COSTS OF DEPLOYING THE MX WEAPON SYSTEM

Staff Memorandum

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SUMMARY

This paper examines the costs of the proposed MX weapon system. The paper first reviews cost estimates, in both constant and current dollars, for the Air Force baseline MX program of 200 missiles and 4,600 horizontal shelters deployed in a "linear-grid/loading-dock" configuration, the design ultimately chosen by the Carter Administration. The paper then describes how MX system costs might increase if higher Soviet threat levels caused the United States to either expand the size of the system, or deploy ballistic missile defenses to protect it.

It must be stressed that the basing system design for the MX program is currently under review by the new Administration. Depending upon the outcome of this review, the estimates of MX system costs presented here could change substantially.

COSTS OF THE AIR FORCE BASELINE PROGRAM

Constant Dollars

Air Force estimates, adjusted using CBO price indices, show that the baseline MX system--which would be designed and deployed between now and 1989--would cost $40.7 billion in constant 1982 dollars. This estimate includes costs for development, procurement, and military construction, and does not include either operating and support costs or Department of Energy costs for warhead production.

CBO has not attempted any independent evaluations of the Air Force cost estimates. But independent checks have been made by such groups as the Defense Science Board and the Air Force's independent cost analysis group. These checks suggest that the estimated cost of the MX missile itself, which accounts for about $11.4 billion (28 percent of the total), seems about right. Military construction costs, which account for about $12.6 billion (31 percent of the total), are more likely to increase. One independent assessment suggested that the estimate of military construction costs was about 14 percent (or approximately $1.8 billion) too low. The remainder of the costs have been reviewed less thoroughly by these groups in part because

of the frequent changes in basing design that have been made in recent years.

Current Dollars

Using CBO assumptions about inflation and likely rates of spending, the current-dollar cost of the Air Force baseline system would amount to $57.2 billion. It should be emphasized that this includes an estimate of anticipated inflation over the next decade and is therefore highly uncertain.

While assembling these estimates, CBO ascertained that Air Force constant-dollar costs, when converted to current dollars using the data and methods employed by the Department of Defense (DoD), did not match the numbers supplied to the Congress in the Congressional Data Sheets. These data sheets apparently include costs associated with the linear-grid/loading-dock system for fiscal years 1982 and 1983 only; estimates for 1984 through 1986 are based on the earlier "racetrack" basing design. Moreover, the outlay factors used by the Air Force to translate budget authority into outlays in the data sheets differ from official outlay factors published by the Office of the Secretary of Defense. The effect of these two anomalies is to shift about $1.5 billion in budget authority, plus additional outlays, from the 1982-1986 period to later years.

EFFECTS ON SYSTEM COSTS OF INCREASES IN THE SOVIET THREAT

The Air Force baseline program is designed to allow approximately 100 MX missiles to survive and retaliate after a Soviet first strike, assuming that the Soviet threat is limited in accordance with the SALT II agreement. But the Soviet threat against MX could be increased, either before the system's planned 1989 completion date or afterward. A wide range of increases is, of course, possible. Using Air Force data and methods, CBO has estimated the costs of expanding the capability of the MX system in anticipation of two potentially higher Soviet threat levels, and has indicated some of the major areas of uncertainty in these costs.

To maintain approximately 100 surviving MX missiles in the face of one possible 1990 Soviet threat envisaged by the Office of Technology Assessment (OTA), the United States might have to spend from $53 billion to $59 billion in constant 1982 dollars.

This compares to total acquisition costs of $40.7 billion for the Air Force baseline program. According to this projection, the Soviet Union might be able by 1990 to attack the MX system with as many as 7,000 warheads. The $53 billion estimate assumes that, in the face of the increased Soviet threat, the United States would abrogate the existing Anti-Ballistic Missile (ABM) treaty and deploy a ballistic missile defense system to protect MX. The higher $59 billion estimate assumes that the United States would instead simply expand the size of the MX system.

Costs could rise to $65 billion under a still greater threat that OTA suggests might be possible in 1995. In this case, the MX system could be attacked by 12,000 warheads. The $65 billion estimate assumes the deployment of ballistic missile defenses, which seems plausible in the face of such a substantial Soviet threat expansion. Without such a defense, costs could total $79 billion.

These cost estimates are subject to great uncertainty. The threat estimates themselves at best represent informed speculation. Moreover, the model used in making the estimates is a rough planning model that, while judged reasonable by the Air Force, has not been updated for the latest MX basing design and may not fully reflect higher costs for labor and materials that a significantly expanded MX system size might entail. These problems greatly magnify the uncertainties discussed above in connection with the cost estimates for the baseline program. Finally, a major expansion of the Soviet threat could require responses other than expanding or defending the MX system, which could alter the results in this paper.

