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THE U.S. AND U.S.S.R. STRATEGIC TECHNOLOGIES AND NUCLEAR WAR FIGHTING: A COMPARISON

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THE CONTRAST BETWEEN U.S. AND SOVIET NUCLEAR DOCTRINES

The cornerstone of U.S. strategic policy with respect to the U.S.S.R. is deterrence through the possession of an "assured destruction" capability; that is, the ability to inflict "unacceptable" levels of damage on the Soviet Union even after absorbing an attack on U.S. strategic nuclear forces. This policy may have been modified to some extent to include the capability to limit damage to the United States, using high-accuracy missile systems to attack hardened Soviet military installations. There have also been recent reports that the U.S. is targeting some of its strategic forces at Soviet conventional forces in order to blunt a Warsaw pact invasion of Western Europe. The major emphasis of U.S. policy, however, still remains assured destruction and consequently, most of the U.S. strategic nuclear missile warheads are small and inaccurate and can be targeted only against soft urban areas. Also, the U.S. warhead inventory is large and they are deployed on a diverse number of strategic nuclear delivery systems (ICBMs, SLBMs, and long-range aircraft). Thus the survival of enough warheads to implement the assured destruction policy is "guaranteed." This policy infers a minimal reliance on nuclear war fighting capability. Also, there is little reliance on strategic defense, whether passive or active, since it is believed that in a nuclear war, no one can win.

The Soviet military literature indicates, however, that their strategic doctrine includes the ability to fight and win a nuclear war and survive as a national entity. Pipes (1) and earlier Goure (2), suggest that the Soviets had articulated a nuclear war fighting and war winning doctrine by the mid-1960s. This does not necessarily mean that the U.S.S.R. is systematically planning an attack on the United States, but rather should general war break out, their strategy would be to insure their survival and rapid recovery. The forces derived from a nuclear war fighting strategic doctrine would be quite different than those derived from the U.S. deterrence concept. A nuclear war fighting doctrine would emphasize forces which would be able to suppress U.S. strategic forces to minimize damage to the Soviet Union. There will also be a significant emphasis on strategic defense, particularly of those assets and personnel required for survival and rapid national recovery.

This paper will attempt to show that the present and projected U.S. strategic nuclear forces are in fact accurate reflections of the U.S. strategic doctrine of deterrence. It will also be shown that well-conceived nuclear war fighting doctrine involves the coordination of six diverse strategic capabilities. The development of this broad spectrum of strategic capabilities should be indicated by rather specific technical indicators. The available information on Soviet strategic technology programs will be examined to determine whether or not these technical indicators are present and support the view that the Soviet Union is systematically developing a nuclear war-fighting capability. A comparative analysis of U.S. strategic programs will be made in order to show whether or not U.S. and Soviet strategic doctrine are in fact diametrically opposed. It will be assumed that the strategic forces on both sides will be constrained by the numerical limits outlined in the SALT II Treaty.

POTENTIAL U.S. AND SOVIET STRATEGIC NUCLEAR FORCES UNDER THE SALT II TREATY

The continued negotiations between the U.S. and the U.S.S.R. to limit strategic nuclear arms is nearing completion. The negotiations are intended to produce a SALT II, a Protocol, and a Statement of Principles. The proposed SALT II Treaty will run to the end of 1985 and the Protocol to the end of 1981. The SALT I Treaty permanently limited strategic ballistic missile defenses (ABM). The objective of SALT II is to limit strategic offensive arms. The Treaty has not been completed but many important details have been made available and these are summarized in Table I and are taken from Ref. (3). The size and composition of present U.S. and U.S.S.R. strategic forces are summarized in Tables II and III [from Refs. (4), (5), and (6).] At present, the U.S. has over 2000 strategic nuclear delivery systems capable of delivering over 10,000 warheads while the U.S.S.R. has over 2500 delivery vehicles capable of delivering over 5800 nuclear warheads.

The important difference between the U.S. and Soviet ballistic missiles is their throw-weights. The key Soviet missiles have throw-weights of 7000 lbs. and 15-20,000 lbs., respectively, three and one-half to ten times the size of Minuteman. The U.S. has agreed to define a "light" missile as the Soviet 7000 lb. system and the "heavy" missile as the 15-20,000 lb. missile. This agreement, combined with the SALT II numerical limits, will clearly allow the Soviets to increase substantially the number of potentially accurate ICBM warheads. Using the characteristics of the present U.S.S.R. systems and the numerical limits of SALT II, the potential size of the U.S.S.R. strategic forces in 1985 can be predicted with considerable accuracy. This is shown in Table IV, using the data from Refs. (4), (5), and (6). It should be emphasized that this projection is not a speculation. The projection is based on high quality data from U.S. intelligence sensors on the size and number of warheads on each of the new Soviet ICBMs which have been extensively tested and are being deployed. Recent reports indicate that the number of warheads on any deployed missile allowed by

Table I

SALT II LIMITATIONS ON STRATEGIC NUCLEAR FORCES
(Treaty Expires December 31, 1985)

- 2250 Strategic Nuclear Launch Vehicles
- 1320 ICBM/SLBM MIRVs** plus aircraft equipped with air-launched cruise missiles (ALCM) with range greater than 600 km
- 1200 MIRV'd ICBMs plus SLBMs
- 820 ICBM MIRVs
- Number of warheads on deployed missiles cannot be greater than tested configuration
- 326 "Modern" large ("heavy") ballistic missiles allowed for U.S.S.R.--none for U.S. No future deployment on either side allowed
- "Light" missile defined as SS-19/6 RV's,* 7000 lbs.
- "Heavy" missile defined as SS-18/10 RV's, 15-20,000 lbs.
- One "new type" ICBM allowed for each side with 6 or 10 RV's
- No limit on "new type" SLBMs
- 24-35 ALCMs with ranges over 6000 km allowed on "heavy" (B-52 class) bomber:
  - Each "heavy" bomber with cruise missiles counts against 1320 MIRV limit
- Significant transfer of weapons limited by treaty to third country banned
- Protocol limitations (expires December 31, 1981):
  - Ban on mobile ICBMs and air-to-surface ballistic missile testing and deployment
  - Ban on deployment of cruise missiles with range greater than 600 km

*RV's - Reentry Vehicles Armed with Thermo-nuclear Warheads.

**Multiple Independently Targeted Reentry Vehicles

Table II

PRESENT U.S. STRATEGIC NUCLEAR FORCES

Total U.S. Strategic Nuclear Delivery Vehicles: 2057

GROUND-BASED ICBMs: 1054 (550 MIRVs, 504 SINGLE WARHEADS):

550 MMIII/3 MIRV 170 KT Warheads/Booster	1650 RV's
450 MMII/Single 1-MT Warhead/Booster	450
54 Titan II-9 MT	54
Total U.S. Warheads in ICBM Force:	2154

SEA-BASED FORCES: 656 (496 MIRVs, 160 MULTIPLE WARHEAD VEHICLES):

31 Poseidons, 16 Launchers per Boat with 10 MIRV'd 50 KT Warheads per Launcher	4950
10 Polaris, 16 Launchers with 3 MIRVs per Launcher	480
Total U.S. Warheads in SLBM Force:	5540
Total U.S. Strategic Missile Warheads:	7594

STRATEGIC BOMBERS:

346 B-52s FB-111 Each with 7 Gravity Bombs or SRAM Missiles	2429
Total U.S. MIRVs:	1286
Total Number of U.S. Strategic Warheads now deployed:	10,023*

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*The 14 Warhead Option on Poseidon could increase the total to 12,007.

