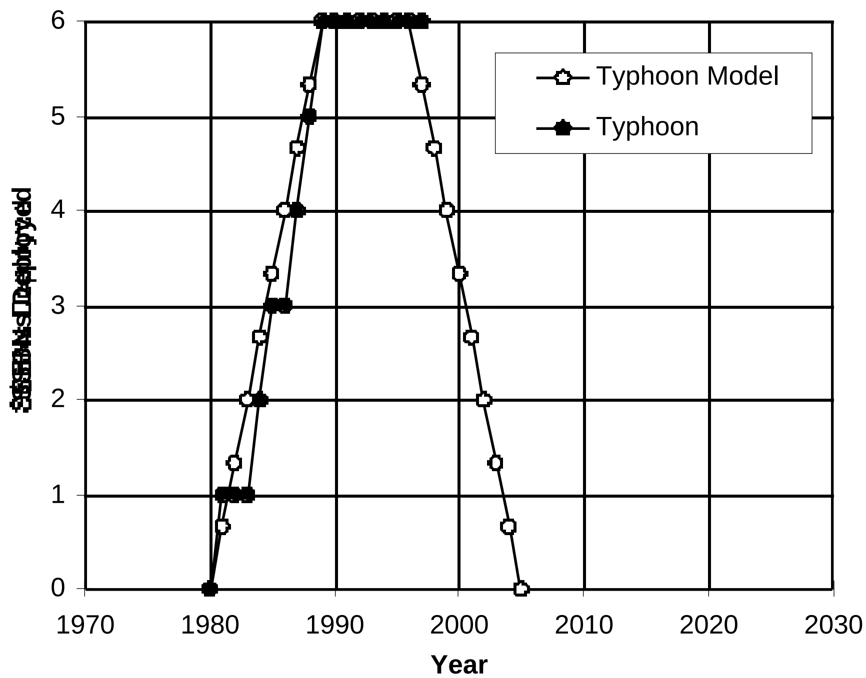

Fig. 17 - Typhoon Deployment

projection for the future assuming a service life of 16 years. This is less than the nominal 20-year service life for Russian SSBNs because the Typhoon is reportedly experiencing maintenance problems and hence is expected to be retired soon, though all six boats are still START accountable.[46] Two Typhoon SSBNs reportedly have been deactivated, although not decommissioned, because they lack replacement SLBMs (presumably the SS-NX-28).[47]

The SS-N-20 (R-39) SLBM carried aboard the Typhoon was designed at the Makeev Design Bureau in Miass, Russia, with the first stage originally built at the Pavlograd Machine-Building Plant in Ukraine and the remaining stages built at the Zlatoust Machine-Building Plant in Russia. The SS-N-20 is the only solid-fuel SLBM in the Russian inventory and reportedly has a service life of 10 years.[48] After the breakup of the Soviet Union, construction of the first stage was transferred to Russia (perhaps to the Biysk Chemical Combine).[49] A new solid-fuel SLBM, the SS-NX-28 (or R-39UTTH missile), is suppose to replace the SS-N-20 for the second half of the Typhoon's service life. However, to date all tests of the SS-NX-28 have failed. The SS-NX-28 is similar in

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[46] This estimate is based on a 1996 claim by the head of the Russian Navy's Technical Directorate, Vice Admiral Viktor Topilin, that two Typhoon SSBNs were already "unfit for combat." Other estimates place the number of operational Typhoons in 2000 between 3 and 4 boats, which is consistent with a 16-year service life. See Joshua Handler, "Russia seeks to refloat a decaying fleet," op cit., 44, 47.

[47] See Paul Podvig, "The Russian Strategic Forces: Uncertain Future," op cit., 17.

[48] Ibid., 17.

[49] See Steven J. Zaloga, "The thunder inside Russia's 'Typhoons'," *Jane's Intelligence Review*, December 1996, 536.

design to the SS-N-20 but with greater range and throw weight, and with an expected payload of up to 10 MIRVs. This may be the missile that once was proposed as a universal ICBM/SLBM to replace the SS-24 ICBM and the SS-N-20 SLBM.[50] It has also been suggested that the SS-NX-28 SLBM will be deployed on the new Borey SSBN.

Borey SSBN

Construction on the first Borey (Project 955) SSBN began in November 1996 at the Severodvinsk shipyard in Russia after a 10-year construction hiatus. The estimated launch date for this boat is 2002, with an initial operational capability projected for 2004 or 2005. The first boat appears to have 12 SLBM launch tubes, although later versions may have 16 launch tubes.[51] Moreover, the design of the boat (its size and the location of the SLBMs behind the conning tower) suggests that the Borey is a follow-on to the Delta-class SSBN (i.e., the Delta V).

Confusion exists about the SLBM that will be deployed on the Borey SSBN. The U.S. Office of Naval Intelligence suggests that the SS-NX-28 will be deployed on this submarine. However, this may be suspect because this missile is a follow-on to the SS-N-20 and may not fit into the smaller Borey SSBN—although this would help explain the small number (12) of launch tubes. Others suggest that a new follow-on to the liquid-fuel SS-N-23, also being designed by the Makeev Design Bureau, will be deployed on the Borey. Since the

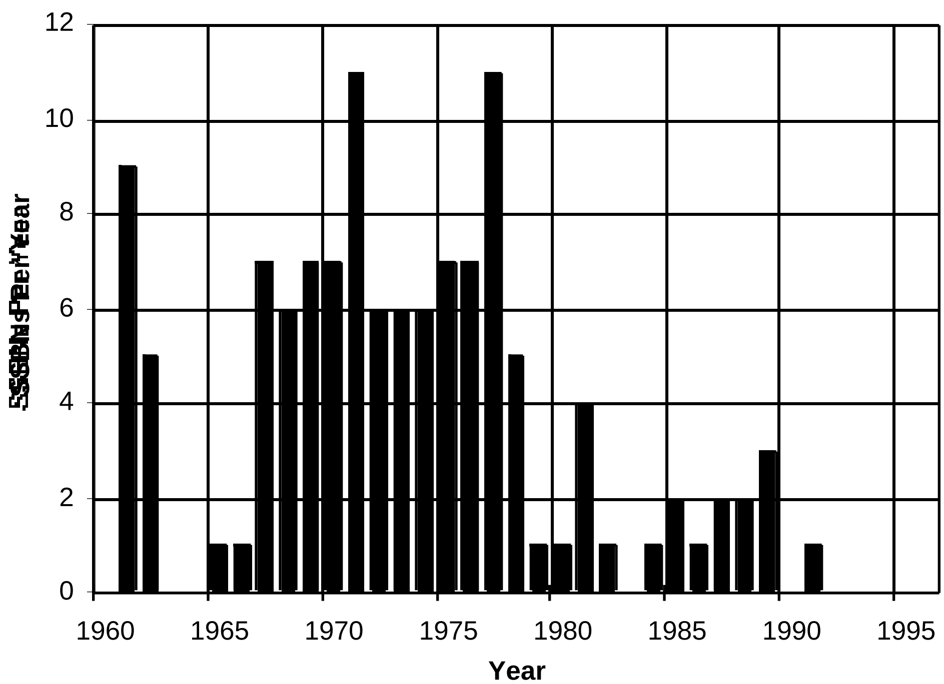

Fig. 18 - Historical Soviet/Russian SSBN Production Rate

[50] See Alexei G. Arbatov, *Implications of the START II Treaty for US-Russian Relations*, op cit., 20.

[51] See U.S. Office of Naval Intelligence, *World Wide Submarine Challenges*, 1997, 16; and Steven J. Zaloga, “The thunder inside Russia’s ‘Typhoons’,” *Jane’s Intelligence Review*, December 1996, 536.

missile has been tested only once (and failed), little is known about its technical characteristics. However, it seems reasonable to assume that it will carry four MIRVs with a maximum payload of up to 10 MIRVs (the SS-N-23 reportedly can carry 10 MIRVs, although it is deployed with only four).[52]

Little is known about the rate at which Borey SSBNs might be deployed or about the total number of boats that eventually will be deployed. Obviously, this depends on funding. Russia apparently retains the capability to produce about three submarines per year.[53] Determining the future split between attack submarine and SSBN production is difficult because it depends on political decisions within the Ministry of Defense, although one estimate places Russian SSBN production at around one boat per year.[54] This is small by past production practices, as one can see from Fig. 18. The average Soviet SSBN production/deployment rate in the 1970s and 1980s was 6.7 and 1.7 SSBNs per year, respectively. The average SSBN deployment rate from 1990 to 1997 was 0.14 boats per year, reflecting the turmoil of the past seven years.

The U.S. Office of Naval Intelligence estimates that the future Russian SSBN fleet will contain 14 boats in 2010, of which eight will be Borey SSBNs.[55] Rear Admiral Aleksey Ovcharenko, deputy chief of the Russian Navy operations directorate, recently stated that a future Russian SSBN force between 10 to 15 boats should be adequate and Admiral Oleg Yerofeyev, commander of the Russian Northern Fleet, recently estimated that a force between 13 to 16 boats should be adequate.[56] Other estimates place the number of Borey SSBNs that eventually will be deployed at seven due to financial constraints, although the original Russian plan in the early 1990s called for an SSBN force with 18 submarines under START II.[57]

This analysis presents three different Borey force structures to capture a range in the number of SLBM warheads that might be deployed on Borey SSBNs. The low, medium, and high forces assume 8, 12, and 16 Borey SSBNs are deployed, respectively, after a 10-year production run (i.e., the production rates are assumed to be 0.8, 1.2, and 1.6 boats per year), with the first boat becoming operational in the year 2004 and the last becoming operational in 2013. These deployment rates are consistent with historical SSBN deployment rates, although a production run of 10 years is long compared to the past. Figure 19 shows these three Borey SSBN projections along with the Delta IV and Typhoon force, assuming the Borey has a service life of 20 years. Finally, each Borey SSBN is assumed to carry 12 SS-NX-28 SLBMs, or SS-N-23 follow-on SLBMs, each carrying four, five, or six MIRVs for the low, medium, and high SLBM force structures, respectively. Obviously, 16 SLBM launch tubes per Borey SSBN is also a possibility and a higher MIRV loading is possible if the SS-NX-28 is deployed on the Borey. Finally,

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52 See Nikolai Sokov, *Modernization of Strategic Nuclear Weapons in Russia: The Emerging New Posture*, op cit., 39–40.

53 See Robert Holzer, "Subs Benefit from Separate Russian Navy Budget," *Defense News*, September 9–15, 1996, p. 14. For example, from 1991 to 1995 Russia launched one new Delta IV SSBN, four Oscar II cruise missile submarines, and five Akula attack submarines. See Joshua Handler, "Russia seeks to refloat a decaying fleet," op cit., 44.

