May 27, 1980

INSURING SURVIVABILITY:

BASING THE MX MISSILE

INTRODUCTION

In his Annual Defense Department Report for Fiscal 1981, Secretary Harold Brown noted:

> Although the Soviets have only just begun to deploy a version of the SS-18 IRBM with 10 MIRVs, within a year or two we can expect them to obtain the necessary combination of ICBM numbers, reliability, accuracy, and warhead yield to put most of our MINUTEMEN and TITAN silos at risk from an attack with a relatively small proportion of their ICBM forces. For planning purposes, therefore, we must assume that the ICBM leg of our TRIAD could be destroyed within a very short time as one result of a Soviet surprise attack.[1]

The Defense Secretary's statement indicated that the Carter Administration has finally begun to think about the problem of American ICBM vulnerability. Nonetheless, the Administration has not yet accepted the seriousness of the Soviet counterforce threat posed by the SS-18 and SS-19, because it still couches its

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1. Report of Secretary of Defense Harold Brown to the Congress on the FY 1981 Budget, FY 1982 Authorization Request and FY 1981-1985 Defense Programs, January 29, 1980, p. 85.

discussion of the counterforce threat in strictly theoretical terms.[2]

The whole problem of U.S. ICBM vulnerability has arisen because of a series of interconnecting technological and political factors that date back at least to the Johnson Administration. The McNamara decision to hold the American ICBM force size to 1000 MINUTEMEN and 54 TITAN missiles in the expectation that the Soviet Union would not attempt to catch up and surpass the U.S. force was one factor. The Nixon Administration's decision to curtail the superior American ABM program and sign the ABM treaty with the Soviet Union was another factor, further complicated by Congress' decision to deny funding to the one remaining ABM site at Grand Forks, several years later. And certainly, the Soviet Union's success in marrying a MIRVing capability to its large throwweight missiles, which in turn were gradually improving in accuracy, was a factor of overwhelming importance.

The Air Force was aware of the theoretical vulnerability of the MINUTEMAN force at least as far back as 1971, when it began a study on mobile ICBMs. However, for the next five years, the concern remained strictly theoretical, since the Soviet Union's fourth-generation ICBMs were only just revealing their new counter-force capabilities and since positive aspects of the bomber and submarine legs of the TRIAD were believed able to offset the shrinkage of deliverable second-strike warheads caused by the hypothetical vulnerability of U.S. fixed-site ICBMs. Only after the Soviet capabilities were fully revealed and the favorable aspects of the bomber and submarine force began disappearing during the first year of the Carter Administration (the B-1 bomber cancelled, the TRIDENT program slipped), did Air Force concern deepen. But by this point, there was little that could be done with the new MX program to bring it on-line in time to offset the period of Soviet strategic superiority in the early 1980s.

Now the Air Force is faced with a situation where its MX program, designed both to offer the United States a heavy ICBM (in comparison with MINUTEMAN) for improving U.S. time-urgent, hard-target capabilities and to provide - through a deceptive basing mode - a survivable ICBM force, is in serious danger of being killed by Congress, because of questions about its basing mode. This paper is an attempt to explain the recent history of

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2. A page later in the Annual Report, Secretary Brown commented: "[T]he hypothetical ability of the Soviets to destroy over 90 percent of our ICBM force cannot be equated with any of the the following: (a) a disarming first strike; a Soviet advantage that could be made meaningful in an all-out nuclear exchange; a significant contribution to a damage-limiting objective; or an increased probability of a Soviet surprise attack." Report on the FY 1981 Budget, p. 86. In this statement, the Secretary appears to be saying that strategic superiority is not now useful and cannot be made useful - that it is little more than a dry fact of history.

the search for a survivable basing mode for MX and to offer a recommendation that would address the need for force survivability in the early 1980s.

EARLIER MX BASING SCHEMES: A BACKGROUND HISTORY

When concept screening for a follow-on missile began in FY 1974 under the Advanced ICBM Technology Program, the need for maintaining the survivability of the United States land-based ICBM was only one of several factors - declining force effectiveness, the evolving Soviet threat, and the potential age-out of the MINUTEMAN force - driving the process. As Lieutenant General William Evans, the Air Force's Deputy Chief of Staff for Research and Development, told the Defense Subcommittee of the House Appropriations Committee in 1973:

> We feel that the Minuteman III is a survivable weapon system through the 1980's. So we have not been anxious to do anything quickly to replace the Minuteman III. However, we feel we should get a handle on the technology involved in case there is a breakthrough on the part of the Russians, if they get added accuracy or technology deems it appropriate for us to go ahead and start an MX program.[3]

