The Future of Russia's Strategic Nuclear Forces Discussions and Arguments

E.V. Miasnikov
Center For Arms Control, Energy And Environmental Studies
Moscow Institute of Physics and Technology
1995

E.V. Miasnikov, *The Future of Russia's Strategic Nuclear Forces: Discussions and Arguments,* Published by the Center For Arms Control, Energy, and Environmental Studies at MPTI, Dolgoprudny, 1995.

Center For Arms Control, Energy, and Environmental Studies
Moscow Institute of Physics and Technology
141700 Dologprudny, Moscow Region
9 Institutski per.
telephone (095) 408-6381

electronic mail: miasnikov@glas.apc.org or eugene@iris.mipt.ru

Translated by Brian Finn and Renee Friedman

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List of Acronyms

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SNF             Strategic Nuclear Forces
MIRV            Multiple Independent Reentry Vehicle
SRF             Strategic Rocket Forces
SSBN            Nuclear Ballistic Missile Submarine
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NSNF	Naval Strategic Nuclear Forces
MoD	Ministry of Defense
ASW	Anti-submarine Defense/Warfare
SSN	Nuclear Attack Submarine
SEWS	Strategic Early Warning System
ICBM	Land-based Intercontinental Ballistic Missile
START	Arms Control Treaty
SL	Source Level
TL	Transmission Losses
NL	Noise Level
VLF	Very Low Frequency
ELF	Extremely Low Frequency
HF	High Frequency, Short Wavelength
UHF	Very High Frequency

1.0 Introduction

Over the past couple of years a heated debate has gone on in the Russian press about the role, problems and composition of the future strategic nuclear forces (SNF). On one hand essentially everyone agreed that while there exists another nuclear power, Russia also must possess nuclear weapons. Moreover, in conditions of deep economic crisis and a decreasing level of combat readiness in the army, the strategic nuclear forces remain the sole hope for defense against any external threat from which Russia is not able to withstand with adequate means.

Practically all of the participants in the discussion recognize the role of strategic deterrence. However, this brief formulation allows for different interpretations and are therefore one of the causes of existing debates and conflicting answers to the following questions. What requirements must Russia's SNF meet? What are the specific problems they must resolve? What should their structure and numbers be?

An attempt is made in this paper to categorize the problems which arise in the course of this discussion. We attempt to show that a number of arguments which are being promoted by advocates of prioritizing the development of ground based missiles, to a small extent, do not have a strong enough basis to support themselves.

At present, when this paper was finished, the State Duma of the Russian Federation had still not ratified the Start-2 Treaty. Moreover, in our view, the political leadership of the country has still not completely defined the future of the strategic nuclear forces. This discussion, about what kind of SNF Russia needs, is continuing. For this reason, we hope that the topic being proposed is of interest to the reader and possibly, this work will, to a small extent, contribute to the forthcoming debates.

The author would like to thank the W. Alton Jones fund for financial support while researching this topic. The author is deeply grateful for valuable remarks and criticisms by A.S. Diakov, V.K. Korobov, N.P. Markov, A.M. Ovcharenko and P.L. Podvig for considerately reading the manuscript. I would also like to express gratitude to V.S. Belous, V.V. Borodin, V.Ye. Yarynich and J. Handler for fruitful discussions of various aspects which are covered in this paper.

2.0 Start-2 and prospects for its implementation

In 1991, when the Soviet-American Start-1 agreement was signed, there were more than 10,000 nuclear warheads on strategic carriers deployed in the USSR, of these 62% were land-based, 26% sea-based and 12% air-based. The Start-1 agreement states that Russia, as successor to the USSR, must remove strategic missiles which are already obsolete and are, in any case, subject to reduction. Related to this agreement is the removal and destruction of all missiles on the territories of Belorus, Kazakhstan and Ukraine

Ukraine.

The Start-2 Treaty, which was signed in January 1994, stipulates an even wider reduction of SNF in Russia and the US to a level of 3000-3500 warheads by 2003. One of the basic assumptions of the Start-2 agreement, and which has provoked much criticism of its defenders in Russia, is the prohibition against deployment of land-based missiles with multiple warheads (MIRV). At the end of 1991 land-based missiles with MIRVs carried 54% of the entire USSR's nuclear arsenal. On the other hand, the disruption in industrial cooperation associated with the break-up of the USSR, and the elapsed service period of the missiles with MIRVs inevitably led to the necessity of their removal from military duty. This is not dependent upon the future ratification of the Start-2 treaty.

In accordance with official declarations by representatives of the Ministry of Defense (MoD) and the General Staff of the Armed Forces of the Russian Federation, in the event of the ratification of the Start-2 treaty, it is planned to create by 2003 a grouping of SRF comprised of 800-900 single-warhead missiles, and sea-based strategic forces that support a level of 1700-1750 warheads. However an analysis of the situation in Russia's SNF show that even supporting the level of 3000 warheads during Russia's current economic difficulties and the existing budget financing practices is hardly feasible.

In accordance with the Start-2 treaty, the SRF may not have carriers with more than 105 UR-100 N missiles with a single-warhead and roughly 300 "Topol'" RT-2PM mobile missiles (see Table 1). By 2003 more than half of these missiles will have exhausted the 10-15 year guaranteed service life. The rate of production of single warhead Topol missiles by 1995 will be less than 20 units a year.[(1)]

Assuming these tendencies continue, it is easy to calculate that the number of deployed land-based missiles would not exceed 350-400 units by 2003. It is also not difficult to estimate that to deploy the planned 800-900 missiles [Volkov, 1995] by the end of this century requires an increase in the rate of production to 100 units a year.

Table 1. The composition of Russia's strategic nuclear forces according to official data (the quantity of deployed warheads was derived)

Missile Type	NATO name	Mid '91	12/94(2)	by 2003
Land-based missiles				
UR-100K	SS-11	326	10	0
RT-2P	SS-13	40	0	0
MR-UR100	SS-17	47x4	10x4	0
R-36M UTTKh, M2	SS-18	308x10	186x10	0
UR-100N	SS-19	300x6	170x6	105x1
RT-23 UTTKh	SS-24	89x10	46x10	0
RT-2PM	SS-25	288	318	700-800
Total		6612	3708	800-900
Submarine-based missiles				
R-27	SS-N-6	192	32	0
R-29	SS-N-8	280	256	0
3M-17	SS-N-17	12	0	0
R-29R, R-29RK	SS-N-18	224x3	208x3	NA(3)
R-39, R-39UTTKh	SS-N-20	120x10	120x10	120x8
R-29RM	SS-N-23	112x4	112x4	112x4
Total		2804	2560	1700-1750
Aircraft with air-launched cruise missiles				
Tu-95MS6	Bear H6	27x6	28x6	NA
Tu-95MS16	Bear H16	57x16	37x16	NA
Tu-160	Blackjack	16x12	6x12	NA
Total		1266	832	NA

Although the Start-2 agreement puts a limit of 1750 strategic warheads deployed on submarines, Russia is hardly able to support this level. The limited guaranteed service life for sea-based missiles (roughly 10 years) and for submarine missiles (20-25 years) the lack of support for Navy repair bases will probably result in Russia having no more than 12-17 strategic submarines (SSBNs) by 2003. According to the most optimistic prognosis, this will be 1250-1600 warheads in the composition of NSNF [Handler, 1995; Miasnikov, 1995].

