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BY THE COMPTROLLER GENERAL

21 **Report To The Congress.** 2

OF THE UNITED STATES

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B.S.

6 **The MX Weapon System:  
Issues And Challenges,**

**LEVEL II**

The MX weapon system is 1 year into full-scale development. Progress has been made, but the Department of Defense still faces major challenges in achieving cost, schedule, and performance goals.

The MX weapon system is designed to be able to respond to an increased threat. The system can be expanded by adding missiles, shelters, and/or a ballistic missile defense. In the absence of an arms limitation agreement, however, it is not possible to accurately forecast the future Soviet threat; thus, the ultimate size and cost of the MX system cannot be predicted.

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COMPTROLLER GENERAL OF THE UNITED STATES  
WASHINGTON, D.C. 20548

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To the President of the Senate and the  
Speaker of the House of Representatives

This report presents our views on the major issues  
concerning the development and acquisition of the MX  
weapon system.

For the past several years, we have reported annually to  
the Congress on the status of selected major weapon systems.  
This report is one in a series that is being furnished to the  
Congress for its use in reviewing fiscal year 1982 requests  
for funds.

We are sending copies of this report to the Director,  
Office of Management and Budget, and the Secretary of Defense.

*James B. Heath*  
Comptroller General  
of the United States

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D I G E S T

Progress has been made during the first year of full-scale development of the MX weapon system--particularly in missile development. The Department of Defense, however, is faced with a tremendous management challenge in directing and coordinating several parallel efforts involving the missile, ground systems, facilities, and land withdrawal issues. Achievement of cost, schedule, and performance goals will be difficult because:

- New requirements could increase costs by about \$700 million (1978 dollars). Costs could be increased further when system requirements are finalized, developmental specifications are completed, and force size is determined.
- Performance requirements for development of many ground mechanical and electronic systems have not yet been finalized.
- Slippages in some milestones may impact on obtaining land for MX, thus increasing the risk of not meeting the initial deployment date.

Air Force program office estimates indicate that the cost to develop, acquire, and operate MX until the year 2000 will be about \$34 billion (1978 dollars). This includes the new requirements discussed above. With Defense inflationary adjustments, this estimate increases to about \$70 billion. The estimate does not include the Department of Energy costs for warhead development, acquisition, and maintenance.

Although Defense has approved new requirements estimated to cost \$700 million, there has been no change in the life-cycle cost estimate. Defense stated that every effort will be made to offset cost increases by cost reductions in other areas. (See pp. 4 and 5.)

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MX costs could increase substantially by force size expansion, split basing, incorporating all-weather capability, and adding a survivable two-way direct communication capability. (See pp. 6 and 7.)

MX is designed to provide a certain number of surviving reentry vehicles assuming a threat constrained by the unratified Strategic Arms Limitation treaty. Without a treaty, the Soviets could build enough weapons to neutralize MX. MX could then be expanded to counter that threat--at considerable cost--by adding missiles, shelters, and/or a ballistic missile defense. The Congress should be aware that it is not possible at this time to predict the ultimate size of the deployment area, the number of missiles and shelters, or the cost of MX. (See pp. 9 to 11.)

The primary method of Strategic Arms Limitation treaty verification should prevent undetected deployment of additional missiles. Some of the additional verification features in the MX design--especially the view ports--appear unnecessary. (See pp. 11 to 13.)

The Air Force's Strategic Air Command assessed existing military bases in Nevada and Utah and concluded that neither land nor facilities were available for an MX operating base. However, excess land at Nellis Air Force Base was not included in the assessment. Further, consideration was not given to placing part of the facilities on existing bases. (See p. 28.)

The Air Force is considering options that would enhance its ability to take actions that may be necessary to protect location uncertainty. Some of these options could be construed as restrictions on public access or activities, but no final decisions have been made. This issue should be resolved so the full implications of public access can be addressed in congressional deliberations on the legislation to withdraw land for MX deployment. (See pp. 29 and 30.)

GAO recommends that the Secretary of Defense:

- Restudy the need for MX verification features. The results of this study should be provided to the Congress, along with information previously requested by the Congress on the cost of view ports. (See p. 14.)
- Have an independent assessment made and inform the Congress of the feasibility of placing one of the operating bases on excess Federal land at Nellis Air Force Base. If not feasible to locate an entire MX operating base at Nellis, the potential for siting some MX facilities at existing military bases should be examined. (See p. 32.)
- Inform the Congress of how the Air Force will enforce measures to assure the preservation of location uncertainty, including an identification of any new laws or changes to existing laws that may be required. (See p. 32.)

GAO did not request official comments on this report because of the tight reporting deadline. Instead, a draft of this report was discussed with high level officials associated with management of the program to assure that the report is accurate and complete. Their points of view are included where they differ with GAO's.

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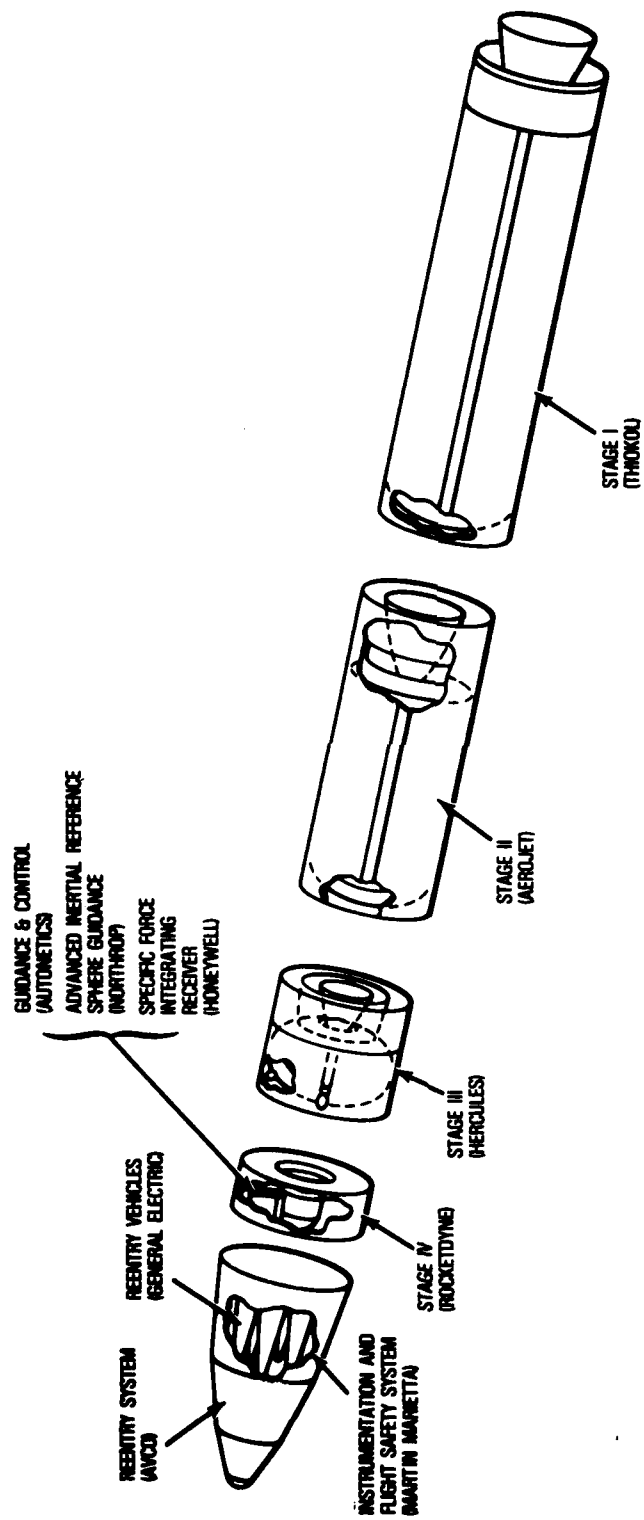
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ABBREVIATIONS

DOD	Department of Defense
GAO	General Accounting Office
ICBM	intercontinental ballistic missile
SAC	Strategic Air Command
SALT	Strategic Arms Limitation Talks



# MX MISSILE

(COURTESY OF U.S. AIR FORCE)

## CHAPTER 1

### INTRODUCTION

The U.S. strategic nuclear forces consist of submarine-launched ballistic missiles, manned bombers, and intercontinental ballistic missiles (ICBMs). Since the 1960s, this Triad of nuclear forces has contributed to achievement of the primary objective of the Nation's strategic forces--deterrence of nuclear war. The Department of Defense (DOD) has noted that in the next few years the Soviet Union, with increasing numbers and improving accuracy of its ICBM warheads, will be able to attack and destroy most of the U.S. silo-based ICBMs with a small fraction of its ICBM force.

After analyzing the alternatives available, DOD concluded that the Triad must be retained and the capability of the ICBM force enhanced. DOD concluded that the MX weapon system with improved missile capabilities and a survivable basing mode was the best solution. Full-scale engineering development began in September 1979.

In April 1980 the Secretary of Defense notified the Congress of major refinements to the basing design selected for full-scale development. These refinements were:

- A change in the transportation network between assembly area and deployment area from railroad to road.
- A switch from an integral transporter-erector-launcher vehicle to separate transporter and launcher vehicles.
- A change in the method of launch: the missile will be launched by the mobile launcher with the physical support of the horizontal shelter. Previously, the missile was to be launched from the transporter-erector-launcher--the shelter had no role in the missile launch process.
- A deletion of the separate shield vehicle because the new transporter shields the launcher from observation when it is outside the shelter.
- An addition of simulators to the production baseline.
- A deletion of the capability to dash from shelter to shelter. However, the ability to dash from

road to shelter and insert the missile during flight time of incoming missiles was retained.

--A reduction in shelter size.

--The minimum spacing between shelters was changed from 7,000 to 5,000 feet.

