BY THE COMPTROLLER GENERAL

Report To The Congress

OF THE UNITED STATES

The MX Weapon System--A Program With Cost And Schedule Uncertainties

Development has begun on the MX, even though many uncertainties exist:

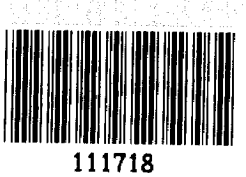
--Proposed method of survivable basing.

--Availability of land and other resources for the construction and operation of the system.

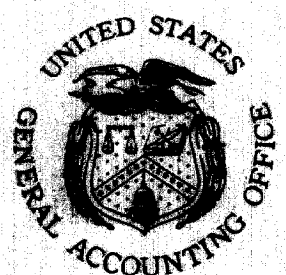
--Attainment of cost, schedule, and performance goals.

--Survivability of the system if arms control agreements do not exist.

The estimated cost is about $33 billion (1978 dollars). With inflationary adjustments, this would increase to at least $56 billion. This high cost raises a serious question regarding its affordability.



111718



008858

PSAD-80-29

FEBRUARY 29, 1980

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

B-196893

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 of the MX weapon system. Agency officials associated with the program reviewed a draft of this report, and their comments have been incorporated as appropriate.

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 1981 requests for funds.

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

Comptroller General
of the United States

COMPTROLLER GENERAL'S
REPORT TO THE CONGRESS

THE MX WEAPON SYSTEM--A PROGRAM WITH COST AND SCHEDULE UNCERTAINTIES

D I G E S T

The new MX weapon system has entered full-scale development, yet many uncertainties remain to be resolved.

--Will the method of survivable basing selected by the President be approved for funding by the Congress while it is considering the fiscal year 1981 budget?

--Can the land necessary for deployment be obtained soon enough, and will the large amounts of electricity, water, and building materials for construction and operations be available at the appropriate time?

--Can the cost, schedule, and performance goals be attained?

--What impact would the lack of arms control agreements have on the survivability of the proposed MX system?

The Air Force estimates that the MX weapon system will cost about $33 billion (1978 dollars). Inflationary adjustments will increase this estimated cost to at least $56 billion. These estimates do not include Department of Energy costs for warhead development, acquisition, and maintenance. (See pp. 1 and 20.)

The $33 billion estimate may not be meaningful because of uncertainties concerning the size of the missile force, the number of surviving intercontinental ballistic missile warheads needed to be able to counter an attack, the number of base support facilities, and the design of the weapon system. These design uncertainties include such things as the spacing between shelters, the size of the shelter, and the size of the transporter-erector-launcher vehicle. (See pp. 19 to 22.)

The high cost of the MX system raises a serious question regarding its affordability. In view of current budget limitations, the Department of Defense is faced with determining what is affordable in terms of a large number of weapon systems. Although this has been a matter of discussion with the Congress as recently as February 1980, it seems that Defense has not established priorities in case all planned programs are not fully funded. (See pp. 20 and 21.)

Initial deployment of the system is planned for July 1986, with full deployment to be accomplished by 1989. It is questionable, however, whether the July 1986 date can be met because land necessary for deployment may not be obtained soon enough.

Normally, public land is acquired through a formal process, known as withdrawal, in accordance with Federal statutes. Withdrawal of public land for a project the size of MX has a large potential for program delay because the process is complex, time-consuming, and politically sensitive. That potential is being compounded because the Air Force is still attempting to determine what site(s) will be considered for MX deployment and what criteria will be used in comparing alternative sites. Further, the Air Force is still in the process of determining what issues will be addressed in the site selection environmental impact statement and what additional analytical work remains to be done. (See pp. 8 to 12 and 20.)

In a letter to the Secretary of Defense on April 18, 1979, GAO reported the potential for schedule delay because the Air Force estimate of the time required for land withdrawal was unrealistic and recommended that the Secretary of Defense establish a memorandum of agreement with the Secretary of the Interior setting forth a time-phased action plan.

Defense agreed with GAO's recommendation but declined to take action until after a basing decision was made. Those steps have been initiated but not completed. Until a basing

decision is made, the Air Force will not know precisely what must be done by whom to accomplish the land withdrawal process within the prescribed time frame. (See pp. 11 to 13.)

The MX weapon system will require large amounts of electricity, water, and building materials for construction and operations. The Air Force has yet to conclusively demonstrate that sufficient resources can be made available at the appropriate time. (See pp. 13 to 15.)