Table III

PRESENT SOVIET STRATEGIC FORCES

GROUND-BASED ICBMs:	REENTRY VEHICLES
MIRV'd ICBM LAUNCHERS:	
100 SS-17/4 MIRV'd - .5-1 MT Warhead	400
200 SS-18/10 MIRV'd - .5-1 MT Warhead	2000
200 SS-19/6 MIRV'd - .5-1 MT Warhead	1200
Total ICBM MIRV'd Warheads:	3600
SINGLE WARHEAD LAUNCHERS (SOME MIRVs DEPLOYED):	
126 SS-9/1-18 MT to 25 MT Warhead (3-5 MT MIRV Version Tested)	126
840 SS-11/13/1 MT Warhead	840
	996
Total ICBM Warhead Inventory:	4566

SEA-BASED FORCES:	LAUNCH TUBES	WARHEADS
15 Delta I Submarines 16 SS-N-8 Single Warhead Launchers	180	180
4 Delta II Submarines 12 SS-N-8 Single Warhead Launchers	64	64
10 Delta III 16 SS-N-18/3 MIRV'd*	160	480
34 Yankee Submarines 16 SS-N-6 Single Warhead Launchers	544	544
Total SLBM Launchers:	948	1268**

TOTAL U.S.S.R. STRATEGIC MISSILE WARHEADS: 5834

STRATEGIC BOMBER FORCES: 135***

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* This brings a total of 63 or one more SSBN that the Soviets are permitted under the SALT I Interim Agreement. Presumably the Soviets will retire one of their older SSBNs in order to keep within the SALT I guidelines.

** The Soviet SLBM inventory includes 24 additional SLBM launchers deployed on 7 Hotel-class submarines. While the Hotel submarines are not counted under the SALT I ceilings, their launchers are giving the Soviet Union a total of 972 sea-based launchers or 12 SLBM over the total agreed upon in SALT I. The official U.S. position on this issue is to assert that the launch tubes on the Hotel-class are being dismantled and, therefore, are not to be dounted in the SALT Totals.

*** Not including Backfire.

Table IV

POTENTIAL SOVIET STRATEGIC OFFENSIVE FORCES UNDER SALT II TREATY

Total Potential U.S.S.R. Strategic Nuclear Launch Vehicles: 2250

GROUND-BASED STRATEGIC FORCES (820 MIRVs plus 345 SINGLE RV LAUNCHERS - TOTAL: 1165):

326	SS-18 Boosters	10 RV's/Booster	3260 RV's
494	SS-19 Boosters	6 RV's/Booster	2964 RV's
345	SS-11's*	1 RV/Booster	345 RV's

*(Possibly some or all high yield (15-20 MT) new RV's allowed under Treaty)

Potential ICBM Warheads: 6569

SEA-BASED STRATEGIC FORCES: (950 LAUNCHERS/380 MIRVs):

34	Yankee/16 Launchers	SSN-6/17
25-26	Delta/16 Launchers	SSN-8/18

Potential SLBM RV's (3 RV's/Launcher - 380 MIRVs Allowed: 2750

Potential Number of Soviet Warheads (SLBM/MIRV/MRV and ICBM MIRVs): 9319

STRATEGIC BOMBERS: (120 TU-95 BEAR & MYA-4 BISON):

If each carries 25 Cruise Missiles: 3000

SOVIET RV YIELDS:

- Soviet MIRV ICBMs - RV's: 1-2 MT
- Soviet SLBM - RV's: 1-2 MT
- Large Soviet ICBM - RV: 15-20 MT

TOTAL POTENTIAL U.S.S.R. STRATEGIC WARHEADS: 12,319 the treaty cannot be greater than the tested configurations. This restriction may be the major positive accomplishment of SALT II. As the table indicates, the total number of Soviet strategic missile warheads would be 9300 and the number of high yield, potentially accurate warheads would increase to over 6500, 70% of the Soviet strategic missile warhead inventory. The yield and numbers of these weapons are high enough so that the Soviet ICBM force would have a significant capability to destroy ICBM siloes for reasonable missile accuracies (0.2-0.15 nm CEP for 90% kill probability with two warheads per silo). If the Soviets place the allowed number of cruise missiles on each of the bombers allowed, the total number of Soviet strategic warheads could be as high as 12,000. The SALT II Treaty guarantees and ligitimizes the deployment of these forces by the end of 1985. There is also a distinction between deployed warheads and a strategic reserve. The Treaty's numerical limits refer only to deployed forces. There is no prohibition on the number of missiles and warheads that could be produced and stored--a significant strategic reserve. There are many who believe that the U.S.S.R. has or will have a significant strategic reserve so that the useful strategic forces could be much larger than that prescribed by the SALT II limits. While it is true that, as Senator Edward Kennedy and President Carter have observed, that SALT II will require the Soviets to dismantle and destroy 300 strategic systems, the destructive power of these ten year old single warhead missiles would be more than replaced by missile systems carrying six or more high yield, accurate warheads.

The options available to the U.S.S.R. are straightforward since they have developed, tested and are deploying a spectrum of new missile systems which can maximize the number of their warheads within the launcher and high MIRV constraints of SALT II. The strategic weapon system options to implement the U.S. policy of assured destruction, however, has been in a state of flux for a number of years. The penetrating bomber option has been dropped, presumably because of the vulnerability of SAC bases to an attack by Soviet SLBMs and the enormous size of the Soviet air defenses. A low vulnerability mobile ICBM would seriously compromise the verification issue and is banned by the Protocol until the end of 1981. Another minimum vulnerability system, called the multiple aimpoint (MAP) or the multiple protective shelter (MPS) system, involves a large number of siloes and the missiles would be moved randomly from silo to silo. Three hundred New ICBMs would be deployed, each assigned to a MPS Site of 30 siloes. The number of hardened targets which the Soviets must attack would be increased to 9000, therefore. An air-mobile system is also under consideration. While MPS would not deny verification, it would certainly make it more difficult and uncertain. Also, if the U.S. started developing a new ICBM now, it would not be operational within the life of the Treaty. Realistically, the only deployment options available to the U.S. involve the use of weapons under development now, specifically the Trident I and Trident II missiles and the air-launched cruise missiles.*

In order to evaluate these two options, let us assume that the U.S. does not want to alter its plans to deploy what the U.S. considers to be an invulnerable sea-based ballistic missile system with an increase in the number of launchers and warheads in the Trident system. This would mean that the U.S. would have 736 MIRVs in the Trident/Poseidon systems during the life of the Treaty. The ICBM and cruise missile total, therefore, must stay within the MIRV constraints of SALT II with 736 MIRVs assigned to the sea-based forces. Consequently, there can be only 464 MIRV'd ICBMs. To deploy 300 new MIRV'd ICBMs, for example, the number of Minuteman IIIs would have to be reduced by 86 to stay within the 1200 MIRV ICBM plus SLBM sub-limit. These siloes would presumably be used to deploy 86 single warhead ICBMs. The U.S. would also be allowed to deploy 120 bombers equipped with cruise missiles (ALCM) and still stay within the 1320 total MIRV plus ALCM limit. The resultant U.S. strategic nuclear force using these options is summarized in Table V. There would be an increase in the total number of U.S. strategic warheads to 15,224 with an increase in the ICBM MIRV warhead inventory to 3482. The SLBM warhead inventory would increase 18% (to 6560) and the force would include 3000 cruise missiles.

Of the potential SALT II U.S. missile warhead inventory, 65% are SLBM warheads which would not present a threat to Soviet ICBM's. The number of accurate ICBM MIRV warheads would be 3500. The accuracy of these warheads would have to be extremely high to present a high confidence threat to ICBM siloes (0.08 nmi for a 95% kill probability with two warheads). The remaining ICBM MIRVs (492 Minuteman III warheads) would presumably use the MK12A warhead, which is reported to have over twice the yield as the present Minuteman III warhead (5). Even with the higher yield, the accuracy of the Minuteman III system would have to be half that reported (0.2 nmi) (6) for a high confidence kill of hardened ICBM siloes. Thus, the potential U.S. ICBM MIRV force will not have and probably cannot have the correct combination of warhead numbers and a yield/accuracy combination to present an impressive capability to destroy the Soviet ICBM force. The large U.S. cruise missile force allowed under SALT II would be very accurate and have a significant capability to destroy hardened missile siloes. However, the total flight time of the aircraft and missile is about 10 hours and the missile could be susceptible

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*A "partly common" U.S. SLBM/ICBM is apparently under consideration. The new missile would carry 10 warheads and engineering development would be completed by 1985.