COSTS OF DEPLOYING THE MX WEAPON SYSTEM

At the request of the Chairman of the Senate Appropriations Committee, CBO has assembled the costs of deploying the MX weapon system. This paper documents those costs. First, the paper examines the constant-dollar costs of the baseline MX system as estimated by the Ballistic Missile Office (BMO), and briefly reviews two independent estimates that were used to check the BMO's cost figures. Next, the paper examines the current-dollar costs of the baseline MX system as presented in the Carter Administration's budget, and shows differences between these figures and those derived from the BMO's constant-dollar costs for the system. Finally, the paper addresses the implications for the size and cost of the MX system of potential future increases in the Soviet ICBM threat.

MX WEAPON SYSTEM ACQUISITION COSTS IN CONSTANT DOLLARS

The Air Force baseline for the MX weapon system consists of 200 MX missiles deployed in 4,600 horizontal shelters in a "linear-grid/loading-dock" configuration. 1/ The baseline includes mass simulators to help disguise the locations of the missiles themselves, and a number of features (such as viewing ports in the shelters' roofs) to aid in SALT verification. This system design, ratified by former Secretary of Defense Brown and presented to the Congress in mid-1980, has not been officially revised. It is anticipated, however, that a new system design could be adopted this summer after the civilian panel appointed by Secretary Weinberger to study the MX basing system makes its report.

1/ In this configuration, each cluster of 23 shelters would be laid out more or less along a straight-line road. The missile and its launcher would be separate from the transporter vehicle, which would not enter the shelter. This contrasts with the previously considered "racetrack" configuration, under which the shelter clusters would resemble closed loops. In the earlier concept, a transporter-erector-launcher vehicle (TEL) would reside in the shelter, and would travel inside an additional "shield vehicle" to disguise the location of the TEL.

The Air Force estimates the cost of deploying the baseline MX missile system to be about $28.6 billion in constant fiscal year 1978 dollars. Using CBO inflation estimates, this would represent approximately $40.7 billion in constant fiscal year 1982 dollars. This estimate includes funding for development, procurement, and military construction; it does not, however, reflect any operating and support costs. The total also does not include the cost of military personnel involved in development and production, Department of Energy costs for production of the warheads, community impact assistance funding, or certain overhead costs traditionally not charged to weapons development and procurement programs.

Of this $40.7 billion in fiscal year 1982 dollars, development and procurement of the MX missile itself would account for about $11.4 billion, or 28 percent. Military construction costs would total approximately $12.6 billion, or 31 percent. The remaining $16.7 billion (41 percent) represents other basing-related costs, such as vehicles, support equipment, power, physical security, and command, control, and communications.

Validity of the Cost Estimates

CBO has not attempted independent cost estimates of the MX weapon system, which would be beyond its resources. A few independent checks of the Air Force's constant-dollar cost figures have already been made, however. CBO's review of two of these studies, and of other Air Force documents, forms the basis of the following remarks.

A consensus appears to exist among both civilian and military analysts that estimates of development and procurement costs for the missile itself will prove to be reasonably accurate. Most of the technological and cost uncertainty in the program involves the basing system, including military construction.

The ICA Review. This consensus was reflected in the results of an "independent cost analysis" (ICA) of the MX weapon system conducted by the Air Force in late 1979 with the participation of the Army Corps of Engineers. The panel conducting the study was to examine the costs of the Air Force's system design; it was directed not to review the system's requirements or technical adequacy. The ICA panel examined the cost estimates for the MX system in the "racetrack" configuration, which was the preferred design at the time of the review.

The ICA panel produced a cost estimate for the development and procurement of the MX missile itself, and the Army Corps of Engineers developed a separate estimate for the military construction costs of the system. As noted above, these two areas represent approximately 59 percent of the total cost of deploying the current linear-grid/loading-dock system baseline. While the ICA panel did not generate independent estimates for the remainder of the system, consisting of basing-related items, it did review the Ballistic Missile Office's cost estimates in most of these areas for "sufficiency." The panel examined the costing methodology used by the Air Force and, where possible, ran independent spot checks on individual system components.

