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ASSESSING THE OPTIONS FOR PRESERVING ICBM SURVIVABILITY

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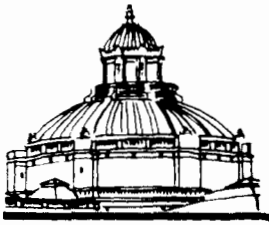

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ABSTRACT

The decision on how to redress the perceived vulnerability of U.S. intercontinental ballistic missiles (ICBMs) is the most controversial strategic nuclear weapon decision now facing the 97th Congress. A full-scale debate on this issue, especially as regards MX missile basing, seems certain. To assist Members of Congress in the debate, this paper discusses nine proposals for treating ICBM survivability: Recognize that ICBMs are invulnerable, rely only on bombers and submarines for deterrence, deploy a large or scaled-down shell-game multiple shelter system, defend MX with antiballistic missiles, launch ICBMs on warning of attack, deploy MX on aircraft or small submarines, and diversify strategic forces, perhaps using small ICBMs.

ABBREVIATIONS

ABM	Antiballistic missile
AMMX	Airmobile MX
ASW	Antisubmarine warfare
C3	Command, control, and communication
CBO	Congressional Budget Office
CEP	Circular error probable
DOD	Department of Defense
FOC	Full operational capability
FY	Fiscal year
GBS	Ground beacon system
ICBM	Intercontinental ballistic missile
IOC	Initial operational capability
LoAD	Low Altitude Defense (ABM)
LOW	Launch on warning
LUA	Launch under attack
MIRV	Multiple independently-targetable reenty vehicle
MPS	Multiple protective structure
nmi	Nautical mile(s)
OTA	Office of Technology Assessment
PLU	Preservation of location uncertainty
psi	Pounds per square inch

R&D	Research and development
RV	Reentry vehicle
SALT	Strategic Arms Limitation Talks
SICBM	Small intercontinental ballistic missile
SLBM	Submarine-launched ballistic missile
SSKP	Single-shot kill probability
SUM	Smallsub undersea mobile

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ASSESSING THE OPTIONS FOR PRESERVING ICBM SURVIVABILITY

INTRODUCTION

The decision on how to redress the perceived vulnerability of U.S. intercontinental ballistic missiles (ICBMs) is the most controversial strategic nuclear weapon decision facing the 97th Congress. At issue are U.S. policy on ICBMs, antiballistic missiles (ABMs), and other strategic forces; the future of SALT; the budget; impacts on large areas of the nation; and perhaps U.S. ability to preserve deterrence.

The United States is developing a new ICBM, the MX. It is to be considerably larger and more accurate than Minuteman III, the only currently deployed multiple-warhead U.S. ICBM. There are, however, fears about the ability of U.S. ICBMs to survive a threat by accurate Soviet ICBMs. The need to retain survivable strategic forces is undisputed. Since U.S. policy is to structure forces that can absorb an attack and still effectively retaliate, ICBMs must be survivable if they are to be consistent with this policy. Since missiles are quite vulnerable to nuclear weapon effects, their survivability depends on how they are based, used, or defended.

Members of Congress have expressed interest in a wide variety of proposals to ensure ICBM survivability. While announcement of an Administration decision on MX basing decision appears imminent, Congress is not powerless in the matter and many Members will continue their interest in the range of alternatives. Accordingly, this report describes the more prominent ones and the major arguments for and against each.

ICBM vulnerability depends critically on the accuracy of the attacking force. The Soviets have been improving ICBM accuracy dramatically in the last few years and deploying many accurate ICBMs. As a result, many in the United States believe the Soviets can now, or in a few years, destroy perhaps 90% of U.S. ICBMs in a preemptive or first strike. 1/ Another position disagrees. It contends that many factors degrade accuracy and otherwise impede a first strike, making ICBM vulnerability a creature of theory that for the foreseeable future can be ignored in the real world.

Few have felt, however, that we could just dismiss the problem. After all, deterrence hinges on whether Soviet leaders believe they could destroy our ICBMs, not whether they would in fact succeed. Moreover, few want the United States to be perceived as having one of its strategic forces vulnerable. These considerations weighed, Congress stated in 1976 that MX must be survivably based on land. 2/

For these reasons, and others discussed later, President Carter recommended basing MX in the shell-game multiple protective structure (MPS) system. He felt it would keep MX on land survivably, verifiably, affordably, compatibly with SALT, and with minimal environmental impact.

President Reagan challenged MPS in his campaign, apparently because of its social and environmental consequences, cost, and complexity. Since taking office, his Administration has been looking for alternatives. At one point or other, the press has reported that it has considered basing MX on surface ships

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1/ See, for example, U.S. Department of Defense. Annual Report, Fiscal Year 1982. (Harold Brown, Secretary of Defense) Washington, U.S. Govt. Print. Off, 1981. p. 111.

2/ U.S. Congress. Committee of Conference. Authorizing Appropriations for Fiscal Year 1977 for Military Procurement . . . and for other purposes. S. Rept. 94-1004. To accompany H.R. 12438. 94th Congress, 2d Session. Washington, U.S. Govt. Print. Off., 1977. p. 40.

and aircraft, in 3000-ft deep silos and a scaled-down MPS, and defending MX with ABMs. 3/ The problems are so complex, with so many requirements imposed simultaneously, that the Administration has delayed the decision several times.

As of early September, the status of various options was as follows. The Air Force and the Armed Services Committees strongly supported MX/MPS; some other Members of Congress opposed it; the President appeared unwilling to deploy the full 200-MX/4600-shelter system Carter proposed. Basing 100 MX in 1000 shelters now seems the leading contender, even though that system by itself has very poor survival prospects in a determined attack. (See p. 25.)

Airmobile MX (AMMX) was reported to be the leading challenger to MPS. In early August, the press reported that Secretary Weinberger wanted to base MX on C-5 aircraft in the mid-1980s, then deploy in the late 1980s a new aircraft, "Big Bird," designed to keep MX aloft for days. Senator Tower, Representatives Price and Dickinson, and some Air Force generals reportedly criticized AMMX sharply. 4/ At this writing, AMMX no longer seems an option for early deployment, but research on it may continue.

Small submarine basing has received modest congressional support, but the Air Force opposes it. The Navy is uninterested in it because, some believe, it could threaten the Trident program, offers no advantages over Trident, and could lead to disputes between the Navy and Air Force over roles and missions.

3/ See: Wilson, George. Weinberger Suggests U.S. More Willing To Station GIs in Trouble Spots Abroad. Washington Post, Feb. 4, 1981: A1, A4 (surface ships); Robinson, Clarence, Jr. Weinberger Pushes Strategic Airmobile MX Concept. Aviation Week and Space Technology, Aug. 3, 1981: 16-19 (airmobile and deep underground basing); Administration Weighing Options in MX Basing Plan. Aviation Week and Space Technology, Sept. 7, 1981: 22-25 (small MPS and ABM).

4/ Tower, John. Press Conference, Aug. 1, 1981. 5 p.; Wilson, George. House Leaders Try To Down Airborne MX. Washington Post, Aug. 13, 1981: A1; Evans, Rowland, and Robert Novak. Weingerger's Flying Trap. Washington Post, Aug. 10, 1981: A17.

The near-term future of ABM defense of MX will be critically affected by the MX basing decision. Silo basing would need an ABM defense to survive unless MX were launched under attack. The 200-MX/4600-MPS system could require a Low Altitude Defense ABM if the Soviets were adding RVs. The 100-MX/1000-MPS would offer negligible survivability without a much more elaborate ABM defense. Small submarines or AMMX would not depend on ABMs for survival. Simple ABM systems have received little attention in Congress.

Launching ICBMs on warning of attack has received some congressional support. Some Senators have urged that this approach be reassessed. 5/ The House Committee on Interior and Insular Affairs recommended improving command and intelligence systems that would enhance U.S. ability to do so. 6/ The Senate passed an amendment on May 14, 1981, adding $31.2 million for a Survivable Optical Forward Acquisition System which, its advocates claimed, would enhance U.S. ability to launch on warning. This option and "dust defense" (see page 33) are the only technically feasible ways to keep ICBMs survivable in the near term.

The case that silo-based ICBMs are invulnerable has not stuck. Air Force spokesmen have recently challenged some of these arguments. Yet there is little support in Congress for abandoning ICBMs.

Some are arguing that MX basing must be decided not as a separate entity but in the context of a broader view of U.S. security interests. Several Senators and the House Committee on Interior and Insular Affairs take this

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5/ Garn, Jake, and Paul Laxalt. MX Basing and a National Security Posture for the United States. Report accompanying press release by Senator Garn of June 25, 1981. 14 p.

6/ U.S. Congress. House. Committee on Interior and Insular Affairs. Basing the MX Missile. 97th Congress, 1st Session. Committee Print No. 2. Washington, U.S. Govt. Print. Off., 1981. 28 p.

position; Secretary Weinberger has reportedly presented to the President a comprehensive plan to upgrade strategic forces. This position further recommends developing various weapons as hedges against Soviet weapons advances.

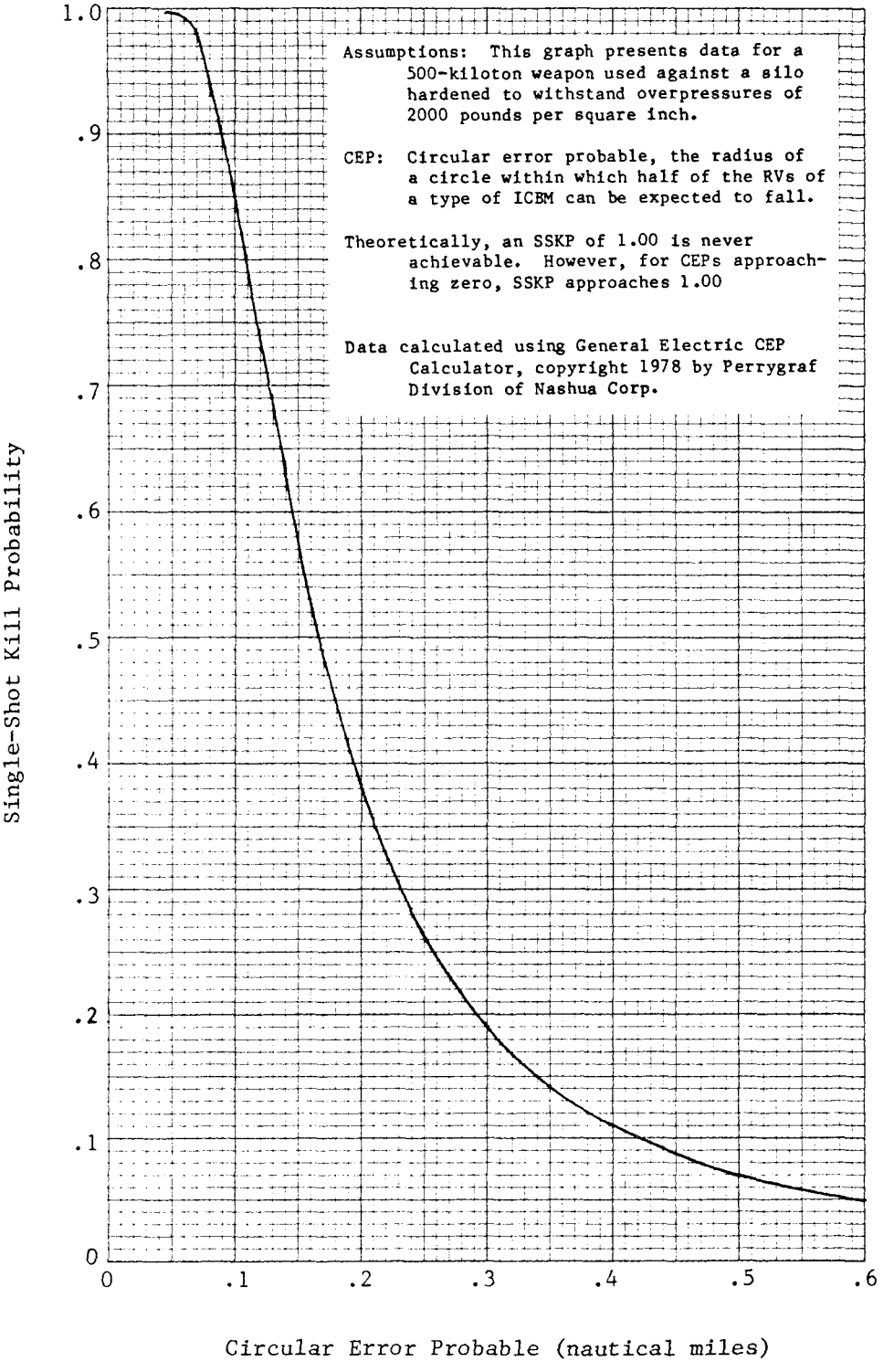
ARE ICBMs VULNERABLE?