Table V. POTENTIAL U.S. STRATEGIC FORCES UNDER SALT II

- No change in planned U.S. SLBM forces
- 300 Trident I or II missiles replace 300 Minuteman IIIs (or a new MIRV'd missile - the MX).*
- Minuteman III MIRVs reduced to 164 to stay withn 1320 total MIRV limit and 1200 MIRV ICBM/SLBM sublimit.
- Bomber force retained at 346 and 25 cruise missiles added to 120 bombers.
- Single warhead Minuteman IIs replace 86 Minuteman IIIs.

GROUND-BASED ICBMs: (464 MIRVs PLUS 590 SINGLE RV LAUNCHERS:	1054)
300 Trident II modified/10 MIRV'd 100-350 KT Warheads/Booster	3000
164 Minuteman III/3 MIRV 170 KT Warheads/Booster	492
536 Minuteman II/Single 1 MT Warhead	536
54 Titan II - Single 9 MT Warhead	54
Total Potential U.S. ICBM Warheads:	4082
Potential U.S. ICBM MIRV'd Warheads:	3492
SEA-BASED FORCES: (736 MIRVs):	
21 Poseidons, 16 Launchers per Boat with 10 MIRV'd 50 KT Warheads per Launcher	3360
10 Poseidons, 16 Launchers per Boat with 8 MIRV'd Trident I, 100 KT Warheads per Boat	1280
10 Tridents, 24 Launchers per Boat with Trident I missiles	1920
Total Potential U.S. SLBM Warheads:	6560
Total Potential U.S. Strategic Missile Warheads:	10,642
STRATEGIC BOMBERS: (346):	
120 Bombers with 25 Cruise Missiles each	3000
226 Bombers with 7 Gravity Bombs or SRAM Missiles	1582
Total Potential U.S. Warheads in Bombers:	4582
Total Potential U.S. Strategic Nuclear Launch Vehicles:	2136
TOTAL POTENTIAL U.S. WARHEADS	15,224

*In one version, the first two stages of Trident II would be the first and third stages of MX. The number of warheads on the resultant MX would be ten and the yield more than three times that of Trident I. If the deployment of the MX in this configuration during the life of the Treaty is impossible, the U.S. ICBM warhead inventory would be 3482, assuming Trident I missiles are used.

to defense countermeasures. The hard target capability of cruise missiles in terms of a prompt and reliable counterforce weapon, therefore, is suspect and clearly inferior to the ballistic missile.

The new ICBM would not even reach initial operational capability by the end of the Treaty. The forces shown in Table V represent, therefore, the potential U.S. forces. The new deceptive basing schemes certainly cannot be implemented during the lifetime of the treaty. Thus the vulnerability of the U.S. ICBM force will continue to be a reality during the life of the treaty. The new force would, however, give the U.S. an important war-fighting capability. While the new force would not have an impressive capability to destroy hardened missile siloes, it would have a significant capability to destroy installations hardened to a few hundred pounds-per-square-inch. Thus it would be possible to target Russian military installations and forces that would be used in an attack on western Europe. There would also be the capability to destroy some of the nuclear war-fighting assets in the Soviet Union. Thus in the sense of strategic doctrine, the potential U.S. forces still would reflect the assured destruction policy.

THE WARHEAD REQUIREMENTS FOR U.S. NUCLEAR POLICY: DETERRENCE THROUGH ASSURED DESTRUCTION

In order to determine the warhead requirements for the implementation of the assured destruction policy, two questions must be answered: What constitutes deterrence and what constitutes assured destruction? The answer to both of these questions, from the U.S. viewpoint, was provided by the former Secretary of Defense, Robert S. McNamara in the early 1960s. (7,8,9) In this statement of U.S. policy, deterrence was defined as the ability to destroy at least 25% of the Soviet population and over 50% of their industrial capacity. He further estimated that this level of destruction could be realized by delivering 400 megaton-equivalent (MTE) nuclear warheads on the Soviet Union. One can place these parameters in better perspective by considering an attack on the first 100 Soviet cities. An estimate of the total area contained within this target complex is shown in Table VI. The size of Soviet cities assumed are in reasonable agreement with the values given by Kemp (9). Under these assumptions, the area contained within this 100-city target complex would be about 7300 square miles. This target complex should contain about 25% of the Soviet population* and 50% of its industrial capacity, as indicated in Secretary of Defense, Harold Brown's Annual Report for fiscal year 1979. (5) Using Glasstone's standard reference on the effects of nuclear weapons (10) the MTE required to place a 7300 square mile area

*About 70 million people based on a 1970 population of 241 million (9) with a 1.2% growth rate for a projected 1980 population of 275 million.

Table VI

ASSUMED SIZE OF THE FIRST 100 SOVIET CITIES

City Rank	R_{95} (Statute Mi)	Unit Area (Mi^2)	Total Area
1 (Moscow	6.9	150	150
Next 35	5.8	105	3675
Next 35	4.6	66	2310
Next 30	3.6	38	1140

Total area in assumed target complex: 7275 mi^2

R_{95} - Radius of city containing 95% of the population

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at risk for various over-pressures from 6 to 12 psi is shown in Table VII. One can see that McNamara's criteria of 400 MTE corresponds to about 12 psi. As the Weapons Effect Handbook indicates, this would mean severe damage to even reinforced concrete buildings, indeed assured destruction. It can also be shown that above 400 MTE the marginal return for additional warheads in terms of destructive capability is small. Thus, as Kemp (9) has inferred, the 400 MTE definition of deterrence and assured destruction by Mr. McNamara may have represented more a management tool rather than any particularly clear insight into what constitutes deterrence. As the table indicates, if the more reasonable 6 psi criteria were used (meaning severe damage to masonary buildings) the warhead requirements would be 165 MTE. In terms of 50 KT Poseidon class warheads, this would mean a requirement of about 1200 warheads delivered. For a 170 KT (Minuteman III Class) yield, the requirements would be about 524 warheads. The bottom of Table VII also shows the U.S. warhead requirements for a 300 city attack. An additional 775 Poseidon warheads (for a total of 1960) would be required. Thus, with 65% of the 3200 Poseidon warheads on station, the U.S. could place at risk about 37% of the Soviet population* and 67% of its industrial capacity, again using the table of Soviet population/industrial capacity versus

*104 million, based on a 275 million total population estimate for 1980.

Table VII
WARHEAD REQUIREMENT FOR U.S. NUCLEAR POLICY: ASSURED DESTRUCTION

(100 Cities with Assumed Total Area of 7300 mi^2)
[25% of Population, 50% of Industrial Capacity at Risk (6)]

OVERPRESSURE		MEGATON EQUIVALENTS (MTE) REQUIRED*
6 psi		161
10 psi	McNamara's Assured Destruction	318
12 psi	←――――――――→	400

	50 KT	170 KT
6 psi	1186	524
12 psi	2947	1303

U.S. Warhead Requirements to Threaten Next 200 U.S.S.R. Urban Areas (300 Cities, 37% of Population, 67% Industrial Capacity at Risk (6)

City 100-200 R_{95} = 3.0 mi. Additional Area - 4800 mi^2

City 200-300 R_{95} = 2.5 mi

Poseidon Warheads Required for 300 City Attack: 1960 (or 13 Poseidon submarines)

Minuteman Warheads Required for 300 City Attack: 875 (or 291 Minuteman III missiles)

$*MTE = NY^{2/3}$

N = Number of warheads

Y = Yield-megatons

number of cities shown in the Annual Report of the Department of Defense for 1979 (5).

Thus, the assured destruction mission could be accomplished using 200 missiles of the Minuteman III class or about eight Poseidon submarines. Also, 300 Soviet cities would be placed at risk by about 13 Poseidon submarines of 290 Minuteman III missiles. An on-station Poseidon force of 20 or 21 submarines would probably place at risk over 600 Soviet cities.

While it is clear that this may not be an exact target list, this analysis shows that the U.S. SLBM forces would place most of the urban areas in the U.S.S.R. at risk, excluding the threat of the tactical nuclear warheads in Europe and the not insignificant French and British ballistic missile submarine forces, (9) even after a successful U.S.S.R. attack on Minuteman and SAC bases.