--The number of shelters that could be built in each cluster was changed from 23 to either 34 or 35 to allow for a potential future threat.

In May 1980 the shelter layout pattern was changed from a closed loop to a linear road system.

This report discusses the tremendous challenge faced by DOD in directing and coordinating several parallel efforts involving the missile, ground systems, facilities, and land withdrawal issues to meet cost, schedule, and performance goals. A description of the system is in appendix I.

#### PROGRAM MANAGEMENT

The Ballistic Missile Office, Norton Air Force Base, California, is responsible for managing the MX program and is the integrating agency for contractor activities. The Defense and Space Systems Group of the TRW Corporation supports the program office with system engineering/technical assistance. Contractors developing some of the major MX components are listed in appendix II.

During fiscal year 1980, an organizational structure was established to manage MX siting and construction activities and to help mitigate anticipated socio-economic impacts of MX deployment. The organizations involved are the Air Force Regional Civil Engineer-MX, the Army Corps of Engineers, and the Office of Economic Adjustment.

#### OBJECTIVES, SCOPE, AND METHODOLOGY

Our objective was to independently review the MX development program to assess DOD's ability to meet acquisition goals. We did not assess the threat to the existing ICBM systems, the need for a new land-based ICBM system, or the validity of the MX cost estimates. With respect to costs, DOD officials advised us that, until a firm baseline is approved, official backup for life-cycle costs will remain internal Air Force data and not available for our review. Thus, although we identified several

issues that will impact costs, we could not fully address the adequacy of estimated MX costs.

In addition, we did not review the activities of the Department of Energy which is responsible for developing, acquiring, and maintaining warheads for MX.

Our work was closely coordinated with the Office of Technology Assessment, the Congressional Budget Office, and the Congressional Research Service. The Office of Technology Assessment, in response to a request of Representative Udall and Senator Stevens, is assessing the technical feasibility, utility, and environmental impacts of various missile basing modes. Accordingly, we did not assess these matters in our study.

We reviewed pertinent documents and held discussions with officials at the Ballistic Missile Office, Air Force Regional Civil Engineer-MX, and Army Corps of Engineers, Norton Air Force Base, California; Rocket Propulsion Laboratory, Edwards Air Force Base, California; Western Space and Missile Center, Vandenberg Air Force Base, California; Tactical Fighter Weapons Center, Nellis Air Force Base, Nevada; Strategic Air Command (SAC) Headquarters, Offutt Air Force Base, Nebraska; Army Ballistic Missile Defense Systems Command, Huntsville, Alabama; Air Force Headquarters, Office of the Secretary of Defense, Office of Economic Adjustment, and the Bureau of Land Management, Washington, D.C.; and selected contractor plants.

We used the results of our oral interviews and reviews of MX documentation to arrive at what we believe to be an accurate assessment of the status of the program. Initial information on specific MX systems/subsystems was obtained at the project office level, then discussed at higher management levels. Where possible, information was obtained from the primary office of responsibility (for example, operational requirements were obtained from SAC). Throughout our review, we compared the results of our analyses with congressional hearings and testimony to obtain added assurance of the accuracy and consistency of data obtained from other sources.

Because of tight reporting deadlines, we did not request official comments on this report. Instead, a draft of this report was discussed with high level officials associated with management of the program to assure that the report is accurate and complete. Their points of view are included where they differ with ours.

## CHAPTER 2

### MX COST AND SCHEDULE ISSUES

In the 1 year since initiating full-scale development, new requirements have been identified by DOD which could increase the life-cycle cost estimate for MX by about \$700 million (1978 dollars). The Air Force, however, is examining ways to accommodate these requirements without increasing costs. Finalizing system requirements, completing developmental specifications, and determining a firm force mix could result in increased costs. In addition, slippages in some milestones may impact on obtaining land for MX deployment. This, in turn, may delay the July 1986 initial deployment date.

#### COST GOALS MAY NOT BE ATTAINABLE

The Air Force life-cycle cost estimate for acquisition and operation of MX is \$33.5 billion (1978 dollars)--\$28.6 billion <sup>1/</sup> for acquisition and \$4.9 billion for operation. New requirements could increase the estimate by about \$700 million to \$34.2 billion as follows:

#### Estimated life-cycle costs (1978 dollars) (note a)

	<u>Billions</u>
Acquisition:	
Development	\$ 6.8
Aircraft procurement	.3
Missile procurement	12.7
Facility design and construction	<u>9.5</u>
Total	29.3
Operations (to the year 2000)	<u>4.9</u>
Total	<u>\$34.2</u>

a/These amounts exclude the Department of Energy costs to develop, acquire, and maintain warheads for MX and impact assistance funds to the areas where MX will be deployed.

1/DOD uses \$33.8 billion (1980 dollars) as the MX acquisition cost in congressional testimony. Some confusion has resulted because the Air Force life-cycle cost for MX in 1978 dollars is almost identical to the DOD acquisition cost in 1980 dollars.

The new requirements accounting for this potential increase are primarily for an upgraded MK-12A fuze and the construction of facilities at the second operating base. However, DOD officials advised us that the MX life-cycle cost estimate has not been increased to reflect these new requirements. Instead, the Air Force is examining alternatives for accommodating the requirements without increasing life-cycle costs. We were advised that although some net cost increases may have to be approved, every attempt will be made to offset these by cost reductions in other areas.

Shifts were also made between the funding categories--without increasing overall costs--as a result of major design refinements announced by DOD in April and May 1980. Some of the most significant changes were a decrease in construction funds because of the reduced shelter size and reduced roads and an increase in procurement funds for the addition of simulators.

The program office has adjusted the estimate of acquisition costs in 1978 dollars to reflect inflationary increases using indices provided by DOD. This adjustment, and DOD adjustments to the operation and maintenance costs, increase the life-cycle cost estimate of MX with the new requirements from about \$34 billion (1978 dollars) to about \$70 billion. <sup>1/</sup> The \$70 billion estimate represents the funding that will be required assuming no future changes develop in cost estimates or inflation indices.

The above program office acquisition estimate was prepared in July 1980 using the April 1980 DOD weighted indices. Separate rates are developed for future years categorized by the various appropriations--development, procurement, military construction, and operation and maintenance. Near term estimated inflation rates used are in the 8.5- to 10.6-percent range. Beyond 5 years, the rates used were 6.7 percent for construction and 6.2 percent for the other appropriation categories. On the basis of past experience, we believe these rates are probably understated. DOD officials have acknowledged that projections of inflation rates have

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<sup>1/</sup>In congressional testimony in March 1980, DOD officials stated that the MX life-cycle cost, with inflationary increases, was \$66.9 billion. This estimate does not include the previously discussed new requirements which, when adjusted for inflation, would increase the cost to about \$70 billion.

historically been low. A schedule of the April 1980 inflation rates used to project MX costs is presented in appendix III.

Costs could increase further because:

- The required number of missiles and shelters is not firm. Current SAC projections indicate the baseline force of 200 missiles and 4,600 shelters may not be adequate.
- Without a Strategic Arms Limitation Talks (SALT) treaty, costs may increase substantially. For example, in appropriation hearings, Air Force officials provided data on cost alternatives to meet a moderate no-SALT threat. For the four alternatives presented, the increased cost for MX ranged from \$13 billion to \$31 billion in fiscal year 1980 dollars.
- The Congress has directed DOD to study the feasibility of split basing. DOD has stated that split basing could increase costs by over \$3 billion.
- The MX transporter and cluster roads are not currently designed to provide an all-weather capability. A preliminary estimate for incorporating this capability into the design of a transporter is about \$600 million. The cost impact on cluster roads has not been calculated.
- The MX system does not currently include a survivable two-way direct communication capability between higher authority and the missile launchers when the airborne launch control centers are not available. This capability is needed for higher authority to obtain the status of the missile force and to obtain acknowledgement of receipt and execution of launch messages. Two alternatives are being considered by the Air Force. One alternative would provide limited short-range capability at an estimated cost of \$100 million. The other alternative would provide extended capability over a wider range of frequencies at an estimated cost of over \$400 million.
- A decision on the number and type of aircraft to be used as airborne launch control centers has not been made. Seven C-130 aircraft are included in the baseline. An increase in the number and a change

in the type of aircraft could increase costs by more than \$100 million.

--Resolution of design uncertainties could significantly impact on ground mechanical and electronic systems costs. (These items are discussed in detail in ch. 4.)

#### DEPLOYMENT IN JULY 1986 IS QUESTIONABLE

In congressional testimony, DOD and Air Force officials stated that MX schedule milestones are extremely tight with little room for slippage. After that testimony, there was an 8-month projected slippage in the selection of the area for MX deployment because of a delay in issuing the environmental impact statement. (This is discussed in more detail in ch. 5.) Despite the slippage, the scheduled date for initial deployment remains unchanged. Some of the current key milestones leading to full deployment in 1989, compared to dates established at the beginning of full-scale development, are as follows:

<u>Milestone</u>	<u>Milestone dates</u>	
	<u>As of Oct. 1979</u>	<u>As of Nov. 1980</u>
Issuance of a draft environmental impact statement	May 1980	Dec. 1980
Issuance of a final environmental impact statement	Sept. 1980	May 1981
Deployment area selection	Oct. 1980	June 1981
Land available	Aug. 1981	Apr. 1982
Begin site preparation	Jan. 1982	(a)
First flight test	Jan. 1983	Jan. 1983
Production decision	July 1983	July 1983
Initial deployment	July 1986	July 1986

a/The Air Force has not yet revised this date.