The basing mode debate assumes that U.S. ICBMs are becoming vulnerable. Some dispute this, arguing that the ICBM vulnerability problem is a creature of theoretical calculations and can be ignored in the real world. 7/

Many uncertainties reduce an attacker's confidence that it can successfully strike first. The ability of an ICBM force to destroy an opposing ICBM force depends on accuracy, explosive yield, numbers, and reliability of reentry vehicles (RVs), and reliability of ICBMs. Accuracy is of particular importance. As figure 1 shows, degradations of accuracy beyond a certain point (depending on RV yield and silo hardness) drastically reduce the likelihood that an RV can destroy an ICBM silo. Yet every ballistic missile trajectory is affected by anomalies in the earth's gravitational and magnetic fields. While an ICBM's trajectory can be adjusted for known anomalies, neither side has flown ICBMs over the north pole for obvious reasons. It is argued that the anomalies of this trajectory, being unknown, would degrade ballistic missile accuracy by some unknown amount. Weather conditions over the target would also affect accuracy.

7/ See, for example, Anderson, J. Edward. Are We Vulnerable to a First Strike? Prepublication draft. Minneapolis, Dept. of Mechanical Engineering, University of Minnesota, May 1981. 34 p.

FIGURE 1. Single-Shot Kill Probability (SSKP) vs. Circular Error Probable (CEP)



The blast, dust, heat, wind currents, etc., of a nuclear explosion would disable or knock off course any RVs flying near it for some minutes, an effect known as fratricide. To avoid fratricide, RVs must attack one side of a missile field, then sweep toward the other side on a precise schedule. A more difficult alternative is to have all RVs in each missile field explode at about the same instant. Each method requires great coordination.

While each RV that reaches its target has a very good chance of destroying the target, ICBM reliability is not nearly so good. An attacker would therefore prefer to use two RVs per target, doubling the number of RVs needed. These RVs should come from different missiles so that one missile's failure would not leave one or more silos untargeted. This "cross-targeting" adds to the complexity of coordinating an attack.

The reliability of equipment and personnel in launching a precisely coordinated attack with thousands of RVs is uncertain. After all, supporters of this position note, the entire system cannot be tested, but must work nearly perfectly the first time. Finally, an attacker would fear that the opposing side would launch its ICBMs on warning of attack. Indeed, on viewing preparations for an attack, such as moving many ballistic missile submarines out to sea, the other side might prepare to launch on warning.

Detailed and specific response to these points would be highly classified. In general, responses are of two types. First, the impact of the error factors have been determined very well by integrating measurements obtained over the last 20 years, using satellites and on-site survey data to measure gravitational anomalies along flight paths, examining changes in the earth's magnetic field under different circumstances, conducting missile flight tests along many

different trajectories, and so on. 8/ Atmospheric conditions have minor effects on accuracy, it is argued, and a missile's trajectory can be adjusted for weather at the target prior to launch. For these and other reasons, the U.S. intelligence community believes that uncertainties would not degrade projected ICBM accuracies beyond the point where they have a high probability of destroying ICBM silos. 9/

The rebuttal to arguments based on difficulties of coordinating an attack is that the United States should not rest the survivability of its ICBMs on problems that Soviet planners may encounter in calculating the times for launching ICBMs and the trajectories their RVs are to follow. So doing, it is argued, would undermine for friends and foes alike the perception that the United States is committed to preserving the value of its strategic forces, especially ICBMs, which comprise a substantial part of our deterrent capability and almost all of our existing prompt counterforce capability. It is Soviet perceptions of the vulnerability of our ICBMs, not our calculations of their vulnerability, that affect Soviet war plans.

8/ Mann, Paul. Panel Examines ICBM Vulnerability. Aviation Week and Space Technology, July 13, 1981: 141+; Administration Weighing Options in MX Basing Plan. Aviation Week and Space Technology, Sept. 7, 1981: 22-25.

9/ U.S. Air Force. Office of the Special Assistant for MX Matters. Telephone conversation, Sept. 16, 1981.

CAN WE ABANDON LAND-BASED ICBMs?

One group of those who assume that ICBMs are vulnerable, or that we cannot rely for deterrence on ICBMs that appear vulnerable, believes that the United States should move to a dyad of submarines and bombers, suitably upgraded. This position opposes deploying new ICBMs for the following reasons:

-- Deterrence doesn't require much in the way of surviving forces. A few hundred RVs that can survive attack and penetrate to their targets could devastate the Soviet Union and deter any rational Soviet leader; no amount of force could deter an irrational leader.

-- There is no politically acceptable way of basing ICBMs survivably on land. MPS- or silo-based ICBMs can be targeted and destroyed. Land-mobile ICBMs can be barraged. Attacks on either would generate huge amounts of fallout. Launching ICBMs on warning of attack entails huge risks. ABM defense would be costly, would require renegotiating or withdrawing from the ABM Treaty, and may be ineffective. It is pointless to pour money into retaining an irremediably vulnerable system.

-- Deploying new ICBMs plays to Soviet strength by providing targets for the many accurate Soviet ICBM RVs. Instead, by enhancing our bomber and submarine forces and foregoing new ICBMs, we could defeat the massive Soviet investment in counterforce ICBMs and the strategy on which it is based.

-- The Trident II (D-5) missile could become operational in 1989, and could improve the Trident I missile's range, accuracy, and

payload. 10/ The United States could design a Trident submarine/Trident II system to execute prompt counterforce attacks. 11/ It would be highly survivable, and could endure (i.e., operate if it survives the initial attack) for months. Since the fleet would operate over vast ocean areas, it would be insensitive to numbers of Soviet RVs. It would attract few Soviet RVs to land. Very few submarines would be needed to provide the 1000 or so RVs that the United States hopes would survive from an MX system. Trident II would presumably carry between 8 RVs (which Trident I carries) and 14 RVs (the maximum permitted by SALT II). Five submarines armed with 8-RV Trident IIs would carry 960 RVs; 3 armed with 14-RV Trident IIs would carry 1008 RVs. If the Trident submarine has a 66% at-sea availability over its lifetime, as planned, 12/ 5 to 8 submarines would permit 3 to 5 to be on station at all times. We could guard against Soviet advances in antisubmarine warfare (ASW) by pursuing

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10/ Zeiberg, Seymour (Deputy Under Secretary of Defense for Research and Engineering (Strategic and Space Systems)). Testimony for the Sea Based Nuclear Deterrent Force Hearing of the Strategic Programs Subcommittee, Senate Armed Services Committee. Feb. 27, 1981. p. 1-3.

11/ Regarding the D-5's counterforce capability, see Carter, Powell, Jr. (Rear Admiral, USN, Director, Strategic and Theater Nuclear Warfare Division, Office of the Chief of Naval Operations). Statement before the Subcommittee on Strategic and Theater Nuclear forces of the Senate Armed Services Committee on Sea Based Deterrent, Feb. 27, 1981. p. 4-6. The required responsiveness would need certain procedures and technology, but they could be obtained if a decision were made to do so. Based on discussions with DOD, Navy, and Congressional personnel, Sept. 1981.

12/ Williams, John, Jr. (Vice Admiral, USN, Deputy Chief of Naval Operations for Submarine Warfare). Statement before the Subcommittee on Seapower of the House Armed Services Committee on the FY82 Budget Request for Strategic and Tactical Submarine Forces. [No date; c. Feb. 1981]. p. 7 (VG-9).

counter-ASW techniques and by conducting research and development (R&D) on several hedge programs, such as ABM, small ICBMs, airmobile ICBMs, and small submarines, any of which we could deploy in response to a specific future Soviet threat. As the U.S. ABM program in the last decade shows, R&D-only programs can advance technology dramatically at modest cost even without deploying operational systems.

-- The United States could also accelerate the air-launched cruise missile program and proceed with a B-1, an advanced technology ("stealth") bomber, or both.

Advocates of retaining a triad composed of land-based ICBMs, bombers, and submarines respond as follows:

-- It is harder to attack several independent forces simultaneously. For example, if ICBMs are launched against bombers and ICBMs, bombers can be launched on warning of attack. But if submarine-launched ballistic missiles (SLBMs) are launched against bombers, and ICBMs are launched against ICBMs, the bombers would be destroyed before the ICBMs arrive, confirming warning of attack so that ICBMs could be launched.

-- It is harder to defend against several independent strategic forces; for example, ICBMs would attack the U.S.S.R. from the north, and SLBMs could approach from various directions. Unlike missiles, bombers can fly low and use evasive or self-defense tactics.

-- Different forces are suited to different missions. SLBMs, for example, are an ideal reserve force because of their near invulnerability.

-- Even if the Soviets believe one of our strategic forces is vulnerable and thus ineffective as a deterrent, the others could still deter.

-- Bombers are of questionable survivability given the prospect that an attack could destroy many bombers at their bases and Soviet air defenses could destroy bombers near their targets. A dyad would thus in effect rest solely on submarines, making our deterrent vulnerable to a Soviet ASW breakthrough.

Some oppose a bomber-submarine dyad on the basis of the need for land-based ICBMs. They note:

-- ICBMs have a unique combination of characteristics, including: Rapid response time, short time to target, ability to destroy hard targets, high alert rate, ability to be retargeted rapidly, and very good command and control. 13/ In some basing modes, ICBMs can have straightforward verification for SALT.

13/ Allen, Lew, Jr. (General, Chief of Staff, USAF). Letter to Representative Melvin Price, Chairman, House Armed Services Committee, Dec. 29, 1978. In U.S. Congress. Senate. Committee on Armed Services. Fiscal Year 1979 Supplemental Military Authorization. Hearings on S. 429, a Bill to Authorize Appropriations for Fiscal Year 1979, in Addition to Amounts Previously Authorized for Procurement of Aircraft, Missiles, Naval Vessels, . . . and for Other Purposes. 96th Congress, 1st Session. Washington, U.S. Govt. Print. Off., 1979. p. 166-167.

-- Eliminating ICBMs would free resources that the Soviets could devote to making our bombers and submarines vulnerable.

-- Just as our bomber and submarine forces give us time to remedy ICBM vulnerability, so maintaining a survivable ICBM force would provide time in which to remedy a future weakness in the bomber or submarine force.

-- The U.S. would convey an image of weakness by letting the Soviets drive U.S. ICBMs from land.

MULTIPLE PROTECTIVE STRUCTURES: THE BASELINE SYSTEM FOR BASING MX ON LAND

A major group of those who believe ICBMs are vulnerable insist that we retain survivable land-based ICBMs. Many of this group want to deploy MX; some want to deploy it in a multiple protective structure (MPS) system. Since MPS is the Air Force's preferred solution, the one preferred by the Ford administration 14/ and the one selected by President Carter in September 1979, it is the baseline system and the one that has received the most attention.

Generically, an MPS is a giant shell game, in which few missiles are moved among many shelters. The shelters may be horizontal or vertical and may be connected by roads, railroads, tunnels, etc. The theory underlying MPS is that the Soviets would not know which shelters contain missiles, so they would have to attack all the shelters in a first strike. Yet the United States would build so many shelters that they couldn't attack them all. As a result, some shelters and missiles would survive. The Soviets, knowing this, would be deterred.