At this time, there are several reasons for the United States' relative complacency about MINUTEMAN survivability. For one thing, reports on the effectiveness of warhead fractionation and missile accuracy in the Soviet Union's fourth-generation ICBMs were still inconclusive. In 1973, the Soviets were still more than a year away from deploying their first MIRVed ICBMs. For another, the Defense Department had already made the decision to counter the probable near-term Soviet threat to MINUTEMAN by futher hardening the missile silos and by defending the missile fields, since SAFEGUARD was still an ongoing program at that time.[4]

One could say that even through 1976, it was the matter of declining U.S. force effectiveness - due to the expanding Soviet target set and the ongoing Soviet hardening program - that mainly

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3. Congress, House of Representatives, Committee on Appropriations, Subcommittee on Department of Defense, Department of Defense Appropriations for 1974: Hearings, Part 7: Research, Development Test and Evaluation, 93rd Congress, 1st Session, 1973, p. 1030.
4. See the testimony of Dr. John Foster, Defense's Director of Research and Engineering, Congress, Senate, Committee on Armed Services, Military Implications of the Treaty on the Limitations of Anti-Ballistic Missile Systems and the Interim Agreement on Limitation of Strategic Offensive Arms: Hearing, 92nd Congress, 2nd Session, 1972, pp. 220-221.

propelled the MX program forward. Understandably then, in the first few years of the program, a relatively small portion of the money was allocated to the development of mobile or alternate basing modes for the new missile. Indeed, Air Force plans even up to the start of FY 1977 called for the initial emplacement of the MX missiles into fixed silos.[5] The Congress finally had to signal its worry about fixed silo survivability by cutting off the FY 1977 funding for fixed silo deployment of the MX.

ALTERNATIVE GROUND BASING CONCEPTS

At the beginning of the MX program, the Air Force began looking at a range of both ground and air mobile basing concepts which could act as alternatives to fixed silo basing, if the need arose. Among the first to be studied were ground-mobile random movement basing schemes. The random movement options were unprotected basing modes, where survivability of the missiles was entirely dependent upon location uncertainty. The off-road random movement scheme envisioned utilizing vehicles for moving the missiles randomly about in non-built-up, relatively unpopulated areas of the country in order to render Soviet strategic targeting of the force more complex. It was thought that in this way the Soviet Union would have to target entire roaming areas with missile barrages in order to destroy the U.S. force. It was later dropped as a candidate basing scheme because the Air Force found that given the limits of economic feasibility and the maximum amount of federal land suitable for off-road deployment, American technology for hardening the vehicles was insufficient to ensure their survivability to blast overpressures from Soviet missile barrages. Planners found that only 10 psi of blast overpressure would render the vehicles inoperable pending repair.

The line movement random basing scheme involved placing the missiles on transporters that utilized existing transportation networks - roads, railroad tracks and waterways - to ensure location uncertainty. This basing mode also failed to meet Air Force acceptance criteria on several counts. In part, it was rejected because movement of the missiles would have involved massive interaction with the general population, since there are not enough isolated highways, railroad tracks or waterways to adequately accommodate the missile force. Another factor in its rejection was the realization that the vehicles would be subject

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5. The Air Force FY 1977 presentation to the Senate Armed Services Committee featured a chart on "Phasing of M-X Development" which listed four phases. Phase 3 was "Limited Deployment in Silos (In Numbers Dictated by the Future Threat and Targets)" and Phase 4 was "Supplement to Silo-Based M-X with Transportable Missile in Alternate Basing." See Congress, Senate, Committee on Armed Services, Fiscal 1977 Authorization for Military Procurement, Research and Development, and Active Duty, Selected Reserve and Civilian Personnel Strengths: Hearings, Part II: Research and Development, 94th Congress, 2nd Session, March 9, 11, 15, 17, and 19, 1976, p. 6271.

to the same blast overpressure damage from missile barrages as off-road vehicles.

Another category of ground basing modes that was studied was the group labeled subterranean interconnected launch point options. These options envisioned insuring missile location uncertainty by hiding the missile in underground tunnels. In the case of the soil tunnel, no hardening was envisioned. Studies quickly found that initial warhead explosions, such as in those resulting from a light Soviet precursor attack, would cause the soil tunnel to cave-in, revealing the missile's location plainly for follow-on Soviet targeting. The other subterranean interconnected launch point option was the rock tunnel. This concept called for the digging of tunnels with launch portals through hard rock (granite) deep below the ground's surface. The Air Force had already become acquainted with some of the technological problems involved in this task during its HARD ROCK program for deep silo basing of part of the MINUTEMAN III missile force. Accordingly, this basing concept was eventually rejected because of both its technological risk and cost.