To meet the above dates, DOD will have to accept risks and overlap of effort. DOD has stated that the program is close to a maximum prudent degree of concurrency. Apparent areas of risk or overlap include:

- Design of roads and utilities that began in November 1980 were based on assumptions of the location of the operating base. The operating base will not be officially selected until June 1981.
- Only a 10-month provision for obtaining land. This process normally takes about 3 years.
- Construction of facilities and roads which will begin at least 1 year before a final decision is made to produce and deploy the system.
- Provisions for only three missile flight tests before a final production decision, and none of these will be from an operationally configured shelter and launcher. Also, no integrated ground tests of the ground mechanical and electronic systems will be made before a production decision.

#### CONCLUSIONS

The cost of new requirements increases the program office life-cycle cost estimate by about \$700 million (1978 dollars) after 1 year of full-scale development. The DOD MX cost estimate, however, has not been increased to reflect the new requirements. Instead, the Air Force is examining ways to accommodate these requirements without increasing costs.

Finalizing system requirements, completing developmental specifications, and determining force size could result in further cost increases. In addition, delays in completing the environmental impact statement have increased the risk of not attaining the July 1986 initial deployment date. In our opinion, special action, such as legislation to expedite the land withdrawal process, may be necessary to meet this date.

### CHAPTER 3

#### IMPLICATIONS OF ARMS LIMITATION AGREEMENTS

##### ON MX DESIGN

The driving need for the MX weapon system is increased survivability to redress the growing vulnerability of the current U.S. silo-based ICBM force. The MX baseline system was designed to provide the necessary survivability assuming the constraints imposed on the Soviets by the unratified SALT II treaty.

Currently, SAC projections indicate the "notional" baseline force of 200 missiles and 4,600 shelters may not be adequate to meet SAC's needs for survivable ICBMs. Further, to maintain survivability in a no-SALT environment, a substantial investment of funding and other resources may be necessary.

The primary method of SALT verification should prevent undetected deployment of additional missiles. Some of the additional verification features in the MX design, especially the requirement for view ports, appear unnecessary.

##### REQUIRED NUMBER OF SURVIVING MX REENTRY VEHICLES IS UNDERSTATED PER CURRENT SAC PROJECTIONS

According to DOD, future U.S. ICBM forces must be able to effectively strike enemy targets after surviving a full-scale attack. Consistent with that objective, the MX weapon system, comprised of 200 missiles and 4,600 shelters, is designed to provide a certain number of surviving MX reentry vehicles. That number was presented by the program office to the first meeting of the Defense Systems Acquisition Review Council which convened in December 1978 to consider advancing the MX into full-scale development; this same number is still being used by the program office for planning purposes.

However, more recent SAC projections indicate that fewer U.S. silo-based ICBMs would survive than initially estimated and that more MX reentry vehicles will be required to retain an equivalent level of surviving ICBM warheads. <sup>1/</sup> The Secretary of Defense has stated that the actual number of surviving MX reentry vehicles, and thus, the number of

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<sup>1/</sup>The required number of additional missiles is classified.

missiles and shelters required, will not be determined until the system advances to the production phase. The Congress, however, in the 1981 DOD Authorization Act, stated that funds are being provided to deploy a MX force of 200 missiles and 4,600 shelters. Further, the public seems to be under the impression that the MX force will consist of 200 missiles and 4,600 shelters.

ICBM SURVIVABILITY WITHOUT LIMITS ON SOVIET  
WARHEADS MAY REQUIRE AN EXPANDED MX SYSTEM,  
A BALLISTIC MISSILE DEFENSE SYSTEM, OR BOTH

The fundamental goal of MX is to deter an attack by forcing the Soviets to expend more ICBM reentry vehicles than the number of U.S. ICBM reentry vehicles they could expect to destroy. The baseline MX weapon system is designed to cope with a certain number of Soviet reentry vehicles as limited by provisions of the unratified SALT II treaty.

In the absence of limitations on reentry vehicles, the Soviets could neutralize the MX weapon system. This could be done by increasing the number of reentry vehicles per missile through substitution of lower yield, lower weight warheads, or by deploying additional missiles using warheads identical to those currently fielded.

If the Soviets choose to escalate the threat, the MX shelter layout is designed to accommodate expansion. The shelter layout consists of 200 clusters on linear roads with 23 shelters per cluster spaced an average of 6,000 feet apart. Each layout, however, provides space for adding 11 or 12 shelters if necessary. Therefore, the MX system could be expanded to 6,900 shelters spaced a minimum of 5,000 feet apart within the boundaries of the deployment area. Because of the reduced spacing, this option would be effective only if the Soviets deployed more warheads with lower yield. If the Soviets deployed more warheads with no sacrifice in yield, additional missiles and more clusters and shelters would be required. This in turn would require additional land.

DOD has also authorized a comprehensive study of a mobile ballistic missile defense system to enhance the survivability of MX. One of our recently issued reports (C-PSAD-81-2, Nov. 12, 1980) discusses issues surrounding the development and deployment of an effective ballistic missile defense system for MX. A follow-on report which discusses technical risks will be issued shortly.

In response to provisions of Public Law 96-107, DOD prepared a report on the capability of MX to survive an increasing Soviet threat. The DOD report examined various combinations of shelters, missiles, and ballistic missile defense--all to be deployed by 1989--at a substantial increase in cost.

DOD concluded that the United States could match any Soviet threat escalation and suggested that if the Soviets agree, this may restrain them from engaging in a strategic weapons race. The DOD conclusion was based on the following premises:

--It would cost no more for the United States to build shelters than for the Soviets to build reentry vehicles/warheads.

--The MX weapon system confronts the Soviets with an adverse exchange ratio of 6:1 to 10:1. If the Soviets added more reentry vehicles to existing missiles, the exchange ratio would be even more in the U.S. favor.

--A ballistic missile defense system could defend the MX shelters at a fraction of the Soviets' cost to increase missiles. 1/

DOD's report did not include an assessment of the practicality of actually implementing the alternatives by 1989. Although the report points out that costs will increase substantially, it does not address (1) the feasibility of obtaining additional land to accommodate up to 4,600 additional shelters, (2) the ability to increase the annual shelter construction rate from 1,150 to 2,000 shelters, or (3) the availability of additional nuclear materials for the MX and ballistic missile defense systems.

SOME VERIFICATION FEATURES  
MAY NOT BE NECESSARY

According to DOD, MX has been carefully designed to be fully verifiable by national technical means, as required by the unratified SALT II treaty. It is hoped that MX verification features will set a precedent to provide assurance that

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1/The deployment of a mobile ballistic missile defense system for MX would require abrogation of the existing antiballistic missile treaty.

any new Soviet mobile ICBM system will be similarly verifiable. Consequently, the design includes some features that are not strictly required for the Soviets to verify MX.

The primary basis for verification is the controlled assembly and introduction of the missile into the deployment area:

--A separate, distinct area is used for missile assembly and for loading the missiles on special vehicles for transport to the missile clusters. In addition, the missile launchers are assembled at the assembly area, shipped to the cluster sites, and remain there throughout their operational life. These activities are designed to be readily observable by satellite photography.

--The assembled missiles are transported between the assembly area and the deployment area via a dedicated transportation network. The transportation network is a system of specially improved roads with sufficient strength and clearances to accommodate the unique size and weight of the special transporter vehicles. This physically limits the potential range of missile locations to areas accessible by the transportation network.

To broaden the verification opportunities, other features have been added to the weapon system design at a cost of about \$1 billion per Air Force estimate. These features include:

--The transportation network being separated from each cluster of 23 shelters by physical barriers that must be removed for delivery of missiles to the clusters. The barriers provide a "seal" which, when altered, leaves an unambiguous signature.

--Two view ports provided on each shelter roof to permit viewing by satellites. At least once a year, the view port covers of each shelter would be removed. In the removal of the view port covers, the 5 feet of earth on top of each has to be removed. Special access roads and equipment are required to remove the view port covers.

The fully assembled launcher can only be moved by the transporter. Physical size, weight, and limited ground clearances confine the transporters to the cluster roads. Physical

separation of the clusters, with barriers on the interconnecting roads, assures that the missiles/launchers cannot be moved among the clusters without leaving a signature.

Since the beginning of full-scale development, there have been some changes to the verification features:

--The designated transportation network has changed from a special and expensive railroad to a paved road.

--The number of view ports has been reduced from four to two.

Also, the Air Force is considering the construction of one barrier to separate all four to six clusters in a valley from the transportation network, instead of one barrier per cluster. DOD officials also stated that use of valley clustering could result in reduced requirements for transporters.

The Congress, in deliberating on DOD's construction appropriation for 1981, questioned the need for the view ports as a verification feature. The Congress recognized that the view ports could be necessary in some SALT scenarios or to support a ballistic missile defense system for MX. The Congress asked the Air Force to provide costs of view ports for 4,600 shelters and stated that the need for view ports would be reviewed with future requests for appropriations.

#### CONCLUSIONS

The Congress and the public seem to be under the impression that MX will consist of 200 missiles and 4,600 shelters. However, current SAC projections indicate that--even within the constraints of the unratified SALT II treaty--a higher number of missiles and shelters may be required to provide the necessary survivability. Without an arms limitation agreement, the survivability of MX will depend on either Soviet restraint or more missiles, more shelters, installation of a ballistic missile defense, or a combination thereof. The Congress should be aware that it is not possible at this time to predict the ultimate size of the deployment area, the number of missiles and shelters, or the cost of MX.

The primary method of SALT verification--controlled assembly and introduction of the missile into the deployment area--should prevent undetected deployment of additional missiles. Some of the additional verification features appear unnecessary. We believe the need for these features should

be reexamined. Of particular concern is the need for view ports--in view of the acquisition and operational costs and the continued environmental impact resulting from annual removal of the earth.

RECOMMENDATIONS

We recommend that the Secretary of Defense restudy the need for MX verification features. The results of this study should be given to the Congress along with information previously requested on the cost of view ports.