As a result of the break-up of the USSR, the most modern part of strategic aviation ended up outside Russia's boundaries. The amount of strategic air-launched cruise missiles, which are on Russian territory, is presently nearly 800 warheads. Even if Ukraine, under any conditions, returns long range aircraft to Russia,(4) as did Kazakhstan, this will hardly help military capability. Moreover, further production of strategic aircraft in Russia has been stopped. [Norris and Arkin, 1995]. Therefore, at best, the quantity of air-based nuclear warheads in 2003 will be equal to present levels.

The difficult economic situation in the country has led to a significant decrease in financing for the strategic nuclear forces. In conditions where there is a shortage of financing for defense, as well as chronic delays in payments and inflation, it was extremely difficult not only for prospective developments but even to maintain the military-preparedness of the SNF. In particular, the level of financing for SRF in 1994 was 50% less than the amount required [Dolinin, 1994b]. Financing for the fleet, a quarter of which was spent on supporting the naval SNF [Ovcharenko, 1994], was 22-25% of the level required by the beginning of July 1994. The situation, certainly, is even worse in 1995. The military budget adopted for this year, even before the galloping inflation in Russia at the end of 1994, turned out to be less than half of the requested by the Russian ministry of defense.

During the present situation Russia may have three alternatives for the development of the strategic forces, converting de facto from a triad to a dyad.

The first alternative - support for the quantitative level of missiles in accordance with the Start-2 treaty - is only possible if there will be a legally consolidated priority for financing strategic nuclear forces and it will be carried out in practice. (5)

The second alternative attempts to increase the rate of utilization and effectiveness of existing strategic missile carriers at the expense of conducting timely repairs and modernization as well as developing infrastructure for the strategic fleet. In order to maintain the scientific and production potential , production of land-based single warhead missiles at a level of 10-15 units a year can begin and can be continued gradually construction of a new small series of strategic submarines. With this variant the center of gravity of Russia's SNF would unavoidably shift to the Navy, but would manage to support the level of the NSNF at 1700-1750 warheads, SRF groupings at 200-300 single missiles and even manage to preserve strategic aviation.

The third alternative provides for the basic support of mass production and development of land-based single warhead missiles. Official declarations from representatives of the Ministry of Defense and the General Staff and speeches by a number of experts in the press have called for this. The acceptance of such a resolution, surely, would lead to the Russian SNF being represented in practically only one form - SRF. Strategic submarines and aircraft, as well as the corresponding scientific and production infrastructure, would not be preserved.

Since the possibilities for financing are highly limited and cardinal changes in planning the MO budget are not foreseen, then evidently in the next year or two Russia's political leadership will need to decide what to gamble on: the development of land or sea based missiles. Presently, by word of mouth, mutually exclusive alternatives are being suggested. Solutions on distributing the finances for the SNF needs, which are acceptable to the MoD and General Staff apparatus, would ensure a more favorable development of the SRF.

The mass media has developed a wide campaign for supporting the resolution to speed up development on the single-warhead missile "Topol". An increase in the number of arguments against NSNF have been brought forward, which, in our view, don't correspond to the real situation.

3.0 How many warheads does the SRF require to support Russia's national security?

Proposals for land-based missiles frequently employ the following theses: (1) the first can be reduced to the belief that the SRF is now and will remain the main element of the Russian SNF; and (2) in order to support a global strategic balance the SRF must have no less than 900-1000 warheads. Otherwise, according to their opinions, Russian national security will be threatened. [Dolinin, 1994a]

Let us focus on the details of the last part of these allegations. It is based on a very typical conclusion from the "philosophy" for using nuclear weapons which existed during the "cold war" years.

For a long period of time nuclear weapons were considered one of the methods for carrying out military activities. It was exactly these ideas about nuclear weapons which gave rise to the arms race. All nuclear powers increased the quantity, warhead yield, and accuracy. They created different types of nuclear weapons, known as "operational", "tactical", and "strategic" nuclear weapons. At staff headquarters they developed plans for conducting a nuclear war implementing first, second and even third nuclear strikes. This continued up until there were ten times more nuclear weapons in the world than needed to destroy the entire planet.

New ideas appeared for utilizing nuclear weapons. Already in the beginning of the 1960's a prominent American political statesman, Robert McNamara, introduced the concept of "assured" destruction of the enemy. Assured destruction, according to McNamara's criteria, meant a nuclear assault in which one-quarter to a third of the population would perish and two-thirds of the country's industrial potential would be demolished. [Ball, 1983]. In the opinion of American analysts, this required 400 warheads with capability of one megaton.

A little later a "softer" idea for providing so called "irreplaceable" damage to the enemy was born. It was based on the model of economic development and social conditions in the enemy's state after the nuclear weapons attack. "Irreplaceable" damage was defined as destruction of a definite portion of the population and economically important objects, which results in the enemy state ceasing to exist as such. However, the level of injury brought about was correspondingly less than for "guaranteed" destruction. In particular, one of these defined "irreplaceable" losses, worked out in the General Staff of the Soviet Armed Forces at the end of the 1970's, suggested that by using nuclear weapons, 5% of the enemy's population and 15% of its industrial potential would be destroyed.

Finally, the idea of "unacceptable" losses, which relates more to the enemy's psychological reaction to the threat of nuclear assault, emerged. "Unacceptable" losses considers destruction and threats to the population which may stop the enemy from any hostile activities.(6)

It is exactly this concept which is the basis for the nuclear deterrence strategy which all nuclear powers are now proclaiming.

However, the concept of "unacceptable" losses has greater shortcomings - its quantity is undefined. In order to produce future steps --- to determine how specific problems of the strategic nuclear forces must be solved-- it is necessary to precisely designate what is to be considered "unacceptable" losses.(7)

The range in which "unacceptable" losses is estimated is very wide. Even McNamara's criteria of 400 nuclear warheads is considerably less than the overall number of nuclear warheads in Russian and US arsenals as a result of reductions in accordance with the Start-2 treaty. This point of view is called "conservative". At the other extreme, a minimal estimate of the magnitude of "unacceptable" losses is one nuclear explosion on the enemy's territory. This is the point of view of the so-called "pacifists."

The question naturally arises: Is an act of nuclear retaliation acceptable if carried out by the side which was inflicted with "unacceptable" losses by its enemy? In other words, what are the ecological, social, political and economic consequences of such a step on a global scale? If one supports the conservative opinion, then accepting such a solution is equal to the end of the world. Not only the enemy, but also the entire world will inevitably be condemned to extinction, regardless of whether or not the enemy is able to respond with a nuclear retaliation of 400 warheads. If one takes the alternative, pacifists position, then the amount of losses which would be incurred by the enemy would essentially be on the scale of a Hiroshima and more so of a Chernobyl. Incidentally, a catastrophe on the scale of Chernobyl may be created even as a result of a conventional weapon attack on an active nuclear power plant as many proponents for nuclear disarmament have noted.

Obviously, as previously noted, after the reductions in the number of strategic weapons in Russia's arsenal (as well as in the US arsenal) in accordance with the Start-2 treaty, there will still be more than the amount required for strategic deterrence even if one only counts SRF warheads. We note that even some in the professional military are calling for reductions in strategic weapons below the levels in START-2 [Ovcharenko, 1994].

A natural conclusion is suggested. The quantitative criterion is not so important from the point of view of nuclear deterrence. Many agree that support of a defined quantitative level is a necessary political goal for achieving parity with the US.(8)

In the end, it may warrant further production of strategic weapons in an attempt to preserve the scientific and production infrastructure. However, these arguments have little in common with the argument about threats to Russian national security.