The last series of ground based alternatives studied were the so-called hard (multiple) aimpoint options. These options included: the revetted rail; canal; pool canal; shelters (surface, pool and hard capsule); covered trench; and buried trench. The revetted rail system envisioned moving the canisterized missile by rail car randomly among a series of revettments. It was rejected by the Air Force because of both cost and vulnerability. Given the amount of land available, it was found that the projected Soviet threat would overwhelm the system. In addition, preliminary cost estimates showed the revetted rail concept to be highly expensive. The second hard aimpoint option considered was the canal. This concept called for the construction of hundreds of miles of deep canals in which the submerged missile and transporter could move and hide. Both cost and survivability criteria ruled this system out. Not only would the extensive, deep-water canals be costly in terms of money and water, but it was shown that the blast effects from nearby warhead detonations would breach the canal walls, exposing the missiles as the water drained out.

The canal option led to a varient basing scheme - the pool canal. This concept involved building a series of pools, thirty-five to forty feet in depth, which would be connected by a series of shallow canals. The submerged missiles would be moved from pool to pool to complicate Soviet targeting. This option was dropped on grounds of both cost and land requirements. However, from it came the pool concept, technically one of the shelter options.

The reasoning behind the pool basing mode was that since roads were cheaper and easier to construct than canals, the missile should be moved from pool to pool using roadways rather than canals. At first glance, pool basing appeared to offer

several advantages, since the water depth in the pool would not only serve to shield the missile from discovery, but would also protect the canisterized missile from the radiation effects of nearby thermonuclear explosions. More detailed study of the proposal revealed problems, however. Costs were one factor, since the concept required high life-cycle support (O&S) funding. Other factors centered on survivability. It was found by the Defense Nuclear Agency that shock waves from nearby nuclear explosions would knock some 60 percent of the water from the pool, vastly reducing the pool's protection against other incoming warheads. In addition to this aspect, studies later revealed that some type of shielding in addition to the water in the pool might be needed to prevent disclosure of the missile's location through technical surveillance. Finally, the pool basing mode would be subject to simple acts of sabotage (for example, the throwing of a grenade into the pool).

The surface shelter idea required the construction of multiple blast-hardened concrete structures for each missile. The missile on its transporter launcher (TL) would be shuffled by roadway among a number of these shelters, complicating Soviet targeting. Following an initial Soviet attack, the transport-launch vehicle carrying the missile would leave the protective shelter to launch the missile. This concept passed the Air Force's basing criteria and was eventually recommended for validation.

The last of the shelter concepts was the hard capsule basing mode. The horizontal hardened capsule system was conceptualized as a horizontal coffin-like structure set flush with the surface of the ground. Its vulnerability lay with its missile transporter vehicle which would be rendered inoperable by a light precursor attack, leaving the missile stranded and subject to follow-on detection and attack. The vertical hardened capsule system was considered to possess somewhat more potential since the capsule itself, though not its transporter, could be constructed with greater survivability and would prove harder to detect once its transporter were put out of commission. Nonetheless, because the existing concept posed severe maintenance and logistic difficulties - thus entailing high O&S costs and manpower requirements - this basing scheme was only recommended for possible additional study.

The covered trench basing concept called for a frangible cover to be placed over the length of a trench, to hide the random movement of the missile. Study of this alternative basing scheme showed that the breakable cover was susceptible to destruction by a Soviet precursor attack, thereby disclosing the missile's position. The final ground basing mode to be studied by the Air Force prior to the validation selection decision in December 1975 was the buried trench, a direct offshoot of the covered trench study.

Under the concept of buried trench basing, the missile and its unmanned transporter launcher would be enclosed in a long

(ten to fifteen mile) reinforced concrete tunnel that was buried five feet below ground in a trench. The missile, its transporter launcher and two airblast plugs (independently powered plugs designed to seal off the tunnel on either side of the TL to protect the missile from airblast and radiation in the event of a warhead explosion breaching the trench) would travel the length of its concrete tunnel, on a random basis, forcing Soviet planners to target the entire length of the trench if they desired to kill the missile. This was the only other ground basing concept to be recommended for validation.[6]

Interestingly, despite the concept basing studies that had been conducted prior to December 1975, there was one alternative basing candidate that had received essentially no attention even though it appeared to be highly survivable and relatively cost-effective. This was the vertical shelter (silo) concept. There was a reason for this obvious omission. Simply enough, the Air Force believed that the American arms control community would not accept this type of basing scheme because it could present problems for the United States in its ongoing strategic arms limitation talks with the Soviet Union.

The Air Force's position on this issue became apparent during its testimony on the MX program in 1976. Lieutenant General Alton Slay, the Air Force Deputy Chief of Staff for R&D told the Senate Armed Services Committee: "If you had a way of playing the same Chinese checkers game with silos as we are proposing with [the] shelter or the trench, it would be infinitely better, it would be much more survivable."[7] One problem with using this "infinitely better" basing system, however, was that the term "silos" had long been intermingled with the term "launchers" in arms control thinking and the number of missile launchers was limited under the terms of the SALT I Interim Agreement. As John Walsh, the Deputy Director of Strategic and Space Systems (O.D.D. R&E) explained:

> If we could redefine the silos as not being launchers since SALT limits launchers, if we could decree that silos were not launchers but rather [that] the canister which held the missile is a launcher, then we could go and build more silos and that would be a very desirable way of doing it.
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> There's no real problem of verification [with silos]. That is, I think an honest Russian would recognize that he could keep

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6. For the Air Force's discussion of the rating of the various ground basing alternatives, provided for the record in the FY 1977 hearings, see Ibid., pp. 6401-6408.
7. Testimony in Ibid., p. 6429.