## CHAPTER 4

### STATUS OF THE DEVELOPMENT OF THE MX MISSILE

#### AND GROUND SUPPORT SYSTEMS

MX missile development continues to satisfactorily progress toward meeting the first scheduled missile test flight in January 1983. Decisions on various ground mechanical and electronic systems performance requirements and developmental specifications have not been finalized. These decisions are needed to establish firm cost, schedule, and performance goals.

#### MISSILE DEVELOPMENT ON TRACK

The overall MX missile specifications have been well defined, and full-scale development has progressed during fiscal year 1980 toward meeting the first missile test flight schedule. Many tasks, principally modifications of existing missile technologies for use on the MX, are still to be completed. However, the Air Force fully expects to satisfactorily complete missile development during the full-scale engineering development phase. Some development issues were discussed in a previous report on MX. <sup>1/</sup> Other development areas that the Air Force intends to closely monitor include

- the possibility of further missile weight growth,
- the ability to meet guidance and control accuracy requirements, and
- the availability of various essential missile materials.

#### Development issues discussed in our prior report

As discussed in our prior report, the Air Force Rocket Propulsion Laboratory was conducting various development efforts in support of MX. These efforts were the development of an improved stage III extendable nozzle exit cone, the feasibility of a liquid fuel tank for stage IV, and the capability to produce carbon/carbon materials for the stage I propulsion motor nozzle.

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<sup>1/</sup>PSAD-80-29, Feb. 29, 1980.

According to laboratory personnel, the stage III extendable nozzle exit cone and stage IV fuel tank programs have been successfully completed. Further development and testing will be conducted by the appropriate contractors during full-scale engineering development. Delays in work on the carbon/carbon material program, however, have extended the scheduled completion from June 1980 to August 1981. As previously reported, this effort involved the only three vendors capable of manufacturing carbon/carbon material in the required stage I nozzle size. One of these vendors is no longer an active participant in the program. The remaining two vendors have each delivered a carbon/carbon component and these components are in various testing and evaluation phases.

Because of limited manufacturing capacity and incomplete testing activities, uncertainty remains concerning the ability to produce a standardized carbon/carbon product in sufficient quantities to meet the MX deployment schedule. However, laboratory personnel remain sufficiently satisfied with the results of ongoing parallel programs to believe that application of carbon/carbon technology to MX will be a low risk area.

Air Force is monitoring  
missile weight growth

Since March 1979, the various missile subsystems have undergone fluctuations in weight as requirements and design were refined. The current projected overall missile weight of almost 193,000 pounds at initial operational capability is well within the limit of 198,400 pounds. According to Air Force officials, throw weight, not general missile weight, is the major factor influencing missile specifications and eventual performance. While MX throw weight with 10 reentry vehicles is presently acceptable, there have been recent weight increases in throw-weight components, particularly guidance and control. The Air Force recognizes that a continued upward trend in weight could adversely affect missile performance and has established guidelines for monitoring further contractor weight growth proposals and missile weight goals.

Planned development activities  
should continue to improve accuracy

One of the most important MX performance goals is weapon delivery accuracy. The planned MX accuracy requirements represent a significant advancement over Minuteman III capabilities. For example, the guidance and control system

must contend with effects of MX mobility and still provide the means of achieving an improved probability of target destruction. To provide a guideline for measuring satisfactory accuracy development progress, the Air Force has established a theoretical guidance and control accuracy budget. The current guidance and control capability estimate is more than twice the accuracy budget specified for an operational missile. Air Force and contractor officials believe the accuracy estimate is satisfactory at this point of full-scale engineering development and that accuracy improvement will continue until established requirements are met by 1985.

Availability of resources is essential for continued missile development and acquisition

Despite having DOD's highest materials acquisition priority, the Air Force is concerned about the continued availability of essential materials/subassemblies when needed and at currently estimated costs because of

- the number of pending defense and commercial procurement programs scheduled for concurrent development and production,
- the reliance on foreign suppliers for many critical aerospace materials and minerals, and
- the current lack of Air Force procedures for funding procurement phase long lead items while the MX program is in the full-scale engineering development phase.

Cumulative production for proposed defense and commercial aerospace programs are projected to result in a general competition for various critical resources, including large forgings and castings, bearings, machining and manufacturing capability, metals (such as titanium, cobalt, and chromium), semiconductors, and skilled manpower. For example, according to a major aerospace firm, the heavy demand for titanium in early 1980 has resulted in mill lead times of up to 2 years, with almost nonexistent inventories at the distributor level. The price of titanium rose with the increases in lead times.

An example of inadequate manufacturing capability involves the production of an essential solid propellant ingredient. According to Air Force officials, the only two suppliers of this ingredient cannot provide sufficient quantities to meet the combined needs of the space shuttle and MX programs.

Also, the aerospace industry is heavily dependent on foreign suppliers for many essential strategic materials. This dependency has caused increasing concern over future availability and cost. For example, during 1979 the United States imported 100 percent of the raw titanium needed to meet production requirements, and as noted previously, titanium lead times and cost are becoming critical. According to Air Force estimates, each MX missile will require about 894 pounds of titanium. On the basis of an estimated 339 missiles necessary for testing, deployment, and spares, the MX weapon system will use some 150 tons of titanium between 1980 and 1990.

If the recent trend of longer material acquisition lead times continues, most MX missile contractors will have to begin ordering many production articles well before the July 1983 decision to enter the production phase. Failure to assure adequate lead times could adversely affect the overall acquisition schedule. Since the Air Force does not have authority to order long lead production phase items before the production decision, it is recognized that special procurement policies may be necessary to assure timely availability of missile materials. The Air Force is developing procedures to address methods of easing potential shortfalls in required resources.

#### IMPACT OF BASING MODE CHANGES ON MX GROUND MECHANICAL SYSTEMS

The missile transporter vehicle and missile launcher were significantly impacted by the changes to the MX basing mode announced by DOD in April 1980. Major engineering refinements caused by this redirection in basing included a change in the method of launch, separate transporter and launcher vehicles instead of an integral transporter-erector-launcher vehicle, and inclusion of simulators in the production program. These refinements have caused substantial changes to transporter and launcher requirements, and the Air Force has not yet finalized

- the scope of various transporter performance factors,
- the design of the missile launcher, and
- many operational road requirements.

### Missile transporter performance factors

The transporter vehicle (see p. 20) moves the missile launcher or simulator from one shelter to another and to the cluster maintenance facility. It is designed to operate on, and is confined to, the cluster roads.

Currently, the total weight of the transporter with the 500,000 pound launcher or simulator payload is about 1.6 million pounds. This is a significant increase over initial estimates, as shown below:

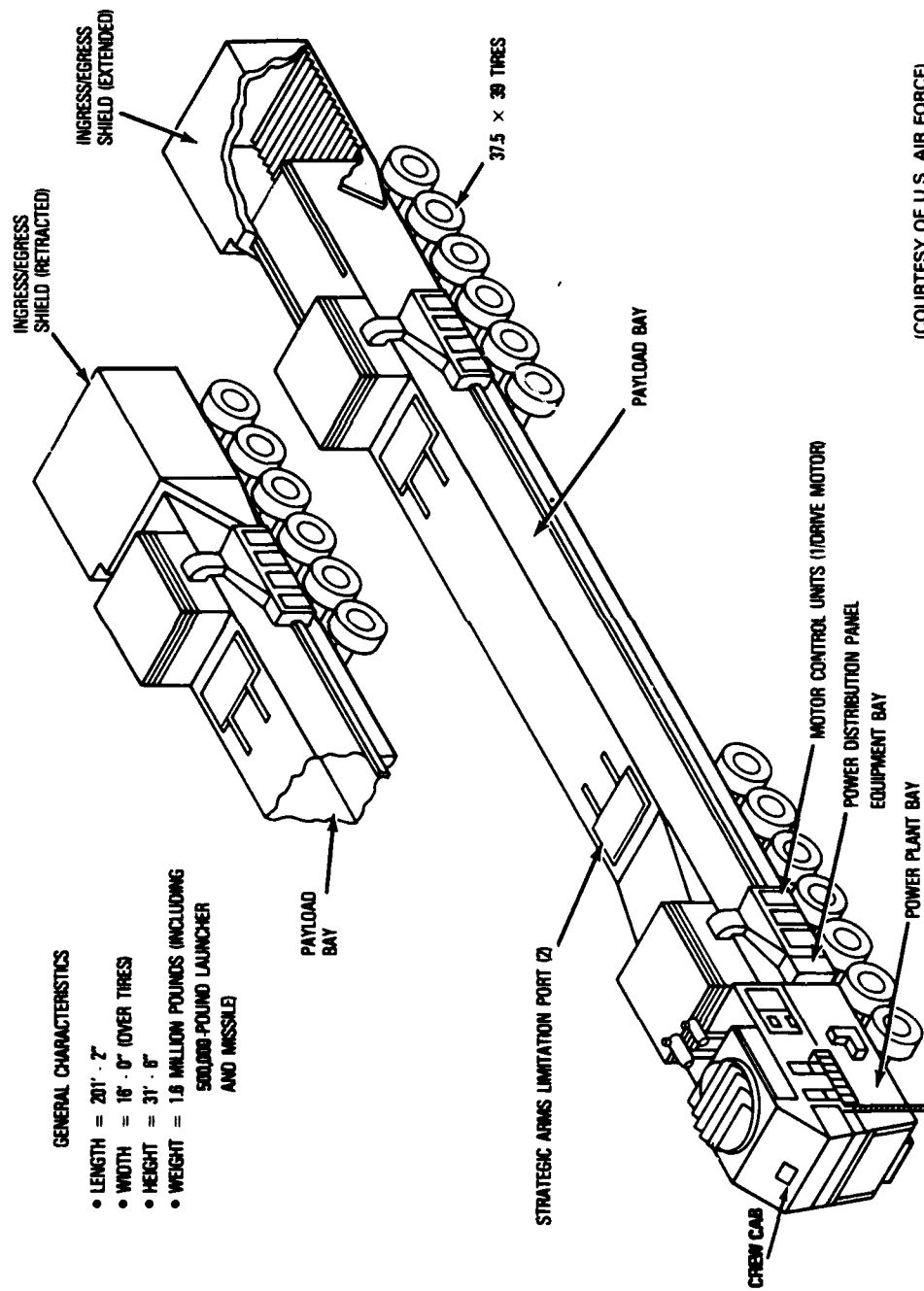
<u>Characteristic</u>	<u>Design</u>	
	<u>May 1980</u>	<u>Oct. 1980</u>
Length	180.0 ft.	201.0 ft.
Height	26.0 ft.	31.5 ft.
Weight	750,000 lbs.	1,100,000 lbs.