The ICA panel's estimate of the cost of developing and procuring the MX missile itself was about 5 percent lower than that derived by the BMO. The panel concluded that the BMO estimates of the MX missile costs might even be high, and that there was little risk that the costs associated with this aspect of the program would escalate substantially. In contrast, the Army Corps of Engineers' estimate of military construction costs for the MX weapon system totaled 14 percent higher than that of the BMO. 2/ The Corps also expressed its opinion that the shelter construction schedule required by the dates set for initial and full operational capability was shorter than the schedule the Corps would have set. The Corps indicated that the accelerated construction rate required could lead to cost escalation in excess of its own baseline estimate. 3/ A 14 percent increase in MX

2/ Because of a misunderstanding between the Corps of Engineers and the Air Force about the design of horizontal shelters and their closures and associated roads, the initial Corps of Engineers' estimate was 25 percent higher than the BMO's. This misunderstanding was subsequently reconciled, with a downward revision of the Corps' estimate.

3/ Land withdrawal proceedings might delay the initial operational capability date. Should this occur without revision of the 1989 completion date, further acceleration of the construction rate would be required. In its February 1981 report, the General Accounting Office (GAO) indicated that the anticipated date for land availability had been slipped by eight months to April 1982, and that the Air Force had not yet revised its previous date of January 1982 for beginning MX site preparation. GAO hence considered the July 1986 initial operational capability date as "questionable." General Accounting Office, The MX Weapon System: Issues and Challenges, MASAD-81-1 (February 17, 1981), p. 7.

construction costs over those in the current linear-grid/loading-dock baseline could total approximately $1.8 billion in constant fiscal year 1982 dollars.

The DSB Review. Selected MX military construction costs were also examined as part of a Defense Science Board (DSB) review of the MX system in the spring of 1980. Like the ICA team, the DSB panel examined construction cost estimates for the then-preferred racetrack basing design, rather than for the present linear-grid/loading-dock configuration. The DSB team concluded that the road and shelter construction costs developed by the Ballistic Missile Office were reasonable. The DSB's estimate of shelter construction costs was approximately 10 percent higher than that of the BMO, however. This 10 percent factor refers only to shelter construction, whereas the Corps of Engineers' estimate was 14 percent higher for the total system construction cost.

Both the DSB and the ICA panels briefly reviewed the cost of the missile transporter vehicles, an area of potential cost uncertainty. For lack of historical experience in building vehicles of this size, procurement cost estimates for the transporters were derived by applying a cost-per-pound factor to the system design. Neither panel produced an independent cost estimate for the transporters, although the DSB reviewer concluded that the BMO estimate of the transporter costs was credible. Both panels expressed the opinion that the development schedule for transporters was too short, leaving little time for full-scale testing.

Since no significant changes were made to the missile in moving from the racetrack configuration to the linear-grid/loading-dock basing design, the ICA's comments on missile costs presumably retain their validity. The transporter vehicles were redesigned, however, and their estimated costs increased sharply. The change in basing design resulted in a large decrease in military construction costs, primarily because the designated transportation railway network was deleted and because road and shelter door costs were reduced. The decrease in military construction costs was almost totally offset by the addition of mass simulators to the system baseline, and the increase in transporter costs. As a result, the total MX weapon system cost remained constant even though the basing configuration was changed.

Any further changes in the MX baseline design will affect the cost of the system. The addition of new requirements would increase system costs, but this might be offset, at least in part,

by further revisions to the baseline. Indeed, the House Appropriations Committee has identified in a recent report a number of elements that might be reduced or eliminated from the MX system, resulting in considerable cost savings. 4/

Conclusion

In summary, the Air Force baseline system of 200 MX missiles in 4,600 shelters would cost about $40.7 billion in constant 1982 dollars for development, procurement, and military construction. Costs for the MX missile itself are unlikely to grow substantially, but there is more chance of escalation in the other costs, particularly the military construction costs.

MX ACQUISITION COSTS IN CURRENT DOLLARS

CBO obtained the program cost for the linear-grid/loading-dock baseline in constant fiscal year 1978 dollars from the Air Force and converted these constant dollars into the current-year dollars that ultimately appear in budget documents. This conversion reflects both inflation estimates and outlay (or spend-out) rates.

This conversion shows that the total cost of the Air Force MX baseline in current dollars using CBO inflation and outlay assumptions is $57.2 billion. These funds would be spent over the next decade. This is only slightly higher than the $55.4 billion shown on the Congressional Data Sheets and the $55.6 billion if Air Force economic assumptions are used to convert the Air Force baseline into current dollars.

In doing this conversion, CBO found several anomalies:

- The most recent Congressional Data Sheets for the MX program combine the costs associated with the linear-grid/loading-dock system for fiscal years 1982 and 1983 with the costs of the outdated racetrack system for fiscal years 1984 through 1986.