> adequate count of the number of missiles we really had.
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> Now the Russian negotiator might have a different story about that. Then there are some [American] arms control academics who invent all kinds of difficulties. But the realities are, it is very easy to verify how many missiles we have.[8]

ALTERNATIVE AIR-MOBILE BASING CONCEPTS

During the same period (1973-1975) that ground basing alternatives were being studied, air-mobile basing concepts were under evaluation. The Air Force analyzed four generic classes of air mobile concepts: continuous air alert; random move; dash-on-warning; and flexible mode.

The various proposals coming under the continuous air alert concept, similar to the one already in use for a portion of SAC's B-52 bombers, were quickly rejected because of cost. The operation and support costs, particularly for aviation fuel, made this category of air-mobile options less than competitive. The random move air-mobile options suffered not only from cost problems, but also from questions of technological risk and survivability. The sea sitter option envisioned the use of a large (one million-plus pounds) seaplane to carry two MX missiles. The seaplane would randomly move from one point to another on the high seas. The Air Force study found that it would not be survivable unless it was frequently moved, given Soviet surveillance capabilities. The option also presented some technical risk. The other random move option analyzed involved the use of a VTOL/VSTOL heavy lift helicopter for moving the missiles around. It was rejected for several reasons, key among them being its projected high cost and susceptibility to enemy surveillance.

The third air mobile option studied was the dash-on-warning system. This basing concept postulated a large transport aircraft - only the C-5A among the existing candidate aircraft had the necessary payload capabilities - having rocket-assisted takeoff and capable of carrying one missile, being launched upon tactical warning of Soviet missile attack. This option proved extremely cost-sensitive to false alarms, since such alarms would dramatically increase O&S costs.

The final concept that the Air Force considered - the flexible mode - envisioned the use of modified existing wide-bodied cargo aircraft in a posture that would incorporate the best characteristics of both dash-on-warning and continuous air alert. Its

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8. Ibid.

technical feasibility had been established during the air mobile feasibility demonstration in October 1974. It was the one such concept proposed for retention.

CONCEPT VALIDATION: 1976-1978

Having decided on three alternative basing concepts for validation by December 1975, the Air Force hoped that one of these three (shelter, buried trench, and air mobile) could be unambiguously selected as the preferred mode following the completion of the validation phase in mid-1978. Unfortunately, it was not to be that simple.

During the first year of the Carter Administration, the buried trench appeared to have the edge as the preferred basing scheme for MX. The Air Force, by this time, had ruled out the air mobile option as more expensive than either of the two ground based schemes. And, although both the shelter and the buried trench were considered roughly equivalent on a first-cost basis, the trench appeared to require lower O&S costs, since it would need fewer personnel to operate it. Preliminary design concepts called for the trench to be between ten and fifteen miles long, with a tunnel composed of fifteen-inch concrete - for housing the missile and its attendant transporter-erector-launcher (TEL) - to be buried in it, five feet below the surface of the ground. The TEL for the missile was to be able to break through the roof of the concrete tunnel and its ground cover and to raise the missile for launching.

By October 1977, Secretary Brown had decided to ask Congress for $245 million for engineering development of the MX in the FY 1979 budget. Just two months later, however, the Defense Department was having second thoughts about buried trench basing as originally proposed. A major factor in this turnabout was the upwardly-revised cost projection for the system. Because of the large amounts of concrete that would be required for a continuous concrete tunnel, the cost per mile for the trench was estimated to range up to $5 million. In December 1977, the Office of Management and Budget argued that full-scale engineering development of the MX missile system should not be started until the basing mode question was completely resolved. The White House sided with OMB and instructed the Secretary of Defense to cut $90 million from the FY 1979 budget submission on MX.

This decision essentially marked a turning point in the Air Force's (and Defense Department's) approach to the alternate basing problem. Under the first Carter defense budget, the MX program's engineering development timetable had been slipped from FY 1978 and now it was to be slipped again. Until late 1977, the Air Force's approach to the MX missile system had been orderly and slow as befitted a program predicated more on the need for greater ICBM throwweight than on the requirement for ICBM survivability. However, by this point in time, the Air Force was

beginning to see the increasing need for a new survivable ICBM. The B-1 bomber program, the Service's hedge for the survivability problem, had just been cancelled and there was now no doubt that the Soviet Union's large throwweight, MIRVed SS-18s, SS-19s and SS-17s were acquiring an alarming counterforce capability. Therefore, the Air Force decided to speed up the search for an acceptable alternate basing mode.