According to program officials, no further substantial increases in transporter weight are expected.

The transporter, as currently designed, is estimated to cost about \$8 million per unit, or some \$1.6 billion to acquire 204 of the vehicles. Final determination of the following performance factors, however, could influence current transporter design and affect cost estimates:

- The methods of providing countermeasures to alleviate existing signature characteristics between launcher and simulator payloads.
- The road/tire interface, particularly undefined road quality and performance on wet, icy, or snow-covered surfaces.
- The acceptable range of road grades.
- The acceptable alignment tolerances between the transporter and the protective shelter.
- The range of transporter acceleration/deceleration to minimize damage to road surfaces.
- An automated guidance system for the transporter.

Regarding the last item, the transporter will be manned but actual movement will be controlled by an automatic guidance



**GENERAL CHARACTERISTICS**

- LENGTH = 20' - 2"
- WIDTH = 16' - 0" (OVER TIRES)
- HEIGHT = 31' - 6"
- WEIGHT = 1.8 MILLION POUNDS (INCLUDING 500,000-POUND LAUNCHER AND MISSILE)

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# TRANSPORTER

system. The Air Force is studying various methods to autonomously control transporter movement. Analysis to date indicates that some risk of increased costs exists in developing the automated guidance software.

Current missile launcher design may require additional modifications

The missile launch system has undergone considerable design modifications to meet the separate transporter mobile launch concept. The launcher is being designed to launch the missile by partially moving out of a shelter, elevating the missile canister from a horizontal to a vertical position, and ejecting the missile by gas pressure. This sequence is unique to MX and has not been used for existing ballistic missile systems. However, program officials do not consider the MX launcher design to be a difficult developmental task.

The launcher must also have the capability to provide structural and shock isolation support against nuclear effects for the missile canister assembly and operational support equipment while in the protective structure. Current launcher design is based on minimum projected weight, power, and cost. As the launcher design matures, preservation of location uncertainty requirements may have to be satisfied by additional modifications. Final design solutions have not yet been identified for various nuclear hardness and survivability environments such as system-generated electromagnetic pulse, thermal effects, and blast effects. This last item is particularly critical since blast and shock damage to a protective shelter and attached launcher running gear could prevent the launcher from moving out of a shelter.

Operational road planning is incomplete

Currently, operational road requirements are incomplete, principally due to transporter design uncertainties and the pending decision to select the weapon system cluster sites. Air Force representatives said that transporter weight, and the method of distributing the weight, as well as variations in proposed cluster site soil characteristics, are major factors in initial road planning.

DEVELOPMENT OF GROUND ELECTRONIC SYSTEMS

The developmental design of the ground electronic systems is incomplete. In addition, the program office is concerned about the capability to develop and/or produce

some components for the electrical power system. Areas of concern are discussed below.

Final configuration of the physical security system will not be established for some time

The physical security system provides protection against unauthorized access or acquisition of nuclear assets and classified elements. The final configuration of this system will not be established for some time. Emphasis has been on minimizing security forces while maintaining proper response time to alarms with the necessary security force.

Elements under study for the physical security system include

- sensors for detecting intrusion into both the fenced shelter sites and the protective shelters,
- radar and optical equipment at the shelter sites,
- long-range radars and use of mobile patrol teams for surveillance within the deployment area,
- equipment to detect deployment and/or retrieval of sensors which pose a threat to preservation of location uncertainty,
- the requirements for the physical security system in the assembly area which are mostly at the conceptual level because the system will differ depending on the site selected and the configuration of the assembly area facilities, and
- the convoy protection and type of facilities to be used at the end of each day while the missiles are being transported between the assembly and deployment areas have not been established.

Design of the command, control, and communications system is incomplete

The command, control, and communications system will control the MX system; monitor, retarget, and launch the missile; and link operations, security, and maintenance personnel. Day-to-day communications will use a fiber optics cable network paralleling the system road and interconnecting shelters, cluster maintenance facilities, remote surveillance sites, area support centers, and

operational control centers. Postattack command and control of the MX force will be provided by an airborne launch control center via a medium frequency radio system.

The developmental design of the command, control, and communications system is incomplete. As discussed in chapter 2, final decisions remain concerning:

- The number and type of launch control center aircraft.
- The method of providing a postattack link, other than the aircraft, between the MX missiles and national command authority.

In addition, final decisions have not been made on the design of the fiber optics and data processing networks.

#### Fiber optics cable network

A major concern to the Air Force in designing the fiber optics network involves repeaters and the source of electrical power for those repeaters. Repeaters are used for amplifying signals that are being transmitted. A repeater is required about every 5 to 6 miles along the network. A large number of repeaters will be required to connect clusters within a valley, interconnect the valleys, and connect the valleys with the operational control centers at each operating base. Each repeater requires a source of electrical power. However, it has not been determined what source of power will be used. To reduce power requirements, the program office and contractor are hopeful that the use of repeaters can be minimized or eliminated by the use of improved fiber optics technology. The contractor, however, has concluded that this technology has not matured sufficiently to permit specifying its usage in the network design. Components are generally scarce, unproven, and experimental. Although microwave may be an alternative for connecting the operational control centers with the deployment area, program officials are not encouraged with the use of microwave. At the conclusion of our review, the program office was still examining ways to minimize or eliminate the use of repeaters.

#### Processors and software

The contractor for the command, control, and communications system is concerned that the delay in defining all data processing requirements will affect the development and design of processors and software. The cost for data processing will be significant because of the number of installations--not only at operating bases, but also at

4,600 shelters, 200 launchers, and 100 to 300 long-range radar surveillance sites. The contractor's major concerns include:

- The processing capability and memory requirements for the launcher computer in a nuclear environment are completely undefined.
- Risks associated with the use of microprocessors at the shelters, including availability of parts for the relatively new technology, software development, and provisions for reserve capability for unknown life use.
- The processor for the computer-aided maintenance management system cannot be designed until all MX contractors furnish information on their systems.
- The compiler for the approved higher-order language for Air Force command and control computer programs has not been fully developed and proven through actual usage.

Development and/or production of certain electrical power system components is a concern

The MX ground electrical power system is required to provide an uninterrupted source of power to the missile at all times. The program office is concerned about the capability to develop and/or produce some components for the electrical power system.

The buried power lines furnishing electricity to the shelters will pick up electromagnetic pulses from a nuclear attack. This will cause a surge of the pulses into the shelters which will damage electronic components to the extent that the missile will lose operational capability. The use of resistive wire is being considered to serve as a buffer to protect against such a surge. Because uncertainty exists as to whether resistive wire technology is advanced enough to meet program requirements, considerable testing will be required during full-scale development to demonstrate feasibility of resistive wire.

The electrical power system is required to provide full power for a certain postattack period. Lithium thionyl chloride batteries are being developed as a source for that power. However, the mass production of these batteries is considered a schedule risk.

Other technological concerns include

- safety from explosions caused by punctures to the batteries,
- protection against hazards caused by shorting and excessive heating of the batteries,
- effects of voltage delay and aging of the batteries,
- effects of radiation on the batteries, and
- protection against toxic effects when the batteries are disposed of.

PROGRESS IN DEVELOPING THE MEANS FOR  
PRESERVATION OF LOCATION UNCERTAINTY

Preventing a potential enemy from determining which shelter contains the MX missile is mandatory. Location uncertainty, more than any other factor, determines weapon system survivability. Therefore, location uncertainty is an absolute requirement and a special MX Preservation of Location Uncertainty Program has been established to provide for development, acquisition, field implementation, and life-cycle testing of effectiveness. We did not review technical aspects of preservation of location uncertainty because this is a major part of the Office of Technology Assessment study discussed earlier.

CONCLUSIONS

Development of the MX missile has progressed substantially on schedule during fiscal year 1980. Continued developmental progress, and the eventual missile production, is dependent on the continued availability of essential resources. Decisions on various ground mechanical and electronic systems performance requirements and developmental specifications have not been finalized. These decisions are needed to establish firm cost, schedule, and performance goals.

## CHAPTER 5

### PROGRESS AND PROBLEMS IN OBTAINING LAND AND RESOURCES FOR CONSTRUCTION AND OPERATIONS

While progress was made in weapon system development during fiscal year 1980, delays in the process of withdrawing land <sup>1/</sup> has increased the risk of not meeting initial deployment in July 1986. Other challenges to the Air Force include selecting location(s) for siting the MX operating base facilities, deciding on enforcement measures necessary to keep the location of the missile unknown, and obtaining resources for construction and operations.

#### SELECTION OF THE AREA FOR MX DEPLOYMENT

In identifying land suitable for MX deployment, the Air Force screened the entire continental United States. This screening process resulted in identifying 7 areas in 10 States having land suitable for MX deployment.