There is still one interesting conclusion which may be a result of this long series of debates - that there is still a huge potential for continued reduction of the strategic arsenal. Perhaps, an overall non-nuclear world can not be achieved within the framework of existing world relations. Nevertheless, strengthening an understanding of the new role of nuclear weapons -- as weapons of strategic deterrence -- must inevitably lead to an understanding that it is senseless to maintain the existing amount of weapons.

4.0 On the criteria for the strategic nuclear forces

As well as quantitative criterion, the accuracy and yield of nuclear weapons are not essential any more for deterrence strategy. The accuracy of hitting a target, which now constitutes several hundred meters,(9) and the yield of nuclear charges, which exceeds the equivalent of a megaton of TNT, is important only for destroying the enemy's strategic missile silos. However, this is scarcely the only or even the most effective means of inflicting "unacceptable" losses. Moreover in scenarios with retaliatory-counter strikes or retaliatory strikes, when the enemy begins a nuclear war, the destruction of missile silos becomes completely senseless.

It should be emphasized that in Russia over the last few years, the customary stereotypes of the requirements which must be satisfied by the SNF have changed. Significantly more weight was given to such criteria as the security of the nuclear weapon service, preservation of the environment and, of course, the cost of supporting the nuclear shield.

Nevertheless, in the idea of deterrence, the most important criteria for the SNF is their invulnerability, i.e. reliable defense against possible attack by potential enemies and the ability, in any conceivable situation, to carry out a retaliatory nuclear attack on his territory. The deeper the process of reducing nuclear weapons in the world proceeds, the more acute this question becomes.

Questions of the SNF surviving in conditions of conflict are sufficiently and actively discussed in the mass media. It is generally accepted and considered that the most vulnerable component of the SNF are the missile silos. A silo's location can be determined with the help of a satellite detection system, and therefore they can be destroyed with a high probability by the enemy in the early stages of the conflict.(10)

It is also thought that a land-based mobile missiles are less vulnerable. Nevertheless, a number of arguments against this opinion have been put forward by V.S. Belous [Belous, 1994] and P.G. Belov [Belov, 1995], and these arguments deserve attention.

However, the most heated controversy has developed around the issue of the vulnerability of strategic submarines. The overwhelming majority agrees that Russian missile carriers are easily detected by the enemy, that US forces constantly trail them, and in critical circumstances they may be relatively easily destroyed by non-nuclear means before successfully completing their military missions. [Stepanov, 1994; Sokolov, Startsev, 1994; Voronin and others, 1995]. Some opponents of NSNF, although admitting the possibility of Russian strategic nuclear submarines participating in a counter attack, nevertheless think that their effectiveness will be essentially worse than of ground-based missiles [Belous, 1994; Volkov, 1994; Prokudin, 1994; Arbatov, 1994].

Similar statements were even formed among scientific workers at Russia's Ministry of Defense's central institutes and the Russian Federation's MoD leadership. This point of view is also shared by many workers at governmental organizations.(11)

It's interesting to note that such a point of view was widespread only in Russia, in contradiction with other nuclear powers. In the USA, Great Britain and France strategic submarines (in which 37 to 100% of the corresponding nuclear arsenal are deployed) are considered as a basic force which is capable of carrying out a retaliation strike. These countries prefer to place strategic weapons far from their national territories, subjecting them to smaller risk. This is shown by the renewal of NSNF in the USA, Great Britain and France. According to the press, plans for creating a new generation of strategic submarines are being developed by People's Republic of China as well [*Navy News*, 1995].

In the following three sections we attempt to show that opponents' apprehension of NSNF, in regards to the vulnerability of Russian strategic submarines, is clearly exaggerated.(12)

5.0 What can threaten Russian strategic submarines?

We should stress that the views on the vulnerability of Russian strategic submarines have deep historical roots. At the end of the 1960s and beginning of the 1970s, Soviet strategic submarines conducted military patrols in the open ocean and along the US coastline where the potential enemy possessed a clear advantage in the area of anti-submarine defense. Moreover, in order to increase the effectiveness of using submarines, they had to go to their regions of combat patrol at a speed in which their noise sharply rose and therefore strategic subs were more noticeable (see Appendix 1).

The situation changed at the end of the 1970s when sea-based missiles came to possess intercontinental range (see Table 2). Submarines achieved the possibility of attacking practically all targets on the US territory, while were located on patrol in the waters of the Barents, Kara and Okhotsk seas or in the Arctic. In these regions the enemy lost the possibility of achieving sea and air dominance. The strategic significance of the SOSUS system, which was expanded along the line of the Nordic cape - Bear Island, Greenland, Iceland, Faeroe Island, Great Britain and in the Pacific Ocean was lost since Soviet SSBNs no longer needed to pass through this line.(13)

Table 2. Armaments of Soviet/Russian strategic submarines

Submarine class		Missile	Range (km)	Entered into Service
pr. 611 AB	(Zulu V)	R-11FM	150	1956
pr. 629	(Golf I)	R-13	650	1960
pr. 658	(Hotel I)	R-13	650	1960
pr. 629 A	(Golf II)	R-21	1400	1963
pr. 658	(Hotel II)	R-21	1400	1963
pr. 667 A	(Yankee I)	R-27	2400 (3000)(14)	1968
pr. 667 B	(Delta I)	R-29	7800 (9100)	1973
pr. 667 BD	(Delta II)	R-29	7800 (9100)	1973
pr. 667 AM	(Yankee II)	3M-17	3900	1980
pr. 667 BDR	(Delta III)	R-29R	6500 (9100)	1983
pr. 941	(Typhoon)	R-39	8300	1983
pr. 667 BDRM	(Delta IV)	R-29RM	8300	1986

A submarine can't be simply destroyed since its location is constantly changing. It is practically impossible to use weapons working at a close radius on surface ships or aviation for a secret preventive attack on designated Russian strategic submarines if they are located on combat patrol in waters adjacent to Russian territory. All the same, it is true that for long-range weapons ensuring the necessary level of accuracy becomes a problem. Therefore, the only way to destroy Russian strategic submarines preemptively in a crisis situation is to organize long-term, continuous tracking over them by nuclear attack submarines (SSNs), which must still be concealed.(15)

Moreover, to exclude the possibility of using strategic weapons from Russian SSBNs, enemy SSNs also must be capable of guaranteeing the destruction of all of them without exception within a very short time after receiving the appropriate order.

How real is this threat? Do American SSNs possess the technical means to continuously track our strategic submarines in their combat patrol regions?

We tried to answer this question by assuming an ideal situation for potential enemies. Namely, Russian submarines took no countermeasures, and the enemy was not threatened by Russia's anti-submarine defensives (ASW). The enemy may fully use its passive acoustic apparatus and possess exhaustive information about the region's hydrology (see Appendix 2).

We note that the estimates on the maximum detection ranges given in Appendix 2 were too high. Nevertheless, even these estimates permit one to make conclusions which may have important significance when planning the future composition of Russia's strategic nuclear forces.

Table 3 gives the values for the probabilities of favorable weather conditions in which the world's most advanced SSN type, the "Los Angeles", can, in principal, detect Russian strategic submarines within a given distance (also see Figure A2.4a-b in Appendix 2). The information in the table corresponds to two extreme situations - favorable and poor conditions of sound propagation. Let's first consider favorable conditions for the enemy's situation (model A).