The MX basing mode can ensure survivability of a sufficient retaliatory force only if the location of a substantial number of missiles is unknown to an attacker. Lack of such knowledge will force him to attack all possible locations to ensure destruction of any one missile. Whether the Air Force can keep the location of the missile unknown using planned security concepts is uncertain. (See pp. 15 to 17.)

Ratification of the Strategic Arms Limitation Talks treaty, as proposed, is currently being held in abeyance. Treaty limitations on the number of Soviet warheads is a critical element in assuring that the MX weapon system with 200 missiles and 4,600 shelters spaced 7,000 feet apart will have the desired level of survivability. Without such limits, the Soviets could build enough weapons to neutralize the MX. In such a situation, the Air Force could expand the system, but expansion would raise questions on funding, resource availability, and land use. (See pp. 17 and 18.)

There may not be sufficient qualified personnel to effectively manage the program during the critical first year of full-scale engineering development. This could have an adverse impact on the entire program. (See pp. 23 to 25.)

CONCLUSIONS

GAO recognizes that as development of the MX progresses, many of the uncertainties will be

resolved. This does not, however, prevent the need, at the very beginning of full-scale development, for a complete disclosure of program uncertainties and the potential impact on cost, schedule, and performance goals. (See pp. 29 and 30.)

RECOMMENDATIONS

The Secretary of Defense should:

--Identify the potential increases or decreases in program cost due to the many uncertainties which still have to be resolved. Related potential impact on schedule and performance goals should also be shown.

--Assure that the high cost of the MX system is adequately analyzed in the context of the overall DOD budget to determine if it is affordable and whether any other major weapon system programs would have to be terminated or delayed.

--Expedite efforts to establish a memorandum of agreement with the Secretary of the Interior setting forth a time-phased action plan which will allow public land to be withdrawn for the MX weapon sytem. This information should include a listing of statutory requirements which cannot be satisfied within prescribed time frames and, therefore, may require special congressional action.

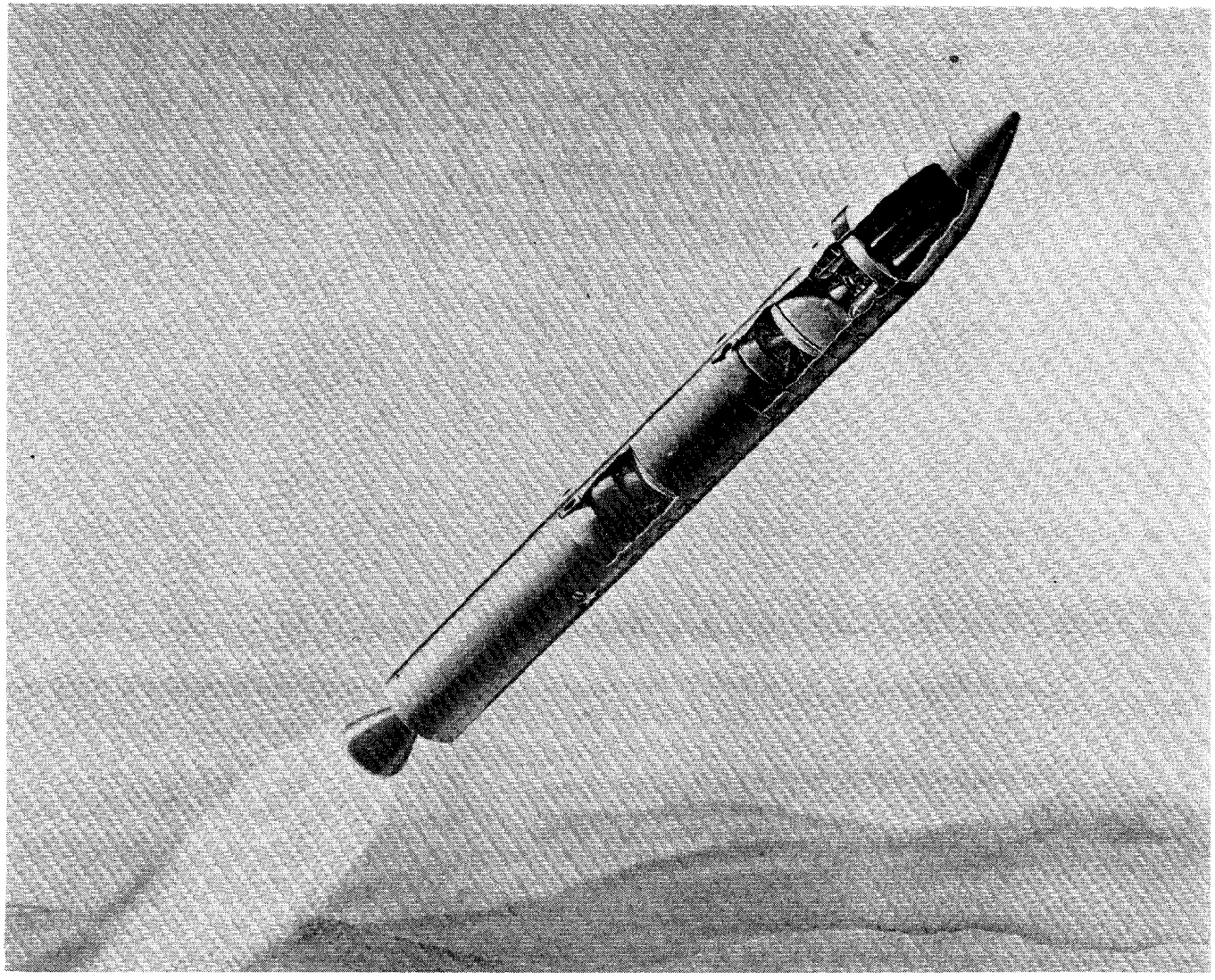
--Identify the changes to the MX weapon system that may be required without arms control agreements. If these changes involve construction of more shelters, information should be provided identifying (1) the additional land, electricity, water, and construction materials needed and (2) the availability of those resources. (See pp. 30 and 31.)