54 See *World Wide Submarine Challenges*, op cit., 16.

55 Ibid., 17.

56 See Joshua Handler, "Russia seeks to refloat a decaying fleet," op cit., 45.

57 See Nikolai Sokov, *Modernization of Strategic Nuclear Weapons in Russia: The Emerging New Posture*, op cit., 40.

Russia has adequate production capacity to outfit 2-3 SSBNs per year, assuming adequate funding, because the Krasnoyarsk Machine Building Plant, responsible for all liquid-fuel naval missiles, can produce up to 40 SLBMs per year and the Zlatoust Machine Building Plant, responsible for all solid-fuel naval missiles, can produce up to 30 SLBMs per year.[58]

Modernized SLBM Force

Figure 20 shows the number of Soviet/Russian SSBNs that have been deployed during the Cold War, the model fit to the SSBN deployment data, and the three Borey SSBN modernization options discussed above.[59] The model fit shows the rate at which existing SSBN types will be retired if no modernization occurs. Again, the rapid buildup of the Soviet SSBN fleet from 1965 to 1975 is rivaled only by the rapid decline in the Soviet/Russian SSBN fleet after 1988. The resulting SLBM force and the projected number of SLBM warheads are shown in Figs. 21 and 22, respectively. Although the total number of SLBMs

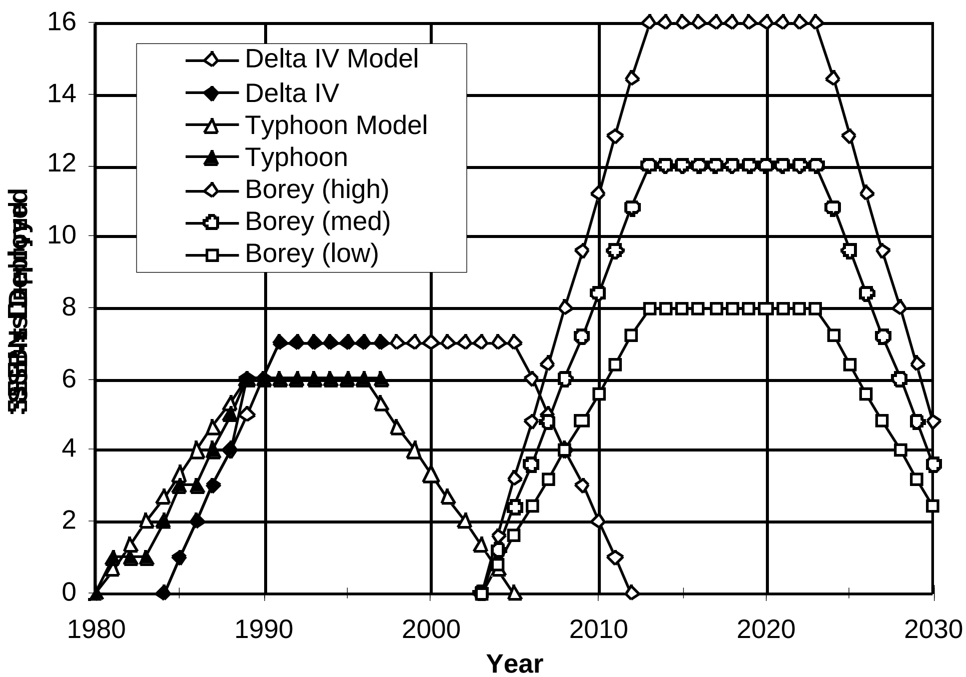

Fig. 19 - Possible Borey SSBN Deployments

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[58] See Vladimir S. Belous, Anatoli S. Diakov, Timur T. Kadyshev, Yevgeny V. Miasnikov, and Pavel L. Podvig, *Nuclear Arms Reduction: The Process and Problems*, Center for Arms Control, Energy, and Environmental Studies, Moscow Institute of Physics and Technology, October 1997, Ch. 3.

[59] The model overestimates the number of SSBNs deployed between 1981 and 1986 because of the poor fit to the Yankee I SSBN data (see Fig. A.7) and it overestimates the number of SSBNs deployed between 1991 and 1995 because Delta I and Delta II SSBNs were retired prematurely.

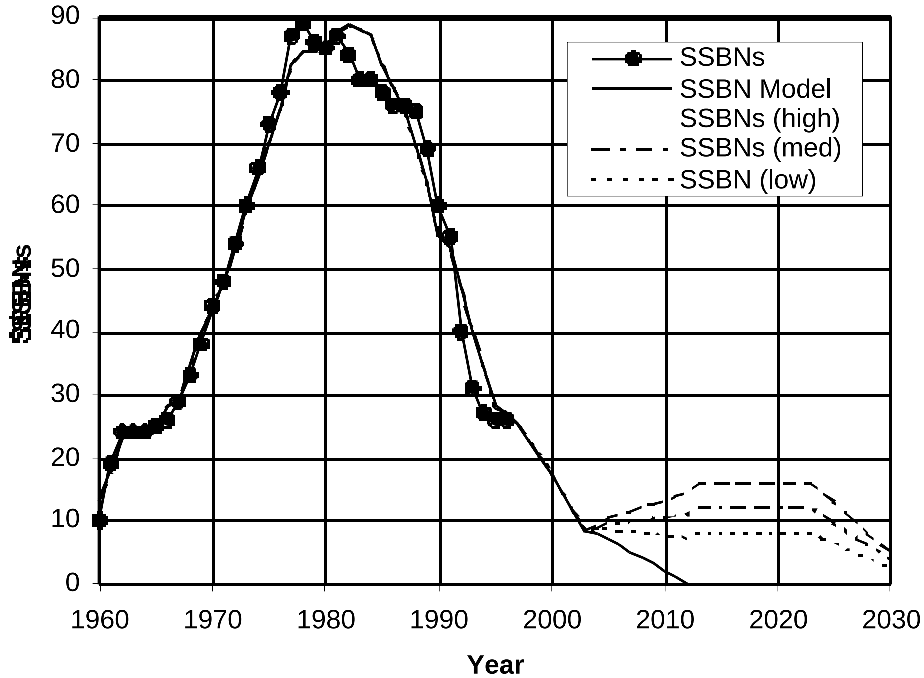

Fig. 20 - Soviet/Russian SSBNs

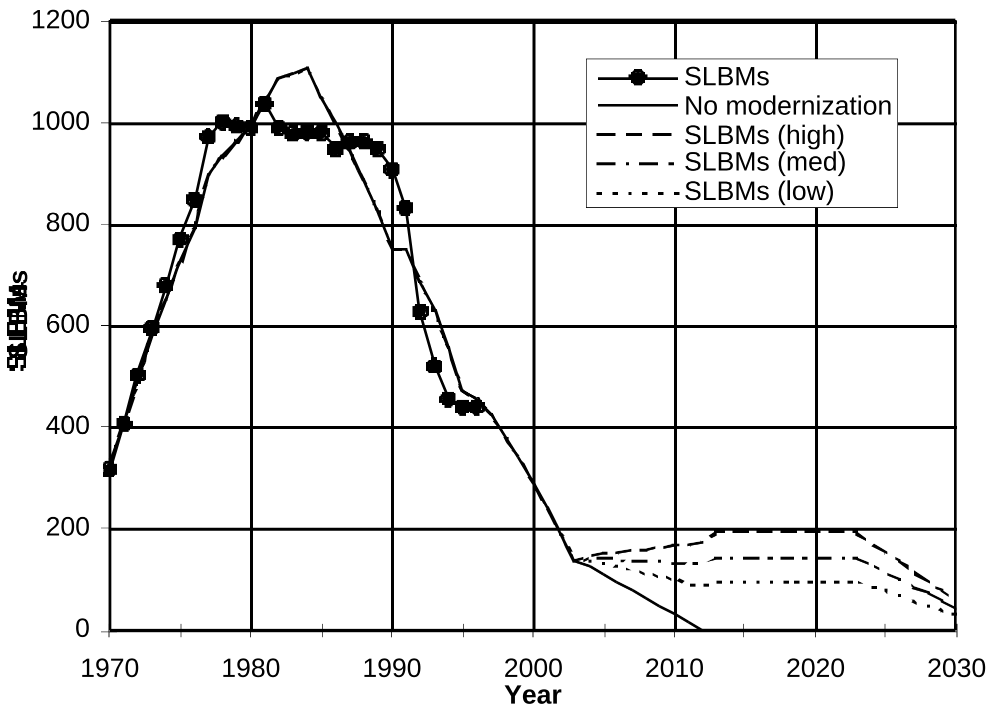

Fig. 21 - Projected Russian SLBM Force

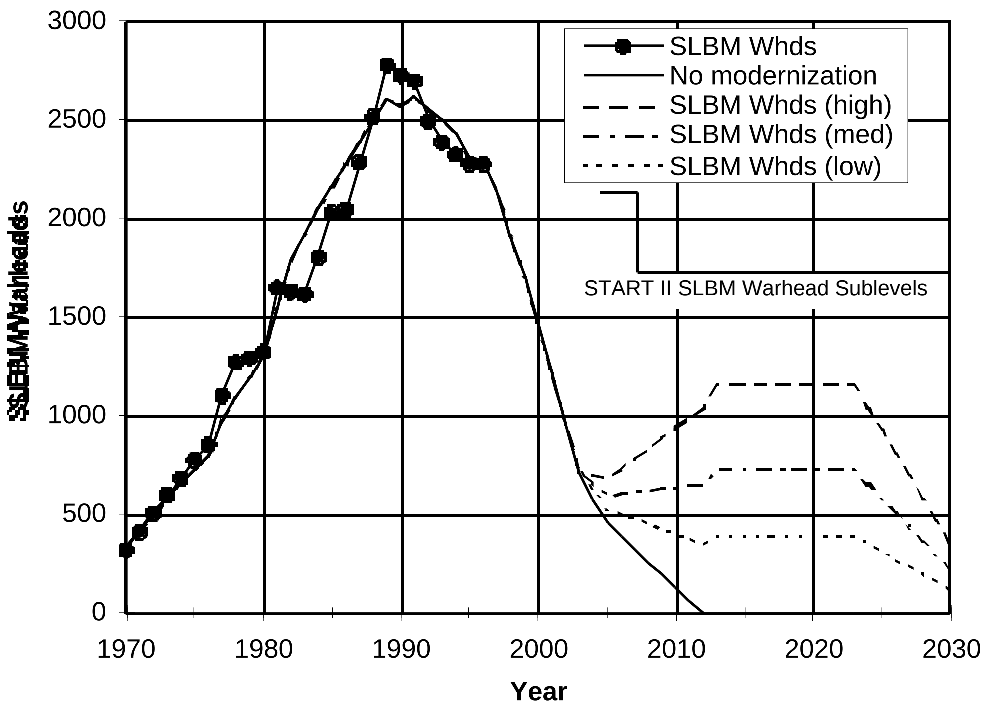

Fig. 22 - Projected Russian SLBM Warheads

deployed will continue to decline in the future, the number of SLBM warheads may be nearly half the maximum number deployed during the Cold War due to the higher MIRV ratios associated with modern SLBMs. Note that none of the SLBM modernization options considered here comes close to the START II sublevels for SLBM warheads (i.e., no more than 2,160 warheads after December 31, 2004, and no more than 1,750 warheads after December 31, 2007), although the 1,750 sublevel might be reached if the SS-NX-28 is deployed with 10 MIRVs each on Borey SSBNs. In summary, the size of the future Russian SLBM force remains quite uncertain because the total SLBM warhead projection changes quite a bit by assuming a different number of tubes on each SSBN or a different number of MIRVs on each SLBM. This is one of the largest sources of uncertainty with respect to Russian strategic force projections.

Strategic Bombers

The strategic bomber force is thought to be the least important of the three legs of the Russian strategic nuclear triad. Nevertheless, there is little evidence that Russia is planning to eliminate this leg in favor of a strategic dyad, despite the fact that heavy-bomber production ceased in 1991. The fact that the Russian strategic bomber force will be the last leg to be modernized is a consequence of the fact that the current force, consisting mostly of Bear H6 and Bear H16 heavy bombers, should last for another 20 years, and not of the insignificance of the bomber force. In fact, ALCM modernization is currently being considered to improve the effectiveness of this leg of the Russian triad (the future Russian heavy bomber force is likely to carry only ALCMs).[60] Moreover, if the United States deploys a limited national missile defense in the future, Russia may come to place greater emphasis on its ALCM-carrying bomber and submarine-launched cruise missile forces.