4/ The report recommended deletion of improvements to the MK-12A reentry vehicle's fuse, reduction of the total number of missile transporters, and elimination of special barriers and viewing ports that had been included in the system to aid SALT verification. See Procurement Practices of the Department of Defense, Surveys and Investigations Staff, House Appropriations Committee (March 17, 1981).

- The hybrid schedule shifts $1.5 billion in budget authority from fiscal years 1984-1986 to 1987 and beyond.

- The hybrid schedule shifts $0.9 billion among the accounts in fiscal years 1983-1986 in a way that would shift outlays from earlier to later years.

- The Air Force uses outlay rates for the MX program that differ from those published officially by the Department of Defense (DoD), with the effect that outlays are shifted from the early years of the MX program to the later years.

- These and other minor discrepancies made it difficult to reproduce the Congressional Data Sheets.

Calculation of MX Costs from the Air Force Cost Baseline and Comparison with the Congressional Data Sheets

In reviewing the DoD MX cost estimates, CBO examined the economic assumptions and methodology that DoD used to create the most recent official statement of MX investment costs--the Congressional Data Sheets published in support of the January 1982 Carter Administration budget.

The Air Force provided CBO with the Air Force cost baseline in 1978 dollars and a set of economic assumptions that the Air Force stated were used to create the Congressional Data Sheets from the constant-dollar baseline. Using these economic assumptions and the Air Force baseline, CBO computed the program by individual appropriation and compared its results with the Congressional Data Sheets. This is summarized in Table 1.

While the results for fiscal years 1982 and 1983 show good agreement, those for the 1984-1986 program do not. From this it appeared that the MX constant-dollar baseline had not been used to create the official DoD MX cost estimate for fiscal years 1984-1986.

CBO was subsequently informed by the Air Force that the costs for fiscal years 1984-1986 did not correspond to the current linear-grid/loading-dock baseline, but were drawn from the earlier racetrack system program. The Air Force representatives stated that the Air Force had attempted in October 1980 to secure from the Office of the Secretary of Defense (OSD) approval of action to incorporate the new (post-April 1980) linear-grid/loading-dock

TABLE 1. MX PROGRAM BY FISCAL YEAR, COMPARING AIR FORCE 1978 DOLLAR BASELINE WITH 1981 CONGRESSIONAL DATA SHEETS, BY APPROPRIATION (In millions of current-year dollars)

Appropriation	1981 and Before	1982	1983	1984	1985	1986	To Completion	Total
Research, Development, Test, and Evaluation, AF								
Air Force Baseline a/	2,311.1 b/	2,388.2	2,253.4	1,777.4	1,063.9	457.7	16.4	10,268.1
Congressional Data Sheets	2,311.1	2,408.7	2,278.8	1,707.7	1,000.9	558.9	333.7	10,599.8
Difference	--	- 20.5	- 25.4	+ 69.7	+ 63.0	- 101.2	- 317.3	- 331.7
Aircraft Procurement, AF								
Air Force Baseline a/	--	--	76.6	160.1	141.6	117.0	95.4	590.7
Congressional Data Sheets c/	--	--	--	--	--	--	--	--
Difference	--	--	76.6	+ 160.1	+ 141.6	+ 117.0	+ 95.4	+ 590.7
Missile Procurement, AF								
Air Force Baseline a/	--	--	1,823.6	4,517.2	5,897.8	5,940.5	7,653.8	25,832.9
Congressional Data Sheets	--	--	1,776.2	4,033.8	5,052.9	5,342.0	9,494.6	25,699.5
Difference	--	--	+ 47.4	+ 483.4	+ 844.9	+ 598.5	-1,840.8	+ 133.4
Military Construction, AF								
Air Force Baseline a/	178.6 b/	528.5	1,983.7	2,904.3	3,781.4	4,175.9	5,331.3	18,883.7
Congressional Data Sheets	178.6	521.3	1,983.7	2,715.3	4,450.7	4,615.7	4,632.2	19,097.5
Difference	--	+ 7.2	--	+ 189.0	- 669.3	- 439.8	+ 699.1	- 213.8
Totals								
Air Force Baseline a/	2,489.7 b/	2,916.7	6,137.3	9,359.0	10,884.7	10,691.1	13,096.9	55,575.4
Congressional Data Sheets	2,489.7	2,930.0	6,038.7	8,456.8	10,504.5	10,516.6	14,460.5	55,396.8
Difference	--	- 13.3	+ 98.6	+ 902.2	+ 380.2	+ 174.5	-1,363.6	+ 178.6

a/ Computed by CBO using Air Force economic assumptions.

b/ Spread not available; assumes Air Force Data Sheet is correct.

c/ Not included in Congressional Data Sheets.

baseline in the Congressional Data Sheets material, and that OSD had approved changes only in the 1982 and 1983 numbers, thus leaving the outdated racetrack program costs for fiscal years 1984 through 1986.