In retrospect, the next two years seem to have been so occupied with multiple basing options in various stages of ascending and descending preference that coherent policy seems to have been overlooked. Within days of the Carter decision to slip the FY 1979 engineering development of MX, SAMSO and the Air Force's Scientific Advisory Board were hard at work studying four different basing modes, including the pool concept that had been rejected more than twenty-four months before, and (for the first time) the vertical shelter. Meanwhile at the White House, Frank Press, the head of the Office of Science and Technology was expressing enthusiasm for the semi-discarded air mobile basing concept.

By June 1978, SAMSO had come out in favor of vertical shelters (MAPS), with the horizontal shelter concept in its next preferred position. By September, however, the hybrid in-line trench was still under consideration. And two months later some Carter Administration officials were calling for diversifying the MX force's basing among MAPS, randomly-moved trucks, and wide-bodied jets.

In November 1978, the Carter Administration had decided that full-scale development money for the MX program would be included in the FY 1979 supplemental. Just a month later, the Pentagon decided to delay MX development for about three months so that it could study air mobile basing again. Therefore, on December 21, 1978, Thomas Ross, DOD's Assistant Secretary for Public Affairs told reporters that there was now "reason to believe that the air-mobile basing mode (air-transportable and air-launched) is a better prospect than first thought."

The Air Force apparently had other thoughts. On December 29, General Lew Allen, the Air Force's Chief of Staff, sent a letter to Congressman Melvin Price concerning MX basing. In this letter General Allen noted:

> During the past year, we have carried on an intense review of numerous alternative basing options and concluded that, from military and technical viewpoints, the vertical shelter, multiple protective structure (MPS) system (formerly referred to as multiple aimpoint or MAP) represents the best means to assure ICBM survivability. Most scientific advisory groups who have studied the problem in depth agree with this conclusion.

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> Over the last few years, about 30 alternative basing modes have been investigated in detail, culminating in an exhaustive review and reevaluation by the Air Force working in cooperation with the Defense Science Board. From this evaluation, the vertical shelter system emerged as the best technical concept.[9]

Nevertheless, despite the Air Force's contention that vertical shelters provided the best basing concept for MX, the Carter Administration continued to back away from it. It became apparent that a certain arms control mentality, prevalent among a number of the President's advisors, dictated the choice of another solution - almost any other solution - to the question of MX basing.[10]

THE "RACETRACK" EMERGES

The air mobile concept favored by Frank Press continued to find adherents up through April 1979, even though Air Force studies had revealed that it was then projected to be far more expensive than ground-based alternatives, that the transporting aircraft would be highly vulnerable in the air or on the ground to blast overpressures from incoming Soviet SLBM warheads, that the dispersed basing of aircraft envisioned would transform large numbers of U.S. military and civilian airfields into priority Soviet targets, and that the system would endure for only thirty-six hours.

As the June 15 signing date for SALT II approached, the Administration scrambled to find an acceptable basing scheme for MX. In May 1979, several variant versions of old concepts, including the hybrid in-line trench, were put forth. One Administration official explained the resurrected trench proposal this way: "This is a $5 billion cosmetic solution, but it solves the problems in the Administration over vertical silo basing for MX." However, by July 1979, trench basing too had failed the test - it was considered a less than cost-effective answer for MX deployment. It had been replaced in the Defense Department's favor by a

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9. Letter from General Lew Allen, Jr. to Congressman Melvin Price, Chairman of the House Armed Services Committee, December 29, 1978, copy of a typescript document, pp. 1 and 3.
10. An unnamed Pentagon official noted: "They caved in in microseconds because vertical shelters look like silos, and silos look like launchers and launchers are surrogates for missiles under SALT. The people who play in the National Security Council, Policy Review Council, State Department, Office of Management and Budget and Office of Science and Technology Policy would not support vertical silo basing." Quoted in Clarence A. Robinson, Jr., "MX Racetrack Questioned in Congress," Aviation Week & Space Technology, November 12, 1979, pp. 17-18.

horizontal shelter scheme soon to be ignominiously nicknamed the "racetrack."

Even as enthusiasm was building up within DOD for the new basing mode, Major General Kelly Burke, the Air Force's principal overseer of the MX program was attempting to deny the Carter Administration's vacillation on the missile basing issue. He said: "This is not vacillating. The President has already made 85% of the decision. He's knocked out airborne basing, the dyad and vertical deployment and the common missile. Now, we've got the best engineering for the legitimate needs of verification and concealment."[11]

On September 8, 1979, President Carter formally announced his approval of the "racetrack" scheme for horizontal shelter basing of the MX missile.[12] Under this basing scheme, each MX missile would be deployed in a road loop that contained twenty-three horizontal shelters. The missile would be transported randomly from shelter to shelter (while protected from enemy surveillance) by a large transporter-erector-launcher (TEL) which would park with its cargo inside the designated shelter until such time that it was necessary to move the missile to another shelter to insure location uncertainty or perform maintenance.