MPS entails two key conditions. First, the United States must prevent the Soviets from knowing which shelters contain missiles. This task, known as preservation of location uncertainty, or PLU, is difficult; the Office of Technology Assessment (OTA) sees it as "the equivalent of a new technology." 15/ A missile, even in a shelter, gives off many signals that can be used to detect it, including acoustic, communications, chemical, magnetic, nuclear, seismic, and thermal. Location uncertainty must be preserved against ground sensors,

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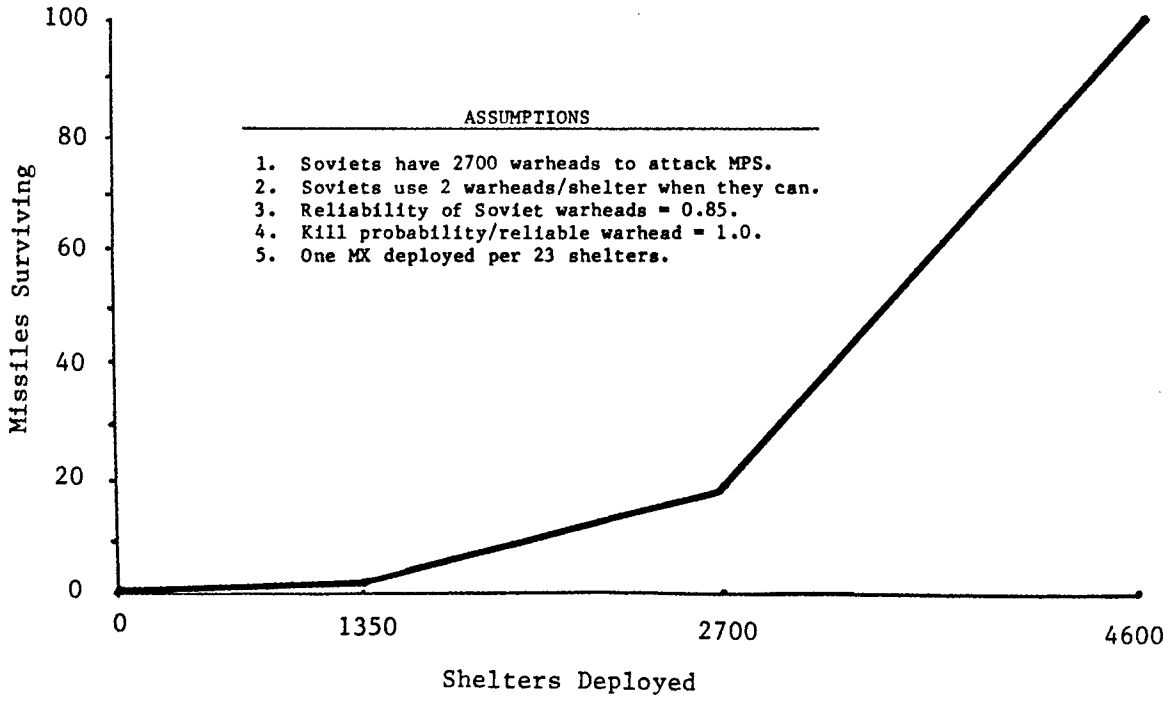
14/ U.S. Department of Defense. Annual Defense Department Report, FY 1978. (Secretary of Defense Donald Rumsfeld) Washington, U.S. Govt. Print. Off., 1977. p. 130.

15/ U.S. Congress. Office of Technology Assessment. MX Missile Basing: Summary. Washington, U.S. Govt. Print. Off., June 1981. (Hereafter cited as "OTA, MX Missile Basing: Summary.") p. 16.

satellites, and security breaches while the missiles are in shelters and being transported. If the Soviets could differentiate on even one observable, the leverage sought by proliferating shelters would disappear because they could attack 200 shelters instead of 4600 and overwhelm the system.

Second, MPS must respond to the threat. MPS survivability does not rise in direct proportion to the number of shelters deployed, but rises very slowly until shelters outnumber attacking RVs, then rises rapidly. CBO notes, "Thus, an MPS basing system is 'indivisible' in the sense that the Congress could not reduce the size of the proposed shelter construction program without jeopardizing the primary purpose of the system." 16/ Figure 2 illustrates these points.

FIGURE 2. MX Missiles Surviving vs. MPS Shelters Deployed



16/ U.S. Congress. Congressional Budget Office. The MX Missile and Multiple Protective Structure Basing: Long-Term Budgetary Implications. Washington, U.S. Govt. Print. Off., 1979. p. 30.

If the Soviets add ICBM warheads, and the United States chooses to retain survivable land-based ICBMs, it must add shelters, missiles, or warheads per missile; defend MPS with ABMs; or some combination of these approaches.

Carter asserted that the system met the following five criteria. 17/ It promotes ICBM survivability. It is adequately verifiable. It "minimizes the impact on the environment," since it requires closing off only 33 square statute miles from public use. It is affordable, costing no more in constant dollars than the Minuteman, Polaris, or B-52 programs. It is "compatible with existing SALT agreements and with our objectives for SALT III." MPS kept ICBMs on land, a sixth criterion that Carter did not state. Finally, it was designed around the MX rather than another missile.

Carter's plan called for each of 200 MX missiles to be based in its own cluster of 23 horizontal shelters, or 4600 shelters in all. The preferred site was the Great Basin area of Nevada and Utah. The shelters were to be connected by closed-loop roads, hence the name "racetrack." In April 1980, the "racetrack" plan was modified in several ways. 18/ The new plan would have the same number of shelters and missiles, but the shelters would be arrayed along linear roads. A smaller transporter vehicle would insert the missile and launcher into the shelter. Transporter, launcher, and missile would weigh 1.6 million pounds. The system would have only a limited capability to move missiles into shelters during attack. To aid PLU, the system would use mass simulators, 500,000-lb arches of steel and concrete that would mimic the mass and other signatures of

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17/ U.S. White House. Office of the White House Press Secretary. Press announcement by the President on MX basing, Sept. 7, 1979. 4 p.

18/ This system is described in intricate detail in U.S. Air Force. Air Force Systems Command. Headquarters Ballistic Missile Office. M-X Horizontal Shelter Weapon System: Baseline Configuration (Dec. 1980). Several hundred pages.

the missile/launcher. Mass simulators would be in each shelter and the transporter vehicle whenever they did not contain a missile. Like the "racetrack," the new plan had several features to facilitate SALT monitoring. Missiles would be assembled at a designated area near the shelters, and moved slowly along a special road network to the shelters. A large earth mound, requiring at least a day to move, would be placed across the entrance to each cluster of shelters; since the transporter vehicles could not travel off the road, the mound would enhance Soviet confidence that we were not moving more missiles into shelters covertly. Shelters and transporters would have "SALT ports," doors that could be removed or opened to permit Soviet satellites to determine that a cluster contained at most one missile.

In normal operation, the missiles would be moved perhaps once each six months from one shelter to another in a cluster. When required, missiles would be moved from a shelter to the cluster maintenance facility and back. To avoid indicating to the Soviets which shelters contain missiles, the transporter would stop at all shelters in a cluster whenever it stopped at any. Each shelter would contain either a missile or a simulator. At each shelter, the transporter would exchange its simulator for one in the shelter, its simulator for the missile/launcher in the shelter, or its missile/launcher for the simulator in the shelter, as the case might be.

The Case For MPS

MPS advocates argue that we need a triad containing land-based ICBMs because of the advantages of the triad and ICBMs noted earlier. MX must be the ICBM we deploy because its development is far along and its counterforce capability is essential. A sea- or air-based MX would have similar vulnerabilities as the

submarine or bomber fleet, and MX's large size prevents it from being freely mobile on land. Thus MX should be based only in silos or MPS. Silos, however, are vulnerable to Soviet attack, and Congress insisted that MX be survivably based. Thus MPS is the only choice. Supporters argue that no other system bases MX on land survivably, verifiably, affordably, in consonance with SALT, and with manageable social and environmental impacts.

MPS raises the cost of a Soviet attack. To destroy 200 missiles dispersed among 4600 shelters, they would need at least 4600 RVs instead of 200. They would need at least 23 RVs to destroy 1 MX with its 10 RVs. Without MPS, they could destroy most of our 2152 ICBM RVs by using 1052 RVs (one for each of 1052 silos), about 25% of their counterforce RVs. 19/ With 4600 MPS, 350 Minuteman III, 450 Minuteman II, and 52 Titans, they would need 5452 counterforce RVs -- more than they now have -- to attack our 3552 ICBM RVs with one RV per shelter or silo. Using two RVs per target doubles this cost. MPS thus creates a poor exchange ratio for the Soviets. Since we have far more weapons on bombers and submarines than they do, an attack on MX/MPS would largely disarm the attacker, moving the postattack balance of RVs sharply in our favor. This consequence holds with or without SALT even if they attack our forces in a "bolt out of the blue." (See figure 3.) Thus MPS deters Soviet attack, promoting strategic stability.

While they could add RVs, we could add shelters to offset them, and the result would be the same -- they would use all their ICBMs to destroy all of ours. If we were reluctant to build thousands of additional shelters, we could achieve the same leverage by defending MPS with the Low Altitude Defense ABM,

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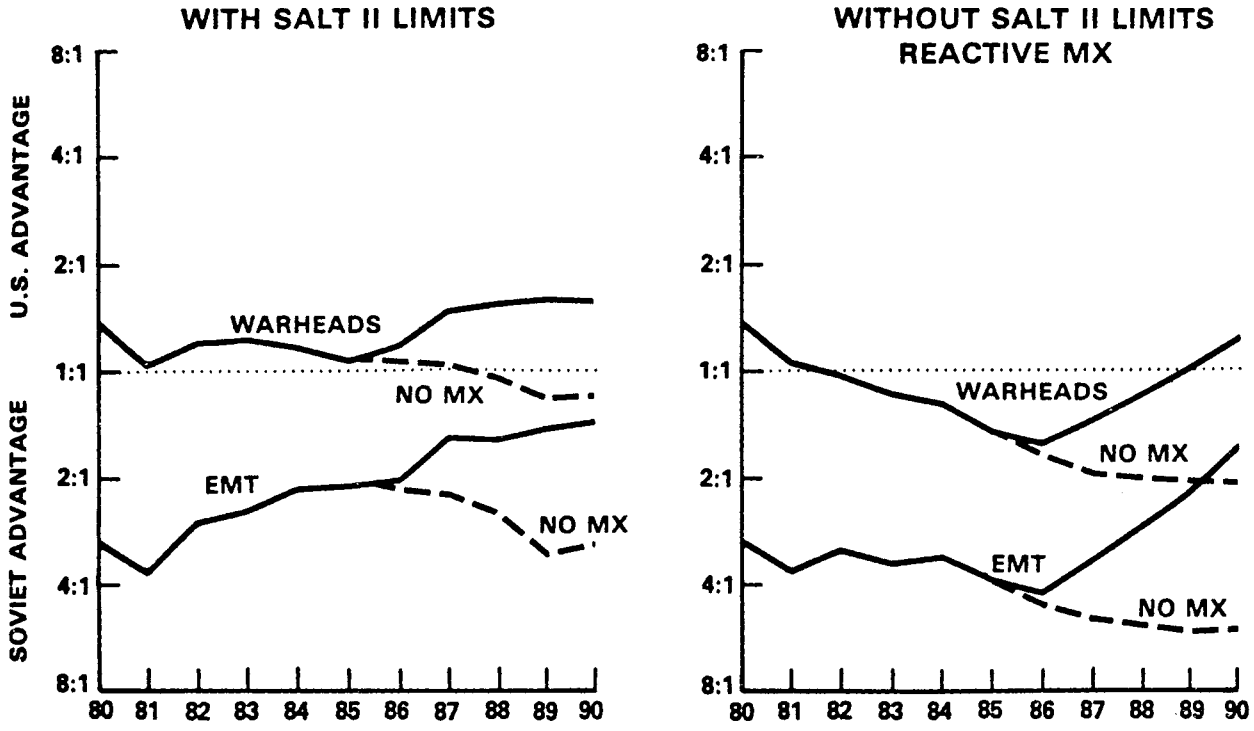
19/ John Collins estimates the Soviets had 4,216 RVs on MIRVed SS-17, SS-18, and SS-19 ICBMs as of January 1, 1981. U.S. Library of Congress. Congressional Research Service. U.S./Soviet Military Balance: Statistical Trends, 1970-1980. Unpublished report, by John Collins, July 1981. p. 15.

discussed later. Knowing they could gain no advantage by adding RVs, they would be led away from so doing and toward mutual strategic arms limitation.

FIGURE 3

POST-EXCHANGE DAY-TO-DAY ALERT FORCES WITH AND WITHOUT MX



Source: U.S. Department of Defense. Annual Report, Fiscal Year 1982. p. 59.

MX will threaten Soviet fixed-site ICBMs, so it should compel the Soviets to spend large sums on ICBM survivability, as they have forced us to do with their ICBM program, further pressing them to seek an equitable arms control ceiling. Of course, if they plan to use their ICBMs for a first strike, they need not respond, but a lack of response would itself be telling. The funds

the Soviets spend on survivability could otherwise be used for other military forces. To compel this diversion of resources, though, MX must be deployed. To preserve the triad as we know it, supporters assert, MX must be deployed on land. Several MPS characteristics promote deterrence. It will have very good command, control, and communication (C3), using several modes for redundancy. It will permit shelters that survive attack to endure for months. Because of the accuracy, responsiveness to national command authority, time on target control, and rapid retargeting that MPS permits, it maximizes MX's warfighting capability, which many advocates of MPS see as essential for deterrence.