This report was reviewed by agency officials associated with the management of the program, and their comments have been incorporated as appropriate.

Contents

ABBREVIATIONS

BLM	Bureau of Land Management
DOD	Department of Defense
GAO	General Accounting Office
ICBM	intercontinental ballistic missile
SALT	Strategic Arms Limitation Talks



THE MX MISSILE

(PHOTO COURTESY OF U.S. AIR FORCE)

CHAPTER 1

INTRODUCTION

In June 1979 the President authorized full-scale engineering development of the MX weapon system, a new intercontinental ballistic missile (ICBM) system. At that time he also selected the missile component for the system. In September 1979 he selected the basing mode for the system and stated that his decision to continue with the development of the MX system could be equated with two other major Presidential decisions: the decision by President Truman to establish the Strategic Air Command and the decision by President Kennedy to establish the silo-based Minuteman missile system.

The Air Force estimates that the MX weapon system will cost $33 billion (1978 dollars) from 1979 until 1999--10 years after full deployment. Adding estimated inflation costs computed by the program office increases this estimate to at least $56 billion. In addition, Department of Energy costs for warhead development, acquisition, and maintenance are not included.

The survivability of the United States' ICBM force rests on its ability to absorb a first strike and retaliate with appropriate force. The Department of Defense (DOD) has stated that a large percentage of the U.S. ICBMs in silos are considered survivable today but will become unacceptably vulnerable during the early to mid-1980s as the Soviets improve the accuracy of their ballistic missiles and deploy new missiles having more warheads. To overcome that situation, the MX weapon system is expected to provide increased survivability as well as higher damage expectancy. According to the President, development of the MX weapon system will enable the United States to continue with a strategic deterrent force comprised of modernized survivable ICBMs, submarine-launched ballistic missiles, and heavy bombers. Current plans call for the MX weapon system to be initially deployed in 1986 and fully deployed by 1989.

MISSILE AND BASING ALTERNATIVES CONSIDERED

Since the inception of the MX development program, 3 different types of missiles and about 30 basing concepts have been considered. The missiles considered were:

--A new land-based ICBM with increased payload and improved accuracy. This is the missile selected for advancement into full-scale engineering

development and will be referred to in this report as the MX missile.

--A Minuteman III missile modified to operate in a mobile environment.

--A missile designed for the MX weapon system with some components which could also be used for a missile to be launched from submarines. The degree of commonality of the missiles considered ranged from one with almost total interchangeability to one with only two common propulsion stages. This missile is generally referred to as the common missile.