The key selling points of this basing mode for the Carter Administration were the system's built-in aids to verification. Among these verification aids were: 1) ports on the roof of each shelter which could be opened for Soviet overhead visual inspection; 2) the weight of the TEL (700,000 pounds) which would prevent the vehicle from moving across country from one road loop to another; 3) a series of slow-to-move barriers separating each road loop from the other; and 4) several time-consuming assembly procedures required before the missile was assembled and mated to its TEL.[13] This overly redundant system verifiability seemingly had been designed to appeal even more to American arms control enthusiasts than to Soviet SALT negotiators. As General Kelly Burke remarked: "[T]his is the first time we've built a strategic system and married it with the arms control process. In other cases, weapons were built before SALT I. Now, we're building a system to accommodate SALT as it is and as it may be."[14]

Having once accepted this basing mode as the best they could hope to get, the Air Force and the Department of Defense set

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11. Quoted in "MX Basing Approval Expected," Aviation Week & Space Technology, July 30, 1979, p. 12.
12. The President had approved full scale development of the missile in June.
13. For a description of these procedures, see The Department of Defense Statement on MX and Strategic Force Modernization by The Honorable William J. Perry, Under Secretary of Defense on Research and Engineering Before the Committee on Foreign Relations of the United States Senate, 96th Congress, 1st Session, September 12, 1979, pp. 5-7 and 10-12.
14. Quoted in "MX Basing Approval Expected," p. 12.

about finding other factors that could be used to sell the racetrack concept to Congress. They immediately hit upon the idea of the enhanced survivability that it offered. As General Burke commented, "it buys two paths for survivability" since not only would it continue to utilize the location uncertainty inherent in the MPS concept, but it would have a capability for rapid reshuffling of the missiles' locations in the event the force's location uncertainty had been compromised. The point which this concept of two paths to survivability failed to address was that if the reliability of the preservation of location uncertainty (PLU) technique inherent in the MPS or "racetrack" basing modes is so open to question that it requires a backup system, then the whole basing mode should have been dropped and new studies begun on finding one that assured survivability without the need for secondary measures.

THE CURRENT MX BASING MODE: FROM "RACETRACK" TO "LOADING DOCK"

Even once the President had signed-off on the integral TEL, horizontal shelter system, factors continued to crop up which boded unfavorably for its eventual deployment. In the haste to come up with a system which avoided the potential verification problems of the vertical shelter basing mode and which in fact employed redundant verification measures, the Air Force had apparently ignored the rapidly increasing price of the system. While the cost of the MPS basing mode had been variously estimated at between $20 and $26 billion (depending upon the level of compatibility with "racetrack" features), in September 1980 estimates for the horizontal "racetrack" system ran up to $33 billion for acquisition and $440 million annually for operation and support in (FY 1980 dollars) without counting the additional $1.4 billion acquisition costs and $10 million annual operations and support cost for mass simulators. Meanwhile, inflation factors pushed this favorable estimate upward. In February 1980, for example, the General Accounting Office reported that inflation would increase the system cost to "at least $56 billion."

TABLE I

MX MISSILE PROGRAM

	Costs estimates adjusted for inflation using DOD rates			
	Development	Procurement	Construction	Total
	(billions)			
1979/1980	$ .8	$ -	$ .1	$ .9
1981	1.6	-	.1	1.7
1982	2.0	-	.3	2.3
1983	2.0	1.4	1.1	4.5
1984	1.6	4.0	3.9	9.5

1985	.9	4.8	5.0	10.7
1986	.5	4.6	5.0	10.1
1987	-	4.1	4.0	8.1
1988	-	1.4	1.0	2.4
1989	-	.2	.1	.3
1990	-	.1	-	.1
To completion	-	.1	-	.1
Total	$9.4	$20.7	$20.6	$50.7

The $56 billion figure cited includes the DOD figure of $28 billion for MX development and acquisition adjusted for inflation (using DOD inflation indices) plus unadjusted operations and maintenance costs of $5 billion.

Source: GAO Report PSAD-80-29, February 29, 1980, pp. 20-21.

In addition to escalating costs, the planned basing mode began suffering from public opposition in the geographic areas deemed most likely to receive the MX deployment. By September 1979, a twenty-four thousand square mile section of federal land in eastern Nevada and western Utah known as the Great Basin was generally acknowledged to be the primary candidate area. This desert site contained some 100 relatively small valleys which appeared useable on topologic and geologic grounds for the 200 planned road loops (forty-seven were eventually selected). The Defense Department hoped that the above-average patriotism of Nevada's and Utah's populations (Nevada had been used for years for above-ground nuclear weapons testing without major complaint) and the favorable influx of federal money to the states would assure quick local public support for the deployment plan. This did not happen.