Table 3. The probability of favorable weather conditions for detection within a given distance in the Barents Sea during the winter (models A and B - minimum and maximum losses due to sound propagation, respectively)

Submarine Type		Distance		
		50km	30km	10 km
Model A				
pr. 667 A	(Yankee)	.12	95	1
pr. 667 B	(Delta I)	.05	.54	1
pr. 667 BDR	(Delta III)	0	.15	.95
pr. 667 BDRM	(Delta IV)	0	.08	.45
pr. 971	(Akula)	0	0	.03
Model B				
pr. 667 A	(Yankee)	.03	.15	1
pr. 667 B	(Delta)	0	.05	.93
pr. 667 BDR	(Delta III)	0	0	.55
pr. 971	(Akula)	0	0	0

Based on our estimates, a "Los Angeles" class SSN may detect a Delta IV at a distance of 30 km, only when it was calm, which in the Barents Sea in winter occurs not more than 8% of the time. At this distance the 667 BDR strategic sub (Delta III) can be found in less than 15% of the naturally occurring conditions. The Yankee SSBNs (which has been removed from service) can be detected in practically any weather condition. At the shortest distance of 10 km, the probability of registering the SSBNs 667 BDRM (Delta IV) is less than 45% and the 667 BDR (Delta III) less than 95%. If one takes into account that in an actual conditions, the external noise level with wind speeds of greater than 10-15 meters/second is correspondingly greater, as noted in Appendix 2, so the repeatability of favorable conditions for detecting third generation SSBNs at a distance of 10 km is considerably less. It is noted that a distance of 10 km is evidently a threshold at which it is still possible to follow a submarine without a large risk of colliding with it (this issue is discussed in greater detail in Appendix 2).

Estimates for model B clearly illustrate that there are areas in shallow waters that, even in calm conditions, the maximum distance for detecting third generation SSBNs is considerably less than 10 km. In 50% of the natural conditions the distance for detecting modern strategic 667 BDRM and 667 BDR SSBNs is not more than 4-5 km. At this range, attempting prolonged trail inevitably will result in submarine collisions. Reliable technical means to prevent collisions do not exist if both submarines try to operate covertly.

Therefore, in agreement with our estimates, the current levels of technology do not allow a potential enemy to conduct continuous and prolonged tracking of Russian SSBNs even under ideal conditions.

We also add that, in practice, a number of factors arise which complicates even more the task of destroying SSBNs preemptively. Russian strategic submarines will use countermeasures such as evasion from pursuit, disengagement, and putting up false targets, and other tactical measures, by which their emitted noise will be less than shown in Table A2 (see Appendix 1). Russian SSBN may also actively fight, using its anti-submarine weaponry. It is impossible to ignore the fact that the enemy's SSN will be located in a hostile environment - superior ASW forces will be working against it.

Table 3 clearly illustrates the importance of constant control of noise levels. The necessity of maintaining submarine noise at a given level by measuring "aging" and wear of their mechanisms is also stressed. So if one assumes that the noise level of a 667 BDR (Delta III) SSBN, which was built in 1976, increased by 5 decibels, then the distance for detecting them in shallow water becomes the same as the 667 B (Delta I), i.e., by almost 1.5-2 times (see Appendix 1).

The next generation of SSBN promises to be even more covert than the present. We've inserted in Table 3 estimates of the distance for detecting the SSN of project 971[(16)]

(Akula), the noise level of which, according to experts, is 10 decibels lower than the 667 BDRM SSBN. At a distance of 10 km in shallow water such a submarine may be detected in not more than 3-5% of the natural conditions, and if the wind speed exceeds 12 m/s - it becomes "invisible" to the enemy.

A number of authors built their claims about the vulnerability of Russian strategic submarines only on the fact that our submarines are noisier than the Americans. This argument becomes complicated to ignore because specialist advancing it have themselves served on strategic submarines.[(17)]

However, as follows from our results, the question of whose submarines have a greater acoustic signature is less important if their noise levels are below a defined value. The maximum operational range of a submarine's sonar in this case is limited not by technology, as used to be the case, but by the natural noise of the ocean from which it is impossible to escape.

6.0 How many SSNs are needed for constant tracking of all Russian SSBNs?

Let us assume that the circumstances, which were stressed above, do not confuse a potential enemy and he tries to organize the constant covert tracking of Russian SSBNs. The question naturally arises: how many attack submarines does this require?

Since the detection distance does not exceed several tens of km even in ideal conditions, at least one enemy submarine should be assigned to each Russian SSBN. At the end of 1994 there were 48 SSBNs in the Russian Navy. If they manage to extend the average service life to 25 years then by 2003 the order of the battle will include 17 strategic submarines. Obviously, having as its goal the preemptive destruction of the NSNF, the enemy will follow a worse case scenario and try to move such number of SSNs up to the Russian shores, how many combat ready SSBNs Russia has. If one assumes that 20% of the Russian SSBNs will be in for repairs [Pustovit, 1995], then this will require not less than 14 SSNs.

For constant tracking to occur, the enemy's SSN must go after Russian strategic submarines the moment they leave their base. Taking into account the previous estimates for detection distance and that coastal waters are tens of millions of square kilometers, it's possible to arrive at the conclusion that the chance of the enemy's SSNs finding Russian submarines in the open ocean will be extremely small. This means that all of the potential enemy's 14 SSNs must carry out continuous patrols close to Russian SSBN bases and wait for strategic submarines to leave.

If one were to analyze the composition of the fleets of the largest countries, one may easily be convinced that now, and for the next decade, only the US will be able to carry out such an activity. As of 1 January 1995 the US Navy had 83 SSNs [Polmar, 1995], of which about 3 to 4 SSNs conducted constant military patrols near Russia's Northern Fleet bases and 2 to 3 near the Pacific Fleet bases. The number of "observing" SSNs doubled when the Russian fleet conducted staff exercises. By the year 2000 the American Navy plans to decrease the number of its SSNs to 45-55. Therefore, in peacetime, the number of American foreword-based SSNs will hardly increase. If a confrontation period begins between Russia and the US, it will be impossible to instantly transfer the necessary number of submarines to regions of Russian NSNF deployment. This requires several days to two weeks - time which may be sufficient to remove a large number of Russian strategic submarines from base and to defended regions. But even if one assumes that in these conditions the US Navy could succeed in deploying 14 SSNs near Russian naval bases, it is not possible to do this covertly.

Nevertheless, opponents of NSNF frequently put forth the argument which focuses on the conditions just enumerated. Let us try to retrace their logic and estimate the significance of their objections.

It is often claimed that the enemy doesn't need many tracking SSNs since only 10% of Russia's total SSBNs are on constant patrol while the remainder are located in base and may be easily destroyed.

Indeed, the strategy for deploying Russian strategic submarines is such that in peacetime constant military patrols include only a few SSBNs. Moreover, twice as many SSBNs in port are kept in a constant state of readiness to go to sea and launch their missiles. In a period of increased threat, the NSNF is brought up to a state of constant military readiness which means that all battleworthy SSBNs are deployed in the ocean.

Certainly, the enemy has the possibility to destroy all strategic submarines located on base as well as missile silos bases and can do this sufficiently quickly. The question naturally arises - can one do this in peacetime? Obviously this issue raises a series of other questions on whether nuclear war will break out during peacetime. If the response given by the NSNF opponent is confirmed, then a potential enemy would hardly limit himself to destroying submarines in port. At the same time he would try to destroy all other elements of Russia's strategic nuclear forces. Obviously, as well as taking this step the enemy will follow with a worst case scenario and try to destroy Russia's nuclear potential in a very short period of time. In principle, Russian SNF are capable of carrying out a counter attack within 15-20 minutes after the enemy launches missiles. Can the enemy keep within this time period in order to fully secure itself against counter actions? A no less simple question - can he guarantee the destruction of Russia's SNF in 15-20 minutes and not use nuclear weapons?