Some question our ability to maintain PLU. But the problem cuts both ways, MPS supporters believe. Could the Soviets really be so confident they had found all the missiles that they would risk their survival as a nation on it? Just as we would not know for sure if the Soviets had broken PLU, neither would they. We will devote extensive resources to PLU. As we do for our missile submarines now, we will have a team of experts, with access to more information than we expect the Soviets could obtain, trying to break PLU, and will adjust the MPS system as needed to correct the problems they discover.

MPS advocates recognize that MPS will affect the deployment area. They argue, however, that only 33 square statute miles of land will be removed from public use, and the Air Force has carefully considered how to minimize social and environmental impacts of MPS. The missile should pose as few hazards to the public as the solid-fueled Minuteman has in two decades of operation. While advocates recognize that an attack on MPS would generate blast and fallout, they argue that MPS will be very effective in deterring attack. Moreover, the Soviets would not just attack MPS in a first strike, but would also attack Minutemen, Titans, bomber and submarine bases, and probably C3 and other military targets. An attack on MPS would cause relatively few additional deaths,

MPS supporters argue. Some impacts will be positive. The project will employ thousands directly and indirectly, bringing billions of dollars into the deployment area and helping its citizens retain their young people rather than losing them as they migrate elsewhere for jobs. The project will improve roads and will survey water and mineral resources.

The Case Against MPS

Critics challenge MPS on many grounds. They note that enough MPS-based missiles can survive attack only if we build enough shelters. Yet how can we know we have built enough? The Soviets will always know if they can destroy MPS because they know how many RVs they have and how many shelters we build. While we have indications of numbers of Soviet RVs, however, we can never know precisely. MPS gives the Soviets an incentive to deny us that knowledge. By building ICBMs covertly, as they can do under SALT I and II, and making provisions to launch them without silos, they could avert a U.S. increase in the number of shelters, so could minimize the number of RVs needed to destroy MPS.

Citing recent U.S. intelligence estimates regarding the Soviet threat in 1990, critics note that even without covert deployment of ICBMs we may need more than 4600 shelters. 20/ OTA has estimated that the Soviets could (assuming no SALT II ceilings) deploy 7,000 RVs in 1990 and 12,000 in 1995 for use solely against MPS. To permit 100 MX to survive, we would need 360 MX and 8,250 shelters in 1990 and 550 MX and 12,500 shelters in 1995. 21/

20/ Garn and Laxalt, MX Basing and a National Security Posture for the United States, p. 3.

21/ OTA, MX Missile Basing: Summary, p. 18.

Moreover, OTA states, we would need to predict the size of the Soviet force several years in advance. We "could not first build a 4,600-shelter system and then decide to expand it if it proved to be too small, unless the United States were prepared to defer survivability into the mid-1990's." 22/ To make matters more difficult, we are starting the race from behind. Critics contend that the Soviets could "fractionate" the payloads on their ICBMs -- that is, divide the payload into larger numbers of lower-yield RVs. The Soviets have tested their largest ICBM, the SS-18, with a maximum of 10 RVs. If they conducted enough flight tests so that we believed they could deploy a 20-RV SS-18 with adequate lethality against hard targets, we could retain confidence in MPS only by increasing the number of shelters dramatically, deploying ABM, or both.

Critics of MPS question our ability to preserve location uncertainty. 23/ Guy Barasch, of Los Alamos National Laboratory, feels that while we can maintain PLU in the 1980s, "I have concerns about 20 or 25 years from now." 24/ After all, PLU will be challenged by Soviet technology of 1990 and beyond, when MX/MPS would be operational. We would never know, of course, if we had maintained PLU. Critics fear that doubts about PLU and unwillingness to use ever-expanding amounts of land will compel us to deploy an ABM to defend MPS. This could lead us to abrogate the ABM Treaty, which many see as the most useful arms control agreement negotiated to date. Even if the Soviets agree to modify the treaty to permit MPS-defense ABM, critics fear, such renegotiation would be the beginning of the end of the treaty.

22/ Ibid., p. 19. Italics in original.

23/ Garn and Laxalt, MX Basing and a National Security Posture for the United States, p. 4.

24/ U.S. Library of Congress. Congressional Research Service. Redressing ICBM Vulnerability: Options for the Future. Seminar Transcript. Report No. 81-157 F. Washington, March 23, 1981. p. 30.

MPS offers the Soviets several advantages, critics argue. First, it plays to their strategy and investment. Three-fourths of Soviet deliverable strategic nuclear weapons are on ICBMs, 25/ many of which can readily destroy the fixed targets that MPS provides by the thousands. In contrast, a system in which vehicles carry missiles over large areas, such as on the U.S. highway system, would render Soviet ICBMs of little value by removing most of their targets. Second, the Soviets would have advantages in an MPS vs. MPS competition. They have much more sparsely populated land and no comparable restraints on environmental impact. They can close off vast areas to help PLU. They can build all sorts of things in quantity rapidly. Third, how confidently could we verify a Soviet MPS? Fourth, a U.S. commitment to MPS would compel U.S. SALT negotiators to seek limits on Soviet ICBM RVs to keep MX/MPS survivable. The Soviets could then exact major concessions from the United States in exchange for these limits.

Critics note social and environmental problems. In May 1981, the Mormon Church, of which more than 70% of Utahns are members, expressed grave concern about the shortage of water, the social consequences of an "influx of tens of thousands of temporary workers and their families," the impact on "the fragile ecology of the area." The statement pointed out that an attack on MX/MPS would cause "near annihilation of most of what we have striven to build," and fallout reaching "across much of the nation." Therefore, it asked that the nation find "viable alternatives." 26/ Ranchers, Indians, environmentalists, and others have expressed similar concerns. Other large projects are also planned for

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25/ U.S. Department of Defense. Annual Report, Fiscal Year 1981. (Harold Brown, Secretary of Defense) Washington, U.S. Govt. Print. Off., 1980. p. 89.

26/ Church of Jesus Christ of Latter-Day Saints. First Presidency Statement on Basing the MX Missile. Salt Lake City, Utah, May 5, 1981. 3 p.

Nevada and Utah in the 1980s, such as power plants, mines, and perhaps synthetic fuel plants. Their cumulative effects along with MX would be immense.

ALTERNATIVE MEANS OF BASING MX ON LAND

MPS is by far the most controversial basing scheme seriously put forth for a strategic weapon system. Many advocates of MX survivably based on land oppose MPS, so are compelled to offer alternatives. Three leading ones are a scaled-down MPS, ABM defense of MPS- or silo-based MX, and launch on warning.

Scaled-Down MPS

The Reagan Administration is reportedly considering a 100-MX/1000-MPS system, which would offset two difficulties of the larger system. The 200-MX/4600-MPS system has been widely criticized because of its social and environmental impacts. Moreover, it would cost $40.7 billion (FY82 $) for acquisition (research, development, test, evaluation, and procurement of missiles and basing mode), requiring expenditures (in then-year $) of about $5.9 billion in FY83, $8.3 billion in FY84, $10.4 billion in FY85, and $10.5 billion in FY86 27/. The small MPS, in contrast, would cost $28.7 billion (FY82 $) for acquisition. 28/ It would have fewer adverse impacts.

There is little disagreement that the smaller system by itself would be extraordinarily cost-ineffective. An Air Force planning guide, assuming SALT II limits, was that the number of accurate Soviet ICBM RVs available to be targeted

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27/ U.S. Air Force. Office of the Special Assistant for MX Matters. Telephone conversation, Sept. 16, 1981.

28/ Ibid. This is a preliminary estimate.

at MX would not substantially exceed 2700 by the MX/MPS full operational capability of 1989. OTA assumes the damage expectancy of each of these RVs is 0.85; 29/ that is, each RV targeted at a shelter will have an 85% chance of destroying it. Using these figures, if the Soviets target 2 RVs on each of the 1000 shelters, then 15% of 15%, or 2.25%, of the shelters (22.5 shelters) would survive. Worse, since the Soviets would in this attack target 2 RVs at each shelter containing a missile, only 2 (nominally 2.25) MX missiles would be expected to survive, at a cost of $14.5 billion apiece. The 900 empty shelters would buy zero additional survivability; since the Soviets could attack each MX with 2 RVs, what they did to the other 900 shelters would not affect numbers of MXs surviving. When there are enough shelters so the Soviets can target only one RV at each shelter, MPS enhances survivability modestly. Only when shelters greatly outnumber Soviet accurate ICBM RVs, so they cannot attack most shelters and missiles, does MPS enhance survivability significantly.

Proponents argue that the small MPS lets us do something now, and provides future options, whereas doing nothing now would kill MX and foreclose mitigating the ICBM vulnerability problem during this decade. In providing a way of deploying MX, it would compel the Soviets to spend vast sums to make their ICBMs survivable, while keeping them off guard as to the composition of the future U.S. ICBM force. This would put positive pressure on them at SALT. Further, it would satisfy West European governments that would find it politically impossible to accept U.S. theater nuclear forces on their soil if we do not base MX on land. The small system is a conservative initial step that maintains flexibility. Our experience with it would assuage concerns on MPS operability and

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29/ OTA, MX Missile Basing: Summary, p. 17.

PLU. It hedges against the failure of several other options because it allows us to make incremental decisions while R&D continues on complementary options. It would provide leverage that would increase the effectiveness and lower the technical risk of an ABM. It could complement a later deployment of a deep underground basing system that stresses the Soviets in an opposite manner from MPS. Deep underground basing would be targeted with large weapons, thereby requiring few RVs per ICBM, whereas the Soviets must use many RVs per ICBM to hold MPS at risk.

Critics respond that we would deceive ourselves with the small MPS. A small MPS keeps us off guard about the future composition of our ICBM force. We must either commit to a much larger system, and to expanding and/or defending it if the Soviet threat requires, or not deploy an MPS. In fact, critics believe, a small MPS invites the Soviets to engage us in an RV vs. MPS race by demonstrating that MPS has so little political support that the United States is unwilling even to start the race, let alone stay the course. Nor should we build a small MPS in the hopes that an ABM could exploit the leverage provided by defending only the 100 shelters with missiles in them. OTA states that while LoAD would not need to be very efficient to force the Soviets to use two RVs per shelter, "it would be exceedingly difficult to exact a price of several RVs," and it is far too soon in the development cycle to rely on the more advanced layered defense ABM. 30/ (See below.) Finally, critics cite OTA on the need for a timely decision on the numbers of shelters to be built (page 22) and Congressional Budget Office on the "indivisibility" of the size of an MPS system (page 15).

30/ U.S. Congress. Office of Technology Assessment. MX Missile Basing. Washington, U.S. Govt. Print. Off., Sept. 1981. (Hereafter cited as "OTA, MX Missile Basing.") p. 121, 132, 135.

Antiballistic Missile Defense of MX

The United States could develop and deploy antiballistic missiles (ABMs) to defend MPS- or silo-based MX (or other ICBMs). There are several types of ABM systems. The choice depends on when the system is to be deployed (a more sophisticated ABM could be used later) and the basing mode in which MX is to be defended. Since the SALT I ABM Treaty of 1972 sharply limits ABM development and deployment, the United States would have to seek renegotiation of the treaty or, failing that, would have to withdraw from the treaty in order to deploy most militarily effective types of ABM.

Low Altitude Defense (LoAD)

This is an ABM system currently under development and is the most rapidly deployable U.S. ABM. It is designed to defend MX/MPS, not silo-based missiles. It would intercept RVs at very low altitudes, a few kilometers. 31/ It would use a nuclear warhead in the low kiloton range. A LoAD unit would reportedly contain 3 missiles, 32/ a radar, and a computer, and could fit into an MX shelter. In a typical LoAD engagement, less than 10 seconds would elapse from the time the LoAD radars detect an RV until the interceptors destroy the RV. 33/ Because of the short range of LoAD missiles, the LoAD unit must be in an MPS shelter near the one containing the MX, so must be mobile.

31/ U.S. Los Alamos Scientific Laboratory. Quick Look Assessment of Ballistic Missile Defense. June 1980. Reprinted in Congressional Record (Daily Edition), June 6, 1980: S 6434. Another article states that the missile would intercept at about 7,000 ft altitude. Administration Weighing Options in MX Basing Plan. Aviation Week and Space Technology, Sept. 7, 1981: 22.

32/ Ibid.

33/ Los Alamos Scientific Laboratory, Quick Look Assessment of Ballistic Missile Defense. Congressional Record (Daily Edition), June 6, 1980: S6434.