Figure 23 illustrates the deployment history for the Bear H6, Bear H16, and Blackjack heavy bombers. Historical deployments for the Bison and Bear A through Bear G bombers can be found in the Appendix. The Bear H (Tu-95MS) heavy bombers were produced at the Kuibyshev Aviation Plant in Russia and the Blackjack (Tu-160) heavy bomber was produced at Kazan, also in Russia. The Bear H6, first deployed in 1987, reportedly carries six AS-15 ALCMs; the Bear H16, first deployed in 1983, is supposed to carry 16 AS-15 ALCMs; and the Blackjack, first deployed in 1988, reportedly carries 12 AS-15 ALCMs.[61] The sharp discontinuities in 1996 for the number of heavy bombers deployed arise because 22 Bear H16 and 19 Blackjack bombers located in Ukraine were not returned to Russia. Negotiations between Russia and Ukraine to have them returned recently broke down, essentially guaranteeing that they never will be returned. The six operational Blackjacks and six additional training aircraft located in Russia are assumed to be retired from their nuclear role due to the high cost of maintaining such a small operational force. Consequently, they are not counted as operational bombers in the subsequent analysis.

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[60] Currently the only two ALCM modernization programs under way are for conventionally armed ALCMs (i.e., the Kh-SD and Kh-101 ALCMs). While the emphasis has been placed on conventional ALCM modernization, there is no reason these programs cannot lead to a modern nuclear ALCM in the future. See Nikolai Sokov, *Modernization of Strategic Nuclear Weapons in Russia: The Emerging New Posture*, op cit., 43–44.

[61] See Robert S. Norris and Thomas B. Cochran, *US-USSR/Russian Strategic Offensive Nuclear Forces: 1945–1996*, op cit., 42.

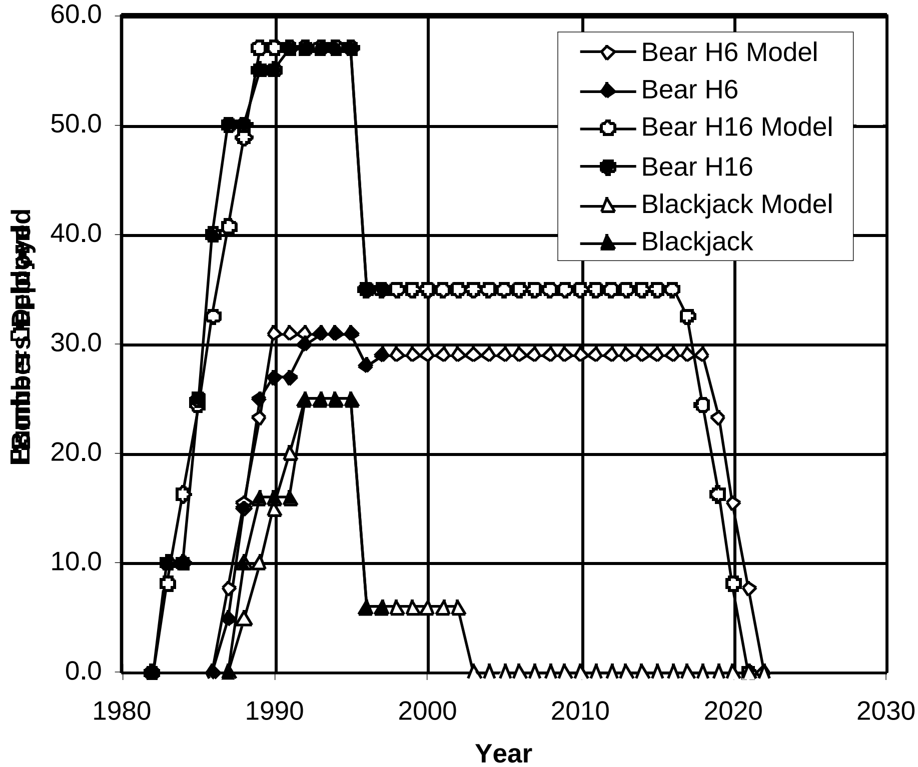

Fig. 23 - Bear H and Blackjack Strategic Bombers

The model for these bombers assumes a 30-year service life because this is the typical service life for older Soviet bombers (see Fig. A.8). Less well known is how well the bomber force will be maintained over the next several decades. This analysis assumes that Russia spends the relatively small amount of money required to maintain these bombers. However, it is also plausible that a significant fraction of these aircraft will be retired in the future due to insufficient funds for maintenance, training, or for ALCM modernization.

Figure 24 shows the historical data for the total number of heavy bombers deployed over time, as well as the model fit to this data.[62] The model assumes that 29 Bear H6 and 35 Bear H16 heavy bombers are retained in the operational force until they reach the end of their service lives. Therefore, the future Russian strategic bomber force is assumed to consist of 64 aircraft, down from a peak of approximately 160 Soviet heavy bombers during the Cold War.

Figure 25 shows the number of heavy bomber weapons deployed over time. The large increase in bomber weapons deployed after 1982 is due to the higher weapon loading on the Bear H and Blackjack bombers when they entered the force in the 1980s. The model projection suggests that the number of Russian bomber weapons deployed after the turn of

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[62] The model overstates the number of heavy bombers deployed between 1989 and 1995 because of the premature retirement of the Bear A–G models (see Fig. A.8 in the Appendix).

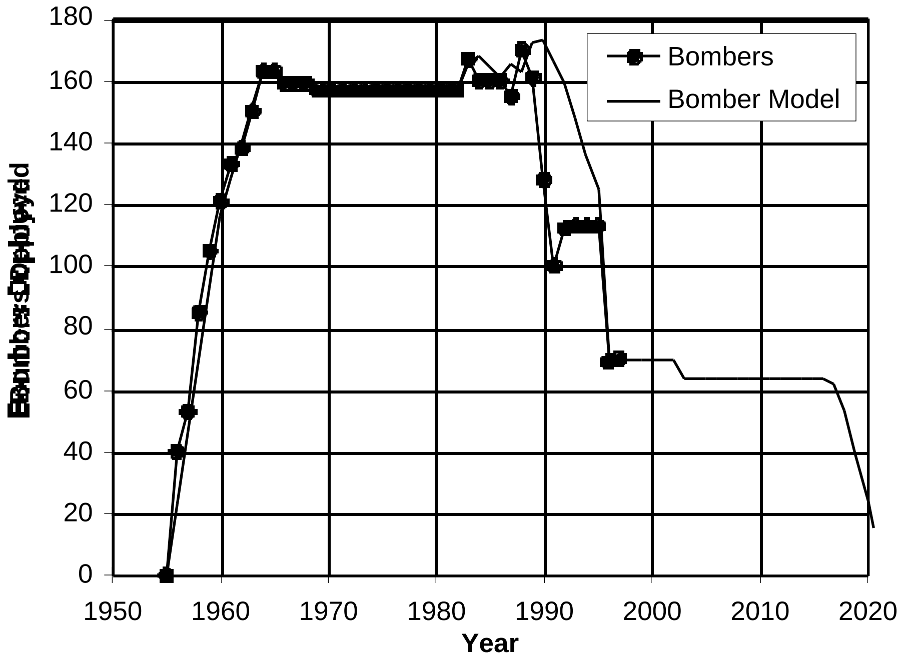

Fig. 24 - Soviet/Russian Strategic Bombers

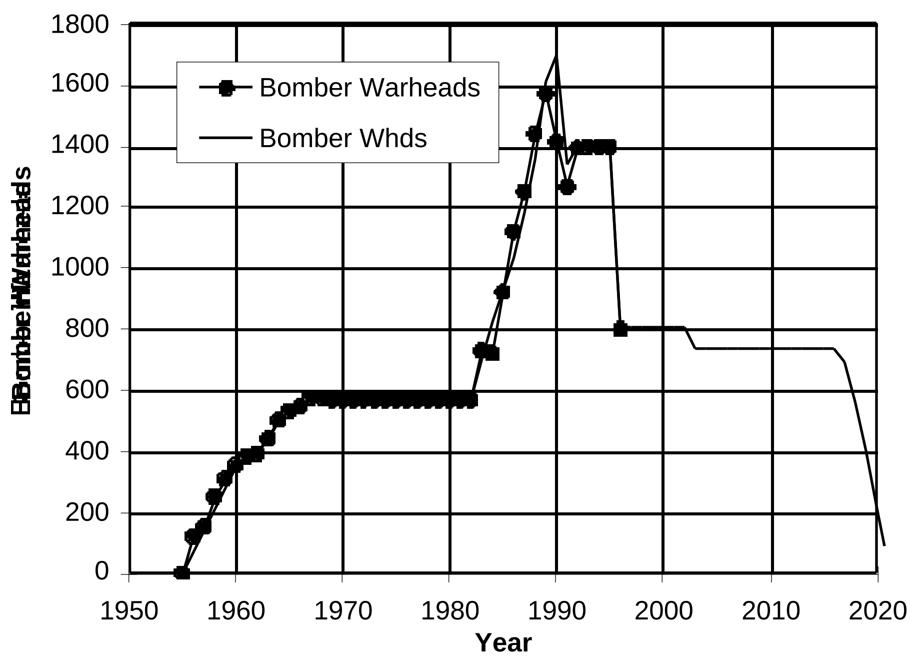

Fig. 25 - Soviet/Russian Strategic Bomber Warheads

the century may be about the same as during much of the Cold War. These model projections represent the maximum size of the future Russian bomber force because, unless bomber production commences, the size of this force can only shrink due to accidents or insufficient funding for maintenance and support. The extent to which the latter might occur is difficult to know because it depends on the size of the Russian defense budget and on the priority assigned to maintaining these assets.

Total Strategic Nuclear Force

Adding the three components of the Soviet/Russian nuclear triad together one arrives at the historical profile for strategic nuclear delivery vehicles and strategic nuclear warheads shown in Figs. 26 and 27, respectively. The model fit in these figures shows the life expectancy for the current Russian strategic nuclear force assuming no force modernization and that the force complies with the START I Treaty. During the Cold War the Soviet Union maintained about 2,500 strategic nuclear delivery vehicles, with the warhead count peaking at approximately 11,000 warheads in 1989. The Russian strategic force shrinks rapidly after 1990 and is largely obsolete by 2005, with the exception of the bomber force.

Figures 28 and 29 show projections for the future number of Russian strategic nuclear delivery vehicles and warheads, respectively. Each of the projected forces assume that all 64 Bear H bombers remain operational until around 2015. The START I Russian force assumes that the service lives of the SS-18, SS-19, and SS-25 ICBMs are extended. To represent a plausible upper bound for a START I force structure, the START I projection assumes the high Topol M projection, with each missiles carrying three MIRVs, and the high Borey SSBN projection, with each SS-NX-28 or SS-N-23 follow-on SLBM carrying 10 MIRVs. From Fig. 29 one observes that Russia may be able to deploy slightly more than 4,000 strategic nuclear warheads under START I until 2017.

The low, medium, and high force projections represent a range of future Russian force structures that are consistent with the START II Treaty and a future START III Treaty. They are constructed by adding the corresponding low, medium, and high ICBM and SLBM force levels to the bomber force. The projected size of the Russian strategic force under START II without force modernization is shown for comparison. Obviously, other ICBM/SLBM force modernization combinations are possible. One should also note that uncertainties with respect to Russian SLBM modernization can easily alter these force projections by several hundred warheads. The low, medium, and high force levels result in a total Russian strategic nuclear force between 2013 and 2015 with approximately 1,320, 1,850, and 2,430 warheads, respectively. The numerical breakdown for these forces by year is given in Appendix B. Finally, if current economic turmoil in Russia delays these modernization options by several years, the shape of these future force profiles will change but not the number of strategic delivery vehicles and warheads that ultimately could be deployed.