The next step was to select preferred alternatives. Of the seven areas, the Air Force initially preferred public land in adjacent areas of Nevada and Utah. These lands are remote and unpopulated, which greatly enhances day-to-day operations, especially those related to preservation of location uncertainty. Land in Arizona and southwestern New Mexico was considered the most attractive alternative to Nevada and Utah because much of that area is also public land. One of the least preferred alternatives was adjacent land in west Texas and New Mexico. Much of this land is privately owned and highly populated and was not favored because

- the Air Force policy is to minimize the acquisition of private land,
- the high population density would complicate efforts to keep the location of the missile unknown, and
- the fiscal year 1979 supplemental DOD Appropriation Act stipulates that MX be deployed on the least

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<sup>1/</sup>Withdrawal is the formal process, governed by Federal statutes, for transferring jurisdiction over an area of Federal lands from the Department of the Interior's Bureau of Land Management to DOD.

productive land (the land in west Texas and New Mexico is considered more productive than the land in Arizona and New Mexico).

Subsequently, in March 1980 the following new criteria were proposed to reselect the deployment area choices:

- 200 nautical miles from the coastline to provide sufficient time to respond to a submarine-launched ballistic missile attack (this criterion eliminated all suitable lands in California);
- 200 nautical miles from the coastline and international borders to neutralize jamming of the MX command, control, and communications system (this criterion eliminated some suitable lands in Arizona, California, and New Mexico);
- 200 nautical miles from high value targets (SAC Headquarters, Minuteman silos, etc.) to mitigate atmospheric disturbance of a very intense nuclear attack that could cause a loss of connectivity between the higher command authority and the MX airborne launch control centers (this criterion eliminated all suitable lands in Colorado, Kansas, and Nebraska); and
- 200 nautical miles from international borders to complicate the use of sensors to determine missile locations (this criterion eliminated some suitable lands in Arizona, California, and New Mexico).

Application of these criteria eliminated all areas but adjacent lands in Nevada/Utah and Texas/New Mexico. These are the two geographical areas being addressed in the site selection environmental impact statement with lands in Nevada/Utah still being preferred.

#### ANALYSIS OF SPLIT BASING

In addition to deployment of the entire MX system in either Nevada/Utah or Texas/New Mexico, the Air Force is studying deployment of half the system in each of those two geographical areas. This deployment concept is referred to as split basing. DOD does not prefer splitting MX basing because it increases costs and complicates day-to-day operations. It will, however, be addressed in the site selection environmental impact statement because of the need for siting alternatives. In addition, the 1981 DOD Authorization Act requires a report on the feasibility of split basing.

#### SELECTION OF THE OPERATING BASE LOCATION

The operating base site(s) in Nevada and Utah have not been selected. If the system is sited entirely in Nevada and Utah, the Air Force plans to build one new base in Nevada and one in Utah. SAC assessed various locations and recommended selection from among the following locations:

- Ely, Nevada;
- Coyote Springs Valley, Nevada;
- Beryl, Utah;
- Milford, Utah; and
- Delta, Utah.

The Air Force prefers siting the operating base with the adjoining missile assembly area and test site at Coyote Springs Valley.

SAC assessed existing military bases in Nevada and Utah and concluded that land and/or facilities were not available for the MX operating bases. We visited Nellis Air Force Base, about 40 miles south of Coyote Springs Valley, and found that some land was available. In fact, about 6,000 acres of an 11,000 acre small arms gunnery range has been on the declared excess list since 1971. SAC officials were not aware of the excess land, and when advised of the potential land availability, they stated that Nellis Air Force Base was too far from Coyote Springs Valley and the deployment area.

In analyzing existing military installations, SAC only considered availability of land and/or facilities to support a complete base. SAC did not consider placing only part of the MX activities, such as the airborne launch control center aircraft, at existing bases. Other Air Force officials, however, stated that the aircraft could be located at any base in the vicinity of the deployment area, such as Hill Air Force Base, Utah.

#### PREPARATION OF THE ENVIRONMENTAL IMPACT STATEMENT TO SUPPORT SITE SELECTION

The preparation of the environmental impact statement to support site selection has been delayed. At the beginning of full-scale development, a final statement was to be submitted in September 1980, but is now scheduled for May 1981.

Air Force officials advised us that the delay can be attributed to

- the decision to consider split basing as an alternative,
- refinements to the MX weapon system basing design which changed the arrangement of the shelters, and
- difficulties in preparing a statement for a project the size of MX.

DOD officials stated that the delay in completing the environmental impact statement increases the risks of attaining initial deployment on schedule. To overcome this problem, the Air Force is working with the Bureau of Land Management to identify actions that can be taken to work around the delays to meet the scheduled initial deployment date.

#### ENFORCEMENT MEASURES IN THE DEPLOYMENT AREA

Activities to keep the location of missiles unknown will be conducted under a point security concept in which the area immediately around a shelter will be fenced to limit access, and the entire deployment area will be under continual surveillance.

Under point security, the ability of the Air Force to limit or control the use of sensors or enemy agent operations will be difficult because

- no restrictions will be placed on the public's activities, and therefore, the public will have unlimited access to the lands within the deployment area outside the fenced site and
- current laws may not provide sufficient legal rights to support the search for and seizure of sensors or to control the activities of suspected enemy agents.

To overcome these potential problems, the Air Force is considering options that would enhance the ability to take actions outside the fenced areas to protect location uncertainty. These options are:

- Seek a law against use of sensing devices similar to laws prohibiting photographs of vital military installations.

--Seek a law that makes the use of sensing devices a felony. This will permit Federal authorities to make arrests on reasonable grounds rather than having to be present when an offense occurs.

--Withdraw additional land as easements--150 feet around each shelter and 150 feet from the center line of the cluster roads--to provide the clear legal authority that would allow the Air Force to search for and seize sensing devices.

A program official emphasized that these measures are not intended to interfere with the public's activities when those activities pose no threat to preservation of location uncertainty. This would include bona fide use of sensing devices for mining or mineral exploration.

#### RESOURCES FOR CONSTRUCTION AND OPERATIONS

The MX weapon system will require large amounts of electricity, water, and cement for construction and operations. Availability of these resources at the appropriate times within current cost estimates remains uncertain.

#### Electrical power

The Air Force plans to purchase power to operate the MX system. An Air Force study indicated that commercial utilities will have to develop new power generation and transmission facilities to satisfy MX needs. Utility companies have plans for new capacity, but the plans do not include MX requirements. The Air Force recognizes that negotiations should begin in the near future to reserve future energy for MX loads. Otherwise, the capacity will not be available when needed. During 1979 and 1980, the program office had discussed MX power needs with suppliers. However, no commitments can be made until the MX deployment site is selected.

Another option available is for the Air Force to build its own power facility. This construction, however, could not be accomplished within current cost estimates or soon enough to meet deployment milestones. A third option being examined is a joint program with the Department of Energy involving the use of renewable energy sources for MX. However, program officials stated that renewable energy sources are not sufficiently developed to be used as a baseline source of energy for MX.

## Water

During fiscal years 1979 and 1980, the Air Force assessed the availability of water and the impact of MX water usage in Nevada and Utah. Additional work is planned in 1981 to finish drilling (1) intermediate wells (500 to 1,000 feet) to complete availability assessments and (2) a deep aquifer to determine connectivity between underground sources. A program official stated that work to date indicates that sufficient water is available in total with no adverse effect on the environment. There are, however, some areas where sufficient underground water is not available, such as the five areas being considered for the operating base. Water rights at these locations must be purchased from existing users. The Air Force position on the availability of water and the effect of usage will be set forth in the environmental impact statement supporting site selection.

In response to concerns expressed during 1980 by the citizens of Nevada and Utah, the President stated that the Air Force must adhere to all State water laws. Consistent with that directive, the Air Force has filed requests for unappropriated water in Nevada and Utah. Public hearings are part of the review process used by the States to approve or reject the requests. A program official told us that these meetings will be a final test of the adequacy of the program office's assessment of availability and impact.

## Cement

Recent Air Force studies indicate that cement is available, but special acquisition procedures will be needed to assure timely delivery and mitigate the effect on other users. The impact of the MX demand for cement on State and local economies will be addressed in the environmental impact statement. In addition, an acquisition strategy for purchasing cement and other construction materials is expected to be prepared in 1981. According to an Air Force study, a long-range commitment for cement must be made by the end of 1981.

## CONCLUSIONS

SAC assessed existing military bases in Nevada and Utah and concluded that neither land nor facilities were available for an MX operating base. However, excess land at Nellis Air Force Base was not included in the assessment. Further, consideration was not given to placing part of the facilities on existing bases. We believe an

independent organization should reassess the feasibility of siting all or some MX facilities at existing bases.

The delays in preparing the environmental impact statement pose an increased risk to meeting initial deployment.

The Air Force is considering options that would enhance its ability to take actions that may be necessary to protect location uncertainty. Some of these options could be construed as restrictions on the public's access or activities, but no final decisions have been made. We believe this issue should be resolved so the full implications of public access can be addressed in congressional deliberations on the legislation to withdraw land for MX deployment.

#### RECOMMENDATIONS

We recommend that the Secretary of Defense:

- Have an independent assessment made and inform the Congress of the feasibility of placing one of the operating bases on excess Federal land at Nellis Air Force Base. If not feasible to locate an entire MX operating base at Nellis, the potential for siting some MX facilities at existing military bases should be examined.
- Inform the Congress of how the Air Force will enforce measures to assure the preservation of location uncertainty, including an identification of any new laws or changes to existing laws that may be required.

MX WEAPON SYSTEM DESCRIPTION

The MX weapon system is to provide a survivable nuclear weapons delivery system capable of effectively attacking designated targets. The MX with verifiable horizontal multiple protective structure basing, as approved by the President, involves 200 missiles based in 4,600 hardened horizontal shelters (earth-covered tubes). The basic elements of the MX weapon include

- the MX missile;
- a cylindrical canister, which houses and protects the missile;
- a separate, mobile missile launcher;
- a transporter vehicle that moves the missile launcher or simulator from one shelter to another;
- a simulator to preserve missile location uncertainty;
- multiple protective structures (horizontal shelters) which protect and conceal the missiles; and
- the ground electronics for communications, security, and power.