Effects of Outlay Assumptions on MX Program Costs

The outlay factors that the Air Force used to prepare its submission for the Congressional Data Sheets appear to differ from the official OSD factors that were published in the Financial Summary Tables of the Department of Defense, January 15, 1981, Tab O. In particular, if the Air Force assumptions for outlay rates for 1981 and beyond are used, the MX program would spend out more slowly over early years, and spending would be extended over a greater number of years than with either the OSD factors or the CBO factors (see Table 2). The net effect of using the Air Force's outlay assumptions, rather than the OSD factors, is to increase slightly the total reported costs in current dollars. This occurs because the slower spend-out means more money

TABLE 2. PERCENTAGE OF BUDGET AUTHORITY SPENT IN FIRST TWO YEARS

Appropriation	Using OSD Factors	Using Air Force Factors	Using CBO Factors
Missile Procurement, Air Force	63	43	68
Military Construction, Air Force	50	45	43
Research, Development, Test and Evaluation, Air Force	94	91	92
Aircraft Procurement, Air Force	52	47	54

must be included to pay for future inflation. 5/ Use of Air Force outlay assumptions also reduces the outlays attributable to the MX in the early years of the program.

MX Baseline Costs Using CBO Economic Assumptions

CBO converted the Air Force baseline into current dollars using its own economic assumptions (see Table 3). The CBO estimates are close to the Air Force estimates because much higher CBO inflation rates are partially offset by faster spending due to use of CBO outlay rates.

It should be noted that these estimates, which incorporate assumptions concerning outyear estimates of inflation, are subject to considerable uncertainty because of the difficulty in projecting future patterns of inflation. The most fruitful use that can be made of them is to compare the individual estimates with one another rather than viewing the totals as firm absolute costs.

EFFECT OF INCREASES IN ANTICIPATED SOVIET THREAT ON MX SYSTEM DEPLOYMENT COSTS

As indicated in the first section, the baseline MX weapon system consists of 200 MX missiles deployed in a complex of 4,600 horizontal concrete shelters. It is designed so that approximately half (or 100) of the MX missiles might be expected to survive an attack by a Soviet intercontinental ballistic missile (ICBM) threat constrained by SALT II limitations.

The MX system is scheduled for full operational capability in 1989. In the absence of SALT constraints, however, the Soviet Union might possess enough accurate ICBM weapons by 1990 to target at least one on each MX shelter. If, in the face of an increased Soviet threat, the United States still wanted approximately 100 MX missiles to survive an attack, it would have to choose between increasing the number of shelters and missiles in the system, defending the system with a Low Altitude Defense System (LoADS),

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5/ More money is needed under the Air Force assumptions, both because the spend-out rate is lower in the early years and because the spend-out occurs over one or two more years.

TABLE 3. INVESTMENT COST OF MX BY FISCAL YEAR (In millions of current-year dollars)

	1981 and Before	1982	1983	1984	1985	1986	To Completion	Total
January 1981 Congressional Data Sheets	2,490	2,930	6,039	8,457	10,504	10,517	14,460	55,397
Air Force Baseline Using Air Force Economic Assumptions	2,490	2,917	6,137	9,359	10,885	10,691	13,097	55,575
Air Force Baseline Using CBO Economic Assumptions	2,490	2,960	6,229	9,470	11,130	11,099	13,837	57,215

or both. 6/ The United States would have to begin modifying the system in anticipation of the increased Soviet threat so that the expanded or defended MX system would be in place when the threat was deployed.

This section of the paper addresses the effect on MX system deployment costs of threat levels greater than those used in deciding upon the currently proposed system size. It assumes that at any given threat level the United States would plan to deploy a system such that 100 MX missiles would be expected to survive an attack. Deployment of the current baseline MX system configuration, described in the first section of the report, is also assumed. This basing mode is now under review, however, and a new (or modified) basing design could be adopted within a few months. In that case, system acquisition costs could change significantly. Moreover, costs in this section are subject to important uncertainties that are discussed more fully below.