The basing concepts considered included multiple protective basing modes which, according to the Air Force, were the ones that provided the most potential for improving ICBM survivability. Under these concepts the missile would be randomly shifted from one protective launch structure to another and precautions would be taken to prevent knowledge of actual missile location. An enemy would have to attack all structures to ensure that the one containing the missile would be destroyed. The multiple protective structure modes considered by the Air Force included the buried trench, the vertical shelter, and the horizontal shelter.

The buried trench mode involves movement of the missile within shallow-buried concrete tubes, each having many launch points designed to withstand the effects of a nuclear blast. The missile, on a transporter-erector-launcher vehicle, could be quickly moved on a random basis among launch points within the tube providing location uncertainty. For firing, the missile in its canister would be elevated through the tube and the Earth cover. To keep an aggressor from using sensors to monitor the underground movement of the missile, it would be necessary to limit public access to the entire MX deployment area.

The vertical and horizontal shelter modes involve moving a missile, with launch and control equipment, among a number of shelters hardened to withstand nuclear weapons' effects. Since the missile and its associated equipment would be moved above ground, they would be shielded from observation and randomly moved in such a way that the location of the missile could not be detected. In contrast to the buried trench mode, only an area immediately around each individual shelter would be off limits to the public. In the vertical shelter mode, each missile would be placed, with its canister, in a sealed vertical concrete structure similar

to current ICBM silos. In the horizontal shelter mode, each missile would be placed, with its launcher and canister, in a sealed, horizontal protective structure (an Earth-covered concrete tube). Each missile would be moved outside the shelter and elevated for launch, or, in one horizontal mode, it could be elevated by breaking through the shelter roof and launched. The verticle shelter and the horizontal shelter basing modes examined by the Air Force during the validation phase did not include the capability to rapidly change location among shelters.

None of the above modes were selected in total. Rather, a hybrid design combining features of both the horizontal and buried trench modes was selected, which is referred to as the verifiable horizontal multiple-protective structure basing mode. According to DOD, it couples the lower cost design, reduced environmental impact, and greater public acceptance virtues of the horizontal shelter mode with the capacity for rapid missile relocation offered by the buried trench mode. A description of the MX weapon system approved for full-scale development is contained in appendix III.

PROGRAM MANAGEMENT

The Ballistic Missile Office, Norton Air Force Base, California, is responsible for managing the MX program. The Ballistic Missile Office was established October 1, 1979, as a component of the Air Force Systems Command and assumed the responsibilities of the Deputy for Intercontinental Ballistic Missiles and the Advanced Ballistic Missile Reentry Systems program offices. These two organizations were formerly components of the Air Force Systems Command's Space and Missile Systems Organization, which was disestablished on September 30, 1979. In managing the acquisition process, the Ballistic Missile Office functions as the integrating agency for contractor activities, while the Defense and Space Systems Group of the TRW Corporation supports the program office with systems engineering/technical assistance. Contractors developing some of the major MX weapon system components are listed in appendix I.

SCOPE OF REVIEW

We monitored events leading to the selection of the missile and basing mode and the approval for full-scale engineering development.

During this review, we interviewed DOD and Department of the Interior officials cognizant of the MX program and reviewed pertinent documentation. We conducted the review at the Ballistic Missile Office, Norton Air Force Base, California; Air Force Systems Command Headquarters, Andrews Air Force Base, Maryland; Rocket Propulsion Laboratory, Edwards Air Force Base, California; Air Force Headquarters and Office of the Secretary of Defense, Washington, D.C.; and the Bureau of Land Management (BLM), Washington, D.C. We also coordinated our efforts with the Congressional Research Service and Congressional Budget Office and gave consideration to their past and current efforts.

CHAPTER 2

BASING ISSUES

Despite progress made in resolving the basing question, critical issues remain which represent potential obstacles to timely deployment of the MX weapon system. The Air Force is aware of the remaining basing-related issues and has initiated several actions to overcome those obstacles. Timely resolution of some of the problems may require congressional action. The following sections describe some of the basing-related issues.

BASING MODE UNCERTAINTY

The process of selecting a basing mode for the MX weapon system was not straightforward. Administration officials were concerned about system survivability, compatibility with arms control agreements, Strategic Arms Limitation Talks (SALT) verification issues, and cost. Those concerns caused postponements in the full-scale development decision and changes in program direction.

When the MX program validation effort began in October 1976, the Air Force was directed to make a detailed evaluation of the buried trench mode and the horizontal shelter mode. 1/ While the horizontal shelter mode was not preferred, it was carried as an alternative because of uncertainties about the cost and feasibility of the buried trench mode. At that time, full-scale engineering development was planned to start in September 1977. With the advent of a new administration, the program was restructured in April 1977, and full-scale engineering development was delayed.