Survivability of the system will be based on two elements: the preservation of location uncertainty and a high degree of mobility. To preserve concealment, the missile will be moved within its cluster of 23 shelters in such a way that the location of the missile cannot be detected. This includes the use of simulators which so closely resembles the actual missile launcher that it is indistinguishable from the launcher. To be assured of destroying each missile, an aggressor would have to attack all the horizontal shelters. A high degree of mobility is provided in two different modes of operation. First, the location of all 200 missiles could be rapidly relocated in about 9 hours. This operating practice might be useful if some concern about location uncertainty develops or if an international crisis appears to be developing. Second, an alternate to rapid relocation is the dash operation that permits some portion of the missile force to become mobile. This maneuver allows the transporter, with attached mobile launcher, to dash from an operational road to a shelter in a period of less than submarine-launched ballistic missile or ICBM flight time.

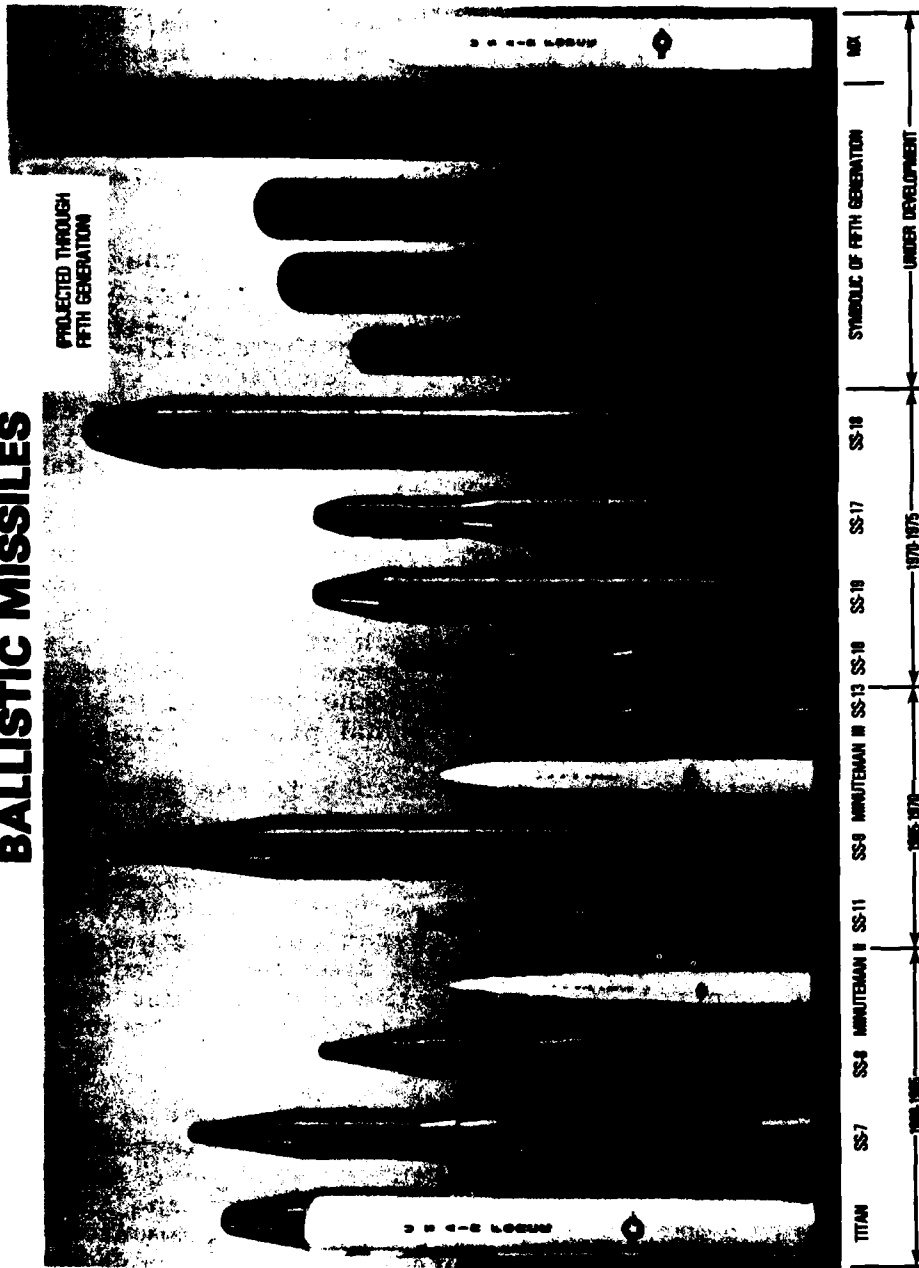
DOD contends that the MX weapon system, as currently proposed, will allow the Soviets to verify the number of launchers as required under terms of SALT. Further, if the Soviets were to design a system similar to the MX system, the United States could monitor, with a very high degree of confidence, the number of Soviet launchers deployed. Verification of the system is accomplished on the basis of several characteristics, such as conducting all missile assembly operations as openly as possible to aid observation by national technical means (primarily satellite surveillance), designing a transportation system to assure that missiles cannot be secretly moved into a cluster, and providing removable plugs in the roof of each shelter to permit viewing the contents of each shelter.

The MX missile will be the largest new missile permitted under proposed SALT II provisions and made up of a three stage, solid propellant booster, a liquid-fueled postboost vehicle, and an advanced guidance set. Further, it will be able to carry the maximum throw weight and deliver the maximum number of multiple independently targetable reentry vehicles allowable under those provisions. The MX missile will use the MK-12A reentry vehicle, and its associated warhead, which has been developed and is to be installed on some Minuteman III missiles. Although a final decision has not been made, MX weapon system cost estimates have been computed assuming that MX missiles would replace Minuteman III missiles. Minuteman III is the only missile in the current U.S. ICBM force capable of delivering multiple independently targetable reentry vehicles. (See p. 35 for a comparison of U.S. and U.S.S.R. ICBMs.) A comparison of some MX and Minuteman III missile characteristics follows:

<u>Characteristic</u>	<u>Minuteman III</u>	<u>MX</u>
Length	60 ft.	71 ft.
Weight	78,000 lbs.	193,000 lbs.
Diameter	66 in.	92 in.
Number of reentry vehicles	3	10
Throw weight	2,400 lbs.	7,000 lbs.

Each MX missile will be contained in a cylindrical canister and placed on a mobile launcher. The mobile launcher contains the operational equipment required to launch the missile and is moved by a transporter vehicle from one shelter to another. The transporter vehicle provides deceptive covering during the transport, emplacement, and removal of the launcher or simulator within the cluster of 23

# U.S./U.S.S.R. INTERCONTINENTAL BALLISTIC MISSILES



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horizontal shelters. The individual horizontal shelter, or protective shelter, is a hardened structure designed to provide airblast, radiation, thermal, electromagnetic pulse, and debris protection from a nuclear attack for the missile and its launcher. The shelters also contain some auxiliary equipment necessary to support the system's operational readiness.

The missile launch sequence begins with the partial launcher movement out of a shelter and erection of the missile canister to a near vertical position. A gas generator at the bottom of the canister ejects the missile and stage I ignites when the missile clears the canister. Since the mobile launcher, rather than the shelter, contains the equipment necessary to launch the missile, DOD contends the launcher and not the shelter should be counted for purposes of determining compliance with SALT restrictions.

The command, control, and communications system being planned for MX provides the capability to reliably monitor and control the MX force during the preattack period and to support the targeting and launch of all missiles that survive a nuclear attack. The system also provides a diversity of communications links with the National Military Command System to receive orders and provide force status.

To meet these basic requirements in the preattack mode, the command, control, and communications system uses both a fiber optic cable network and radio broadcast communication links to link together the ground and airborne control centers with the missile launchers and horizontal multiple protective structures. During preattack operations, command and control of the MX system will be executed from two ground-based operational control centers via the buried fiber optic cable network. Voice and digital data traffic will be encrypted to assure security.

All communication relay points will receive, process, and retransmit digital messages to assure dissemination throughout the network. The control centers will have multiple landline interconnectivity with national command authorities as well as two-way voice and digital radio communications with SAC and other national authority command posts.

Postattack command and control of the MX force will be provided by an airborne launch control center via a medium frequency radio system. Each missile launcher will receive commands and provide status by means of a radio transceiver. There will be one airborne control center on continuous

airborne alert and one on continuous ground alert dedicated to support MX.

Physical security for the MX weapon is necessary to deny unauthorized access to or acquisition of any nuclear weapons material, classified security material, or other critical components of the weapon system.

Physical security must be maintained at all facilities within the deployment area and the assembly area. In addition, the designated transportation network and other operational transportation networks must be protected. Security must be maintained for the missiles themselves as well as all the varied vehicles which support the system. The scope of the "targets" to be protected include the following:

<u>Threat events</u>	<u>Adversaries</u>	<u>Targets to be protected</u>
Unauthorized launch	Enemy agents	MX missiles
Theft	Terrorists	Transport vehicles
Sabotage/pindown	Paramilitary	Command, control, and communications equipment
Compromise missile location	Dissidents	Physical security system equipment/facility
Harrassment	Disaffected	Power equipment
Malicious damage	Vandals	Maintenance control and support facility
	Pranksters	Supply storage/distribution facility
	Thieves	Transportation facility

Physical security is accomplished by long-range surveillance of protective structures, the intervening roads and terrain by radar, individual target discrimination at the area support centers, site surveillance by intrusion sensors, access monitors, and random air patrols and ground patrols. Potential security events will be tracked and identified, and security force responses will be directed to deter any unauthorized attempts to penetrate the sites, plant sensors

for missile detection, or any activity deemed to lead to such actions. The public has access to the designated deployment area, except for fenced areas. Certain restrictions may apply as to travel time, location, length of stay, and other such national park-type rules. The legal rights of the public and of the security forces may be similar to those established for the Department of Energy nuclear test facility at Mercury, Nevada.