One argument the opponents of the NSNF still give is that the potential enemy may prove to be successful in destroying part of the Russian SSBNs in the early stages of a conflict. Moreover, it is possible to use conventional weapons. According to A.G. Arbatov "one torpedo with conventional charges (may send - E.M.)....one submarine, with all its missiles and 100-200 warheads, to the ocean's bottom" [Arbatov, 1994]. What follows from this threat? Will the enemy take similarly limited preventive measures and destroy only part of Russian SNF?

During the 1980's in the USA there was large support for such a similar strategy. However, it's important to notice that preventive destruction of part of the SSBNs was seen only as a response to an offensive attack by Warsaw Pact countries' forces [Brooks, 1986]. This was, in fact, the one of few methods for non-nuclear deterrence of the Warsaw pact's conventional forces in Europe. The strategy for a preemptive destruction of part of the Soviet SSBNs may hardly be warranted now, when the threat to Europe from the East is practically nonexistent.

Although the opinion exists that "...a reasonable man will not give the order to conduct a retaliatory nuclear attack and deliver the country to the verge of complete destruction..." [Prokudin, 1994], in our view, a more convincing argument is that: "a reasonable man .... will seriously weigh the expediency of giving an order to begin war with conventional weapons against a state which possesses a smaller, but very capable nuclear potential..." [Pustovit, 1995].

Earlier we looked at only part of the problem of trailing submarines, namely the possibility of their destruction. There is still one fundamental problem which the enemy's SSN has to confront : the identification of SSBNs. Russian attack nuclear subs will be located as well in regions where strategic submarines are on patrol. The noise characteristics, which they create, are barely distinguishable from strategic submarines' noise. This problem becomes more urgent in proportion to the suppression of the discrete component in the noise spectrum of contemporary submarines (see Appendix 1). The differences in the noise created by strategic and non-strategic nuclear submarines is less and less noticeable. During the 1980's complications in identifying SSBNs, were one of the arguments in the US against a strategy of so-called forward naval deployment [Mearsheimer, 1986; Ball, 1985-86; Posen, 1982]. According to this strategy, with the beginning of the conflict between the USA and the USSR, the US SSNs must be directed to the Northern and Pacific Fleets deployment regions. They had the task of blocking Soviet SSNs going into to the open ocean and destroying a large portion of them in the oceans surrounding the USSR.

There are presently 54 attack and strategic submarines in the Russian Navy which were built after 1978. The enemy's task is extremely complicated if Russia manages to preserve even half of them in battle-readiness by 2003. But how many SSNs are needed by the enemy for organizing constant tracking of strategic submarines if the Russian fleet will use sound imitators which create a noise exactly like SSBNs? We also want to stress that the enemy's SSNs must also reliably identify "their" own submarines from "others" without betraying their presence.

Moreover, in a period of conflict, the Russian SSBN patrol zone prove to be far from a single theater of military activity. If needed, the Russian Navy will employ a number of offensive measures directed at weakening the enemy's potential. In particular, a number of these will be related to creating a threat to his aircraft carrier groupings, sea and ocean lines of communications as well as coastal targets. The central role in fulfilling these tasks will be played by Russian attack SSNs. Obviously, a significant part of the enemy's submarine force will be employed in battle with them.

The facts are implacable - even if one suggests that the enemy's submarines were able to carry out secret tracking of Russian SSBNs, he will not be in the position to provide a sufficient number for this.

7.0 How is it possible to suddenly and completely destroy Russian SSBNs?

Again we propose that the opponents of the NSNF are correct and the enemy is capable of carrying out constant tracking of all Russian strategic submarines. If, somehow, in a situation where he sets the goal of carrying out a surprise attack on Russian SSBNs, then in a comparatively short period of time he must guarantee the destruction of all strategic submarines. Otherwise, as we discussed in the preceding paragraph, "the game" doesn't have a point - even one remaining submarine is capable of carrying out an attack on not less than 48 targets.

Questions naturally arise. How reliably, and, without betraying the location of its SSNs, can the enemy's high command know, at any specific moment, that all the Russian strategic submarines are "in their sight?" All enemy submarine in such a situation will be in constant communication with their command posts. The enemy's two-way communications which take place in the patrol zones of its SSBNs will scarcely go unnoticed by the Russian Navy's reconnaissance forces.

It should also be taken into account that there exist several peculiarities of anti-submarine torpedoes, methods and means for defense against them which will reduce their effectiveness below 100%. The torpedoes, that are used against Russian submarines, have a limited speed which, as a rule, does not exceed 50-60 knots (25-30 m/s) [Surnin et al., 1991]. If the firing distance is sufficiently great (more than 10 km) then the torpedo will reach the target in not less than 5-6 minutes and that is sufficient time for detecting it and taking measures to disorientate it. A hydroacoustic decoy which creates noise identical to the noise of the SSBN can be released. A cloud of gaseous bubbles which "blind" the torpedo's active detection system can be created. And finally, the SSBN can maneuver away from or outrun the torpedo. The torpedo's range is not more than 40 km if its speed doesn't exceed 20-25 knots (10-12.5 m/s). Strategic submarines can accelerate to such speeds. At maximum speed a torpedo can not go more than 10 km.

As we already mentioned, it is extremely risky to carry out tracking at a close distance to the SSBN (less than 5-10 km), particularly because of its inexact localization. But if, for a minute, we allow that the enemy possesses comprehensive information about the environmental conditions during the period of conflict, then that allows him to determine, with sufficient exactness, the target's location which is being registered by the submarine's sonar. The explosion of one powerful (not necessarily nuclear) depth charge will be enough to disturb the natural state of the ocean's physical properties within a radius of not less than several tens of kilometers and it deprives the enemy of such an important tactical advantage as knowing the environment. It will take at least several hours until the environment's physical properties are restored. And what if one disturbs the ocean with a small capacity nuclear charge? The results will be felt for a radius of several hundred kilometers from the epicenter of the explosion over the course of several days. Moreover, after the explosion the background noise will increase to such an extent that it will be impossible to distinguish the noise produced by submarines. The majority of the enemy's SSNs will "lose trail" and the enemy loses all hope of again detecting Russian submarines. Will the Russian armed forces refrain from taking such measures if a real threat to its naval strategic force arises? Especially as this explosion will not be a threat to any submarines(18)

nor anyone's territory.

Therefore, it seems unrealistic to neutralize all strategic submarines, even if they are located at sea and they are being continuously tracked.

8.0 On controlling SSBNs

Opponents very often relate the NSNF insufficiencies to the one-way and unreliable communications with submarines. This, in their opinion, significantly lowers the possibility of transmitting orders for using strategic weapons.(19)

In our view, such a formulation reflects only the superficiality of the actual situation in controlling the SSBNs and is not an accurate argument in favor of prioritizing the development of land-based missiles, even if it is assumed that in critical situations the certainty of carrying out an order to launch land-based missiles is greater than missiles deployed in the ocean.

Regardless of the composition of the system for control over either NSNF or SRF, an absolute guarantee that launch orders are transmitted to all delivery platforms can be achieved only in theory. The actual probability of carrying out this order is always less than one and still depends on several factors: how complex the system is, how well protected the system is from external affects, and the specific battle conditions. One may only raise the reliability of the combat control system by creating a reserve system and using channels which are working on different physical principles, that, in the final analysis, lead to increased financial outlays.

The question naturally arises - to what degree should the probability of sending orders to strategic weapon platforms be increased?