LoAD could defend MX/MPS effectively, advocates claim, because it would need to intercept only those RVs headed for shelters containing MXs or LoAD units (preferential defense). To take a hypothetical example, if the Soviets use 23 RVs to attack all 23 shelters in an MX cluster containing one MX and one LoAD missile, the defense, by using the LoAD missile to intercept the RV headed for the MX, defeats the attack. Still not knowing the location of the MX, the Soviets would need to expend another 23 RVs (one per shelter) to destroy the shelter with the missile. This leverage, advocates argue, enhances deterrence by increasing the cost and risk to the Soviet Union of launching a first strike. While adding MPS shelters would provide the same leverage, advocates claim LoAD is less costly, more rapidly deployed, and less disruptive to the environment. They contend that "shoot-look-shoot" tactics, where the Soviets attack MPS, then use satellite or ground sensor data to determine which shelters survived, then attack only surviving shelters, are unrealistic. The Soviets could not depend on their satellites or ground sensors surviving or not being jammed, and the United States could launch ICBMs between the first and second waves.

Proponents claim that it is quite feasible to build an effective LoAD as long as it uses nuclear warheads, with initial deployment possible in the mid-1980s. 34/ They assert that an expanded Soviet threat to MX/MPS could be offset far more cheaply with LoAD than with many more shelters.

Proponents believe LoAD would enhance deterrence. Since it could only defend ICBMs, not cities, it would lower Soviet confidence in their ability to destroy our ICBMs preemptively while not affecting their confidence in their ability to retaliate against U.S. cities in response to a U.S. first strike.

34/ Ibid.

Critics charge that LoAD would have extremely serious operational problems. They question if we could have confidence that LoAD could force the Soviets to use more than 2 RVs per shelter. OTA finds it would be difficult to make LoAD able to survive and operate with nuclear explosions a mile or so away. 35/ LoAD compounds the problem of preservation of location uncertainty (PLU) for MPS. LoAD would require the same observable features as MX and mass simulators, but since LoAD is a "functional object," OTA notes, "PLU would become considerably more complex if [LoAD] were added to MX/MPS." 36/ Since the LoAD unit would be in a shelter near the MX, critics argue, if the Soviets could locate LoAD units they would narrow the location of the missiles to within a few shelters. They could then overwhelm those shelters with several RVs apiece, using fewer RVs than would be needed to destroy an undefended MPS. Ben Plymale, a former Deputy Director of Defense Research and Engineering, wrote that "LoAD was not designed to engage a responsive Soviet threat, which might include maneuvering RV's, anti-radiation homing RV's, jammers, decoys, or a myriad of other potential countermeasures." 37/

A full LoAD defense of MX/MPS is clearly forbidden by the ABM Treaty, as it would use ABM launchers and radars not of "permanent fixed types," and for other reasons. The treaty might permit deployment of 100 LoAD missiles using fixed units near Grand Forks, North Dakota, the only ABM site permitted the U.S. by the treaty, but this would surely not be cost-effective.

35/ OTA, MX Missile Basing, p. 113, 122-123.

36/ OTA, MX Missile Basing: Summary, p. 27.

37/ Plymale, Ben. Issue Papers. Congressional Record (Daily Edition), Sept. 10, 1981: E 4151.

Layered Defense

Another type of ABM could be used to defend silo-based ICBMs. This system, called layered defense, would have two tiers. An "overlay" of long-range missiles, each with multiple nonnuclear warheads, would intercept RVs in space, above 300,000 ft. This overlay is in early experimental stages. The "underlay" is simply LoAD or a similar system. Any militarily useful layered defense is forbidden by the ABM Treaty.

Either layer by itself would have great difficulty in defending silo-based ICBMs. Since silos would offer only a fraction of the aimpoints of MPS, the Soviets could concentrate many RVs against each silo. Even if the overlay could destroy most attacking RVs, the United States would have to assume that the Soviets could use so many RVs that enough would leak through and destroy most silos. At the same time, the Soviets could probably defeat a LoAD-only defense by using a precisely coordinated attack with many RVs and special tactics. Together, however, the overlay could break up the attack in space, making the Soviets unable to rely on RVs reaching LoAD in vast numbers with precise coordination, while the underlay, facing a ragged and weakened attack, could intercept many remaining RVs headed for silos.

In this way, layered defense would seek to compensate for the leverage lost by using silos rather than MPS. Advocates cite by way of example that if each layer could intercept 80% of the attacking RVs, then only 4% (20% of 20%) would leak through, so that two moderately "leaky" layers could together intercept most RVs. 38/ Using several nonnuclear warheads per overlay interceptor missile

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38/ Donald Brennan used this example in BMD Policy Issues for the 1980s, in Schneider, William, Jr., et al. U.S. Strategic-Nuclear Policy and Ballistic Missile Defense: The 1980s and Beyond. Cambridge, Mass., Institute for Foreign Policy Analysis, Inc., 1980; sponsored by the U.S. Army Ballistic Missile Defense Advanced Technology Center. p. 20.

and perhaps concentrating interceptors to defend certain silos while leaving other silos undefended (preferential defense) could also increase leverage.

Critics assert that this leakage example is misleading. Silo basing lowers our cost of basing MX, but also lowers the number of aim points the Soviets must target. If they could target 2700 RVs on MX, they could in theory devote 13-14 RVs to each of 200 silos. Unless both ABM layers are extraordinarily good, concentrated attacks using clever tactics would have a very good chance of destroying a silo. OTA cites an example in which the overlay can destroy any attacking RV it targets 85% of the time and the offense sends 8 RVs per silo. The overlay would destroy all the RVs only 27% of the time (0.85 to the eighth power). If the underlay could destroy the first RV reaching it 70% of the time, and the second 50% of the time, then a defended silo has a 62% chance of surviving. The results are sensitive to overlay effectiveness. If the overlay can destroy 65% of the RVs and the underlay has the effectiveness stated above, then a defended silo has only a 22% chance of surviving. 39/

Opinion is sharply divided on the question of overlay feasibility. Advocates recognize that the overlay faces more difficulties than does LoAD. They argue, however, that the technology required for the overlay is, or soon will be, available. Critics are extremely pessimistic. They believe that the needed technology is very distant and that the overlay cannot work against a massive Soviet attack. Critics and those involved in ABM development would agree with OTA's assessment that "For the moment, it would be quite risky to rely on the Overlay, or on layered defense, as the basis for MX basing." 40/

39/ OTA, MX Missile Basing, p. 132-134.

40/ OTA, MX Missile Basing: Summary, p. 32.

Some advocates hope that layered defense or a more advanced ABM could defend cities against limited attacks. They believe that the U.S. policy of deterring nuclear war by having the populations of both sides hostage to attack is immoral, that the United States should defend its citizens rather than kill Russians, and that Soviet military programs are rapidly removing the mutuality of mutual assured destruction. They thus believe the U.S. should withdraw from the ABM Treaty and build layered defense and more advanced ABMs to limit damage in the event of war. Critics contend the mutual hostage relationship is the only one feasible: With today's huge nuclear arsenals the Soviets know the United States could retaliate with devastating effect even after absorbing a first strike. They thus see perpetuation of the ABM Treaty as desirable to preserve deterrence and avoid a race between ABMs and ballistic missiles in which both sides would spend large sums without improving security. They view layered defense as breaching the spirit as well as the letter of the ABM Treaty.

Simple Systems

Several analysts outside DOD have proposed cheap low-technology systems to defend MPS- or silo-based ICBMs. Examples include:

"Bed of Nails": Thousands of 7-ft long steel rods would be driven into the ground just north of silos or shelters. ICBM RVs generally follow a north-to-south trajectory. Since RVs used to attack ICBMs would need extreme accuracy, RVs with low aerodynamic drag would probably be used to minimize atmospheric effects on the RV. These RVs approach their targets at shallow angles, so would impale themselves on the rods. 41/

41/ Garwin, Richard. Effective Military Technology for the 1980s. International Security, Fall 1976: 53-54.

"Pebble-Curtain Defense" or "Porcupine": Pellets or darts would be placed over a bed of chemical explosives just north of an ICBM. A radar would detect an RV headed for the silo and trigger an explosive, launching the projectiles into the RV's path. 42/

"Swarmjet": Very small, cheap, fast missiles would be fired in salvos for low altitude defense, destroying RVs by impact.

Advocates contend that these systems can successfully defend ICBMs, and that their simplicity, low cost, low technical risk, and possibility of rapid deployment make them attractive. The Ballistic Missile Defense deputy program manager believes they "are difficult to synthesize and still meet the criteria of low cost, rapid deployability and adequate effectiveness." 43/

"Dust Defense": Clean nuclear devices would be detonated on or under the ground near ICBMs to send up clouds of dust to disable attacking RVs. There is no technical challenge to the assertion it would be highly effective. The radioactivity of these devices could be held to a low level, 1% of that for a nuclear weapon of standard design, OTA estimates. 44/ The system could be deployed rapidly and at low cost. The "preemptive fratricide" would make Soviet planners highly uncertain of their ability to destroy ICBMs, advocates argue, enhancing deterrence.

The drawback is that political support for the system would be very hard to obtain. Two potential problems are of minimum concern. The likelihood that

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42/ Ibid., p. 54-56.

43/ Davis, William, Jr. Ballistic Missile Defense Into the Eighties. National Defense, Sept.-Oct. 1979: 62.

44/ OTA, MX Missile Basing, p. 127.

the devices would detonate without authorization is low, as for nuclear weapons in general, and the additional fallout they would generate in a nuclear war with thousands of large Soviet RVs detonating is immaterial. The real concern is that the President might detonate hundreds of these devices on false warning, killing many Americans. For this reason, critics believe, no President would use it, making its deterrent effect low and its deployment useless.

Launch on Warning

ICBMs could be launched on warning of attack, a concept termed launch on warning, or LOW. A variant is launch under attack, or LUA, sometimes defined as launch upon attaining high confidence that a massive attack was underway or after RVs had exploded on U.S. territory. This method places great reliance on accurate warning: error would mean nuclear war by accident or the destruction of our ICBMs. For fear of the first error, the U.S. has preferred to have its ICBMs able to ride out an attack before being launched. But with ICBMs widely seen as becoming vulnerable, some believe that we should prepare to LOW so as to increase the size and coordination of the retaliation, thus maximizing the deterrent value of each deployed ICBM.

U.S. policy has been neither to confirm nor deny that we would LOW. At issue now is not whether we state LOW to be our policy, for the Soviets could believe we would (or would not) LOW regardless of our statement. For LOW to enhance deterrence, what counts is the extent to which we can make the Soviets believe we would LOW. The credibility of a stated or unstated LOW policy depends on acquiring the capability to LOW. This includes hardware, such as augmenting sensors and communication equipment; procedures for handling information, transmitting decisions, and passing the authority to launch nuclear

weapons from one person to another rapidly as circumstances require; and making key decisions well in advance so they can be implemented rapidly. For example: Would we launch ICBMs irrevocably armed, unarmed but armable in flight, or armed but disarmable in flight? What portion of the force would we launch in response to what magnitude of attack? At what targets? 45/

Advocates argue that LOW hasn't been looked at seriously, but deserves attention. They claim LOW is the only way to salvage substantial military value from the current ICBM force during the 1980s. It is "available now," DOD states. 46/ Major advances in electronics give us high confidence that LOW would work properly, advocates contend. As improvements were added, our confidence would increase further. Any risks of LOW must be weighed against the (presumed) erosion of deterrence and increased risk of war by having vulnerable ICBMs through 1990 or so. A decision to use LOW would spur improvements needed in C3 anyway. Like spare parts and maintenance, C3 has been passed over in favor of new weapons, yet it is the most critical aspect of our strategic forces: It presents a tempting vulnerability to an attacker unless it can perform instantly and flawlessly despite attempts to disrupt it. This capability is essential to LOW as well as to C3 in general; indeed, some proponents of LOW might argue that the capability to LOW is one minimum test of adequacy of C3.

45/ See Garwin, Richard. Launch Under Attack to Resolve Minuteman Vulnerability? International Security, Winter 1979/80: 117-139; and Graham, William, et al. Discussion: Viable U.S. Strategic Missile Forces for the Early 1980s. In Van Cleave, William, and W. Scott Thompson. Strategic Options for the Early Eighties: What Can Be Done? New York, National Strategy Information Center, Inc., 1979. p. 143-146.