Russian Motivations for Ratifying the START II Treaty

Russian concerns with the START II Treaty, and hence the potential benefits associated with a future START III Treaty, fall into three categories: maintaining rough parity with the

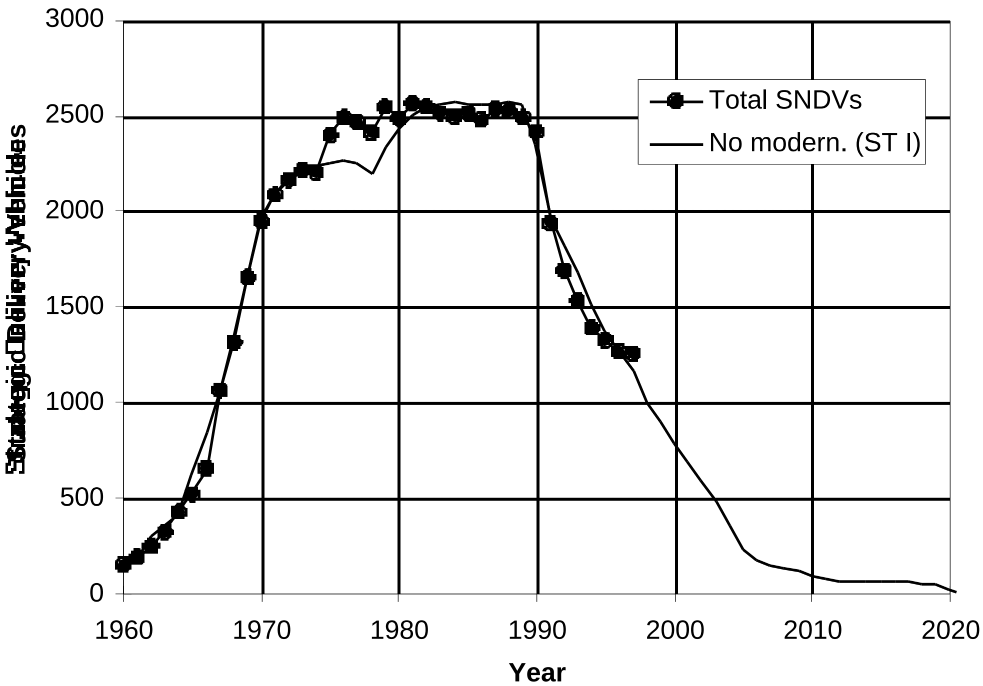

Fig. 26 - Russian Strategic Nuclear Delivery Vehicles (w/o Modernization)

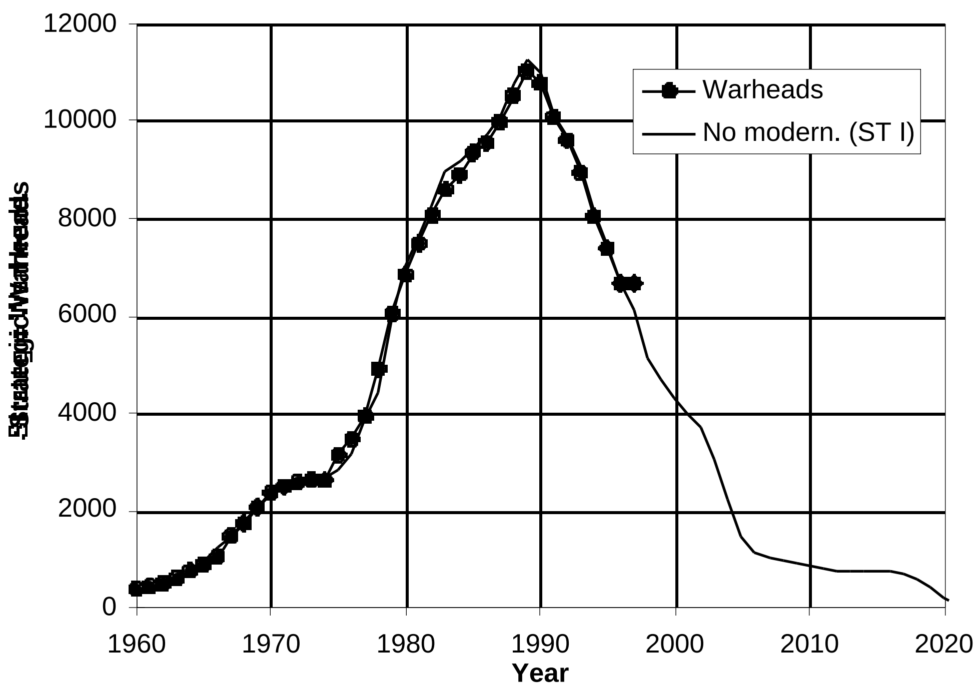

Fig. 27 - Russian Strategic Nuclear Warheads (w/o Modernization)

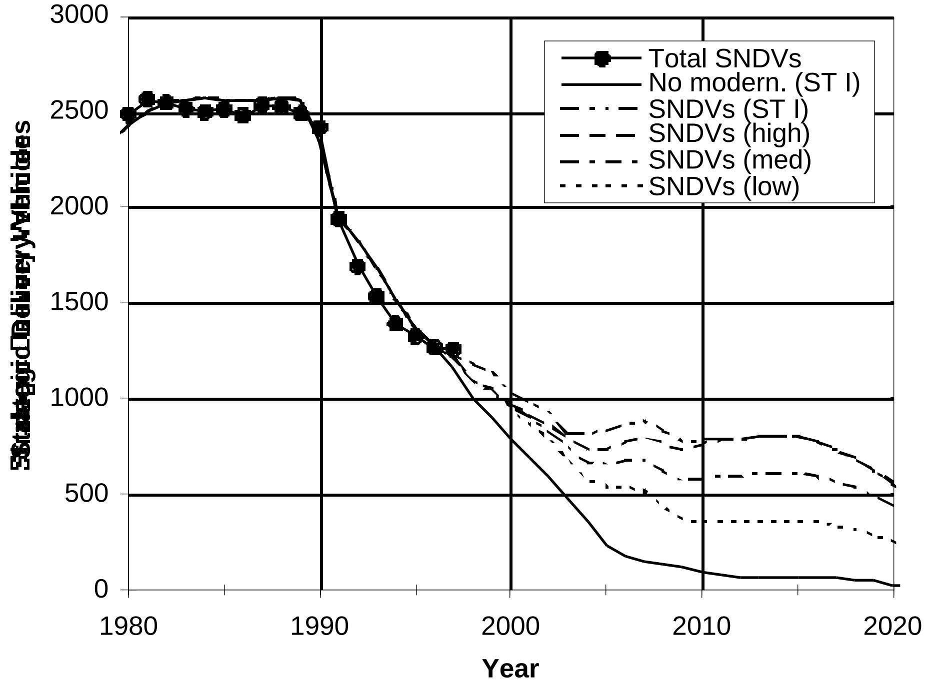

Fig. 28 - Projected Russian Strategic Nuclear Delivery Vehicles

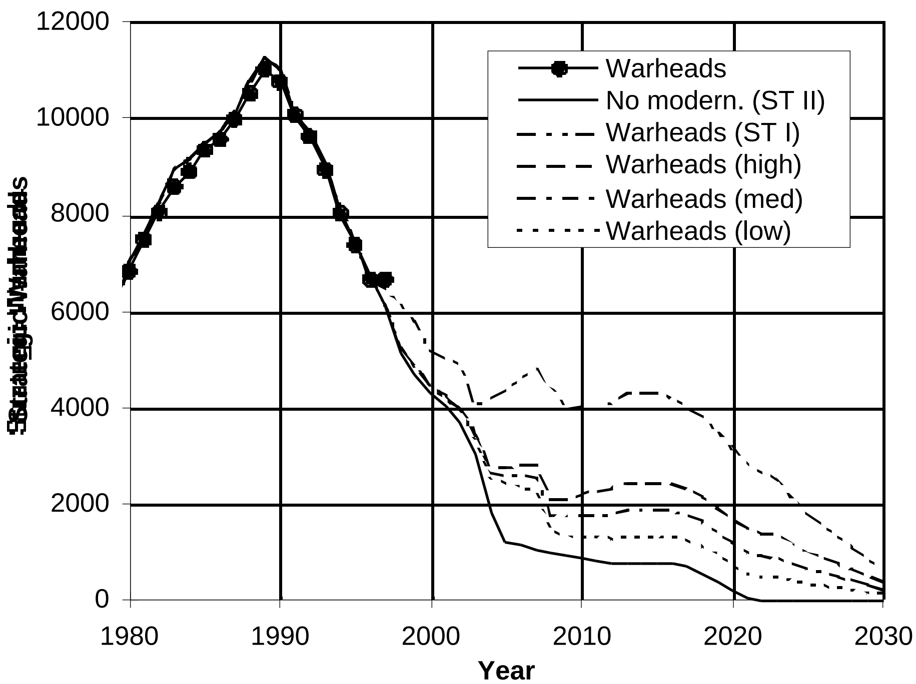

Fig. 29 - Projected Russian Strategic Nuclear Warheads

United States, avoiding asymmetric strategic nuclear reconstitution capabilities, and avoiding asymmetric counterforce capabilities. Without START II ratification, START I is the only treaty that will be in force by 2000. Hence, the choice facing Russian leaders is between having U.S. and Russian forces constrained only by the START I Treaty or ratifying the START II Treaty so negotiations can proceed toward START III. Two questions thus arise: How bad are the asymmetries associated with START II relative to the alternative, START I? and Can these asymmetries be altered significantly by START III? The aggregate force level for a future START III Treaty has been announced (2,000–2,500 strategic warheads). However, START III negotiations may be protracted if constraints on, or confidence-building measures with respect to, non-strategic warheads, the size of each country's nuclear stockpile, the amount of weapons-grade fissile material, and the size of each side's nuclear warhead production complex are included in the negotiations in an effort to ensure the irreversibility of START III reductions. Consequently, Russian leaders are concerned that having the START II Treaty enter into force, with all of its inequities from the Russian perspective, without substantial prior agreement on the content of a follow-on START III Treaty, undercuts Russian negotiating leverage.

Maintaining rough parity with the United States is the main reason why Moscow should ratify the START II Treaty. Under START I Russia will have, at most, slightly more than 4,000 strategic nuclear warheads (see Fig. 29). The United States, on the other hand, could deploy up to 6,000 START accountable warheads, which equates to between 8,000 and 8,500 actual warheads given the START I bomber counting rules—although it is quite possible the United States will deploy fewer than this number to save money given the likely size of Russia's future force. Hence, a failure to ratify START II could lead to a 2:1 U.S. advantage in deployed strategic warheads.

If Russia ratifies the START II Treaty, then the high and medium Russian force projections discussed above are plausible estimates for Russia's future strategic force. Magnified illustrations of these two force projections are shown in Figs. 30 and 31. Neither of these modernized forces reaches the 3,500 weapon limit allowed by the START II Treaty, implying that the asymmetry in deployed warheads could still be between 1.5:1 and 2:1 in the United States' favor. Hence, the numerical asymmetry under START II is no worse than it would be without START II, and it comes at reduced cost. Moreover, START II ratification opens the door to a follow-on START III Treaty that limits each side to between 2,000 and 2,500 strategic nuclear warheads, thereby guaranteeing rough parity with the United States. Absolute parity with the United States probably is less important to Russian leaders in the post–Cold War era. However, Russian leaders have stated that rough equivalence is important as a hedge against an uncertain future in which threats to Russia's vital interests may arise.