Obviously, the less vulnerable the platform, the lower will be the demand for reliable communication with them. From this point of view, requiring an equally reliable communication system for a land-based silo system and a submarine makes no sense. Providing equal effectiveness requires greater control of a land-based missile silo.

Secondly, within the framework of a systemic approach, stressing the reliability of control is warranted only when it is the weakest link in the chain, associated it with the process of making a decision on and carrying out a nuclear attack. For example, if the operational probability for the missile attack warning system (SEWS) is only .5, then difference in reliability of the control system for land-based missiles of .9 or .999 is not important. Under any circumstances the number of missiles fired in a counter attack, will differ by not more than 10% due to differences in the control system's reliability. It is logical to suggest that the enemy will consider a retaliatory attack either as unacceptable in both cases or tolerable irrespective of the size of unacceptable losses.

Thirdly, as discussed above, fulfilling the task of deterrence with the existing number of deployed strategic weapons is not at all related to achieving an absolute control of SNF. Even if only a tenth of the strategic potential that Russia intends to have by 2003 survives an enemy preemptive attack, and if the reliability of the communications system is only .5, then the enemy risks receiving 150 to 175 nuclear warheads on its territory.

Returning to the reliability of communications from submarines we stress one circumstance. In principle, the system for controlling the NSNF may include two types of tasks. It depends on what role for NSNF is envisaged in the operational plans for using strategic forces [Stefanick, 1987]. If the operational plan presupposes centralized control over all strategic submarines during a conflict and a continuous exchange of information with the High Command, then the control system must support large flows of information and be highly reliable, efficient and secret during a long period of unfavorable actions on the communication channels. If the task of strategic submarines is simply to survive and be in a constant state of combat readiness during a conflict, then the requirements for the NSNF management system are significantly simplified.

Are efficient and reliable bilateral communications with SSBNs, as claimed by opponents of NSNF, necessary for completing the second task? As is known, a strategic submarine, which is on a combat patrol even in peacetime, is instructed to observe radio-silence. It may only communicate in an extreme situation or on order from the command center. This type of communications is followed not only by Russian submarines, but also by American, English and French SSBNs.

Is this largely insufficient? Opponents say "yes" because the Supreme Command and Russia's General Staff will not know about the actual situation in the NSNF, since in such a situation the location of the submarines will be unknown." A logical counter question arises - can the enemy's commanders monitor the situation? It is hard not to agree with the opinion that in strategic deterrence " ... the fact that strategic submarines are at sea, not high or low reliability for controlling them, is the decisive factor." [Ovcharenko, 1994]

Here it is appropriate to return to the preceding section where we discussed the possibility of preemptive destruction of all Russian SSBNs by the enemy in the course of 15-20 minutes. Obviously, to carry out this task the potential enemy requires all of the types of command and control listed above. The enemy's antisubmarine SSN command and control system must be two-way, efficient, reliable, and secretive; most complicated of all, these qualities must be guaranteed during the entire conflict right up to carrying out the preemptive attack.

For Russian strategic submarines to fulfill the mission of deterrence it is quite enough to have the second type of operating system. In order to inflict unacceptable losses on the enemy, launch orders needed to be transmitted to only a single strategic submarine. The time frame for doing this will be mild. As noted by V.N. Polyakov: " A most important thing is that a strategic submarines essentially don't need a warning system. The launch command doesn't have to be sent 10 minutes after detection ...(of the enemy's missiles -E.M.)..., for that one would have a heart attack. The order can be sent the next day." [Polyakov, 1995].

We also mention the essential differences in the conditions in which these operating systems will function if the actions will arise in waters adjacent to Russia. As we already mentioned, the enemy's submarine will be operating far off from its bases, in a hostile environment, and within the Russian navy's and air force's dominion. Even attempts to limit the reception of information to the tactical characteristics of enemy submarines will increase the probability of being noticed by the Russian Navy's ASW forces - not to mention attempts to transmit information. On the other hand, the risk of being detected will be correspondingly less for Russian SSBNs, even if they have to deploy an antenna above the see surface to receive information. A submerged enemy submarine in these conditions does not have any additional advantages. Radars on the enemy's ships and aircraft will be located too far away to effectively detect the Russian strategic submarine's antennas.

One of the arguments the opponents of the NSNF, in discussing the efficiency of the SSBN communications system, appears at first glance sufficiently convincing. As is well known, on American strategic submarines, in contrast to Russian, there exists the technical possibility of an autonomous missile launch. In an extreme situation, when the submarine has convincing evidence that all command points from which orders may be sent to use weapons have been destroyed, the launch of strategic missiles may be implemented by the ship's crew. It is easily noted that this possibility creates the risk of an unsanctioned missile salvo which will be impossible to prevent (in other words, absence of "negative control"). Therefore the possibility of an autonomous launch is interpreted by the opponents of NSNF as evidence of the unreliability of the control system [*Nuclear Weapons*...,1992]

However, one has the right to another explanation of why American submarines have the technical possibility for an autonomous launch. In our view, this is a result of the historical development of the command system of the US strategic forces as well as a consequence of the more privileged status of the Navy in the US armed forces.

It is well known that the first strategic submarines were equipped with relatively short-range missiles. At that point, the problem of supporting covert and reliable control over them arose for both the US and the USSR. For both countries there was only one possible solution during this period: the submarine crew received the maximum authority, including the real possibility for autonomously launching missiles. By the end of the 1970's both countries possessed intercontinental sea-based missiles. Strategic submarines patrolling regions were close to their shores and that essentially simplified the problem of providing them with communication. The USSR and the US became significantly advanced in the creation of principally new efficient and reliable systems for communicating with submarines. In particular, a communications system on extremely low frequencies and very long wavelengths emerged and it became possible to transfer information via satellites retransmitters. The system for controlling the USSR's armed forces always gravitated towards the most rigid centralization. Therefore as the corresponding technical pre-requisites arose, the leadership of the USSR's armed forces fully monopolized the possibility to use strategic weapons. The launch of an SLBM can now be accomplished only after receiving the codes which release the missile's targeting system; these codes are received together with the launch order. In the US possibility of an autonomous missile launch by SSBN crews has remained, although this issue was sharply debated.

Thus, the opponents of NSNF have not made weighty arguments which confirm the unreliability of communications with submarines. We note that the issue of organizing the communication system with submarines is essentially absent in the domestic literature. For this reason, in Appendix 3 an attempt was made to outline its structure, elements and physical working principles. The reader has the right to judge for himself whether communications with submarines is reliable and whether the enemy is capable of completely disabling it in 15-20 minutes, without permitting a nuclear attack, as claimed by the opponents.

9.0 The SRF and the NSNF: Which is more effective?

The criterion of effectiveness is frequently used in a comparison of land- and sea-based missiles. Herein, under effectiveness of this or that type of SNF we will take to be the portion of deployed nuclear warheads, which reach their targets in a nuclear counter-attack. Let us examine in detail the results of the research on effectiveness by participants in this discussion, especially as this gives an additional chance to compare the quantitative estimates given above with the conclusions of other authors.

When estimating the effectiveness of the NSNF, as a rule, similar methods are used. The following parameters are usually taken as initial: the probability of finding an SSBN in the ocean, on base, or in repairs; the survival probability of these ships as a result of the enemy's preemptive measures, and the probability that the launch orders are received.