46/ U.S. Department of Defense. Office of the Deputy Under Secretary of Defense for Research and Engineering (Strategic and Space Systems). ICBM Basing Options: A Summary of Major Studies To Define a Survivable Basing Concept for ICBMs. December 1980. p. 16.

LOW has several beneficial military consequences. It would provide a disincentive for the Soviets to build an ABM, for it would be far harder for an ABM to defend against a large, well-coordinated retaliatory strike coming all at once than against a ragged attack from a small surviving force. LOW would enhance the value of our bomber force. ICBMs would be used to destroy Soviet air defense sites, creating corridors for bombers; LOW would permit more ICBMs to be used for this purpose. Finally, the increased number of Soviet targets struck by ICBMs and bombers would permit holding more U.S. SLBMs in reserve, increasing our bargaining leverage for war termination. All this is achieved, advocates state, by a system that is totally compatible with existing and prospective arms control agreements and means of verification, since no new weapon systems are involved.

LOW is cheaper than other strategic force options; OTA estimates that the substantial C3 and warning improvements needed for LOW would cost several billion dollars. 47/ LOW would create no environmental impact beyond that already created by ICBMs.

Some might argue that LOW would be destabilizing because the Soviets, seeing a U.S. LOW capability emerge, might fear we would launch a first strike and prepare to do so themselves. Yet that fear is ungrounded, advocates would counter. If the Soviets believed that we could LOW, they would realize we had no need to strike first. Moreover, Soviet discomfort caused by LOW should be of no concern to us. Soviet actions have put our ICBMs into a use-or-lose situation. Why should we spend tens of billions to remedy a problem they have created in a way comfortable to them? If we believe some stigma attaches to

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47/ OTA, MX Missile Basing: Summary, p. 30.

a U.S. declaration of LOW, we can simply acquire the capability to LOW. The Soviets will read the same message whether or not we declare a LOW policy.

Critics note that, with LOW, ICBMs would have no endurance (i.e., the ability for missiles that survive attack to operate for long periods). Proponents respond that endurance is difficult to obtain with any fixed-site ICBM. MPS provides endurance only if the Soviets do not have enough RVs of sufficient reliability and capability to destroy all the shelters, in which case they would probably not attack. An ABM defense of silos or MPS reliably increases endurance by at most a few minutes, for once the ABMs have been exhausted or destroyed, the next wave of RVs could destroy the ICBMs. Clever tactics might permit earlier destruction of defended ICBMs. It is pointless to spend billions on alternative basing modes, ABM, etc., to gain a few minutes of decision time, proponents believe; we should simply recognize that technology has made fixed-site ICBMs unable to endure, and adopt LOW.

Opponents of LOW respond that the United States, with all its resources, shouldn't have to rely on a system that places a hair trigger on nuclear war. They doubt we could have confidence that the entire system -- sensors, communications, procedures, and people -- would work right instantly. The President might lack information needed to LOW, such as which targets the Soviets chose not to attack, so might be unable to determine which targets to strike in retaliation before the attacking RVs arrive. If we depend on LOW, DOD states, "the Soviets would surely devise ways to blind our warning systems in a precursor attack, thereby inhibiting our ability and willingness to launch a retaliatory attack with only inconclusive evidence." 48/ The system needed

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48/ Department of Defense, ICBM Basing Options, p. 17.

for high-confidence LOW -- the only kind we should contemplate -- would take time to deploy; OTA estimates that almost all the needed improvements could be deployed by the end of the decade. 49/ Despite deploying this system, OTA notes, we could never eliminate the "lingering fear" that the Soviets could defeat the LOW system or that the system could fail catastrophically. 50/

Opponents fear that some may see LOW as a panacea and think we need do nothing else. In reality, opponents assert, we must face up to the need to spend billions on strategic forces that can survive and endure. With LOW, our ICBMs would be launched or destroyed at the start of a war, eliminating our most controllable and fastest-reacting weapons, and severely inhibiting our ability to fight a war or negotiate war termination. By launching many ICBMs at the start of war, we would accept the risk of escalating the war beyond what we would prefer. As a result, we would weaken our ability to control escalation and provide "intrawar deterrence" -- the ability to deter the Soviets from striking certain targets during a war, in this case by threat of precise retaliation. In sum, critics believe, the President should never have to make the most momentous decision possible under the extreme pressure that LOW entails; we should buy survivable and enduring forces instead.

Perhaps the worst problem with LOW, critics argue, is that it would threaten us. Realizing that the United States was attaining the ability to LOW, and recognizing that false warning could result in a U.S. attack that could destroy most Soviet ICBMs, the Soviets would feel compelled to adopt a LOW policy. With both sides having accurate ICBMs ready to launch on a moment's notice, the risk of nuclear war would increase.

49/ OTA, MX Missile Basing: Summary, p. 30.

50/ Ibid., p. 31.

NON-LAND BASING FOR MX

Others believe that the United States must respond to the threat posed by Soviet ICBMs, view LOW as inadequate, and find that each land basing mode for MX proposed so far has fatal defects. As a result, they contend, we have no choice but to give up on deploying new land-based ICBMs. To retain some desirable features of the triad, they believe, we should deploy MX on aircraft or on small submarines.

Airmobile

Press reports of August 1981 indicated the Administration was considering airmobile MX (AMMX). 51/ Under this concept, ICBMs would be dropped from large aircraft by parachute, then fired. The Air Force demonstrated the concept's feasibility in 1974 by launching a Minuteman from a C-5 large transport aircraft and completing a 10-second test firing. 52/

The reported plan envisioned modifying perhaps 115 C-5s to carry one MX apiece in order to maintain 100 aircraft on alert at any time. 53/ Since the United States now has 77 C-5s, the production line, closed in 1973, would have to be reopened. Lockheed, which built the C-5, has reportedly submitted a brief proposal for so doing. 54/ The first aircraft might be operational as early as 1986.

51/ See, for example, Cannon, Lou. Reagan to Recommend an Air-Launched MX. Washington Post, Aug. 1, 1981: A1.

52/ Drop of Minuteman by C-5A Tests Air-Mobile ICBM Concept. Aviation Week and Space Technology, Nov. 11, 1974: 21.

53/ Robinson, Clarence, Jr. Weinberger Pushes Strategic Airmobile MX Concept. Aviation Week and Space Technology, Aug. 3, 1981: 17.

54/ Ibid.

While deploying MX on C-5s, DOD would also develop, and perhaps deploy in FY88, a fleet of aircraft designed to carry MX as a follow-on to the C-5s. The aircraft, "Big Bird," would look like a huge glider, with a wingspan of 360 ft and a fuselage 164 ft long. It would have four 24-ft propellers. 55/ (By comparison, the C-5 is 247 ft long, has a 222-ft wingspan, and has four jet engines.) Big Bird would cruise at 5000 ft at 100 knots (115 mph). It could remain airborne for nearly 7 days unrefueled.

SLBMs pose the greatest threat to airmobile ICBMs. SLBM flight times could be as short as 7 minutes, 56/ and current (modest) Soviet SLBM accuracy suffices to barrage airbases. Therefore the airmobile system would require enhancing the sensors, communication systems, etc., to warn of SLBM attack, and having the aircraft take off immediately on warning. Hardening the aircraft to resist nuclear weapon effects would also reduce the effectiveness of the SLBM threat. 57/

The aircraft could be based in several ways. They could be dispersed at austere bases in north central United States and maintained on ground alert, ready to take off on warning. This deployment might be vulnerable to SLBM attack. Alternatively, the aircraft could be moved to coastal bases and kept on airborne alert over the oceans during crises. This approach, however, is extremely costly if C-5s are used and stresses the aircraft. DOD notes that these two approaches might be combined, using ground alert usually and air

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55/ Ibid.

56/ Perry, William (Under Secretary of Defense for Research and Engineering). Testimony. In U.S. Senate. Committee on Armed Services. Fiscal Year 1979 Supplemental Military Authorization. Hearings. p. 103.

57/ OTA, MX Missile Basing, p. 228.

alert in crisis or if Soviet SSBNs were massed near the coasts. 58/ Big Bird is designed to be so fuel-efficient that the United States could afford to keep a substantial fraction of the force on continuous airborne alert at all times.

The accuracy of an air-launched ICBM is inherently less than that of a land-launched ICBM because the initial launch position, velocity, and orientation cannot be known as precisely. To compensate, the United States would need to deploy a network of navigation aids, either ground transmitters (ground beacon system, GBS) or navigation satellites (Navstar).

OTA estimates that a ground alert airmobile basing force could be acquired and operated until 2000 for about the same cost as a 200-MX/4600-MPS system. OTA estimates that a continuously airborne force, using a special large turboprop aircraft (not Big Bird), could cost $91 billion (FY80 $) to acquire and operate for 10 years after full deployment. 59/ The Air Force has not yet determined firm life-cycle cost estimates for Big Bird. 59a/

Advocates point out many advantages of AMMX. It avoids the social, environmental, and political problems of MPS. It is not nearly as sensitive to increased numbers of Soviet ICBMs as is MPS, and is insensitive to fractionation or increased accuracy of those missiles. It can endure for hours, or days in the case of Big Bird, whereas MPS might be overwhelmed if the Soviets built enough RVs or learned which shelters contained missiles. The basing mode entails no real technical risk, since C-5s have been built and air launch of ICBMs has been demonstrated. SLBM warning capability would have to be built up, but with good warning and immediate takeoff, about 90% or more of the force could

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58/ Department of Defense, ICBM Basing Options, p. 35.

59/ OTA, MX Missile Basing, p. 220, 230-231.

59a/ U.S. Air Force. Office of the Special Assistant for MX Matters. Telephone conversation, October 2, 1981.

survive except in one case, OTA finds. 60/ The system poses no difficulties for arms control, since air-to-surface ballistic missiles are permitted by SALT II under the same relevant restrictions as ICBMs. AMMX would provide surviving RVs for each unit deployed, and could do so before other basing modes. The added expense of building a fleet of C-5s before Big Bird to provide this early capability would not be wasted because the C-5s could be used for airlift when Big Bird enters the inventory.

Advocates contend that Big Bird would offset two key concerns of AMMX using C-5. It would be 5 to 10 times more fuel-efficient than C-5, 61/ so perhaps half the aircraft could remain aloft at all times and still retain a moderate life-cycle cost. As a result, it would be far more survivable than a C-5/MX fleet on strip alert and would not rely on warning for survivability.

Critics list the following flaws with AMMX. It ends the strategic triad because it has a key failure mode in common with bombers. The Soviets could use SLBMs to destroy both simultaneously. Resting the survivability of two triad elements on adequate warning is too much of a risk. Moreover, the warning system must be one that the Soviets could not spoof, for if they could make us send our bombers and AMMX aloft, these aircraft would be quite vulnerable when they landed. AMMX would also give the Soviets an incentive to build many additional ICBMs to barrage the area where bombers and AMMX would be after takeoff.

60/ OTA, MX Missile Basing, p. 225-228. The exception is that, if the Soviets attacked airfields at which airmobile ICBMs were based using submarine-launched ballistic missiles launched on fast trajectories from submarines at the coasts, they could under certain circumstances destroy about 1/4 to 1/2 of the aircraft. Ibid., p. 227.

61/ Pincus, Walter. '2 Little Guys' With a Big Idea. Washington Post, Aug. 13, 1981: A10.

AMMX endurance would be limited even if the aircraft escaped SLBM attack and ICBM barrage. C-5 could stay aloft for 7-8 hours unrefueled; Big Bird for days. The Soviets could force us to use or lose our AMMX by destroying the few hundred airfields able to recover C-5s. This problem could not be remedied by building more austere airfields than the Soviets had ICBM RVs. As OTA notes, "4,600 airfields spaced 25 miles apart would fill the entire 3 million square miles of the continental United States." 62/ Moreover, if AMMX would patrol over the oceans, might the Soviets locate them with radar or infrared satellites and destroy them with an ICBM barrage? This would be more of a problem with Big Bird than C-5. Big Bird's slower speed permits it to cover less distance than a C-5 following ICBM launch, so the Soviets could attack it with fewer missiles.

AMMX would be somewhat less usable than land-launched MX in counterforce attacks. It could not respond as rapidly to a launch command because the aircraft would have to take off before the missile could be fired. It would be very difficult to coordinate an attack placing RVs on targets thousands of miles away on schedules for which the margin of error is measured in seconds or less, since the aircraft would be at widely dispersed and rapidly shifting locations.