The second principal Russian criticism of the START II Treaty concerns the U.S. warhead reconstitution advantage the treaty allows. This advantage, of course, is important only in a hypothetical scenario where the United States decides to break out rapidly from the START II Treaty and upload its nuclear delivery vehicles to achieve a strategic advantage—a rather unlikely scenario given that the strategic advantage that can be gained by having several thousand more warheads than another nuclear power armed with several thousand warheads is marginal. Moreover, if the breakout is not rapid, Russia can respond by

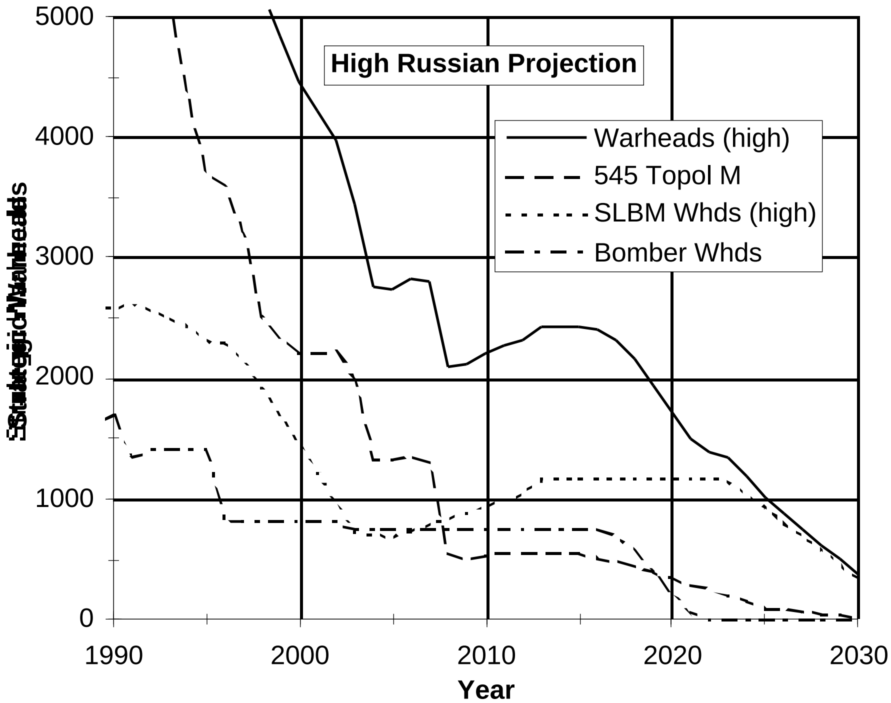

Fig. 30 - Possible 2,430-warhead Russian Force

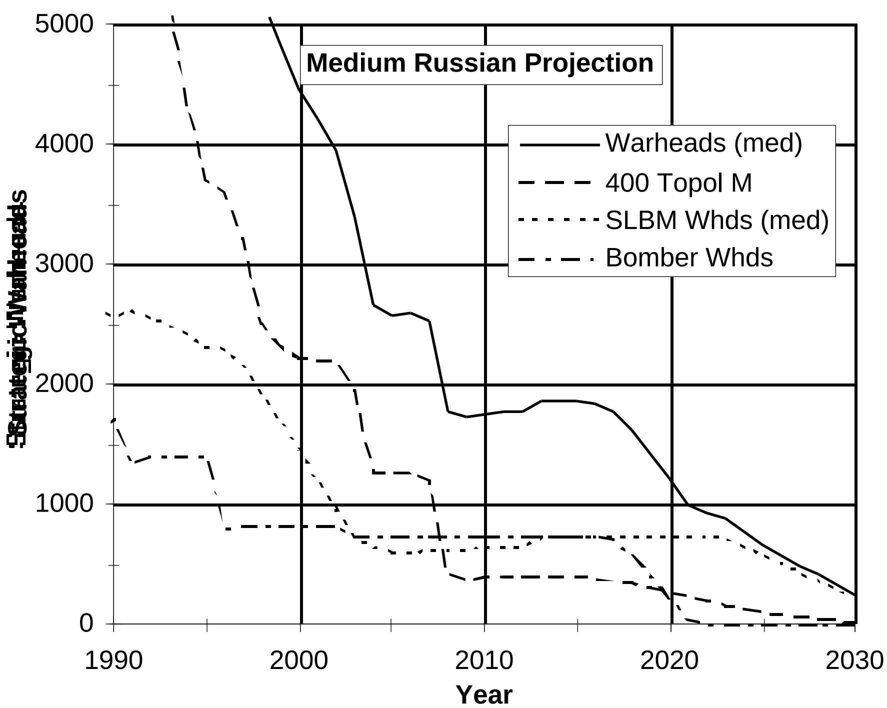

Fig. 31 - Possible 1,850-warhead Russian Force

deploying more warheads on new post-boost vehicles for existing ballistic missiles or by increasing its ICBM production capacity, which surely it would do if Russian vital interests are threatened.

Nevertheless, the U.S. ballistic missile upload capability is likely to be around 2,700 warheads under START II and nearly 2,000 warheads under START III.[63] In addition, although bombers are counted under START II according to the number of weapons they actually carry, the Treaty contains an exclusion of up to 100 non-ALCM-carrying former heavy bombers that are not counted against START II ceilings provided they are converted to conventional missions. This provision allows the United States to convert 95 B-1B heavy bombers into conventional bombers. If these bombers are returned to the nuclear mission, which presumably would not be difficult although suitable weapons may no longer exist in the stockpile, the U.S. strategic force could increase by an additional 1,520 weapons, bringing the total U.S. reconstitution capability up to approximately 4,200 weapons under START II and approximately 3,500 weapons under START III, again assuming the extra weapons exist in the U.S. nuclear stockpile.

The Russian reconstitution capability under START II, by contrast, is more limited. Russia essentially has no warheads that can be rapidly uploaded on ballistic missiles after 2005 because the SS-18 and SS-24 ICBMs likely will be retired and the SS-19 is assumed to remain MIRVed until 2007, shortly after which it will be retired. However, several Russian missiles can carry more warheads than the number with which they are currently deployed provided new post-boost vehicles are built. Of course, building new post-boost vehicles would take some time. Whether the time delay required to build these post-boost vehicles is strategically significant is difficult to say. Nevertheless, the SS-25 and SS-27 probably can carry three MIRVs, the SS-N-18 can carry up to seven MIRVs, and the SS-N-23 and SS-NX-28 SLBMs (or SS-N-23 follow-on SLBMs) probably can carry up to ten MIRVs. Finally, Russia has no former heavy bombers that will be deployed as conventional bombers, although the 29 Bear H6 bombers probably can be refitted to carry 16 ALCMs, thereby adding 290 bomber weapons to the Russian reconstitution capability.

Figure 32 shows the total Russian reconstitution capability, which is largely due to its ballistic-missile reconstitution capability, for the medium and high Russian force projections, assuming new post-boost vehicles can be deployed on these missiles and 290 ALCMs can be added to the bomber force. As one can see, Russia will have a ballistic missile upload capability between approximately 1,500 and 2,150 warheads over the next two decades. The spike in 2004 occurs because all SS-18s must be deactivated by this time. However, since the missiles do not have to be destroyed until 2007, they add to Russia's reconstitution capability until the missiles reach the end of their service life. The spike in 2008 occurs because 105 SS-19s can remain as single warhead missiles after 2007, thus adding to the upload capability until all SS-19s are retired (one year according to this estimate).

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[63] This assumes a U.S. START II force containing 500 Minuteman III ICBMs downloaded from three to one warhead each, eight Trident submarines carrying 24 C-4 SLBMs downloaded from eight to four MIRVs each, and ten Trident submarines carrying 24 D-5 SLBMs also downloaded from eight to four MIRVs each; and a U.S. START III force containing 300 Minuteman III ICBMs and 14 Trident boats armed with 24 C-4 or D-5 SLBMs downloaded from eight to four warheads each.

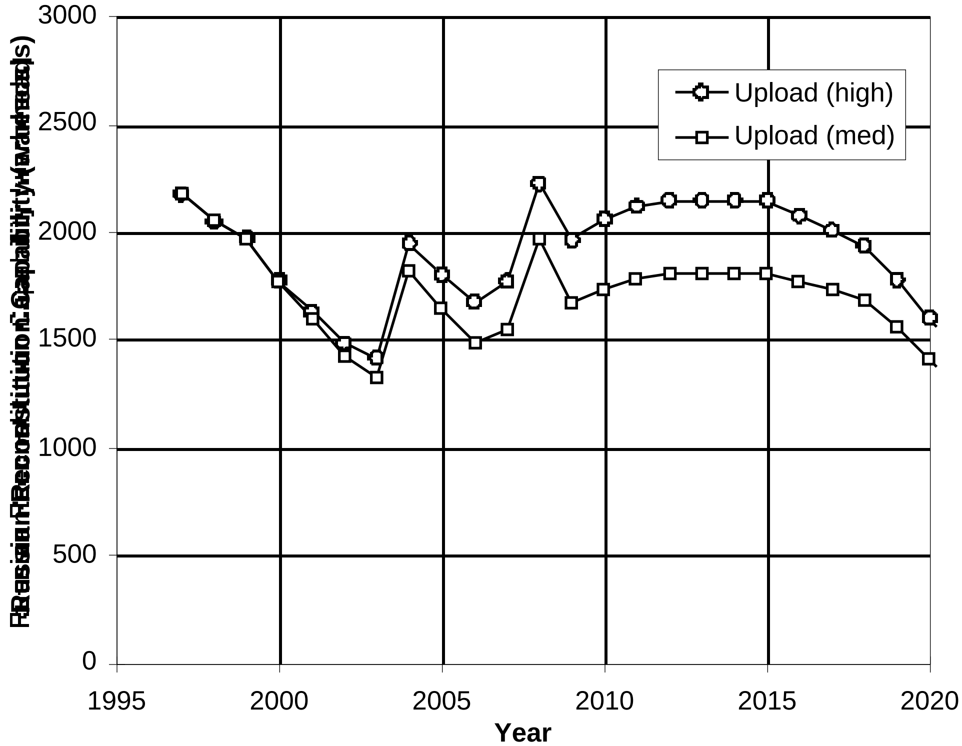

Fig. 32 - Projected Russian Reconstitution Capability

Therefore, assuming the time delay required to build new post-boost vehicles and to refit Bear H6 bombers with 16 ALCMs is not important, the Russian reconstitution capability is approximately 35 to 50 percent that of the United States under START II. Under START III the Russian reconstitution capability will be approximately 40 to 60 percent that of the United States, assuming the 95 B-1B conventional heavy bombers are excluded from the START III ceilings as well. Again, whether this U.S. advantage is strategically significant is doubtful given that Russia still will have several thousand strategic nuclear weapons in its arsenal. In any case, the asymmetry in reconstitution capability is not appreciably affected in moving from START II to START III. Therefore, improving the relative reconstitution capability provides a weak rationale for ratifying START II and proceeding toward START III.

Finally, the argument has been made that the START II Treaty gives the United States an advantage in counterforce capability. This argument usually refers to an advantage in prompt hard-target-kill (HTK) capability that can threaten ICBM silos and not to less accurate ICBM or SLBM warheads that may have substantial counterforce capability against SSBNs in port, mobile ICBMs in garrison, and bombers that fail to escape from their bases on warning of an incoming attack, or to hard-target bomber weapons that take hours to deliver on target. Again, the incentive to ratify START II occurs only if START III ameliorates this asymmetry relative to what it would be under START I.