The MX ground electrical power subsystem receives power from utility companies. Diesel generators are located at each distribution center to supply standby power up to 30 days in the event of a failure of the utility network. Emergency power for 2 hours of operations is supplied by lead acid batteries at each shelter site and separately on each launcher. In addition, survival power is supplied during postattacks by lithium thionyl chloride batteries on each launcher.

The MX weapon system will include 2 operating bases, 4,600 shelters, about 9,000 miles of roads, and related support facilities. Construction of MX facilities, roads, and utilities will be an immense effort--one of the largest construction projects ever undertaken by the military.

The MX operating bases will provide personnel and operational support and will have all the standard military base features including hospitals and other health care facilities, recreational facilities, schools, and family housing. The military and civilian work force will be 7,400 personnel at one base and 5,300 personnel at the other base. The base having a work force of 7,400 personnel will have a larger work force than all but 2 of the current 24 SAC bases.

In the proximity of one of the bases will be the designated assembly area and the operating base test site. The designated assembly area contains technical facilities required for missile/canister/launcher assembly and associated storage and maintenance facilities. Once assembled, these components are transported to the deployment area. Missiles must be returned to the assembly area for major repair. The operational base test site will be a system test facility with deployment area prototype facilities for weapon system testing.

The 4,600 shelters will be sited in 200 clusters--23 shelters per cluster. The shelter will be 171 feet long concrete cylinders, 14-1/2 feet in diameter with walls 1-3/4 feet thick. Each cylinder will be buried 5 feet underground.

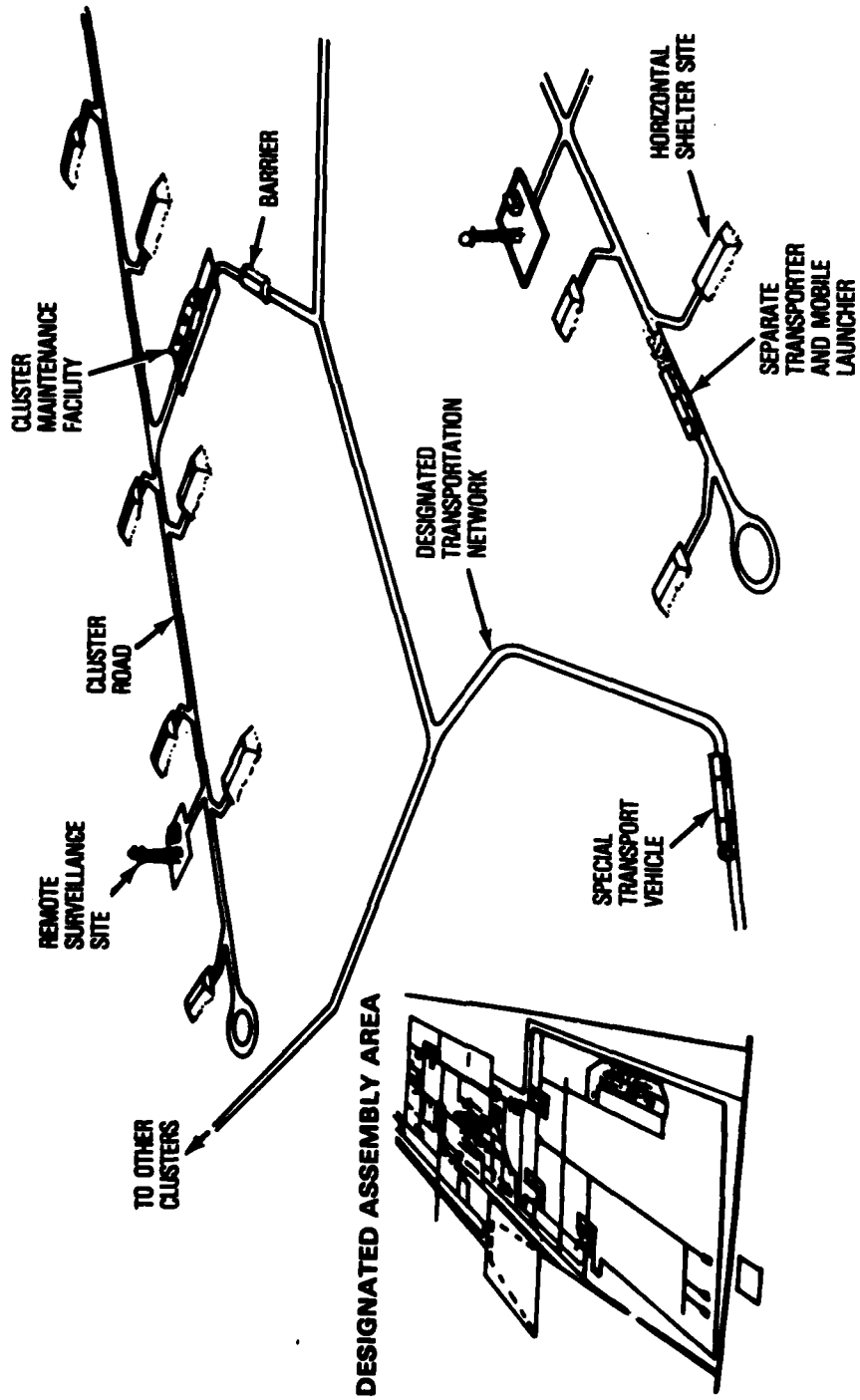
The 4,600 shelters are located in the designated deployment area along with maintenance and security facilities such as the cluster maintenance facility, remote surveillance sites, and area support centers. Each cluster of 23 shelters will contain a cluster maintenance facility where transporter, launcher, and minor missile repairs will be performed. Remote surveillance sites will provide radar detection and tracking of vehicles and aircraft in and over the clusters. Five area support centers will provide facilities for equipment storage and repair, security control, maintenance dispatch, helicopter transport and maintenance, and other services necessary to support the system in the field. Area support centers will be sited to allow forces to arrive via helicopter at any threatened area within 30 minutes.

There are three categories of roads that support the weapon system operations and maintenance. They are the designated transportation network, the operational roads, and the operational support roads.

The designated transportation network connects the weapon system's designated assembly area to the designated deployment area for the principal purpose of allowing transportation of the missile/canisters via a special transport vehicle to the clusters. The designated transportation network consists of about 1,422 miles of 24-foot wide paved road (equivalent to a two-lane highway from Seattle, Washington, to San Diego, California).

The operational road system joins the designated transportation network at the cluster barrier and connects the designated transportation network to the cluster maintenance facility and the protective structures. The operational roads are used by the transporter when moving either the launcher and missile or the simulator among the 23 shelters within each cluster. There are about 6,400 miles (more than twice the distance from California to New York) of 21-foot wide hard surface unpaved operational roads.

Operational support roads connect the designated transportation network or the operational roads to support facilities such as the cluster maintenance facility, the remote surveillance site, and the area support center. The operational support roads are designed to prevent either transporter or special transport vehicle usage. Current plans provide for about 1,335 miles of operational support roads. The MX horizontal basing concept is illustrated on page 40.



(COURTESY OF U.S. AIR FORCE)

# MX HORIZONTAL SHELTER BASING CONCEPT

DESIGNATED DEPLOYMENT AREA

The Air Force prefers siting the MX weapon system entirely in adjacent areas of Nevada and Utah. However, other alternatives are being considered--siting entirely in adjacent areas of Texas and New Mexico or siting half of the system in Nevada and Utah and half in Texas and New Mexico.

Spacing 4,600 shelters an average of about 6,000 feet apart dictates deployment of the MX system over a large area. If sited entirely in Nevada and Utah, the perimeter of a rectangle around the deployment area, as defined in September 1980, would be 248 miles from east to west and 192 miles from north to south. This equates to an area of about 48,000 square miles, approximately the size of Pennsylvania.

The 48,000 square miles include suitable and unsuitable (mountains, wilderness areas, etc.) terrain. Within that area, the Air Force estimates that 8,550 square miles of suitable area would be required to properly arrange the 4,600 shelters and other facilities. The Air Force will, however, use only 3,543 square miles as follows:

	<u>Square miles</u>
Fenced areas--restricted access	33
Safety zones--unlimited access, but no habitable buildings can be constructed	3,429
Roads--unlimited access, but Air Force usage has precedence	<u>81</u>
Total	<u><u>3,543</u></u>

LISTING OF CONTRACTORS DEVELOPINGSOME OF THE MAJOR MX WEAPON SYSTEM COMPONENTS

<u>Weapon system component</u>	<u>Contractor</u>
<b>Propulsion system:</b>	
Stage I	Thiokol
Stage II	Aerojet
Stage III	Hercules
Stage IV	Rockwell International (Rocketdyne)
<b>Guidance and control system:</b>	
Flight computer and systems integration	Rockwell International (Autonetics)
Inertial measurement unit	Northrop
<b>Reentry vehicle system:</b>	
Reentry system	AVCO
Reentry vehicle	General Electric
<b>Separate transporter and mobile launcher:</b>	
Launcher	Martin-Marietta
Transporter	Boeing
<b>Assembly, test, and systems support</b>	Martin-Marietta

DOD INFLATION RATES

April 1980  
Annual Percent Growth

<u>Fiscal year</u>	<u>Development</u>	<u>Procurement</u>	<u>Military construction</u>	<u>Operation and maintenance</u>
1980	9.0	9.3	10.2	9.7
1981	9.4	9.7	10.6	10.1
1982	8.6	8.9	8.5	8.7
1983	7.8	8.1	7.8	7.6
1984	7.0	7.2	6.7	6.2
Per year thereafter	6.2	6.2	6.7	6.2

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