In January 1978 DOD again deferred initiation of full-scale engineering development. At about the same time, a Defense Science Board Task Force on ICBMs/MX met to consider the propriety of the Air Force's choice of basing modes. Following that meeting, the program office began an intensive review of all multiple-protective structure basing modes because the Task Force (1) was not satisfied with the level or consistency of the Air Force's cost and technical analyses of basing alternatives and

---

1/This horizontal shelter mode did not include design features to enable rapid relocation of the missile.

(2) expressed doubt that the buried trench and horizontal shelter modes were the only suitable alternatives. At the direction of DOD, this review included vertical shelter basing which had not been previously analyzed in detail. In May 1978 the program office presented the results of its review to the Task Force. The results showed that the MX missile in the vertical shelter mode was the most cost-effective method to achieve the desired survivability against the projected threat. After this reassessment, the program office began a validation program to demonstrate vertical shelter design concepts.

In June 1978 the program office was directed to prepare for a Defense Systems Acquisition Review Council meeting in October 1978 for advancing the MX weapon system into full-scale engineering development. That meeting was not held until December 1978, and the Air Force recommended advancing the MX weapon system with vertical shelter basing into full-scale engineering development. The Council unanimously agreed that the MX weapon system, as proposed by the Air Force, could meet the need and was a low-risk, feasible solution. However, because of questions regarding verifiability and arms control compatability, the Undersecretary of Defense for Research and Engineering directed the Air Force to restudy the air mobile basing mode 1/ and to present its results to the Council in March 1979. That presentation was made on March 31, 1979, and there were no changes in the Air Force's recommendation.

Between May and August 1979, the National Security Council and DOD considered a number of MX basing options with advice and information provided by the program office as requested. The goal was to identify an affordable basing mode which would provide a sufficient degree of survivability and would be acceptable under proposed SALT provisions. Based on the advice of the National Security Council and DOD, the President selected the horizontal shelter mode with a quick dash capability as the mode for the MX.

In announcing his decision, the President stated that the verifiable horizontal multiple-protective structure basing mode, with its high degree of mobility, "does the best job" to meet the growing threat. According to the

---

1/The air mobile basing mode involves transporting and launching ICBMs from aircraft. Survivability is achieved through random movements of the aircraft among a large number of dispersal sites.

administration, the MX weapon system, as currently approved, provides the following advantages compared to other alternatives.

--The system design will best satisfy requirements for adequate verification under SALT.

--The system design provides very high confidence that the United States could monitor SALT compliance if the Soviets deployed a duplicate of that design.

--The shelters cannot be construed as launchers. They are only protective structures having no part in the launch sequence since the transporter-erector-launcher vehicle is the launcher.

--The system design allows for a high degree of quick mobility enhancing the potential for survivability.

In selecting a basing mode, the vertical shelter was rejected in favor of the verifiable horizontal shelter, which cost an additional $7 billion, to enhance verification of compliance with SALT provisions and increase survivability. A program official said the vertical shelter was rejected because

--a vertical shelter could possibly be construed as a launcher,

--it would be too time consuming to relocate missiles if their location was compromised or perceived to have been compromised, and

--there was doubt that a system of verification could be designed that would give the United States sufficient confidence it could monitor SALT compliance if the Soviets deployed a duplicate system.

In commenting on our draft report, DOD officials said the decision on the basing mode may not be final. The Congress amended DOD's 1980 appropriation bill to preclude use of 1980 funds in a manner that would commit the United States to only one basing mode. During congressional hearings on DOD's fiscal year 1981 appropriations request, the Air Force is to present a comparison of the cost and capabilities of the vertical shelter mode, the horizontal shelter mode without dash, and the horizontal shelter mode with dash. Therefore, congressional decisions emanating from those hearings could have an impact on the basing mode.

WITHDRAWAL OF PUBLIC LAND FOR DEPLOYMENT OF THE MX WEAPON SYSTEM

The Air Force is proposing to deploy the MX weapon system in one or more of the following states: Arizona, Nevada, New Mexico, and Utah. The Air Force plans to select the specific deployment area in November 1980 and to obtain enough land by December 1981 so that site preparation can begin in January 1982.