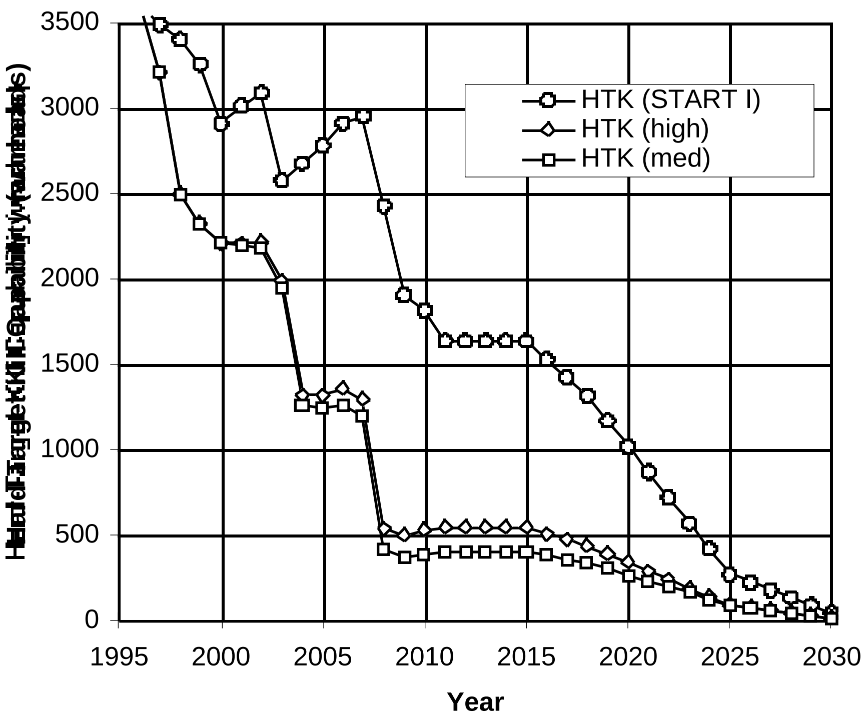

Fig. 33 - Projected Russian Hard-Target-Kill Capability

The United States will have approximately 1,860 prompt HTK warheads under START I, 884 prompt HTK warheads under START II, and around 684 prompt HTK warheads under START III.[64] On the Russian side, only the SS-18 Mod 4/5/6, SS-19 Mod 3, SS-25 and SS-27 ICBMs have prompt HTK capability. Figure 33 illustrates the projected number of prompt HTK warheads in the Russian arsenal under START I, along with the high and medium Russian force projections assuming START II is ratified. Under START I, Russia can match the United States in prompt HTK capability, assuming the SS-27 carries three MIRVs. On the other hand, under START II Russia will have between 45 to 60 percent as many prompt HTK warheads as the United States after 2007, depending on whether one assumes the high or medium Russian force projection. Under START III, the Russian prompt HTK capability would be approximately 60 to 80 percent of the U.S. value after 2007. Thus, if parity in prompt HTK capability matters, Russia would be better off staying with the START I Treaty, assuming it has the resources to deploy a large number of MIRVed SS-27 missiles. If Russia is committed to a single-warhead SS-27 ICBM, then START III reduces the U.S. advantage in prompt HTK capability somewhat relative to what it would be under START II.

However, the absolute number of ballistic missile HTK warheads is not a good measure of each side's ability to threaten the silo-based ICBM forces of the other side.

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[64] Under START I the United States likely will have 975 W76 warheads on Minuteman III ICBMs, 500 W87 warheads on Peacekeeper ICBMs, and 384 W88 warheads on D-5 SLBMs. Under START II the U.S. prompt HTK capability likely will consist of 500 W87 warheads on single-warhead Minuteman III ICBMs and 384 W88 warheads on D-5 SLBMs. Finally, under START III the United States may have 300 W87 warheads on Minuteman III ICBMs and 384 W88 warheads on D-5 SLBMs.

The ratio of prompt HTK warheads to the number of silos is more relevant. The United States is projected to have approximately 550, 500, and 300 ICBM silos under START I, START II, and START III, respectively. Hence, Russia would have enough HTK capability to threaten each U.S. ICBM silo with two warheads under START I, but could only threaten U.S. silos with one warhead apiece under START II and approximately 1.5 warheads under START III. Clearly, Russia has the greatest countersilo capability under START I, which is not surprising because the START II and START III treaties are designed to reduce prompt HTK capabilities. On the other hand, Russia currently has 350 ICBM silos and will have 334 silos under START I by 2000. Under START II or START III Russia may have no more than 195 ICBM silos. Hence, regardless of the START Treaty by which Russia abides, the United States will have enough prompt HTK capability to threaten Russian silos with two warheads each (the maximum thought to be practical due to fratricide effects). Consequently, although the START II and START III Treaties reduce the number of U.S. prompt HTK warheads, they do not reduce the hypothetical threat to Russian ICBM silos.[65] Therefore, Russian silo-based ICBMs may be vulnerable to hypothetical U.S. counterforce attacks regardless of whether START II is ratified or not. Moreover, START III will not ameliorate this problem. However, the Russian ability to hold U.S. ICBM silos at risk will be reduced under START II, though it increases somewhat under START III, making the retention of a more robust Russian counter-silo capability a valid, if somewhat dubious, reason for rejecting START II (and START III). Obviously, this must be weighted against the benefits of START II and START III from the Russian perspective.

Among the benefits of START II and START III is the fact that the overall Russian strategic force is more survivable despite the potential vulnerability of Russian ICBM silos. Recall that the SS-27, when deployed in former SS-18 and SS-19 silos, may be very difficult to destroy. But, even if the silo-based SS-27 is vulnerable, only a small fraction of the future Russian force will be deployed in silos under START II or START III (approximately 10 percent of the warheads compared to approximately 60 percent during the Cold War). Russian force survival under START II and START III will depend increasingly on the ability to deploy mobile ICBMs out of their garrisons, SSBNs at sea, and placing bombers on high states of alert if warranted by a future crisis. The Soviet Union did not practice rapid base escape for its bombers in response to tactical warning during the Cold War, but this may be required as the Russian strategic force shrinks in the future. Under normal peacetime conditions it may be too expensive to keep a large fraction of Russia’s mobile ICBMs deployed out of their garrisons and SSBNs deployed at sea, rendering the Russian strategic arsenal more vulnerable to a bolt-out-of-the-blue attack. However, this is an implausible scenario for strategic planning in the post–Cold War era because the political basis for surprise attacks in peacetime is completely lacking—although this vulnerability may pressure Russia to generate its forces early in a crisis, which could create misperceptions of hostile intent.

It is worth noting that Russian planners sometimes assume their SSBNs at sea and mobile ICBMs out of garrison cannot survive U.S. counterforce attacks. From a worst-case perspective, Russian SSBNs may be vulnerable to U.S. antisubmarine warfare even when deployed in bastions close to Russian territory, and the communication links to submerged submarines may be disrupted long enough for attrition to take its toll on the

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[65] Note that even though U.S. and Russian ICBMs will carry a single warhead under START II (and presumably under START III), this is not sufficient to guarantee that ICBM silos will not be targeted in a hypothetical counterforce attack—notwithstanding the logic which states that single-warhead ICBMs are stabilizing.

Russian SSBN fleet. Similarly, mobile ICBMs out of garrison may be hunted by U.S. B-2 bombers flying search-and-destroy missions. While this perspective adds a useful counterpoint to the traditional U.S. view that submarines at sea and mobile ICBMs out of garrison will always survive, such fears greatly exaggerate the vulnerability of future Russian forces. The U.S. antisubmarine warfare capability that can be brought to bear and the number of B-2 bombers that can conduct search and destroy missions will be so limited in the future that it would take days or weeks to threaten the survival of a significant fraction of these elements of the Russian force. During this time Russia could launch its surviving forces in retaliation.

This "launch under attack" capability is much less risky than the launch under attack capability the Soviet Union practiced during the Cold War, where SSBNs in port and mobile ICBMs in garrison were prepared to launch within 10 to 15 minutes of receiving warning of an incoming attack. This posture is unnecessarily dangerous in the post–Cold War era because it gives rise to the specter of an inadvertent missile launch based on false warning of an incoming attack—a serious problem given the current deteriorating state of Russia's ballistic missile early-warning network. The former "launch under attack" scenario has much less severe time pressures because the missiles would be launched several days after, and not several minutes before, an attack begins.[66]

Concluding Observations

The majority of the current Russian strategic nuclear force will become obsolete shortly after the turn of the century. Hence, Russian strategic force modernization is essential if Russia is to remain a nuclear power on a par with the United States. Moreover, this modernization effort will appear larger than the U.S. strategic modernization program over the next several decades because U.S. strategic nuclear delivery vehicles are newer and last longer than their Russian counterparts. Numerous uncertainties, especially financial uncertainties, prevent accurate estimates of Russia's future strategic force. Nevertheless, Russia can probably maintain a force with slightly more than 4,000 strategic nuclear warheads over the next two decades under the START I Treaty. This is about half the number of strategic warheads the United States could, in principle, maintain. Under START II, Russia is likely to maintain a strategic force between 1,800 and 2,500 warheads, compared to up to 3,500 warheads for the United States. Therefore, Russia should have an interest in ratifying the START II Treaty, if only to pursue a START III Treaty that limits U.S. and Russian strategic nuclear warheads to between 2,000 and 2,500 warheads. This is the least expensive way to retain rough parity with the United States. While the United States may have an advantage in reconstitution capability and prompt HTK capability under START II, this asymmetry is neither so great nor so consequential that Russia should consider rejecting the START II Treaty for these reasons alone. Moreover, the total Russian force will be less vulnerable under START II (and START III) relative to START I, despite the U.S. advantage in prompt HTK capability, because a smaller fraction of their force will be based in ICBM silos. On the other hand, the worst outcome from the Russian perspective may be ratifying the START

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[66] Note that if Russian planners believe the communication links to Russian SSBNs at sea can be destroyed rapidly and that communication with these submarines cannot be reestablished before U.S. antisubmarine warfare efforts destroy the bulk of the fleet, then SLBMs at sea must also be ordered to launch on 10 to 15 minutes warning in order to survive.

II Treaty without adequate assurances that a START III Treaty to their liking will be signed and ratified by the United States, although again this depends on the somewhat dubious value assigned to U.S. warhead, reconstitution, and prompt HTK advantages under START II.

If Russia ratifies the START II Treaty, Russia's future strategic nuclear force will appear a lot different than its Soviet predecessor. In particular, the emphasis on land-based ICBMs will disappear. On the other hand, if START II is not ratified, the START I Treaty allows Russia to maintain a force structure more akin to that of the former Soviet Union, albeit one that is relatively vulnerable. Under START II the Russian force will be a balanced triad and, consequently, should be a highly survivable, stable force—assuming Russian leaders allocate the resources required to ensure that their SSBNs can survive at sea, that mobile ICBMs can survive out of garrison, and that a sufficient number of strategic bombers can escape from their bases upon warning of an incoming attack.

Appendix A: Historical Soviet Strategic Force Deployments

Soviet ICBM Deployments

Figure A.1 illustrates the historical deployment of the SS-6, SS-7, SS-8, and SS-9 ICBMs, along with the model fit for each of these missiles. The service lives were 8, 14, 14, and 10 years and the deployment rates were 2.0, 39.4, 7.7, and 46.7 missiles per year for the SS-6, SS-7, SS-8, and SS-9, respectively. All of these missiles carried a single warhead except for the SS-9 Mod 4, which reportedly carried three multiple reentry vehicles (MRVs) that could not be independently targeted.[67] The MRVs are counted as a single warhead in this analysis since they cannot strike independent targets.