According to the estimates of L.I. Volkov, at the moment the nuclear conflict begins, not more than 60-80% of SSBNs will be on patrol in the ocean [Volkov, 1995]. Further, L.I. Volkov claims that "the probability that Russian submarines are not defeated by ASW forces is 0.3-0.5," which is significantly less than would have been expected from the results we received above. Nevertheless, we stress that even using more conservative estimates of the survival probability of the SSBNs of 0.1-0.2 there should still be 1-2 combat ready strategic submarines remaining at sea after an enemy preemptive attack.

Also taking into account that "the probability of transmitting an order ...(to submarines - E.M.)... is extremely small both at present and in the near future" (expressed as a number it is 0.5 based on L.I. Volkov's conclusions), the author, nevertheless, estimates that the effectiveness of NSNF is 10-20%. Further computations by the authors, M.S. Vinogradov and R.A. Zubkov [Vinogradov, Zubkov, 1995], found that if there were 15-20 strategic submarines in the NSNF with a total of 1750 warheads, then a counter attack would include 112 to 272 nuclear warheads.

Similar assumptions are taken by V.S. Belous [Belous, 1994]. Of the 60% of the SSBNs, at sea in the initial period of war, in accordance with these premises, 30-40% of them would be lost. Also taking into account that the probability of destroying a submarine, which is located on base, is extremely great, then at the beginning of the war the total losses, according to V.S. Belous, may reach 70-80%. Thus, it is not difficult to calculate that 20-30% of the strategic submarines would participate in a counter attack which would include 140-1000 warheads.

And now let us turn our attention to Volkov's estimates of SRF effectiveness. Unfortunately, he did not comment on the estimates of the effectiveness of land-based missiles, which turned out to be 75-85%. This shortcoming is justifiably noted by his critics [Vinogradov, Zubkov, 1995]. By their estimates, the survival rate of land based missiles is less than 25% as a result of an aggressor's nuclear attack, and the portion of SRF in a counter attack is 225 nuclear warheads which is comparable with the portion of NSNF - not an order greater as claimed by L.I. Volkov. It is a noteworthy fact that M.S. Vinogradov and R.A. Zubkov are not supporters of the NSNF [Zubkov, Vinogradov, 1994].

In either event, the arguments by the opponents of the NSNF do not confirm that land based missiles are more effective than submarine-based missiles. They do not demonstrate weighty arguments in favor of the necessity of deploying up to 900 "Topol" missiles. Moreover, the estimates of the effectiveness of the SRF put forth by their supporters are themselves needed in the arguments because their premises are far from obvious. Nevertheless, the results which were obtained by the opponents of NSNF disprove the widely shared opinion that all Russian submarines are in the enemy's sights and may be suddenly destroyed.

In our view, an interesting approach for comparison is suggested by V.N. Polyakov [Polyakov, 1995],(20)

which examines the effectiveness of SRF and NSNF as a function of the probability of the successful operation of the missile attack warning system (SEWS) and taking the decision to counter attack. According to V.N. Polyakov, the SRF is more effective than NSNF only if the combined probabilities that the SEWS operate and the decision on issuing launch orders within 45 minutes after the enemy begins a nuclear attack is less than 0.4. If one considers that a significant part of the former USSR's SEWS is abroad, and also that the period for making decisions on counter attacks is subjective, it is obvious that the product of these probabilities will be significantly less than 1. Consequently, it is not possible to ignore the stated factors, as done, for example, by L.I. Volkov in his estimates on the effectiveness of SRF.

10.0 The future of Russia's SNF: The economic viewpoint

As mentioned by the participants in the discussion, the cost of supporting "a nuclear shield" is far from the last factor when considering the problem of the future development of the strategic forces. Moreover this is during a period of time when Russia is experiencing significant economic difficulties.

A powerful argument is made by the sides which prioritize the development of SRF as one of the cheaper types of armed forces. Officially they claim that 5-6% of the MoD budget is spent on meeting the needs of the SRF. [Baichurin, 1994]. However, V.S. Belous thinks that the actual expenses on the SRF is two times greater [Belous, 1994]. Rear Admiral A.M. Ovcharenko has the opinion that "expenses on supporting the combat readiness of the naval SNF is, at a minimum, four times less than that spent on the ICBMs" [Ovcharenko, 1994]. Taking into account the number of SRF and NSNF warheads deployed at the present time (see Table 1), even the most rough estimates on the criteria of cost do not favor land-based missiles.

The situation will change after the ratification of the Start-2 Treaty. With the ratification of the Start-2 treaty and the resulting elimination of land-based multiple warhead missiles, the cost of deploying of one warhead on land, will be significantly higher than on the ocean, as opponents of NSNF admit as well.

According to estimates by the main expert for the Committee for Military Technical Policy of the Ministry of Defense of the Russian Federation, B.I. Pustovit, spending on support of one warhead in the SRF to 2010 will be 3.5 times more than in the NSNF. [Pustovit, 1995]. Unfortunately the author does not comment on how the strategic development of Russia's SNF is planned, i.e. how many land based mobile and silo-based missile they are suggesting to deploy, and how many new strategic missiles will be built.

It also remains unclear how to finance the reorientation of industrial enterprises that previously supported the SNF, but now exist without state orders. Practically nothing is said about the proposed expenditures on dismantling weapons and equipment which sooner or later are to pay for themselves. Obviously, in the future there will also be the rehabilitation of territory on which currently strategic weapons are based. People, living in areas neighboring the regions where silos and mobile missiles are based, as well as those near strategic submarine bases, were extremely interested in receiving information on what the proposals will be and how financing from the budget will be apportioned. It is no less important for them to know what the probability is of an accident occurring during the operation of this or that type of nuclear weapon, and what the potential damage that accident might be. It may be that more money needs to be invested in the reliability of systems, the development of infrastructure and management of a smaller number of stocked strategic missiles, rather than spending an order of magnitude more on eliminating the effects of a "mini-Chernobyl." Maybe less is better than more?

The issue of cost is still open. In our view, publication of the more complete information on the cost expected for the variants for developing Russia's SNF, would put many in their place.

11.0 Conclusion

The analysis which was carried out in the present work permits the following conclusions.

1. The ability of Russia to support the Start-2 levels of 3000-3500 units of strategic weapons is most doubted on economic grounds. Nevertheless, the ratification of this treaty is in Russia's interests and following such a course will not weaken its national security. In the present situation it would be expedient not to postpone defining a national program for developing Russia's SNF. In our opinion, the optimal strategy would have included not attempting to deploy the maximum number of weapons, as permitted by the treaty. It should be directed at insuring the SNF invulnerability, preserving the key elements of the strategic nuclear triad, as well as attending to the scientific and production infrastructures. It would be in Russia's interests to conclude further agreements on deeper reductions of strategic nuclear weapons.

2. Widely varied opinions about the vulnerability of Russian NSNF don't correspond to the actual situation. Our estimates of the distance for detecting SSBNs in their combat patrol regions show that to organize continuous prolonged secret tracking of all strategic submarines does not seem technically possible. Moreover, even if the potential enemy were to attack, there would be no guarantee that it would destroy all the strategic submarines. Trying to use even a conventional weapon against a Russian strategic submarine may provoke an asymmetrical reaction, right up to inflicting unacceptable losses using nuclear weapons against the enemy's territory.

3. To insure identical effectiveness of the NSNF and SRF, the requirements for the command and

control system for strategic submarines can be correspondingly lower in comparison with the requirements for controlling the SRF. The argument about the unreliability of communications with submarines, which were put forward by opponents to the NSNF, needs to be substantiated. We inserted data about the structure of the communications system and physical principles which gives evidence to the contrary.