AN ESTIMATE OF THE NUMBER OF STRATEGIC NUCLEAR WARHEADS REQUIRED FOR A SOVIET WAR FIGHTING CAPABILITY

If the Soviet strategic doctrine is nuclear war fighting, one important capability would be the ability to destroy U.S. strategic offensive forces in the event of general war. The other important capability in nuclear war fighting would be strategic defense or the ability to mitigate retaliation and this will be discussed later. Assuming that the U.S. SLBM force cannot be detected and is therefore invulnerable, then the primary U.S. strategic force which the U.S.S.R. must destroy would be Minuteman ICBM and the SAC bombers. After a long debate, it is now generally agreed that the quality and quantity of the U.S.S.R. ICBM MIRV'd systems, the SS-18 and SS-19, will both be adequate to threaten the Minuteman ICBM force in the 1980s. If the circular-error-probability (CEP) of these Soviet missile systems is 0.10 nmi or less, the number of warheads required to destroy Minuteman would be equivalent to the number of siloes, almost independent of yield. On the other hand, it is difficult to conceive of a successful attack on Minuteman siloes using a ballistic missile system in which the accuracy is not at least 0.2 nmi CEP. If one assumes that the Soviet Union can achieve a missile accuracy of 0.15 nmi CEP, the number of 1 megaton warheads required for the destruction of Minuteman would be 2000, that is, two ICBM warheads per silo.

A Soviet counterforce attack would also include the approximately 100 air fields from which the bombers of the U.S. Strategic Air Command could be launched. The most effective Soviet attack would be SLBMs fired on depressed trajectories. The maximum flight time on these warheads would be 5-7 minutes from either coast. It is well known that most aircraft are relatively vulnerable to even a few pounds-per-square-inch overpressure. Thus a single one megaton burst could place at risk all the exposed bombers in an airfield which is several miles in diameter. Thus, about eight Delta or Yankee class U.S.S.R. submarines could place at risk all the exposed SAC bombers located on 100 airfields. Only three of the Delta III class submarines with the SS-N-18 MIRV'd missiles would be required to execute the same mission. Even if it is assumed that the Soviet SLBM attack on SAC could be detected by U.S. infrared early warning satellites or the PAVE PAWS radar system located on either coast, the maximum time available to allow the SAC bombers to escape would be 5-7 minutes. Also, the U.S.S.R. SLBM force would require only a few more warheads to destroy or disable the fraction of the U.S. Poseidon/Trident fleet in port at Charleston, West Virginia and Bangor, Washington. Thus the warhead requirements for an attack on all of the strategic offensive forces located in the continental United States would be 2200 1-megaton weapons, the majority of which would be accurate ICBMs.

If the Soviet strategic doctrine is in fact nuclear war fighting, then a good argument could be made that they would not waste warheads on the relatively innocent general population. However, they may want to target U.S. industrial centers which negate any U.S. war fighting and survival capability. Even in a war fighting strategic doctrine, therefore, the Soviets may target U.S. industrial centers and indirectly place at risk a substantial fraction of the U.S. population. In any case, it would be instructive to consider the translation of an assured destruction policy on the part of the U.S.S.R. with respect to the U.S. urban/industrial complex. This analysis is not intended to infer that the strategic nuclear policy of the U.S.S.R. Is a mirror image of the U.S. deterrence doctrine. It was again assumed that the prime target complex would be the first 100 U.S. cities. The size of each of the targets and the total area within the target complex are summarized in Table VIII and again are in agreement with Kemp (9). The total area within the target complex would be about 21,000 square miles. The population within this area is 126 million and would contain about 60% of the U.S. industrial capacity. The addition of the next 100 cities to the target complex would increase the population at risk by only about 20 million. The warheads required to place this area at risk for overpressures of 6 psi and 10 psi are shown in Table IX. As the table indicates, about 458 MTE would be required to place this target complex at risk for a 6 psi destruction criteria. The bottom of Table IX shows the effect of large warheads. Forty 5-megaton weapons would place the 10 top cities at risk. The population within this area would be 55 million and would contain about 30% of the U.S. industrial capacity. The Soviets are reported to have a deployment option involving a very large warhead on the SS-18. The size of this warhead could be as high as 25 megatons. As the table indicates, only 15 of these massive weapons could place the top ten U.S. cities at risk, clearly weapons of mass destruction. In addition,

Table VIII

SIZE OF FIRST 100 U.S. CITIES

		R_{95} RADIUS	AREA (m^2)
1	New York	15	708
2	Los Angeles	18	1018
3	Chicago	16	804
4	Philadelphia	14	616
5	through 10	12	2262
10	through 25	9	3817
25	through 100	7	11,545
			20,769

- Population at Risk - 125 million
- 60-65% of U.S. Industrial Floor Space at Risk
- Next 100 Cities would add about 20 million population at risk.

Table IX

IMPACT OF U.S.S.R. NUCLEAR ATTACK ON U.S.

(100 Cities - 125M Population at Risk)

6 psi	458 (Megaton equivalents)
10 psi	907

Effectiveness of High Yield Weapons on U.S. Cities:

- 40 - 5 MT/6 psi, (5300 mi^2), ~ 10 top cities, 55M population, 30% of U.S. industrial floor space at risk, or,
- 15-25 MT at 6 psi produces same damage

Conclusions:

- U.S. extremely vulnerable to even a small attack
- 5% of potential soviet inventory adequate to deter U.S.(?)
  - Even 1% is staggering
- Vast majority of potential Soviet inventory available for attack on U.S. forces.

the detonation of such a large weapon at the optimum height of burst for maximum overpressure on the ground (about 29,000 ft.) would result in a thermal flux directly under the detonation of 500 calories per square centimeter and at the edge of a 10 mile radius city the flux would be 100 calories per square centimeter. At these thermal fluxes, almost all combustible material will ignite, thus causing extensive fire damage in target area.

These calculations show the incredible vulnerability of the U.S. urban-industrial complex to a nuclear attack. Thus, the ability to destroy the top U.S. urban centers within a few tens of megaton class weapons should provide the Soviets with an adequate deterrent. From the the U.S. viewpoint, the ability of the Soviet Union to destroy the top 100 cities with about 500 one-megaton weapons constitutes a massive overkill. The Soviet Union would have a more than adequate deterrent with respect to the U.S., with about 1-5% of the total number of warheads that could be deployed in her long range strategic forces.

The total number of U.S.S.R. warheads required to execute a counterforce mission against the Minuteman and SAC bomber bases as well as to destroy industrial United States would be no more than 2800 one-megaton class warheads. Thus the residual number of warheads in the Soviet inventory allowed under SALT II would be substantially in excess of those required to implement both a war fighting and deterrence policy. It is the possible doctrinal asymmetry between the U.S. and the Soviet Union and the substantial residual U.S.S.R. forces that would be allowed under SALT II that has led many U.S. strategic analysts to the conclusion that the U.S.S.R. will achieve strategic superiority over the U.S. in the mid 1980s.

SOVIET UNCERTAINTIES IN A MINUTEMAN ATTACK

In planning such a drastic action as an attack on the U.S. Minuteman force, the Soviet planners are faced with three significant uncertainties. The first uncertainty would be the colateral damage to the civilian population that would result from such a large scale attack on the Minuteman bases. If the colateral damage were high, then an attack on the Minuteman could, in fact, be considered an attack on the civilian population. The U.S. response could be an all-out attack on the Soviet Union. Department of Defense calculations of the colateral damage to civilian population from an attack on Minuteman involving two warheads per silo suggests that as many as 20 million Americans would die a dreadful death of radiation sickness. The calculations by Drell and Von Hippel (11) indicate that an attack on Minuteman bases as well as the four Titan II bases, could mean a lethal fall-out of radiation on

Chicago, Detroit, Cleveland, St. Louis and as far east as Washington and Atlanta. In addition, there would be a significant amount of fall-out in Canada, particularly along the border where most of the Canadian population is concentrated. Thus, the attack on the U.S. ICBM bases from the Soviet planners' viewpoint could easily be considered a population attack on the U.S. (and Canada?) and invite an immediate U.S. response.