AMMX would raise several international concerns, critics contend. It might raise the risk of war. The Soviets would have to prepare in advance to preempt or launch on warning because, upon seeing the United States send AMMX aloft, they would not know if we did so for training, for fear of a Soviet attack, or for launching a first strike. Canada and Mexico might fear that the Soviets would destroy any airfields they had that could recover AMMX, though

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62/ OTA, MX Missile Basing: Summary, p. 38.

the same concern would arise regarding bombers and tankers. West Germany and other West European nations have indicated that it would be nearly impossible politically to permit U.S. theater nuclear weapons (Pershing II and ground-launched cruise missiles) on their soil if the United States does not base MX on land, for they would then believe that the United States was not willing to run the risks of having nuclear weapons on its territory that it was asking the Europeans to run. 63/

This last point is ironic, AMMX critics point out, because a Soviet attack on AMMX would kill many more Americans than an attack on MPS, 11.3 million vs. 5.9 million in a first exchange and 67 to 93 million vs. 6.1 million in a second exchange, according to one Department of Defense (DOD) study. 64/

AMMX is complex and difficult to maintain, critics note. The repeated shocks of air turbulence and landings will necessitate frequent maintenance for aircraft and missiles. Yet missiles in aircraft are harder to access and maintain than missiles in silos or shelters. Moreover, a complex logistics system is needed to provide spare parts and maintenance for missiles and aircraft at many dispersed bases. 65/ Thus using two sophisticated technologies, aircraft and missiles, instead of one increases the risk of failure.

The system entails many hidden costs. Navstar or a ground beacon system will be needed for accuracy. SLBM warning will have to be upgraded. Operating costs will be high, especially for airborne alert, and especially if fuel prices

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63/ Geddes, John. West Germans See a Tiny Utah Town as Barometer of U.S. Missile Plans. Wall Street Journal, June 17, 1981: 32; and Schmidt Warns Reagan on MX Siting. Washington Post, June 21, 1981: A26.

64/ Cannon, Lou. Reagan To Recommend an Air-Launched MX. Washington Post, Aug. 1, 1981: A1.

65/ Gregory, William. Magic Elixir for MX. Aviation Week and Space Technology, July 27, 1981: 11.

increase. AMMX will require costly and complex C3 and logistics. The Air Force believes 291 C-5s would be needed to keep 100 on strip alert, rather than the 115 that DOD's Office of Program Analysis and Evaluation estimates. 66/ A new fleet of tanker aircraft would presumably be needed. Finally, they ask, would a commitment to C-5, Big Bird, B-1, and perhaps a Stealth bomber increase the costs of other military and civilian aircraft? Indeed, do we have the production capacity to build all those aircraft in a short time?

Because of these difficulties, AMMX has attracted powerful opponents. A DOD study of December 1980, "ICBM Basing Options," found no major positive features for wide-bodied jet basing of MX. 67/ Three Air Force generals reportedly would resign if AMMX were chosen. Some members of the Townes Committee reportedly opposed AMMX. Representatives Price and Dickinson wrote to Secretary Weinberger voicing their objections to AMMX. Senator Tower, in a press conference of August 1, said: "The air mobile plan has been carefully studied and virtually discarded by the House and Senate [Armed Services Committees] as too unreliable, too costly, and of questionable survivability." As a result, he indicated, Congress might reject the proposal. 68/

Small Submarine Basing

This concept envisions using small submarines to carry two or four MX (or other) missiles horizontally in canisters outside the pressure hull. Perhaps

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66/ USAF Analysis Attacks Airmobile MX Concept. Aviation Week and Space Technology, Aug. 17, 1981: 30-31; and Robinson, Clarence, Jr. Weinberger Pushes Strategic Airmobile MX Concept. Aviation Week and Space Technology, Aug. 3, 1981: 17.

67/ Department of Defense, ICBM Basing Options, p. 34.

68/ Regarding criticism of airmobile MX, see footnote 4 on p. 3; and Tower, John. Statement on the MX Missile, Aug. 1, 1981. p. 1.

51-72 boats would be deployed, with 28-55 on station at any time. 69/ A fleet operating from two bases, one each on the east and west coasts, with a patrol radius of 1000 nmi and using a 6500-nmi range missile, would have a patrol area of 2 million sq nmi. 70/ The missiles could probably meet the accuracy requirements of land-launched MX by using stellar inertial guidance. Alternatively, Navstar satellites or a ground (radio) beacon system (GBS) could have the same result. 71/ Varying designs have been set forth, including ones by DOD and OTA, and "smallsub undersea mobile," or SUM, by Sidney Drell and Richard Garwin. Pressure hull displacement would be 1100-3300 tons, vs. 18,700 for Trident; crew size would be 15-45, vs. 133 for Trident; small submarines could operate 500-1500 nmi from the U.S. coast vs. thousands for Trident, but there is little reason to believe they could not operate 2000 to 3000 nmi from their bases if it were necessary to do so. Initial operational capability (IOC), when the first units would be operational, is variously estimated as 1988-1992, with full operational capability (FOC), when all units would be operational, about four years later.

A small submarine system could hold costs down in several ways. Small submarines would not need nuclear turbine propulsion, but could use diesel-electric propulsion. Communication would require lower power transmitters than are used for Poseidon. The submarines would use extensive automation to minimize crew

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69/ OTA, MX Missile Basing: Summary, p. 33; and Drell, Sidney. Testimony on basing the MX at sea on small submarines: the SUM system, before Defense and Military Construction Subcommittees of the Senate Appropriations Committee, June 19, 1981. p. 11, 20.

70/ Telephone conversation, OTA staff, Sept. 23, 1981.

71/ OTA, MX Missile Basing, p. 202-208. See also System Planning Corp. An Assessment of Small Submarines and Encapsulation of Ballistic Missiles -- Phase 1. Unclassified Version, Executive Summary. May 1980. Prepared for Deputy Under Secretary of Defense for Research and Engineering (Strategic and Space Systems). p. 7.

size. For its analysis, OTA postulates a fleet of 51 submarines, with 28 at sea at all times, operating from three bases. Each would displace 3,300 tons (pressure hull only) and carry four MX missiles. This fleet, OTA estimates, would cost $32 billion (FY80 $) for acquisition and $7 billion for operation until 2000; since no detailed design exists, these costs are approximate. 72/

Advocates claim that this fleet would be very survivable against any known or foreseeable antisubmarine warfare (ASW) threat. 73/ Its operation relatively near the coasts hampers acoustic ASW, the most widely used form, and would facilitate Navy protection. The United States could complicate acoustic ASW by placing decoys and acoustic generators in deployment zones. Diesel-electric propulsion is quieter than nuclear. It would be difficult to destroy the entire fleet simultaneously with standard ASW methods because many submarines would be deployed, and the deployment area would be too large for the Soviets to barrage with nuclear weapons. Radar detection while snorkeling could be rendered a "very limited" problem, a DOD study finds. 74/ If a radar threat develops, the United States could convert submarines to fuel cell propulsion during overhauls or could use nuclear-electric propulsion.

The difficulty of destroying individual submarines has many consequences. Each one deployed contributes surviving missiles while MPS enables few missiles to survive until most shelters are deployed, so, supporters argue, it is unfair to compare the IOC of this system with that of MPS. The number of survivors is insensitive to numbers of Soviet RVs, so the system gives the Soviets no

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72/ OTA, MX Missile Basing: Summary, p. 32-36.

73/ See Drell, Testimony on basing the MX at sea on small submarines, for the case for this basing mode.

74/ System Planning Corp., An Assessment of Small Submarines and Encapsulation of Ballistic Missiles -- Phase 1, Unclassified Version, Executive Summary, p. 11.

incentive to add RVs. The program could be completed with a known number of submarines, making its cost and schedule more predictable. With MPS, in contrast, the Soviets could add RVs, forcing us to add shelters, delaying survivability, and driving up costs.

This system is highly compatible with arms control, proponents assert. Procedures for monitoring numbers of submarines are well established. It places no premium on launch-on-warning, thus reducing the risk of accidental war. It avoids the need for an ABM, thus helping preserve the ABM Treaty.

Small submarines could use existing technology and operational procedures; OTA finds the technical risks of its proposed design to be low. 75/ It would have minimal societal and environmental impact, since it would use only a few coastal bases. By moving strategic weapons from land, small submarines reduce the fallout likely from a nuclear war.

Advocates reject charges that using small submarines instead of land-based MX would move the United States to a strategic dyad. The essence of the triad, they argue, is that three independent strategic forces obstruct a first strike: They are harder to attack or defend against; the weapons are suited to different missions; the triad provides time in which to remedy weakness in one or two of its elements; etc. This system accomplishes these goals, its supporters contend. Since its size, numbers, deployment area, observable features, and operational characteristics would differ from those of Trident, it poses a different ASW problem. As OTA notes: "The differences between the Trident fleet . . . and the [submarine] MX fleet . . . could make it more difficult, and perhaps impossible, for the Soviets to deploy an anti-submarine warfare force capable of attacking both." 76/ They would have to

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75/ OTA, MX Missile Basing: Summary, p. 34.

concentrate their resources in what OTA calls the "very unpromising" area of strategic ASW. 77/ In addition, launching a missile from a Trident submarine reveals the position of 23 other missiles, while launch from a small submarine reveals the position of only 1 or 3 other missiles. Small submarines thus enhance our least vulnerable strategic force by hedging against Soviet advances in ASW. In contrast, MPS enhances our most vulnerable strategic force in a way that the Soviets could defeat simply by adding RVs. Indeed, supporters argue, a force composed of bombers, Minuteman, Trident, and small submarines would be a quadrad, not a dyad.

Advocates believe the first units could be deployed by 1988, with FOC in 1992, despite dire claims about shipbuilding capacity. 78/ Admiral Thomas Moorer, former Chairman of the Joint Chiefs of Staff, noted in a CRS seminar on MX basing that "the bottleneck is in the nuclear powered construction . . . it wouldn't begin to take seven years to build one of [the submarines]." 79/ The congressional Reform Caucus is suggesting that the United States cannot afford enough nuclear attack submarines, so must supplement them with diesel attack submarines. 80/ Doing so would spread the costs of developing diesel submarines among those ships as well as small strategic submarines. The United States has excess submarine building capacity; for example, the Electric Boat

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76/ Ibid., p. 35.

77/ Ibid., p. 48

78/ Drell, Testimony on basing the MX at sea on small submarines, p. 17.

79/ Congressional Research Service, Redressing ICBM Vulnerability, Seminar Transcript, p. 31.

80/ Wilson, George. Caucus Urges Review of Boosts for Defense to Prevent cklash. Washington Post, Aug. 11, 1981: A10.

Division of General Dynamics, which makes nuclear submarines, is laying off workers, and its facility for manufacturing submarine hull cylinders is under-utilized. 81/ Foreign shipyards could also build diesel submarines. For example, Howaldtswerke-Deutsche Werft of West Germany, which builds small diesel submarines, has designed a 2,182-metric-ton submarine and would build it for the United States. 82/

Advocates raise other points. Some believe MPS would cost at least $10 billion more than small submarines with SALT II, and even more without SALT II. Because of the near-coastal deployment, the United States could obtain high confidence in its ability to communicate with small submarines. They could endure for months during a nuclear war. If SALT II constraints on numbers of RVs take effect, the United States could deploy 14 RVs on a submarine-launched missile vs. 10 on a land-launched one. SALT II permits each side to deploy one new type of ICBM. By foregoing MX and using Trident II on small submarines, the United States could avoid using up its one new type of ICBM. It could then develop MX and a small ICBM and decide which, if any, to deploy on the basis of future arms control agreements and Soviet weapon deployments.

Opponents argue that a move to small submarines would create a dyad of strategic forces, with all the disadvantages that entails. That system has the same failure mode as Trident. It would have to be defended with ASW

81/ Veliotis, P. Takis (Executive Vice President - Marine, General Dynamics; General Manager, Electric Boat Division). Statement before the Subcommittee on Seapower and Strategic and Critical Materials of the House Armed Services Committee, Mar. 25, 1981. p. 33; and discussion with General Dynamics Corp. personnel, July 1981.

82/ Tagliabue, John. Germans Try to Sell Submarines to U.S. New York Times, Sept. 22, 1981: D6.

forces, one Senator notes, at a hidden cost of about $12 billion. 83/ A Soviet ASW breakthrough would be "highly destabilizing," OTA finds. 84/ It would threaten a large portion of our strategic forces; with ICBMs and bombers already vulnerable, the United States would have no effective deterrent. Secure land-based ICBMs are thus essential to hedge against ASW developments.