For one thing, local mayors became worried that the rapid influx of construction workers and accompanying support personnel would overwhelm existing facilities in the surrounding small communities. Also, local ranchers who have been using the federal land for grazing their herds began complaining that the water requirements for construction of the road loops and shelters would drastically reduce available local water supplies in the desert region, and that government plans for 200 large road loops and 4600 shelters would put much of the land out of bounds to the civilian population. Administration hopes for early public acceptance in the West began fading.

By early this year, the public questioning of the planned MX deployment in Nevada and Utah had risen to such levels that the states' U.S. Senators felt compelled to write to the President. Three of the senators, who are strongly pro-defense by philosophical conviction, had been troubled for some time by what they saw as the "racetrack" basing mode's technical flaws. The letter sent to President Carter said, in part:

> As you well know, the so-called "Racetrack" basing mode has not been popular in the Congress....The "Racetrack" is also unpopular in our states, because of its substantial social and environmental impacts.
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> "Racetrack" is clearly a product of the era of presumed U.S.-Soviet cooperation which, if it ever existed, is clearly no longer with us. As we see it, the time has now come to recognize that the changed security environment also provides us with a chance to build a new generation ICBM, and base it in a mode which would be cheaper, more effective, and come on line quicker than would be possible with "Racetrack."...
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> ...Accordingly, we urge you to direct your senior national security policy makers to undertake a comprehensive new look at alternative MX basing modes, as well as "Racetrack," in light of this situation as quickly as possible.[15]

Prompted by rising congressional and local questioning of the "racetrack," the Air Force modified certain aspects of the older basing mode and evolved the current MX basing system - the non-integral TEL, horizontal shelter system, since nicknamed the "loading dock."

The "loading dock" basing mode differs from "racetrack" in a number of ways, but these changes were all made at the margin - the concept of using road loops and horizontal shelters remains the same. The advantages of this modified system over "racetrack" are: 1) that the horizontal shelters are smaller (and thus cheaper), since the transporter will not be driven into them; 2) that the vehicles are lighter; and 3) that the shield vehicle can be done away with since the transporter can carry its own shield.[16] Overall, the modified system is estimated to be about $3 billion cheaper than the "racetrack."

However, some of the disadvantages of system are: 1) that the system no longer has a real-time, rapid reshuffle capability (if it ever really did under the "racetrack" concept) - the

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15. Letter from Senators Jake Garn, Howard W. Cannon, Paul Laxalt and Orrin Hatch to President Carter, February 7, 1980, copy of typescript document.
16. See The Department of Defense Statement on the MX System and Ballistic Missile Defense by The Honorable William J. Perry, Under Secretary of Defense for Research and Engineering, before the Subcommittee on Research and Development of the Committee on Armed Services of the United States Senate, 96th Congress, 2nd Session, March 12, 1980, pp. 5-6.

missiles must now move continuously in periods of crisis and move to shelter upon warning of Soviet attack; 2) that the shelter verification ports, though reduced in number, still remain (lessening structural integrity); and 3) that the 600 psi blast resistance level of the "racetrack" shelters has been retained rather than upgraded - there is actually some question of whether concrete horizontal shelters of the type envisioned can structurally withstand even 600 pounds per square inch of overpressure.[17]

The "loading dock" basing mode has only one advantage over the vertical MPS system. Its missiles can be reshuffled in a much shorter time.[18] On the other hand, vertical shelter basing of MX presents a number of advantages over the "loading dock." It is significantly cheaper, if one discounts DOD's attempts to maximize component comparability for both systems (thus increasing the price for MPS). It is more highly survivable within a given land size. Vertical shelters are among the easiest type of structure to harden, and vertical shelters present the smallest possible target cross-section to incoming warheads, a factor which for a given level of hardness, maximizes the survivability of the system. Vertical MPS basing makes the Soviet Union's detection of missile location more difficult, while not preventing adequate Soviet verification of the system. Finally, vertical structures present far fewer engineering uncertainties than do horizontal structures.

THE MINUTEMAN III - MPS ALTERNATIVE

It is apparent that a method of basing the MX missile that is less expensive in both money and land requirements than the "racetrack" must be found if the program is ever going to reach the deployment stage. Congressional dissatisfaction with the "racetrack" basing mode is increasing, and it is not immediately apparent that the "loading dock" modifications will prove significantly more able to garner legislative support.

If a need exists for the new, large MX missile equipped with ten counterforce-capable reenty vehicles, even more of a need exists to insure a survivable ICBM force as quickly as possible. The present initial operational capability (IOC) of ten operational MX missiles and 230 shelters in July 1986, not to mention the crossover point in completed shelters in 1988, will be too far in the future to positively influence the problem of American ICBM vulnerability in the early 1980s.