Projection of Future Soviet Threat Levels

Any projection of Soviet ICBM warhead levels 10 to 15 years in the future is necessarily highly speculative. Such a projection involves estimates of Soviet production capability and assumptions about Soviet intentions. It also requires making a critical assumption about the existence or absence of future SALT constraints; such constraints could severely limit the anticipated threat. For this reason, CBO has chosen to examine the general trends in system cost as a function of a range of threat levels. Particular attention is paid, though, to the threat levels projected by the Office of Technology Assessment (OTA).

6/ If a minimum of 100 missiles is required to survive, a larger system deployment is needed than if the expected value of MX survivors is 100 (meaning that there is approximately an even chance that the actual number of survivors would fall either above or below 100). It is possible that, in the face of an increasing Soviet threat, the United States would be willing to accept far fewer than 100 surviving missiles. Indeed, some MX proponents argue that even if the expected number of survivors would be zero, the Soviet Union would be deterred from attacking the United States if it had to exhaust its entire ICBM arsenal in attacking U.S. land-based missiles. Others, however, argue that the United States might want more than 100 survivors with which to attack Soviet ICBM silos.

In a March 10 briefing on MX missile basing options, OTA projected that the Soviet Union might possess enough "counter-force" ICBM warheads by 1990 to allocate about 7,000 against the MX system, even after setting aside two warheads for every Minuteman silo and a number of other unspecified U.S. targets. 7/ OTA made a similar projection for the 1995 Soviet threat, indicating that by that time the Soviet Union might be expected to devote as many as 12,000 ICBM warheads to attacking the MX system alone.

Least-Cost MX System Configurations Corresponding to Increased Soviet Threat Levels

In performing this analysis, CBO has employed a methodology developed by the Air Force for determining the least costly mix between shelters and missiles for a particular threat level, using as a data base Air Force estimates for marginal shelter and missile costs. 8/ CBO has also examined MX configurations that would include the Army's proposed LoADS ballistic missile defense system, recognizing that testing and deployment of a mobile LoADS system would require abrogation of the 1972 Anti-Ballistic Missile (ABM) Treaty. 9/ Cost-estimating relationships used here for the LoADS system were developed by the Army, and have not been independently evaluated by CBO.

7/ These counterforce warheads are assessed to have a combined accuracy, yield, and reliability sufficient to produce an 85 percent chance of destroying a shelter with each warhead. The OTA briefing does not give any estimate of how many other Soviet ICBM warheads--presumably not as well suited for destroying hardened shelters--would be available for other missions.

8/ See the first section of this report for a discussion about uncertainty in the projected costs of the baseline MX missile system. CBO has not attempted an independent evaluation of these costs.

9/ The LoADS concept proposed by the Army would consist of one defense unit deployed near each MX missile. Like the missiles themselves, the defense units would be mobile, and would move among shelters once or twice a year (whenever the MX missiles were moved). The true locations of the defense units, like those of the missiles, would be hidden from the Soviet Union.

It should be noted that the model used to determine the least-cost solutions identifies rough cost levels for the MX system. It does not provide detailed breakdowns of categories of costs (research and development, procurement, etc.). In addition, the data base used by the model was derived from estimates of the previous racetrack system costs. The Air Force has informed CBO, however, that the cost estimates produced by the model are reasonable for use in comparing costs of alternative systems under the current linear-grid/loading-dock concept. Indeed, the model's estimates fell within 10 percent of the cost of the current version of the MX system on several test runs performed using the Air Force's more detailed model.

If the United States decided to expand the size of the MX system in anticipation of the 1990 OTA-projected threat (7,000 warheads allocated to the MX system), the least costly mix between missiles and shelters to provide 100 expected MX missile survivors would be about 325 missiles and 8,570 shelters. Development, procurement, and construction costs for a system this size could total approximately $59 billion in constant fiscal year 1982 dollars. This is higher than the $40.7 billion in constant 1982 dollars for the Air Force's baseline program of 200 MX missiles and 4,600 shelters. 10/ (Costs of the expanded system could, of course, be significantly higher because system construction would have to be accelerated to meet the 1990 threat. The $59 billion estimate does not account for such an acceleration.)

If, on the other hand, the United States deployed LoADS to defend the MX system against the 1990 OTA-projected threat, deployment of 225 missiles and 5,370 shelters along with 225 defense units would represent the least-cost solution. Total acquisition costs for this system would amount to roughly $53 billion, or about 10 percent less than an undefended system for the same threat level.