A second Soviet uncertainty is reentry vehicle fratracide. It is well known that the continuous impact of small particles at high velocities on reentry system heat shields could cause significant surface erosion and eventual destruction of the vehicle. In addition, if the erosion process should be asymmetric, the vehicle could acquire some aerodynamic lift with a severe degradation in its accuracy. Thus, the timing and the geometry of the attack must be structured to avoid long term flight of reentry vehicles in the dust cloud produced by previous detonations. The Soviets must plan the attack to destroy the southern part of each of the six bases first and work north, that is, the attack plan must include a "south-to-north" walk. The geometry of a "south-to-north" walk attack would be such, therefore, that a subsequent reentry vehicle would not have to pass through the dust cloud produced by a previous detonation. Such an attack, however, would mean that the northern part of each base would be attacked last and thus allow time for the launch of these missiles.

The RV fratracide uncertainty, therefore, leads to the third and perhaps most serious uncertainty; that is, the possibility that the U.S. will launch the Minuteman as a result of the detection of a large attack by the U.S. early warning systems. The first U.S. early warning system to be considered is the infrared satellites which continuously observe launches from the Soviet Union. These satellites are presently capable of detecting and tracking a launch with sufficient accuracy to determine if the azimuth of the attack is directed at the Minuteman bases and determining the size of the attack. Consequently, these satellites will give 25-30 minutes warning of an attack directed at the Minuteman. Thus, the Soviet planner must consider the possibility that this 30 minute warning time would be adequate to launch the entire Minuteman force, with devastating effects on the U.S.S.R. It seems reasonable, therefore, that a Soviet planner must consider deactivating the infrared satellites by a direct attack. These satellites are in synchronous orbit at an altitude of about 23,000 miles and consequently a missile flight time would be of the order of 5 hours. Thus, a direct attack on the satellite system would provide a more than adequate early warning of the possibility of large scale Soviet hostile action. An alternative approach would be to place in orbit with the early warning infrared satellites, an anti-satellite system (e.g., a high power laser or a simple pellet-kill system) that would deactivate the satellite very shortly before the initiation of an attack. However, a Soviet planner must then consider the U.S. early warning radar systems, i.e., the BMEWS at Flyingdale, England, Thule, Greenland and Clear, Alaska as well as the sophisticated phased array intelligence radar located in Shemya, Alaska. Even if the Soviet planner intends to attack these relatively vulnerable early warning sites, he must also consider the early warning system located at one of the principal targets, namely the Grand Forks Minuteman base. The long-range Perimeter Acquisition Radar (PAR) was installed at Grand Forks, North Dakota as part of the Sentinel/Safeguard ABM system. This large, sophisticated phased array radar has been incorporated into the U.S. early warning system and could provide up to 20 minutes early warning of an attack. In addition, the U.S. has in place, a large over-the-horizon radar early warning system. Thus, this multilayer U.S. early warning system ranging from space-based infrared satellites to a high traffic, powerful phased array radar located at one of the key targets, could easily provide an adequate amount of early warning to allow a launch of the Minuteman system. Thus, the possibility that the U.S. could obtain adequate early warning to allow a launch of Minuteman is the largest uncertainty in any Soviet plan to attack Minuteman. It is not obvious how one could reduce this uncertainty without an elaborate and sophisticated plan to neutralize all of the U.S. strategic early warning systems.

THE STRATEGIC CAPABILITIES REQUIRED FOR NUCLEAR WAR FIGHTING AND A COMPARISON WITH STATED SOVIET STRATEGIC DOCTRINE

The substantial Soviet risk associated with an attack on Minuteman suggests that a nuclear war fighting capability involves more than just the possession of a sufficient number of accurate MIRV ICBMs to destroy Minuteman and SLBMs to destroy the SAC bases. A well-conceived nuclear war fighting capability should include the ability to prevent retaliation or mitigate its effect. In order to prevent the retaliation by U.S. SLBM forces or the launch of Minuteman while under attack, three strategic capabilities would be required: An anti-satellite system to destroy the U.S. infrared early warning satellites in geosynchronous orbit, an anti-submarine system which would prevent the launch of the Poseidon/Trident system, in addition to the accurate ICBMs, MIRVs, and SLBMs required to destroy Minuteman and SAC bases. Mitigation of a retaliatory attack would be accomplished through a combination of active and passive defense; that is, civil defense, ballistic missile defense, and an air defense system to counter the surviving U.S. manned bombers, some armed with cruise missiles. Thus, nuclear war fighting involves the coordination of six diverse strategic capabilities.

Many students of the Soviet military literature suggest that the Soviet strategic nuclear doctrine is, if necessary, to fight and win a nuclear war and survive as a national entity (1,2). Pipes (1) indicates that stated Soviet strategic doctrine contains seven elements. It is interesting to compare the six technical capabilities required for nuclear war fighting and the elements of stated U.S.S.R. strategic doctrine and this is shown in Table X. The first three elements of stated U.S.S.R. strategic doctrine, preemption, quantitative superiority, and counterforce relate to those technical capabilities required to prevent retaliation. The key element in Soviet strategic doctrine is the emphasis on strategic defense which is reflected in their substantial programs in civil defense, air defense, and ballistic missile defense. Pipes (1) suggests that the Soviet military doctrines of "combined arms operations" would then include their Armies and Navies, a seventh capability in the present context. The large troop concentrations of Warsaw pact forces in Eastern Europe are well in excess of reasonable defense requirements. They are there not only to launch a surprise land attack against NATO but to seize Western Europe with minimum damage to industry in the event of a strategic nuclear exchange with the United States. The task of the Soviet Navy would be to clear all U.S. ships from the seas, to cut the sea lanes connecting the U.S. with its allies and sources of raw material.

The interesting observation is that there seems to be a close correlation between the six diverse technical capabilities required for nuclear war fighting and the key elements of the stated U.S.S.R. strategic doctrine. If it could be shown that the U.S.S.R. is developing a significant capability in all of the required six areas, a good argument could be made that the Soviets are indeed developing a nuclear war fighting capability and that their strategic doctrine is diametrically opposed to that of the United States.

TECHNICAL INDICATORS OF U.S.S.R. NUCLEAR WAR FIGHTING CAPABILITY

From the viewpoint of U.S. strategic technology, the six technical/military capabilities required for a high confidence nuclear war fighting capability is a massive program in research and development, field testing and deployment of complex and costly strategic systems. Fortunately (for world stability), modern intelligence sensors should be able to monitor the R&D and the field testing of strategic programs of this size. There has been published a wide spectrum of information in U.S. newspapers and other periodicals, as well as European publications, on the status of the U.S.S.R. strategic system developments,

Table X

U.S.S.R. STRATEGIC DOCTRINE AND REQUIRED TECHNICAL/MILITARY CAPABILITIES

Element of U.S.S.R. Strategic Doctrine	Required Technical/ Military Capability
Presumption	• Real time coordination of SLBM's, ICBM's, anti-satellite and ASW systems to destroy U.S. strategic missile and bomber forces.
Quantitative Superiority	• Ability to execute counter-force strike with 75% of the strategic force re-maining (Under SALT II limits)
Counterforce	• Deployment of enough accurate warheads and ASW to destroy Minuteman, SAC and on-station SLBM's with minimum chance of U.S. launch-on-warning by destroying U.S. early warning satellites.
Combined-Arms Operation	• Integration of all six capabilities to destroy U.S. nuclear forces and annex Europe.
Defense	• ABM, civil defense and air defense to minimize damage to U.S.S.R., to political/ military/industrial "cadre" required for rapid recovery.

presumably derived at least in part, from data provided by these sensors. These published reports indicate that the U.S.S.R. has extensive R&D and field test programs in five of the six technical areas required for a nuclear war fighting capability. The amount of published information on the sixth area, Soviet and U.S. ASW programs, is minimal. In any case, it will be shown that a nuclear war fighting strategy which relies on ASW would be very risky, in view of recent U.S. programs to minimize the ASW threat to the U.S. SLBM force. It will also be shown that the higher confidence tactic to obtain a war fighting capability with respect to U.S. SLBMs would be to mitigate the effects of the attack through a combination of active and passive defense.