The Air Force is assuming that some Federal land administered by BLM of the Department of the Interior (referred to as public land) will be required for MX deployment. In fact, the Air Force's preferred siting area is almost entirely public land in adjacent areas of Nevada and Utah. Under normal circumstances public land for such projects as the MX is acquired through a formal process (known as withdrawal) in accordance with Federal statutes. Withdrawal of public land for a project the size of MX has a large potential for major program delay because the process is complex, time consuming, and politically sensitive. The ability of the Air Force to withdraw the land necessary for MX deployment within prescribed time frames is being further jeopardized because decisions have not yet been made by the Air Force and actions have not been taken which, in our opinion, are key to the timely process of withdrawing public land.

Land requirements

The need for a large number of protective structures and adequate spacing between the structures dictates that the MX system will be deployed over a large area. The exact size of the deployment area is uncertain because the location of that area has not yet been determined; the amount of unsuitable terrain containing features such as mountains, archaeological sites, mineral deposits, and wilderness areas will vary by location; and the spacing between shelters has not been definitized. If sited in the preferred areas of Nevada and Utah, however, the MX weapon system will be deployed over a rectangular area encompassing about 45,000 square nautical miles of land, an area about the size of Georgia. Within the deployment area, the MX weapon system will require a number of suitable parcels of land totaling 5,400 square nautical miles for its 4,600 shelters (spaced 7,000 feet apart) and its supporting facilities.

The Air Force states that only 25 square nautical miles within the deployment area will be fenced. This

assumes the use of a security concept, referred to as point security, where only an area around the supporting facilities and each shelter would be fenced. According to the Air Force, the public's access to areas within the fenced areas would be strictly controlled, but the public would have access to all other lands within the deployment area for activities such as mining, agriculture, and recreation. The activities of the public will, however, be subject to continual surveillance, and there will be some usage restrictions on an additional 3,510 square nautical miles--81 square nautical miles for roads and railroads and 3,429 square nautical miles representing a .75 square nautical mile safety zone around each of the 4,600 shelters where no habitable buildings would be permitted.

Site selection

In identifying land suitable for MX deployment, the program office screened the entire continental United States. This screening process resulted in identifying 83,480 square nautical miles of potentially suitable land in 11 states: Arizona, California, Colorado, Idaho, Kansas, Nebraska, Nevada, New Mexico, Oklahoma, Texas, and Utah.

According to the program office, the lands most suitable for MX deployment are in Arizona, Nevada, New Mexico, and Utah. Their preference is adjacent areas of primarily public land in Nevada and Utah which best satisfy the operational needs for a remote unpopulated area. Accordingly, the program office has concentrated its efforts of further gathering and analyzing data regarding the suitability of siting areas to public land in Nevada and Utah. This effort includes assessment of the quantities and qualities of underground water, the availability of electricity, and the availability of sand and gravel. A limited amount of additional data refinement has been done in Arizona, but none has been done in New Mexico. The Air Force has conducted several meetings in Nevada during 1979 to gain public acceptance, with only a few similar meetings being held in Arizona and New Mexico. No further analysis of the lands were made in the other seven states that were considered potentially suitable because for one reason or another these areas were eliminated.

Even though the program office has concentrated most of its postscreening siting efforts in Nevada and Utah, it is uncertain whether additional studies will be needed in other states. Internally, the Air Force has been

attempting since November 1978 to prepare a report that describes the analytical basis for concentrating its siting and related environmental impact analyses primarily on suitable lands in Nevada and Utah. Also, if it is decided that additional siting studies are needed in other states, program officials stated that land withdrawal actions could potentially be delayed.

Use of current military installations for MX deployment

Within Arizona, Nevada, New Mexico, and Utah there are several military installations having land suitable for MX deployment, but no single installation has enough land to satisfy the total MX land requirement. There is, however, no DOD land within the preferred deployment area in Nevada and Utah. Rather, the preferred area is comprised almost totally of Federal lands managed by BLM. BLM officials have said DOD must clearly demonstrate that DOD land cannot be used for MX deployment before BLM would consider allowing DOD to withdraw public land.

At the request of Air Force Headquarters, the Tactical Air Command did examine the impact of deploying MX on Luke Air Force Base in Arizona and Nellis Air Force Base in Nevada which are used by the Command for pilot training. The Command reported that usage of those bases for MX deployment would have a serious impact on the Command's force readiness. No additional studies have been conducted to determine if other military installations could be used for MX deployment or to determine if current activities could be relocated to make military installations available for MX deployment. A program official said it has not yet been determined if BLM will require additional analysis of DOD lands as alternatives for deploying the MX weapon system.