Designing an undefended MX system in anticipation of the 1995 OTA-projected threat (12,000 warheads dedicated to destruction of the MX system) would require tripling the number of

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10/ This cost does not include any operating and support costs, nor does it comprise Department of Energy costs for warhead development and production. Unless otherwise noted, all costs in this report refer to acquisition costs (development, procurement, and military construction costs), in terms of constant fiscal year 1982 dollars.

shelters in the baseline. This would result in a least-cost system of about 410 missiles and 13,510 shelters at a cost of $79 billion. It appears more likely, however, that the United States would decide to abrogate the ABM treaty if faced with the prospect of this very high threat level, and would deploy defense units. 11/ Given this decision, the least-cost defended system would be 265 missiles and 8,150 shelters with 265 defense units. Such a system would cost approximately $65 billion to deploy, representing an 18 percent saving over the cost of an undefended system.

Figure 1 demonstrates the general relationship between possible threat levels and the price of least-cost MX system configurations for both defended and undefended systems.

Implications of Ballistic Missile Defense Deployment

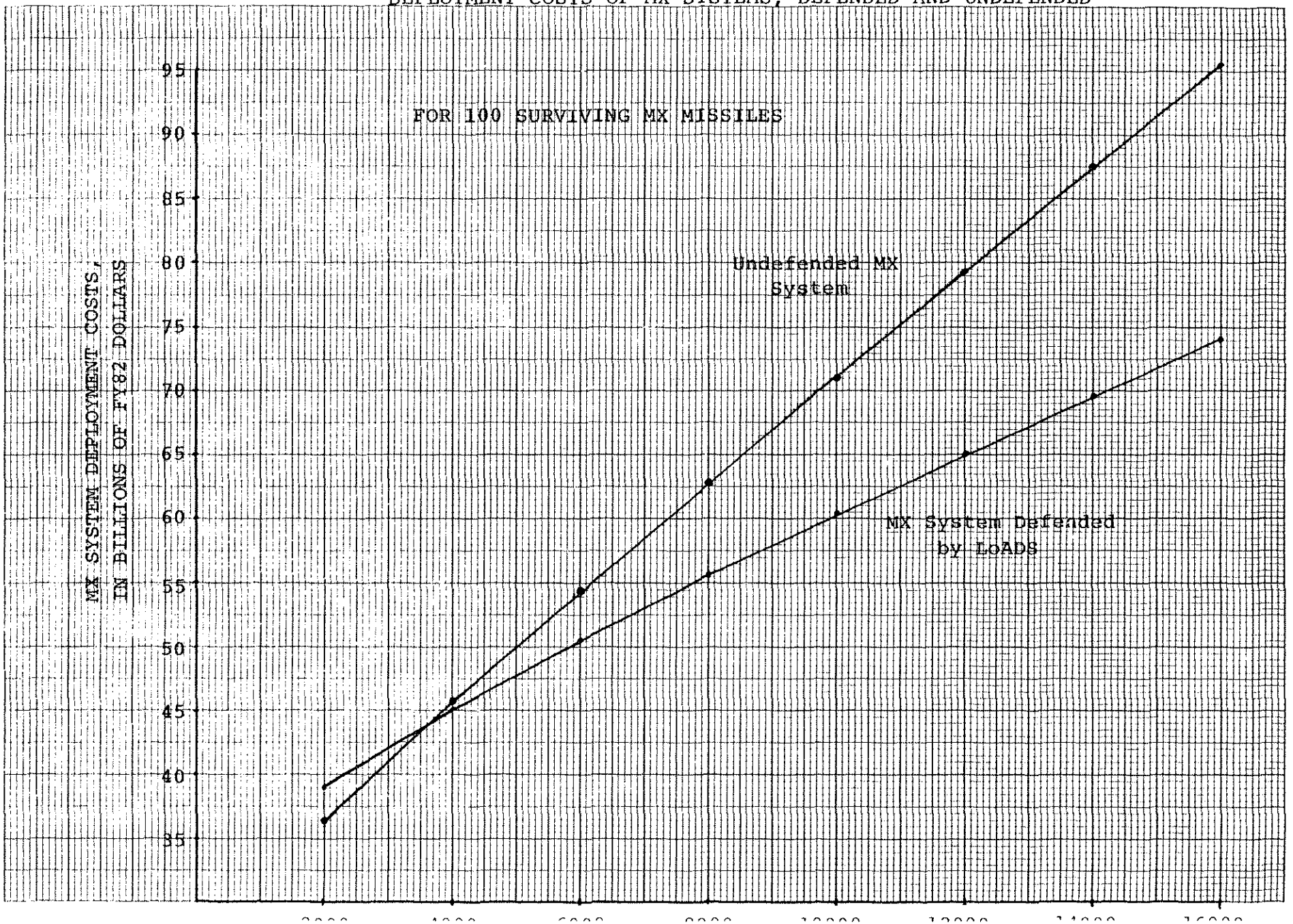
As shown in the figure, deployment of ballistic missile defense units could greatly decrease the total cost of the MX system, especially at high threat levels. The 1972 Anti-Ballistic Missile Treaty specifically prohibits the development, testing, or deployment of ballistic missile defense systems or components that are mobile land-based, however. Testing of LoADS in a mobile mode would constitute a clear violation of the treaty. 12/ At some point in the engineering development of LoADS, therefore, it would become necessary to abrogate, modify, or withdraw from the treaty. 13/