SOVIET PROGRAMS TO PREVENT RETALIATION

The ICBM MIRV Program

The Soviet Union is developing four new ICBMs with a substantial MIRV capability (4,5,6). U.S. industry and population are so concentrated that there is very little justification for these new systems from an "assured destruction" or "mutual deterrence" viewpoint. One could readily conclude that these missiles have principally one mission, an attack on hardened U.S. military installations, particularly the Minuteman system. As shown previously, SALT II will legitimize the first capability required for nuclear war fighting, i.e., accurate ICBM MIRVs, at a warhead inventory equal to three times that required to destroy the Minuteman force.

The importance that the U.S.S.R. places on its MIRV'd ICBM force can be seen in the extremely revealing reaction by Soviet Foreign Minister Andrei Gromyko to the Carter Administration's so-called comprehensive proposal in March of 1977. The clear purpose of the proposal was to limit MIRV'd ICBMs (to 550) and thus mitigate the single issue which fuels the nuclear arms race now--at least from an American viewpoint--the vulnerability of Minuteman. In an extraordinary statement, Mr. Gromyko criticized the proposal and accused the Carter Administration of trying to achieve "unilateral advantages." Thus, as Burt (3) in his SALT II article has observed, "What the Carter Administration viewed as a serious threat to strategic stability--accurate MIRV'd ICBMs--the Soviet leadership undoubtedly viewed as the cornerstone of its strategic power."

The Anti-Satellite Program

Since 1968, the U.S.S.R. has conducted at least 17 antisatellite tests (13) with intercepts at altitudes around 500 km. The capability of these interceptors is, therefore, restricted to low altitude electronic and photographic reconaissance satellites. However, the U.S. strategic technology community views these intercept systems as extremely provocative. The flight time to the geosynchronous orbits of the U.S. early warning infrared and strategic communications satellites is five hours, so that the present Soviet antisatellite system is not a threat to these important U.S. space assets. However, it is not inconceivable that these intercept systems could be placed in orbit with U.S. early warning satellites and activated prior to the initiation of the Minuteman attack.* The least capability these antisatellite systems have is the possible denial to the U.S. of critical reconaissance data during a crisis or to prevent U.S. observations of the development of U.S.S.R. strategic systems and verification of an arms limitation agreement. The development of these antisatellite systems seems to be completely unwarranted particularly since space-based nuclear weapons are banned by Treaty and it is well known that the U.S. has never considered space-based offensive nuclear weapon systems to be technically or strategically credible.

Anti-Submarine Warfare

In the mid-1980s. the range of the U.S. sea-based ballistic missile forces will have been extended to as much as 5,500 nautical miles. The current Polaris/Poseidon missiles have ranges of 2000 to 2500 nautical miles. The ballistic missile submarines on patrol operate, therefore, with an ocean area of 9 to 10 million square miles. Also, the deployment area for the present SSBN force is relatively close to the Soviet Union and subject to surveillance by air and naval forces operating out of home bases and susceptible to fixed acoustical systems comparable to the U.S. SOSUS (Sound Surveillance System). At a missile range of 5500 nautical miles, the submarines' operating area would increase to 95 million square miles. Many U.S. analysts have argued that such a vast deployment area would post insuperable problems for any Soviet ASW program. Both the enormous size of the area and its remoteness from Soviet bases would make the ASW task extremely difficult if not impossible. First, the Soviet ASW forces will have to increase by a factor of ten to cover the larger area and they must be

*There have been recent reports of a substantial increase in Soviet antisatellite tests--15 launches in January and February of this year alone. The same source infers that the U.S.S.R. will conduct an anti-satellite test at geosynchronous altitude (Aviation Week & Space Technology, p. 11, March 5, 1979.)

capable of detecting the much quieter Trident submarine. The extended area would require much longer transit times, shorter on station cruises and would reduce the utilization rate of the U.S.S.R. ASW forces. At-sea replenishment may even be required, implying a substantial increase in the logistical fleet train. Consequently, the total effort required to cover the extended ocean area would be substantially greater than the simple factor of ten suggested by the additional area.

These long range sea-based ballistic missile forces will also provide the U.S. with two new strategic capabilities. The first is the ability to launch from port. The extended range would allow missile launches from both the Charleston, West Virginia, Bangor and Washington bases to targets within the U.S.S.R. This capability, combined with shorter transit time required for these long range systems to get on station, would mean that the warheads available to the U.S. at the initiation of a U.S.S.R. counterforce strike would be greatly increased, even if the attack warning time were only five minutes. The recent statement by Dr. William J. Perry, Undersecretary of Defense for Research and Engineering before the Senate Arms Services Committee on U.S. strategic Nuclear Forces (1 Feb. '79, p. 11) indicates that the new submarine will spend more time at sea so that only one-third of the fleet could be attacked in part. The number of SLBM warheads on station, therefore, could be from 4600 to 5300, much larger than the present force of 3000 warheads.

The second capability provided by these long range sea-based systems is even more significant. With the extended range, the submarines could operate relatively close to the east or west coast of the U.S., say within 500 to 1000 miles. If U.S. Naval forces could monitor the activity of any Soviet Naval vessel capable of attacking the U.S. SSBNs in this area, then it may be possible to combine the low detectability of the long range U.S. SSBNs with an active defense of the critical component of the U.S. strategic forces.

Thus, there are compelling technical reasons why many U.S. strategic analysts consider the long range SLBM forces "invulnerable." It should be emphasized, however, that if the SSBNs on station would be the only surviving U.S. strategic forces, they could be regarded as simply 20-30 more relatively soft targets which, if detected and tracked, are easily destroyed. For example, is it possible to conceive of a "technological breakthrough" in which the U.S.S.R. could locate each submarine with sufficient accuracy to launch 20 to 40 ICBMs equipped with warheads tht penetrate the surface of the ocean and detonate near the submarine?

Thus, with the introduction of the long range Trident I and II systems, the possibility that the Soviets could completely prevent a retaliatory launch of the U.S. SLBM force is not very great. Certainly, a Soviet war fighting plan which relied on the destruction of U.S. SLBMs on station would be very risky.

SOVIET PROGRAMS TO MITIGATE THE EFFECT OF RETALIATION; PASSIVE AND ACTIVE DEFENSE

Thus, it is reasonably clear that it will be difficult for the Soviets to prevent the retaliation by U.S. Poseidon/Trident SLBMs after the Minuteman/SAC attack. In order to develop a meaningful nuclear war fighting capability, therefore, the U.S.S.R. must be able to mitigate the effects of U.S. SLBM attack through passive and active defense. It should be emphasized that, should the Minuteman/SAC attack be successful, the Soviets could tailor their passive and active defense systems to specifically accommodate a U.S. SLBM attack. They will also have a good knowledge of the technical details of the weapons in the SLBM force. The number and many of the key technical characteristics of the warhead of the reentry system in the deployed U.S. SLBM forces have been widely publicized and are available in a number of sources. (For example, references (4), (5), (6), and (9)). It is also widely known that the U.S. does not have penetration aids on many of the strategic missile systems but rather relies on local exhaustion of the interceptor stockpile with real warheads to suppress ballistic missile defenses.

It has been suggested by Goure (12) and others that the major objective of the large Soviet civil defense program is in fact to mitigate the effect of a U.S. retaliatory strike, particularly by the SLBM forces. These analysts suggest that the Soviet Union would evacuate all the major urban-industrial areas in a crisis prior to the breakout of general war. Major industrial installations would be protected so that they could survive high overpressures; apparently up to 100-300 psi. Prior to the attack on Minuteman, all major urban-industrial areas would be evacuated and the civilian population would be assigned to predetermined places, removed from the areas which could be threatened by the U.S. sea based strategic forces. Thus, when the U.S. SLBM attack occurs, the major urban industrial centers would be severely damaged, but the industrial capacity would be only marginally impaired. The civilian population, or at least a cadre of political and military leaders as well as industrial managers and skilled workers, would have been provided special protection. They would return to the cities immediately and the industrial capacity of the U.S.S.R. would be restored to pre-attack levels in six months. The surviving cadre of political, military and technical leaders would then reestablish the political and economic system after the war. This is the prime U.S.S.R. strategy to survive and recover after a nuclear war according to Goure. (12).