Figure A.2 shows the deployment profile for the SS-11 ICBM. The SS-11 Mod 1 and Mod 2 were single warhead missiles, with the Mod 2 carrying penetration aids. The SS-11 Mod 3 carried up to three MRVs. The model here is applied to the Mod 1 and Mod 2/3 separately because the SS-11 Mod 2/3s were deployed nearly 10 years after the Mod 1, suggesting that the Mod 2 and Mod 3 were a new missile. The SS-11 Mod 1 deployment profile demonstrates that a simple trapezoidal model does not always fit the historical data. The model fit shows a buildup of 165 missiles per year and a nominal 8-year service life for the SS-11 Mod 1, although quite a few missiles were operational for a longer time (some with a service life around 15 years). The model fit to the SS-11 Mod 2/3 data shows a linear buildup with an average deployment rate of 105 missiles per year and a nominal service life of 17 years for the SS-11 Mod 2/3. These missiles appear to have been retired faster than what one would expect based on service-life considerations alone.

Figure A.3 illustrates the deployment profile for the 60 single-warhead SS-13 ICBMs deployed at Yoshkar Ola. The SS-13 model assumes a deployment rate of 15 missiles per year, each with a service life of 21 years. Again, it appears that the SS-13 was retired in 1990 more rapidly than one would expect based on service-life considerations alone. Given this uncharacteristically long service life, it is possible that two sets of missiles were deployed in SS-13 silos, with the latter missiles not designated as a new modification.

Figure A.4 shows the deployment history for the SS-17s at Kostromo and Yedrovo. The SS-17 Mod 1 and Mod 3 were deployed with four MIRVs. The Mod 2 had a single warhead. The model is applied to each of the three Mods separately because their initial deployment date was fairly far apart, although it could also be applied to the sum of the first two Mods. Applying the model to each Mod individually gives a deployment rate of 32.5, 20.0, and 75.0 missiles per year and service lives of 7, 5, and 8 years for the SS-17 Mod 1, Mod 2, and Mod 3, respectively.

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[67] See Robert S. Norris and Thomas B. Cochran, *US-USSR/Russian Strategic Offensive Nuclear Forces, 1945–1996*, op cit., 21.

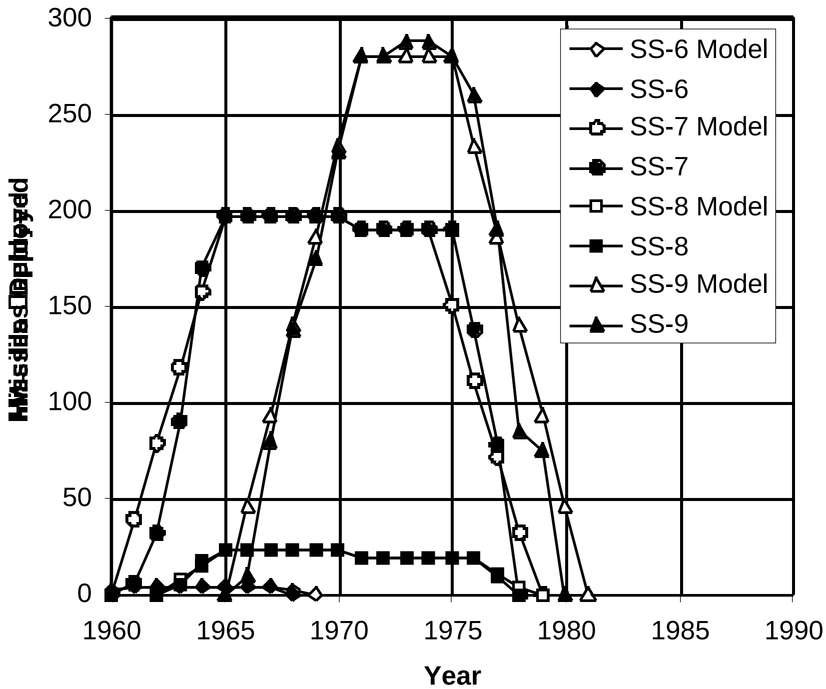

Fig. A.1 - SS-6, SS-7, SS-8, and SS-9 Deployments

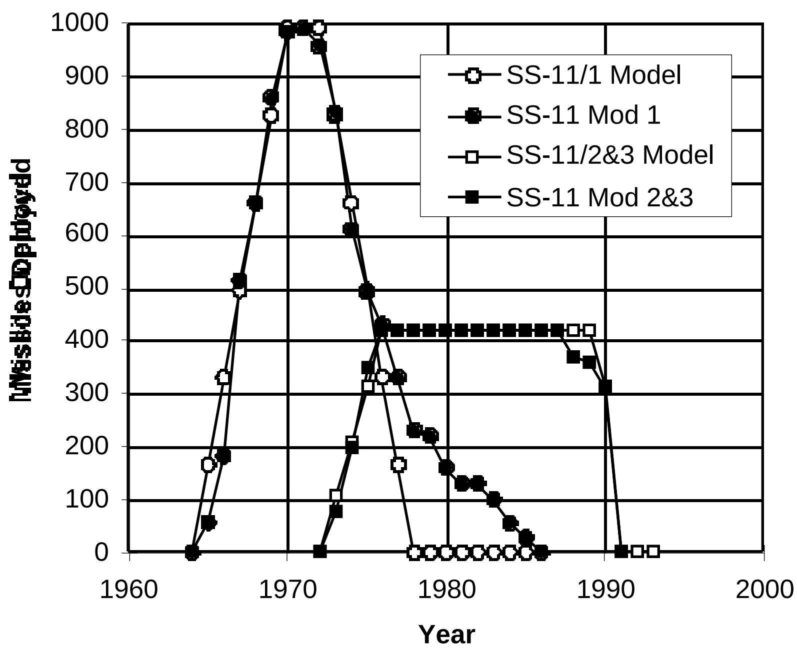

Fig. A.2 - SS-11 Mod 1 and Mod 2/3 Deployments

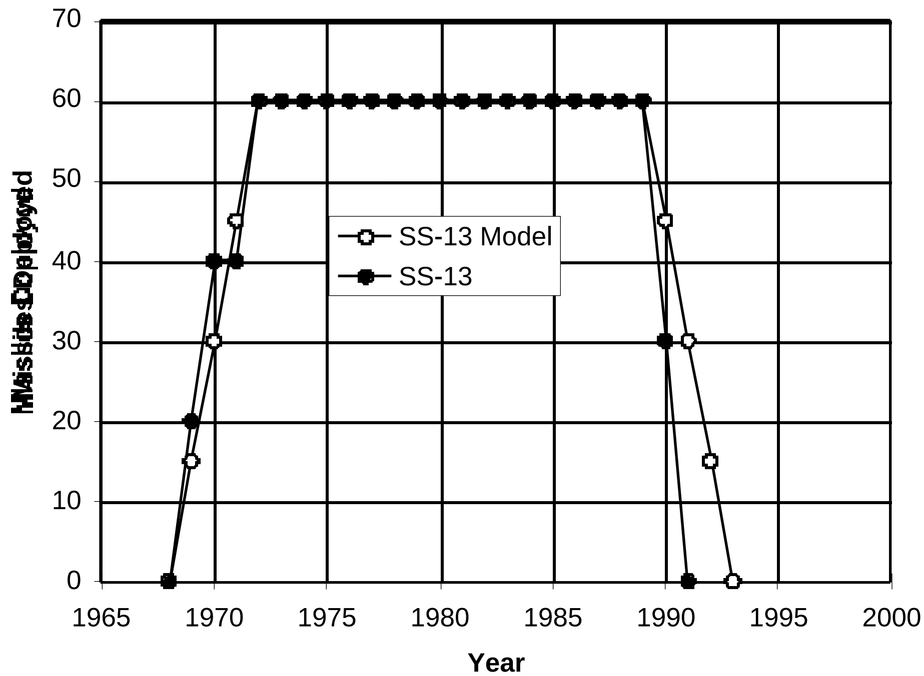

Fig. A.3 - SS-13 Deployment

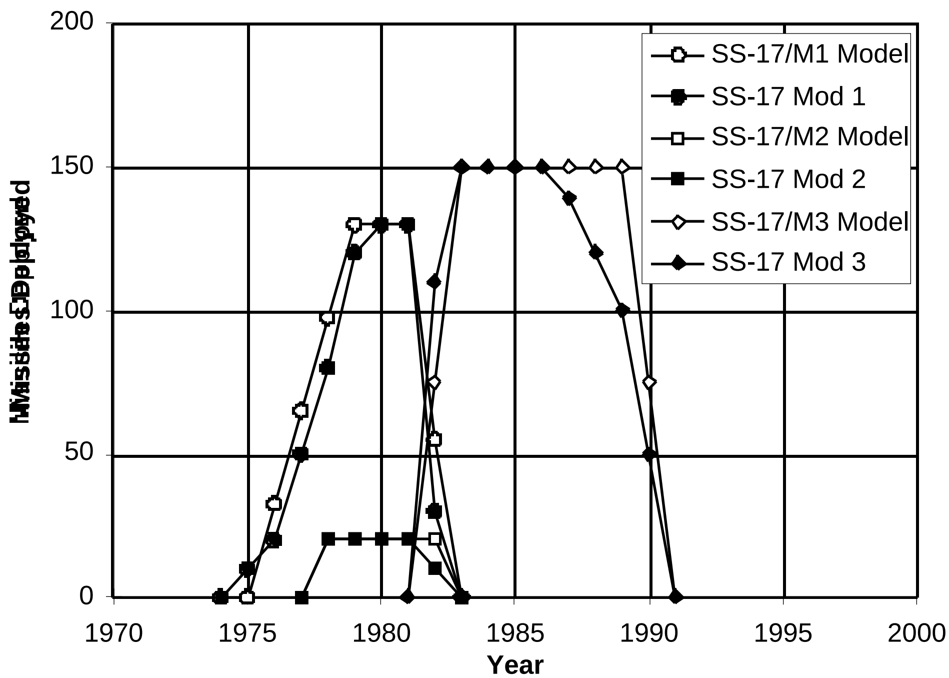

Fig. A.4 - SS-17 Mod 1, 2, and 3 Deployments

Soviet SSBN Deployments

Figure A.5 illustrates the deployment profiles for the two most numerous variants of the Golf SSBN. The Golf I carried three SS-N-4 single-warhead SLBMs and the Golf II carried three single-warhead SS-N-5 SLBMs. The Golf I deployment appears to be the superposition of two different profiles. The model fit to the Golf I data assumes that 15 boats with service lives of 9 years were deployed between 1958 and 1962 (a deployment rate of 3 boats per year) and 7 boats with service lives of 18 years were deployed between the same years (a deployment rate of 1.4 boats per year). The Golf II follows the more familiar pattern, except for the first submarine deployed in 1962. The service life for the Golf II is 22 years and the deployment rate was 2.2 submarines per year. The Golf III and Golf IV were single submarines used as test beds for new SLBMs and hence are not shown in the figure.

Figure A.6 illustrates the deployment profile for the Hotel I/II SSBN. These boats carried three single-warhead SS-N-5 SLBMs. The Hotel III was a Hotel I/II converted to an experimental platform to test the SS-N-8 missile in 1968. The Hotel I/II model assumes a service life of 17 years, with one boat deployed in 1962 and the remaining six deployed between 1965 and 1968 at a rate of 1.5 boats per year. The Hotel III had a service life of 21 years.