11/ In his March 12, 1980, testimony before the Research and Development Subcommittee of the Senate Armed Services Committee, then Under Secretary of Defense William Perry stated that Soviet deployment of more than twice the number of ICBM warheads permitted under SALT II could drive the United States to defending the MX system.

12/ Deployment of LoADS would violate other provisions of the treaty as well. The first violation would come, though, when the developmental LoADS unit or any of its components became demonstrably mobile.

13/ The ABM treaty states that either the United States or the Soviet Union can withdraw from the treaty if "extraordinary events" jeopardize a country's supreme interests. Six months' prior notification is required, however, before withdrawal.

FIGURE 1. RELATIONSHIP BETWEEN ANTICIPATED THREAT LEVELS AND DEPLOYMENT COSTS OF MX SYSTEMS, DEFENDED AND UNDEFENDED



Departure from the ABM treaty could have an important impact on the structure of U.S. offensive strategic forces if the Soviet Union in turn decided to deploy ballistic missile defenses on a large scale. In that case, the United States might be faced with the unpleasant choice of either greatly increasing the number of missile warheads in the U.S. land- and sea-based forces--in the hope of "flooding" Soviet defenses with more warheads than they could destroy--or developing and deploying maneuvering warheads that could evade the Soviet defenses. Either path would prove costly.

Uncertainties in System Costs and Deployment Timing

It should be stressed that a great deal of uncertainty surrounds the costs of greatly expanded or defended MX systems. The first section of this report identified areas of uncertainty that are considered to exist even in the costs of the current baseline MX system of 200 missiles and 4,600 shelters. These uncertainties could be magnified greatly in the case of substantial expansion of the size of the system or acceleration of the rate of system deployment, especially if scarcity of critical resources (such as labor, water, concrete, or other materials) resulted in increased construction costs. It is possible, on the other hand, that longer production runs and economies of scale could tend to lower the costs of some items, but the net effect is likely to be an increase in costs not reflected in the costs in this report. The LoADS ballistic missile defense system is another source of cost uncertainty. Because the system has not entered full-scale engineering development and is quite far from a production decision, the cost of developing and deploying defense units is certainly subject to substantial revision.

The timing of system deployment would also be a critical consideration. In order to maintain the survivability of the MX system, expansion or defense of the system would have to be complete before an increased Soviet threat was in place. In the case of expanded systems, this could require a significant increase in shelter construction rates over that planned for the current baseline system. The current baseline system, for example, assumes construction of 4,600 shelters over a period of five years (1985 through 1989); expansion of the system to respond to the 1990 OTA-projected threat would entail completion of almost 8,600 shelters in just six years. Even if the required acceleration in shelter construction could be achieved, it might cause an increase in average shelter construction costs.

The relative timing of LoADS deployment would be critical as well. If the MX system depended upon LoADS for its survivability, and if deployment of the defense units did not keep pace with shelter and missile deployment, the system would be vulnerable until LoADS reached full operational capability. It might then become necessary to field additional shelters and missiles until LoADS was ready. Delays in LoADS deployment relative to the rest of the system could thus erode the savings that would stem from deploying a defended system.

Conclusion

Anticipated increases in the Soviet ICBM threat clearly would require either expansion or defense of the MX system if the United States wished to maintain the survivability of the system. Either expansion or defense would significantly increase MX costs. It must be recognized, however, that a major buildup of warheads would also prove quite costly to the Soviet Union. Any such decision would have to be taken in the context of other Soviet military requirements and in view of their domestic economic constraints. Moreover, a major expansion of the Soviet threat would demand that the United States consider alternatives other than a simple expansion of MX, which could alter the results in this paper.