However, to accept the argument that civil defense is the prime Soviet war fighting capability, one must believe that they are not deterred by the very real possibility of the substantial destruction of 300 to 600 Soviet cities in the first hour of conflict by the surviving U.S. SLBM forces. Also, the U.S. SLBM attack could be modified to reduce the effectiveness of a Soviet civil defense program. For example, all the warheads could be fused to detonate only on ground impact. The radioactive fallout from the groundburst of several thousand Poseidon class warheads would then be deposited over a substantial part of the Soviet Union. An additional source of stress to the Soviet civil defense would be the warheads of any surviving Minuteman missiles or SAC bombers. If only a few percent of the Minuteman siloes survive, several hundred more warheads would be deposited on the U.S.S.R. Any surviving SAC bombers would present an even greater problem. If only a few tens of these bombers survive, as many as 1000 cruise missiles could arrive over the Soviet Union ten hours after the U.S. SLBM attack. The destructive power of this force would be almost as large as the original SBLM attack. Thus, there are many U.S. analysts who believe that civil defense can be an effective nuclear war fighting instrument only if it is complimented with an active defense.

The American and Soviet Perspective of Strategic Missile Defense

The role of active defense in a strategic nuclear force structure derives directly from the strategic doctrine. In the U.S. strategic doctrine of deterrence, passive and active defense of the American perspective of national value, that, the population, is believed to be technically and economically infeasible. Defense is also perceived as stratigically destabilizing in the sense that any defense would be neutralized by a corresponding increase in the size of the Soviet offensive forces. In the American perspective of ballistic missile defense to protect national value, the defense components associated with NIKE-X Technology (phased array radars and high performance interceptors) would be deployed around all of the major U.S. urban centers. The defense components would be deployed in proportion to national value, that is, in proportion to population. This concept of urban defense would always fail if the number of offensive warheads targeted exceeded the number of interceptors in the defense inventory. Also, since the defense must protect the soft urban target, it must be extremely reliable. The defense must also be able to operate in the cluttered environment associated with a nuclear engagement. The defense must also be able to distinguish between the reentry vehicles and any penetration aids in real time. Thus, a defense deployed from an American perspective to protect soft urban targets would probably collapse when faced with the large and sophisticated attack that could be mounted by the Soviet Union.

The conclusion that large scale ABM using "NIKE-X" technology and civil defense is impractical when applied to soft urban targets is based on an American analysis derived from the assumption that both the U.S. and the U.S.S.R. have the same strategic policy. However, let us assume that the defense objective is to protect areas that contain what the U.S.S.R. believes is "national value," that is a selected cadre with an industrial capability to insure rapid recovery after a nuclear exchange. The ABM effectiveness analysis should be reexamined within the framework of a U.S.S.R. perspective of a war fighting strategy with passive and active defense, i.e., the protection of a large number (500-1000) of small, hardened (50-300 psi) sites with a ballistic missile defense. The deployment of this ABM would not be proportional to the population, but would be distributed uniformly throughout all the sites. The U.S.S.R. could correctly assume that the only retaliatory strike by the U.S. will be a countervalue SLBM attack involving only low yield warheads. The stockpile of interceptors required at each site would be reduced and the hardness of the sites will allow intercepts lower in the atmosphere. Thus, this ABM is less complicated and the operating environment is simpler. The technical credibility of the system would be higher since offensive penetration aids are more difficult to design for low altitudes. The shorter operating range of the terminal defense radars would also mean a substantial decrease in power and size so that the radar could be deployed rapidly.

The first consideration is the impact of small hardened sites on the strategic performance of Poseidon missiles. The impact of target hardness on the performance of Poseidon missiles is significant for a CEP of 0.3 nmi, the accuracy value reported by Collins (6). The number of Poseidon warheads required for 50 and 100 psi targets would vary from 5 to 8 for a high kill probability, so that the number of targets which the surviving Poseidon missiles could threaten would be drastically reduced. Above a target hardness of about 100 psi, the number of the small Poseidon warheads required for a high kill probability rapidly becomes prohibitive.* A ballistic missile defense at

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*However, if the Poseidon CEP were half that suggested by Collins (6) only 1.5-2 warheads would be required for a 90-95% kill probability of a 100 psi target.

each site would increase the number of warheads required by the local defense missile inventory. Thus, if the number of these hardened sites were hundreds and each site were protected by only a few defensive missiles, the number of U.S. SLBM warheads required to exhaust the defense and destroy the site could exceed the on-station inventory by a factor of three or four.

This U.S.S.R. perspective of an ABM is in sharp contrast to the large scale urban defense described previously to protect "national value," that is, the population and industry in the large urban areas. The "Soviet" ABM to protect their perception of national value would probably be more effective, less costly, and could be designed to be responsive to U.S.S.R. strategic doctrine. But, this defense would defend only the Soviet "national value," that is war fighting and survival capabilities. The areas near these sites (and many must be near large cities) would be exposed to enormous damage. However, if the U.S.S.R.'s nuclear doctrine is war fighting, involving a counterforce attack on the U.S. strategic forces followed by the absorption of U.S. SLBMs by a Soviet ABM/civil defense protecting select facilities and cadre, then a sound technical/strategic argument could be made that the defense would be feasible and would give the U.S.S.R. a decided strategic advantage, in striking contrast to the U.S. perception of ABM as applied to "national value."

The key technical capability required would be a rapidly deployable version of U.S. "NIKE-X" technology which could be integrated with the Soviet civil defense program. The U.S.S.R. has been reported to be testing a small sophisticated phased array radar and an interceptor of the U.S. Sprint class, the ABM-X-3 system (4). There are also reports that the radar is transportable. This rapidly deployable ABM combined with the Soviet civil defense is to many U.S. analysts the key technical indicator of a high confidence, Soviet nuclear war fighting capability.

The Soviet Air Defense System

The U.S.S.R. has had deployed for over a decade a truly massive air defense system involving 1000 sites and 10,000 supersonic surface-to-air missiles (4). This massive deployment should have a significant capability against any manned penetrating bomber. The cruise missile, however, has significantly improved the penetration capability of these air breathing strategic systems. If the surviving bombers carry ALCMs, the potential destructive power of each bomber would be enormous. For example, if 50 bombers each with 25-200 KT cruise missiles survive, they would have the same destructive power as the surviving Poseidon missiles, but without the ability to cover a large number of geographically dispersed targets. Thus, the surviving SAC bombers armed with ALCMs are a much greater threat to the U.S.S.R than the manned bomber alone. During the terminal phase the missile flies at altitudes of about 100m and is guided to the target by a terrain-contour-matching radar (TERCOM). Accuracies on the order of 10m are possible, as indicated by Tsipsis (14). These missiles, therefore, when armed with 200-400 KT nuclear weapons could have a significant hard target capability. The radar cross-section of cruise missiles is low and at these very low flight altitudes, will probably escape detection by the present Soviet radars until it is too late to launch the air defense missile. However, the technical problems associated with upgrading air defenses to engage the cruise missiles are substantially easier than those associated with a ballistic missile engagement. In fact, there is only one technical issue, i.e., the ability of Soviet ground-based or airborne radar to detect and track the cruise missile. Once the subsonic cruise missile is detected and tracked, it could easily be engaged by the supersonic surface-to-air or air-to-air defense missiles. There are two ways to improve the defense capability to detect cruise missiles. The first is simply to place a standard air defense radar on a tower. A second is to equip fighter aircraft with look-down radars. These improvements to the Soviet air defense system, while costly, are within the state-of-the-art and are permitted by SALT II (which limits cruise missile deployments but not countermeasures). In a well-conceived war fighting plan, therefore, the U.S.S.R. must not only execute an SLBM attack on SAC bases, but must also upgrade their air defense to absorb the cruise missiles launched by the surviving bombers. Recent reports suggest that the Soviets have already conducted some tests of these two techniques. In addition, the new SA-10 may have some cruise missile capability.