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17. Blast pressure waves travel along the surface of the earth, exerting their full force on structures which (unlike the essentially below-ground vertical shelters) extend appreciably above the surface.
18. Recent DOD studies have found that the minimum amount of time required for a reshuffle of all vertically-based missiles with present technology is something over twenty-four hours (versus less than twelve hours under the loading dock scheme).

It is evident that what is needed are both a missile and survivable basing mode that can start being deployed in the 1982-1983 time span, when the Soviet counterforce capability will be fully ascendant. The only combination that could fulfill this requirement would be the deploying of MINUTEMAN III (MM III) missiles in vertical MPS. Although the MINUTEMAN production line has been closed down for some months, the United States has some 150 MM IIIs currently in stockpile which could be deployed while the production line is reestablished or, conversely, the fixed-site MM III missiles are modified and redeployed into the MPS silos.[19] In order to deploy the MINUTEMAN III in a multiple protective structure mode, certain modifications would have to be made to the missile. Among other things, the missile would have to be canisterized for cold-launching, its guidance system would have to be updated for greater accuracy and to enable it to cope with problems of transit from one silo to another, and the missile would have to be made transportable in a fully-assembled state.

These modifications would take about two years. The cost for the modification program would include between $500 million and $1 billion in total strategic R&D, about $1 million per missile for conversion, and an additional $1 million or so per canister (including ground-support electronics and other support linkages).[20] The incremental cost of the vertical shelters themselves would be between $500,000 to $1,500,000 once development of the facility had been completed. The shelters would be made large enough to accept the MX missile when it came on line.

The candidate basing area for the initial deployment of the 150 missiles would be the current MINUTEMAN missile fields. Our six MINUTEMAN wings are deployed in the states of Montana, South Dakota, North Dakota, Missouri, and Wyoming. The present silos are, on the average, about five miles apart. This leaves a more than sufficient amount of room for the new multiple protective structures to be placed between existing silos, in the spaces between the squadrons and around the periphery of each wing.[21]

Beyond adding early survivability to a portion of the land-based ICBM force, such a deployment would serve as a testing

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19. 250 were originally produced for stockpile. Of these, between 50 and 100 have since been fired off in missile tests.
20. Discussion with Dr. William R. Graham. See also, William R. Graham and Paul H. Nitze, "Viable U.S. Strategic Missile Forces for the Early 1980s," in William R. Van Cleave and W. Scott Thompson, editors, Strategic Options for the Early Eighties: What Can Be Done? (New York: National Strategy Information Center, 1979), p. 138.
21. For an extremely valuable statement on this basing scheme, see Statement of Professor William R. Van Cleave, Director, Defense and Strategic Studies, University of Southern California on Solutions to ICBM Vulnerability Before the Subcommittee on Military Construction of the Senate Appropriations Committee, May 7, 1980, copy of typescript document.

ground for the preservation of location uncertainty concept. When the MX missiles begin deployment, they in turn could be retrofitted into the MINUTEMAN multiple protective structures already in place. An additional 100 MX missiles could be emplaced in the "loading dock" basing mode in the Great Basin, giving the system's design concepts a chance for full validation through actual deployment. Any command and control problems inherent in such "split basing" could be worked out ahead of time. Additional increases in the Soviet counterforce inventory could be met by building additional shelters to whichever of the two basing modes better met the survivability criterion and eventually by resort to Ballistic Missile Defense (BMD), in particular, LoADS (low altitude defense system).

CONCLUSION

There is no doubt that the United States urgently needs both an advanced counterforce-capable ICBM and a survivable basing mode for it. The MX missile envisioned by the Air Force would adequately fulfill the first requirement. The second requirement, however, is the sticking point. There is some question whether Congress will support the Administration's favored basing mode. And if the basing mode is not found acceptable, the missile itself may be lost.

The Defense Department is certainly aware of this possibility and, as a result, has begun rethinking those aspects of the MX basing mode that seem to have garnered the greatest public disapproval. For example, several weeks ago, the Air Force publicly hinted that it might be possible to split the planned MX deployment scheme so that half of the missile force would be based in the Great Basin and the other half in an alternate site, possibly in West Texas and eastern New Mexico. This concept of dual basing would certainly have appeal to the members of Congress from Utah and Nevada. In addition, on May 6, 1980, Secretary Brown testified that the Department had dropped its plan for the land-intensive "racetrack" road loops in favor of a "linear track" road network, in which the "loading dock" horizontal shelters would be sited off straight roadways. Such changes should go far in alleviating some of the environmental criticisms that have emerged in recent months.

It is incumbent upon the Carter Administration to convince Congress that its emerging MX basing scheme has a definite military utility. If the members of Congress cannot be persuaded that the choice of the MX missile's basing mode is motivated primarily by factors other than the need to appeal to the self-imposed requirements of our arms control community, they may well vote the program down before the first missile is deployed.

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