4. In accordance with the results of the analysis of available information, placing priority on Russia's strategic submarine force within its strategic arsenal would not only, to the greatest degree, satisfy the criteria of invulnerability, but also be expedient regarding economic considerations. An increase in the openness in the Russian MoD and the government on issues such as financing and planning expenses on supporting strategic forces would permit elaboration of concepts for developing the SNF, which, to a large extent, respond to Russia's national interests.

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1. For comparison, in 1990, the Machine Building Plant at Votkinsk produced 56 missiles, in 1993 - 20, and, by the mid of 1994 - only 9 (interview with the Deputy Director of Machine Building Plant in Votkinsk Valeriy Ledvanov, *U.S. specialists reveal no missile treaty violations,* ITAR-TASS, 5 July 1994. A leading expert of the international environmental organization *Greenpeace* Joshua Handler estimates minimal and maximum production rates of SS-25 missile correspondingly as 11 and 40 a year. [Handler, 1995]

2. This number includes only deployed missiles on the territory of Russia.

3. NA - non accountable

4. According to START Treaty MOU data on 5 December 1994, forty four strategic airplanes were based in Ukraine. Twenty Tu-95MS16 (Bear-H16) and five Tu-95MS6 (Bear H-6) airplanes were based in Uzin (Kiev region), nineteen Tu-160 (Blackjack) bombers were located in Priluki (Chernigov region).

5. The idea of giving the highest priority within the defense budget to strategic nuclear forces has been proposed many times in the press. In particular, Alexei Arbatov, a Deputy of the State Duma and a Member of the Defense Committee of the Duma, referred to a widely shared opinion within the military that "...the strategic nuclear forces is the priority of military policy..." and suggests that "...the strategic nuclear forces must get nearly 100% of their needs for maintenance, R&D, manufacturing and deployment of armaments, removing and disposal of old armaments" [Arbatov, 1994].

6. A deeper insight into the concept of "unacceptable damage" includes a probabilistic approach -- see, for example, [Yarynich, 1994].

7. For this purpose, basic provisions of Russian Federation military doctrine and operational plans contain a term of a "given" damage. In theory, the "given" damage is defined as undoubtedly "unacceptable" damage for a potential enemy. In existing practice of planning strategic retaliatory strikes, the "given" damage does not practically differ from the one for "guaranteed" destruction.

8. In particular, such a point of view is suggested by A.G. Arbatov [Arbatov, 1994]. Other arguments on the role of parity are interesting as well. "...Strategic stability is achieved not by supporting parity, but by a threat of inevitable retribution for a possible assault. The cost of such a retribution will be much higher than any advantages of causing the assault..."[Tsygichko, 1994]. "A degree of objectivity in estimating the consequences of the use of nuclear weapons, and not the quantitative parity in deployed warheads has become the index of the deterring effect of nuclear weapons." [Pustovit].

9. The accuracy of delivering nuclear weapons has become so high that, having admired by achievements of national defense industry, authors of some "advertising" papers as well as their readers frequently forget about the huge destructive effects of the weapons themselves. These effects make it senseless to further improve the accuracy of the delivery systems. One 100 KT nuclear warhead reduces everything to ashes within a radius of 1 km from epicenter of the explosion. Such a warhead, if burst within a city, set everything on fire within a circle of 5 to 10 km from the epicenter, and any living thing caught in that fire would be destroyed. An area of tens of thousands of square kilometers would be contaminated with radioactivity for a period of several hundred years.

10. We note that silo based missile have many proponents. For instance, one of advantages of such missiles is claimed, that an adversary is only able to destroy them by nuclear means in his preventive

strike. On the other hand, mobile land- , air- and sea-based missiles can be destroyed during conventional period of a conflict [Stepanov, 1994; Belous, 1994; Belov, 1995].

11. As a rule, the opposite point of view is expressed only by representatives of the Russian Navy and shipbuilding industry [Ovcharenko, 1994; Voronin, 1994b; Aleksin, 1995; Pustovit, 1995].

12. Some of the results of our research have been already published in earlier papers. See, for example, Miasnikov (1993); Miasnikov (1994a); Miasnikov, (1994b).

13. It is interesting , that in order to prove vulnerability of Russian strategic submarines, opponents of NSNF use the argument, that Americans have been improving their SOSUS system for the last forty years -- see, for example, Belous (1994); Prokudin (1994); Voronin et al. (1995). In our opinion, the most convincing criticism of this argument can be found in papers by G.P. Voronin and B.I. Pustovit [Voronin, 1995; Pustovit, 1995].

14. The range of missile modifications are given in parenthesis.

15. Currently, another source of possible threat to Russian NSNF is discussed by arms control experts. There is a concern, that such a source of threat may occur, if the ABM Treaty will be reconsidered. In particular, the U.S. administration proposes to achieve an agreement on distinguishing between strategic and non-strategic ABM systems, which would allow to deploy medium range missile interceptors on board of ships and airplanes in future. It can not excluded that, having been deployed, such interceptors can be used against strategic missiles during the boost phase of their trajectories. According to S.K. Oznobischev and A.V. Surikov, the U.S. deployment of 1500 such interceptors aboard ships and aircraft "...will lead to a reduction in the retaliation capability of the sea-based component of the Russian SNF by the factor of 10..." and "...Navy's strike will be blocked..."[Oznobischev, Surikov, 1995].

A detailed consideration of the feasibility of such a threat for the Russian NSNF goes beyond the subject of this particular paper. Nevertheless, we note principle technical complications which have to be solved by a potential adversary in order to deploy an efficient ABM system. First, when missiles are intercepted during the boost phase of their trajectories, the time interval, which is necessary for reliable detection, interceptor targeting and destroying the missile, is substantially reduced. An area ABM defense, which intercepts strategic warheads on reenter phase of their trajectories (we note that neither the U.S. nor Russia have developed any such effective systems), has at least 30 minutes for detecting and attacking the targets. A system, which acts against missiles in their boost phase, has one tenth the amount of time to accomplish these tasks. Second, a potential adversary will have to defend its interceptor platforms (airplanes and ships), which operate close to Russian territory. In any event, developing and deploying an effective anti-interceptor defense is much simpler and cheaper than ABM defense itself.

Nevertheless, these arguments do not represent support for accepting ABM Treaty modifications. A possible danger of modifying the Treaty, as proposed by the U.S. administration, is not that the U.S. or Russia will be able to deploy effective ABM defenses, but that such a step could stop the process of further strategic weapon disarmament in the world or even make it reversible. Such a move could also promote other so far "non-nuclear" states to develop their own nuclear weapons -- see, for more details, Podvig (1994); Lewis, Li Bin, (1995).

16. Project 971 ("Bars" type according to Russian Navy classification) SSNs have been produced since 1986. By 1995, twelve submarines of this class were in the order of battle of the Russian Navy.

17. See, for example, Khraptovich (1994); Kolton (1995). We note that the attentive reader will not miss the fact that the arguments from two different discussions are confused. One of these discussions is between proponents and opponents of NSNF on whether or not it is possible to trail continuously all strategic submarines. The second discussion reflects long standing tensions between the Navy and the shipbuilding industry on the subject what kind of ships must be built and in what a readiness these ships must enter into service.

18. According to estimates by Tom Stefanick, a nuclear warhead with a yield of 1 MT is capable of destroying a strategic submarine within a distance of 4 nm (near 7.3 km) [Stefanick, 1987].

19. See, for example, Arbatov (1993); Volkov (1994).

20. The author thanks V.N. Polyakov for the opportunity to read his paper prior to publication.