Of substantial concern to U.S. strategic planners for over a decade is the possibility that the Soviet air defense system could have some ABM capability. U.S. studies in the early 1970s suggest that with some modest upgrading of the SA-5 radar, the Soviet air defense system could have some capability against the old Polaris reentry system in which the reentry vehicle slows down rapidly in the atmosphere. This modest "upgrade" of the SA-5 would have no capability against the high performance reentry systems on Minuteman III, Poseidon, or Trident. However, the clandestine installation of the mobile ABM radar and the higher performance interceptor at these air defense sites would mean a major shift in the strategic balance of power to the U..S.S.R. While there is no published evidence that the U.S.S.R. is engaged in such an improvement, there were Soviet tests using the SA-5 radar in 1973 and 1974 which involved tracking a ballistic missile during reentry at their ABM test range.

The last of the six technical/military capabilities which could give the U.S.S.R. a strategic advantage is an ASW program directed at the on-station U.S. SLBM systems. Congressional testimony suggests that the U.S.S.R. has a large ASW program. However, in contrast to the other five capabilities required for nuclear war fighting, there are no published reports to indicate that the U.S.S.R. has conducted a test to track and destroy a long range SSBN. Also, as indicated previously, the possibility that a Soviet ASW system could neutralize the U.S. SLBM force with the introduction of Trident system is small. Since there is hard, technical data in the public literature to suggest that the U.S.S.R. is developing five of the technical/military capabilities required, (and has, in fact, deployed or is deploying strategic systems in four areas), the acquisition of similar data on the sixth area, ASW, would be strong evidence to support the thesis that the U.S.S.R. is systematically developing a nuclear war fighting capability. Also, if the U.S.S.R. strategy is nuclear war fighting, they are strongly motivated to complement the other five capabilities to neutralize the third leg of the U.S. triad.

In general, it is difficult to believe that the overall budget for U.S.S.R. strategic programs is less than $30-40 billion annually, more than three times the U.S. budget for the strategic forces.

COMPARISON OF U.S. AND U.S.S.R. STRATEGIC PROGRAMS FOR A NUCLEAR WAR FIGHTING CAPABILITY

A comparison of the U.S. and the U.S.S.R. programs in the six areas required for nuclear war fighting is shown in Table XI. The U.S. has not deployed a new missile system in over a decade and the introduction of MIRVs into Minuteman III and Poseidon was completed in the late 1960s. All the U.S. MIRVs have minimal hard target capability and 80% are SLBMs that could only be used for one mission, assured destruction. The long range Tride I missile is nearing completion of its development phase and will soon replace about one-third of the shorter range Poseidon missiles. The new Trident submarine with the Trident II missile will have an initial operational capability in 1981. The Trident submarine and missile programs are the major U.S. strategic nuclear initiatives over the past decade. They are also an unambiguous reflection of U.S. strategic doctrine--deterrence through the possession of a survivable assured destruction capability. The Trident program does not provide the U.S. a new capability which could improve the U.S. strategic posture with respect to the U.S.S.R. The enormous investment in the Trident program shows the extent to which the U.S. and the Western Alliance rely on a survivable SLBM deterrent force with no attempt to provide a significant nuclear war fighting capability.

The U.S. has had no anti-satellite program of any kind for over a decade and recently initiated a relatively modest effort (in response to the Soviet program) which will not even be tested until the 1980s. The U.S. has no ABM sites and a $215 million R&D program in ballistic missile defense, only half of which will produce equipment that could have any military capability. The U.S. air defense system involves 331 manned interceptors and almost all air defense sites with defensive missiles have been abandoned. The U.S. civil defense program is small ($125 million) and has negligible strategic value. The U.S. ASW program is large but is primarily oriented toward protection of the sea lanes and not toward the neutralization of U.S.S.R. SLBM systems. The entire strategic forces budget in the U.S. is $9.8 billion (5) or 7.8% of the U.S. defense budget.

It is fairly clear, therefore, that a detailed examination of U.S. strategic technology programs shows that it would be impossible for the U.S. to develop a high confidence nuclear war fighting capability in the forseeable future. Even though there has been a great deal of publicity about high accuracy U.S. programs, none have been deployed. Also, it is U.S. policy not to defend the country against a nuclear attack of any size using any delivery system, bombers, ICBMs, SLBMs, or cruise missiles and as Table IX indicates, even ten nuclear warheads are devastating. Thus, the technical possibity of the U.S. developing a significant nuclear war fighting capability with respect to the U.S.S.R. is remote, even unthinkable from an American perspective.

The first part of this paper attempts to show that a nuclear war fighting capability is extremely risky, even irrational, but through an "American" analysis. However, an analysis of Soviet strategic technology programs, particularl- when compared to U.S. programs leads one to the conclusion that the technical indicators suggest that the U.S.S.R. is systematically developing a significant nuclear war fighting capability. The harsh reality is that the U.S.S.R. has deployed or is deploying strategic systems in five of the six areas required. In addition, there is a significant R&D program in the sixth (ABM), and even there the key technical characteristic (radar mobility) is that which would be required to contribute to nuclear war fighting. In sharp contrast, the key comparable U.S. programs are essentially nonexistent as deployed or deployable strategic systems and even the relevant R&D programs are small. While it is impossible to ignore the very real risks of reciprocal mass destruction, the disturbing reality is that the U.S.S.R. is apparently willing to develop the option to fight and win a nuclear war and the published technical indicators seem to support that conclusion.

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Table XI. COMPARISON OF U.S. & U.S.S.R. STRATEGIC PROGRAMS FOR NUCLEAR WAR FIGHTING CAPABILITY

Required First Strike Technical/Military Capability	Present U.S.S.R. Programs	Present U.S. Programs

High Accuracy MIRVs	• Four new ICBMs with MIRVs
	• SS-17, SS-18, S -19 have payloads 3-10 times larger than Minuteman III.
	  • Warheads large enough to attack hardened siloes with modest accuracy.
	  • Mobile ICBM SS-X-16 under development
		• 80% of U.S. MIRV'd warheads are inaccurate, low yield SLBMs--no counterforce capability.
		• 550 MMIII MIRVs yield and accuracy are too low to attack hard targets (0.34 SSKP against 2000 psi @ 900 ft. CEP).
		• Some high accuracy programs in development
		• No new missile deployed in decade:
		  • Trident missiles and submarine in development.
		  • Trident program reflects deterrence policy not nuclear war fighting

Anti-Satellite System	• Developing an extensive system
	• 30-40 field tests disclosed
	• Ground-based laser attempts to blind recon. and early warning satellites(?)
	• Very provocative
		• No program in a decade
		• Modest non-nuclear R&D program recently
		  o Response to Soviet programs
		  o No tests until 1980s

ASW	• Large Program • Alarming if aimed at U.S. SLBMs. • Very risky for nuclear war fighting since Trident program. • Very effective if directed at U.S. SLBM retaliation	• Extensive Program • Not oriented to destroy Soviet SLBMs (?)

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Table XI
(Cont.) COMPARISON OF U.S. & U.S.S.R. STRATEGIC PROGRAMS FOR NUCLEAR WAR FIGHTING CAPABILITY

Required First Strike Technical/Military Capability	Present U.S.S.R. Programs	Present U.S. Programs
Civil Defense	• Large program • Large number of hardened sites for industry and cadre	• $100-$125 million • Negligible strategic value
ABM	• One operational site at Moscow • Large program on development of rapidly deployable ABM components. • Extensive testing • Urban as well as hard site defense • Very effective if applied to hardened, dispersed sites and integrated with civil defense	• One site deactivated • $215 million S&D, only half for testing militarily useful equipment • ICBM defense primary mission • Some area defense technology • No urban defense • Not more than 10-15 tests planned for 1975-1985 o No new ABM radars
Air Defense	• 10,000 surface-to-air missiles at 1000 sites • Continuous R&D • Cruise Missile Upgrade Required • In progress (?)	• Air defense system abandoned for all practical purposes.

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