Small submarines offer no advantage relative to Trident, critics charge. Trident would place 15 to 20 submarines in a 15 to 20 million sq mi patrol area, vs. 28 to 55 small submarines in perhaps 2 or 3 million sq mi. This concentration would make U.S. coasts "a fertile hunting ground for Soviet ASW forces," DOD states. 85/ A DOD study estimates the life cycle cost of an at-sea Trident II missile on a Trident submarine at $230 million, vs. $475 million for an MX on a small submarine. 86/

Even though the system appears technically feasible, critics note many areas of risk. The missiles would need reliable waterproof canisters. To reduce crew size, the submarines would need much more automation than current submarines use, the Navy finds. The amount of modification to requalify MX for underwater deployment can be determined only after missile and boat have been firmly defined. The effects of underwater shock from a nuclear explosion and mitigation of shock transmission between capsule and submarine are uncertain.

83/ Garn, Jake. SUM: It Doesn't Add Up. Armed Forces Journal International, Jan. 1980: 36-37.

84/ OTA, MX Missile Basing: Summary, p. 48.

85/ Department of Defense, ICBM Basing Options, p. 22.

86/ System Planning Corp., An Assessment of Small Submarines and Encapsulation of Ballistic Missiles -- Phase 1, Unclassified Version, Executive Summary, p. 14.

The IOC would be 1990-1992, with an FOC of 1993-1995. The bases would be the slowest-deployed element because of the need for site selection, environmental impact statement preparation, and base construction, so would pace IOC. 87/ The submarines would also take time to build. Three shipyards that do not now build submarines would have to do so, OTA states. 88/ Timely acquisition of needed parts, materials, and skilled workers could be difficult, especially given the Administration's shipbuilding program. Use of foreign shipyards might speed construction. However, an amendment to H.R. 3519 (FY82 DOD authorizations) that passed the House on July 8 would, if it becomes law, forbid use of foreign shipyards for building or overhauling Navy ships. 89/

Small submarines would be incompatible with arms control because encapsulated missiles attached to "the least capable submarine in the world" could be placed on other submarines and would be impossible to verify. It is argued that when the "hidden costs" are included, this system could cost as much as $10 billion more than MX/MPS. 90/ Reliance on external navigation aids like Navstar or GBS "is a risk inappropriate to take for a central strategic system," DOD finds. 91/ The Soviets might detonate nuclear weapons just off the continental shelf to destroy any small submarines operating there; the resulting tidal waves would be disastrous for coastal cities.

87/ Ibid., p. 14-15.

88/ OTA, MX Missile Basing: Summary, p. 33-34.

89/ See Congressional Record (Daily Edition), July 8, 1981: H4089-H4090.

90/ Garn, SUM: It Doesn't Add Up, p. 36-37.

91/ U.S. Department of Defense. Office of the Deputy Under Secretary of Defense for Research and Engineering (Strategic and Space Systems). An Evaluation of the Shallow Underwater Missile (SUM) concept. April 9, 1980. p. 4.

It would be difficult to find the needed personnel, given that the Navy is 1,050 officers short of the 3,550 it needs for nuclear submarines, only 34% of officers choose further submarine duty after their first opportunity to leave it, and the attack submarine fleet is projected to grow from about 80 to 100 between now and 1990. 92/ In light of all these problems, critics reject small submarines as fatally flawed.

A BROADER SOLUTION: STRATEGIC FORCE DIVERSIFICATION AND SMALL ICBMs

Another approach sees problems with any single MX basing mode, and holds that strategic force diversification -- using several basing modes for ICBMs while retaining submarines and bombers -- offers many advantages. Many advocates of this approach envision using a small ICBM (SICBM) because they contend it can be based in many survivable ways. Accordingly, this section links diversification and SICBM even though they can be considered independently.

The justification for diversification is the same as for the triad itself: Several systems provide more assurance of survivability, are harder to attack or defend against, etc. Similarly, its advocates hold, several basing modes can promote ICBM survivability. They see any single basing mode as putting all one's eggs in one basket. MPS, for example, could be overwhelmed if the Soviets break PLU or build enough RVs to destroy all the shelters. This encourages the Soviets to concentrate their resources on countering it.

Years ago, it sufficed to deploy single ICBM, submarine, and bomber systems, for each would be effective despite Soviet counters. As a bonus, R&D costs were spread over many units of a system, lowering unit cost. Now, however, there are great uncertainties about future Soviet strategic forces, SALT policy, and

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92/ Wilson, George. Built-up Navy Founders as Submariners Opt Out. Washington Post, Aug. 4, 1981: A1, A4.

intentions; ICBMs are becoming vulnerable; and the Soviets can increase their threat. Thus, any single ICBM basing option is of uncertain effectiveness. We must hedge against these uncertainties, diversification advocates hold; adding options, while costly, is the only way to do this.

Proponents contend that deploying several systems instead of MX/MPS, each on a small scale, offers key advantages. The choice of an MX basing mode merits painstaking consideration because it affects deterrence, is costly, will foreclose alternatives, and will be with us for decades. With several basing modes, however, each procured in modest numbers and less expensive than MPS, there would be less need for delay to make certain that each system was the absolute best. We could learn the pros and cons of each system from operational experience. If the Soviets increase their strategic threat, that experience would let us select confidently one option or more to deploy rapidly on a larger scale in response. This prospect should itself dissuade the Soviets from seeking to counter our systems.

Some believe the MX basing decision is so difficult because MX is the wrong missile. They note that MX is a creature of SALT II: The United States regards SALT II as permitting a launch weight of 90,000 kg (198,414 lb) and a throw weight of 3,600 kg (7,937 lb) for MX; MX's launch weight is 192,000 lb, and its throw weight is reportedly 7,900 lb. 93/ SALT II limits each side to 820

93/ "On August 16, 1977, in a plenary statement, the United States informed the Soviet Union that ' . . . for planning purposes, with respect to ICBMs it might develop, test or deploy in the future, the United States considers the launch-weight limit on light ICBMs to be 90,000 kilograms and the throw-weight limit to be 3,600 kilograms.' These figures are based on our estimates for the [Soviet] SS-19 [ICBM]. The Soviet Union did not respond to this statement. The United States will regard these figures as the limits for the one new type of light ICBM permitted to the United States under Paragraph 9 of Article IV." U.S. Department of State. Bureau of Public Affairs. SALT II Agreement, Vienna, June 18, 1979. Selected Documents No. 12A. Washington, U.S. Govt. Print. Off., 1979. p. 13; MX Throw weight data from Air Force Wants Space Sensors for Warning of Aircraft Attack on U.S. Aerospace Daily, Feb. 5, 1980: 187.

ICBMs carrying multiple independently targetable reentry vehicles (MIRVs) and one new type of ICBM that, if MIRVed, can be tested with at most 10 RVs. We can thus deploy the maximum allowed number of RVs by making our one new ICBM large enough to carry 10 RVs. MX supporters contend we need ICBMs on land to preserve the advantages of the triad. Some force diversification advocates, however, believe that mobility is the only way to gain survivability on land, for any missile in a fixed location can be destroyed. They see MX as too large to be truly mobile, so support SICBM as well as MX. Said one, "We no longer have the luxury of enduring survivability and a prompt response in offensive systems that we have had in the past with Minuteman. Partitioning the force with MX and SICBM weapons is needed to provide both capabilities simultaneously." 94/

SICBM, in one preliminary design, is 38 ft long, weighs 22,013 lb, has 2 or 3 stages, and can carry a single 335- or 500-kiloton RV. Its range would be 5,500 to 6,500 nmi. It would use Navstar satellites or stellar updates for high accuracy. 95/ It might become operational in 1986. 96/ It could be carried on large trucks, medium sized cargo aircraft, barges, surface ships, etc. It could be extremely difficult to detect; in 1979, there were 1,339,000 combination tractor-trailer units in service in the United States. 97/ It could also be placed in silos that, according to one report, could be hardened to 7,000 to 8,000 psi, vs. about 2,000 psi for Minuteman. 98/

94/ Robinson, Clarence, Jr. U.S. Weighs Small ICBM Development. Aviation Week and Space Technology, May 4, 1981: 50.

95/ Ibid., p. 49-52.

96/ Pincus, Walter. Boeing Offering Small Alternative to Big MX Missile. Washington Post, June 29, 1981: A1.

97/ American Trucking Associations, Inc. American Trucking Trends, 1979-1980. Washington, American Trucking Associations, Inc., 1981. p. 17.

98/ Robinson, U.S. Weighs Small ICBM Development, p. 49.

Several diversification alternatives use SICBM. Professor Donald Snow, of the University of Alabama, proposed using SUM, silo-based MX defended by ABMs, and road-mobile SICBMs based on military reservations but dispersed on the interstate highway system in crises. 99/ Another approach would accompany MX/MPS with small ICBMs based in hardened silos, on trucks, and on aircraft. 100/ One could, of course, imagine a SICBM-only force with several basing modes.

Advocates recognize that SICBM would force the U.S. to breach the SALT II limit of 2,250 strategic nuclear delivery vehicles. They counter that SALT lets the Soviets build a force able to destroy our ICBMs while barring us from making our ICBMs survivable. The ABM Treaty precludes defending fixed-site ICBMs, while SALT II's requirements for verifiability and its limits on launchers and delivery vehicles preclude deploying SICBM. This result, they argue, is contrary to the spirit of SALT, contrary to stable deterrence, and contrary to our security interests. We chose the expedient course in limiting launchers rather than RVs or throw weight, they believe; the MX decision, with its choice between survivable ICBMs and SALT-compatible ICBMs, highlights the error. To provide survivable ICBMs, they conclude, we must reorient SALT. If the Soviets are unwilling to negotiate SALT agreements that permit both sides to provide for stable deterrence, then we must choose security over SALT and proceed with SICBM, survivably deployed among diverse basing modes.

Discarding SALT and building SICBMs would actually promote arms limitation, they argue. We would move to a new arms control regime in which weapons are

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99/ Congressional Research Service, Redressing ICBM Vulnerability, Seminar Transcript, p. 17.

100/ Robinson, U.S. Weighs Small ICBM Development, p. 50.

limited not by formal agreements but by deploying weapons that give the Soviets no incentive to add to their ICBM force and give us no concern if they do, since those missiles would be of no use in attacking SICBMs they couldn't locate.

Critics note military problems with SICBM. A counterforce attack, in which each RV must arrive on a precise schedule, would be difficult to coordinate for thousands of SICBMs based in many areas and several basing modes. They envision immense problems for the national command authority in communicating with thousands of SICBMs on trucks, barges, aircraft, and in silos. With MX, only 200 or fewer missile launches need be coordinated.

Critics point out the value of SALT. SALT II would cap numbers of ICBMs and RVs, foreclose Soviet fractionation of ICBMs, ban light RVs that could be used for fractionation, prevent certain types of concealment, etc. The ABM Treaty has prevented an arms race between one side's offensive forces and the other side's defense, thus permitting deterrence with fewer forces. The SALT process establishes a U.S.-Soviet dialog that fosters cooperation and future agreements. Yet SICBM would violate SALT II. It would breach the limit of 2,250 strategic nuclear delivery vehicles. Under most concepts, it would violate the SALT II prohibition of deliberate concealment. SICBM and MX together would violate the SALT II limit of one new type of ICBM.

Critics also dispute force diversification. Several basing modes, even in small numbers, would be far more costly than one. They question each basing mode proposed for SICBM. Hard silo basing would require thousands of missiles and silos to provide survivability against the current Soviet threat; if that threat grows, then, like MPS, many more silos would be needed. The costs of silo basing would be high and could skyrocket.

Road-mobile basing would create a public outcry over nuclear weapons on public highways. The missiles would have to be guarded against terrorist

hijackings. Basing SICBMs on military reservations during peacetime to avoid these problems and dispersing them on highways in crises would create other problems. The system would require warning. Traffic jams in crises might prevent the trucks from dispersing. Moving the trucks onto the highways could lead the Soviets to preempt, for after several hours the trucks would be untargetable. Since SICBM trucks would be vulnerable to low overpressures, the Soviets might attempt to barrage large areas with nuclear weapons, thus potentially killing more people than they would by attacking MX/MPS.

Airmobile SICBMs would replicate the flaws of airmobile MX. They would require warning, have short endurance, and be costly. Barges on inland waterways would interfere with commercial traffic and would require extensive security forces. With more RVs, the Soviets could barrage all the U.S. inland waterways. Satellites and ships or submarines could detect and attack surface ships. SICBM, with its one RV, would not be cost-effective for use on small submarines. Why, critics ask, deploy SICBM if the missile and each basing mode have serious problems?

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