Figure A.7 illustrates the deployment pattern for the Yankee I and II SSBNs. Like the SS-11 Mod 1, the Yankee I provides a good example of a submarine whose deployment pattern does not conform to the simple model used in this analysis. The Yankee I SSBN carried 16 SS-N-6 SLBMs, each with one or two warheads. The two warhead versions were MRVs as opposed to MIRVs. The model fit to the Yankee I deployment gives an average deployment rate of 5.0 boats per year and a service life of 17 years. A single Yankee II SSBN was deployed in 1977 with 12 SS-N-17 SLBMs, each carrying a single warhead. Its service life was 14 years.

Soviet Strategic Bomber Deployments

Figure A.8 shows the historical deployment of the Bison bomber and models A through G of the Bear bomber. The discontinuities in the Bison profile represent aircraft losses due to crashes. Apparently, the Bear A–G models were retired more rapidly than would be expected based on their service life alone. The production rate was 11.6 and 11.7 bombers per year and the service life was 28 years and 32 years for the Bison and Bear A–G models, respectively. Thus, Russian heavy bombers last longer than any other strategic nuclear delivery platform. The bomb loading for these aircraft is difficult to determine since, in the early years, insufficient bombs were available to fill all bombers. The following counting rules have been used to determine the bomb count: Bison bombers are assumed to have carried 4 bombs apiece, the Bear A is assumed to have carried 2 bombs each, the Bear B/C four bombs (it could also carry a single AS-3 air-to-surface missile), and the Bear G four bombs and two AS-4 air-to-surface missiles each.[68]

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[68] Ibid., 42.

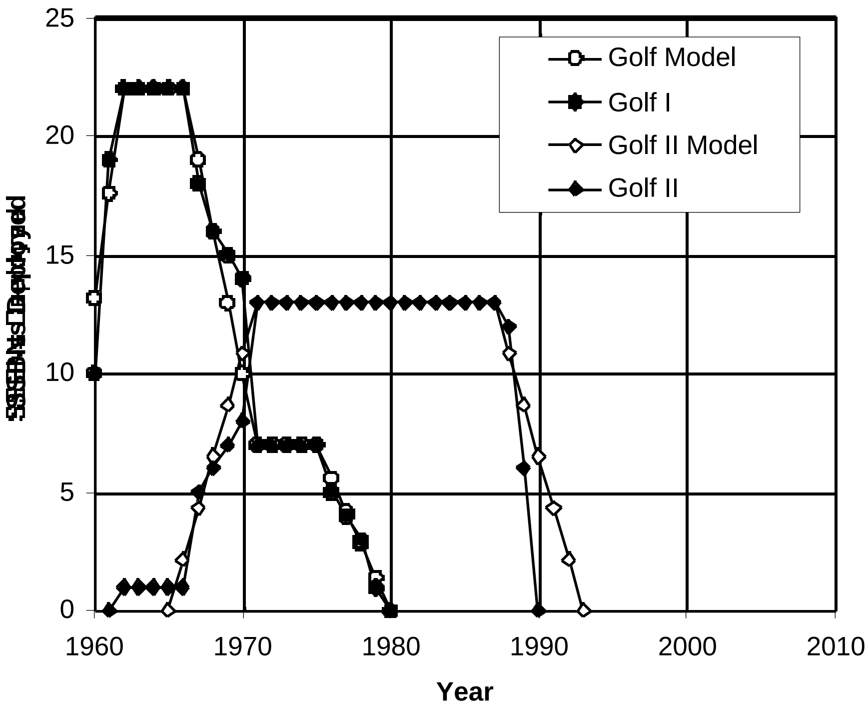

Fig. A.5 - Golf SSBN Deployments

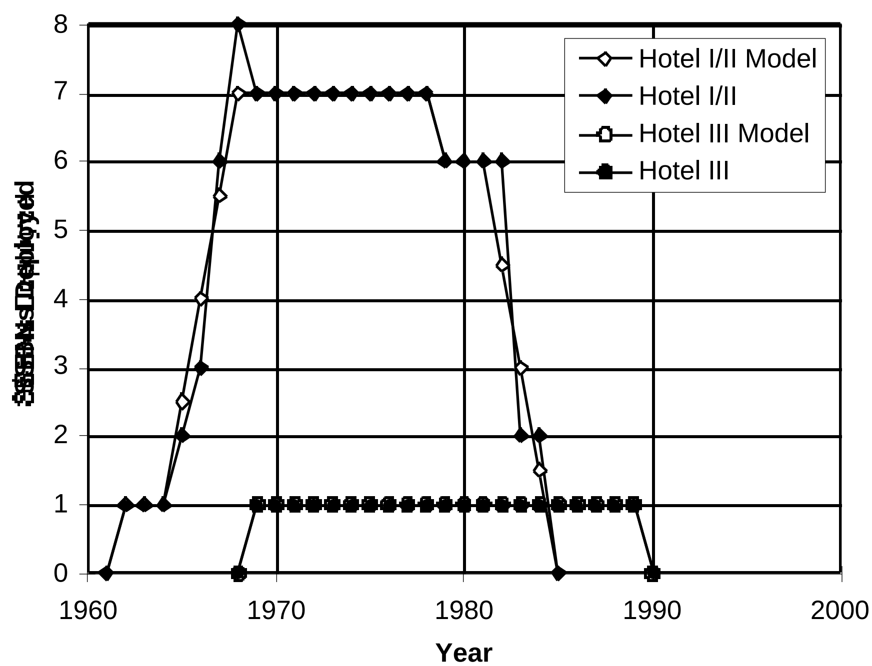

Fig. A.6 - Hotel SSBN Deployments

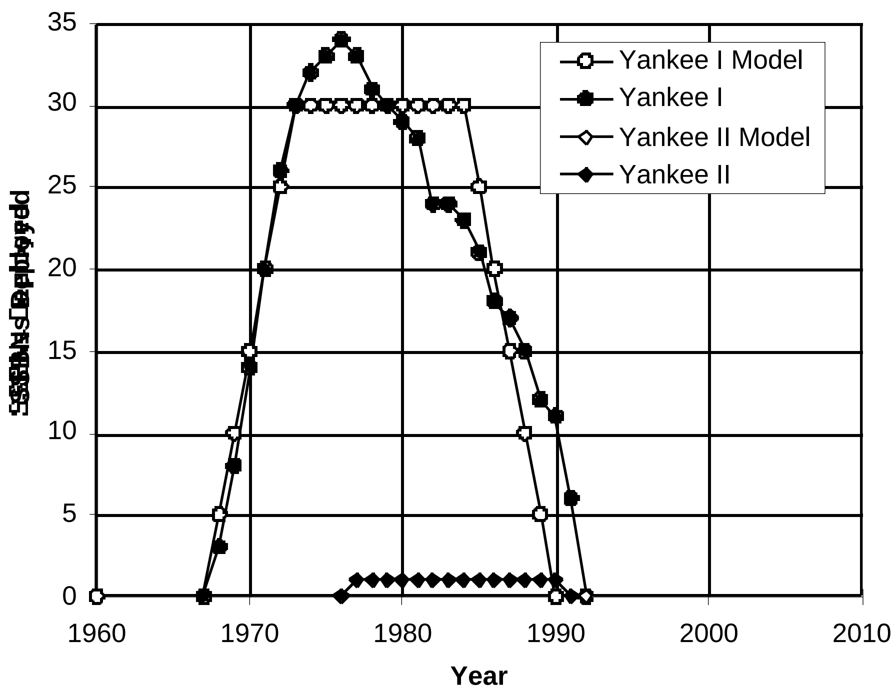

Fig. A.7 - Yankee SSBN Deployments

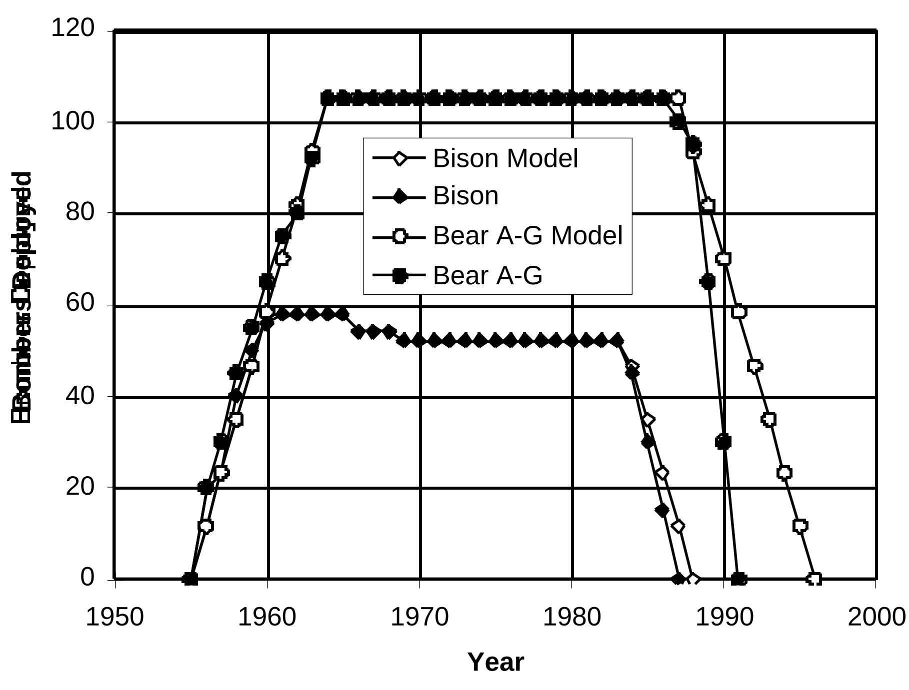

Fig. A.8 - Bison and Bear A−G Strategic Bomber Deployments

Appendix B: Russian Force Projections

Table B.1
Breakdown of Russian Force Projections by Year

Year	Low Projection (Warheads)				Medium Projection (Warheads)				High Projection (Warheads)			
	ICBM	SLBM	Bomber	Total	ICBM	SLBM	Bomber	Total	ICBM	SLBM	Bomber	Total
1998	2500	1909	806	5215	2500	1909	806	5215	2500	1909	806	5215
1999	2317	1696	806	4819	2325	1696	806	4827	2325	1696	806	4827
2000	2195	1451	806	4452	2211	1451	806	4468	2211	1451	806	4468
2001	2165	1205	806	4176	2199	1205	806	4210	2213	1205	806	4224
2002	2135	960	806	3901	2186	960	806	3952	2215	960	806	3981
2003	1880	715	734	3328	1949	715	734	3397	1992	715	734	3441
2004	1175	620	734	2528	1261	653	734	2648	1319	697	734	2750
2005	1144	525	734	2403	1249	592	734	2575	1321	678	734	2733
2006	1146	499	734	2379	1268	600	734	2602	1355	730	734	2818
2007	1052	474	734	2260	1191	608	734	2533	1293	781	734	2807
2008	262	448	734	1444	418	616	734	1768	534	832	734	2100
2009	191	422	734	1348	366	624	734	1724	496	883	734	2113
2010	193	397	734	1324	385	632	734	1751	530	934	734	2198
2011	200	371	734	1305	400	640	734	1774	545	986	734	2265
2012	200	346	734	1280	400	648	734	1782	545	1037	734	2316
2013	200	384	734	1318	400	720	734	1854	545	1152	734	2431
2014	200	384	734	1318	400	720	734	1854	545	1152	734	2431
2015	200	384	734	1317	400	720	734	1853	545	1152	734	2430
2016	189	384	734	1307	380	720	734	1834	510	1152	734	2396
2017	178	384	695	1257	359	720	695	1774	475	1152	695	2322
2018	167	384	565	1116	339	720	565	1623	440	1152	565	2157
2019	149	384	400	933	303	720	400	1423	390	1152	400	1942
2020	131	384	223	738	268	720	223	1211	340	1152	223	1715