Environmental impact statement preparation

The Air Force will prepare an environmental impact statement to support the selection of the MX siting area and the withdrawal of public land in compliance with provisions of the National Environmental Policy Act of 1969 and related regulations issued by the Council on Environmental Quality, the Federal organization responsible for overseeing Federal efforts to comply with the act. The Air Force plans to issue a final statement in October 1980.

The Council's regulations require the use of a new process referred to as scoping. As part of the scoping process, the lead agency is required to invite the participation of affected Federal, state, and local agencies; any affected Indian tribes; the proponents of the action; and any other interested persons, including those who may not be in accord with the action on environmental grounds.

Scoping can begin only after the lead agency publishes a notice of intent in the Federal Register that an environmental impact statement will be prepared. The Air Force published such a notice on November 27, 1979, for the MX site selection and land withdrawal statement. Scoping is planned to be completed by the end of February 1980, and a draft statement is planned to be completed by June 1980. Whether the Air Force can meet their schedule is dependent upon the results of the scoping process. Only then will it know precisely what issues need to be addressed and what analytical work remains to be done by whom.

Land withdrawal

The Air Force assumes that the withdrawal of public land will be required for MX basing. The withdrawal of public land is governed by several acts, including:

--Federal Land Policy and Management Act of 1976 (Public Law 94-579, October 21, 1976).

--Engle Act (Public Law 85-337, February 28, 1958).

--Antiquities Act of 1906 (Public Law 59-209).

--Historic Sites Act of 1935 (Public Law 74-292).

--National Historic Preservation Act of October 15, 1966 (Public Law 89-665).

--National Environmental Policy Act of 1969 (Public Law 91-190).

--Mining Resources Act of 1872.

--Wilderness Act of 1964.

--Endangered Species Act of 1973 (Public Law 92-305).

Under the provisions of the Federal Land Policy and Management Act, the Secretary of the Interior is responsible for requesting the Congress to act on a withdrawal and

for ensuring completion of analyses required by the act, such as an environmental impact statement, a mineral resources survey, an archaeological survey, and a biological survey.

The Air Force estimates that in order to initially deploy the MX weapon system by July 1986, it must have land available by December 1981 to begin site preparation in January 1982. This provides the Air Force about 2 years to accomplish a task which it estimates to take 3 to 5 years under normal circumstances. Despite this schedule compression, the Air Force has yet to

--determine the site(s) that will be considered for MX deployment,

--develop the criteria to support an equal comparison of siting alternatives,

--determine the issues to be addressed in the required environmental impact statement,

--determine the level of detail necessary for the studies required by statute to support land withdrawal actions, and

--determine the roles and responsibilities of participating State and Federal agencies.

In a letter to the Secretary of Defense on April 18, 1979, we reported the potential for schedule delay because the Air Force estimate of the time required for land withdrawal was unrealistic. In that letter, we recommended that the Secretary of Defense take immediate steps to establish a memorandum of agreement with the Secretary of the Interior, setting forth a time-phased action plan which will allow land to be withdrawn in accordance with Federal regulations in time to support the planned deployment date. This memorandum would also formalize the cooperative measures and specific responsibilities necessary for implementing the plan. Where land withdrawal requirements cannot be met within the time available, agreements should be reached on the extent to which the requirements can be relaxed. Those requirements which cannot be relaxed or met within available resources should be reported to the Congress.

DOD's response, dated August 3, 1979, supported our recommendation that a memorandum of understanding be established, but it was DOD's opinion that initiation of land withdrawal prior to the basing mode decision

would be premature and counterproductive. The DOD reply was not, in our opinion, responsive to our recommendation. We felt steps should be initiated immediately to establish a working relationship, define roles and responsibilities, and delineate a course of action so that the Air Force would be better prepared to accomplish land withdrawal in a timely manner once a decision was made. Now that a basing mode decision has been made by the President, those steps have been initiated but not completed. Until then, the Air Force will not know precisely what must be done by whom to accomplish the land withdrawal process within prescribed time frames.

The Air Force recognizes that withdrawing public land has a large potential for program delay. It stated that a delay at any point in the process could cause a month-for-month slip in the scheduled date for initial deployment. As a result, it is actively considering a request to the Congress for passage of special legislation to expedite the land withdrawal process. In that regard, the Air Force has drafted proposed legislation and has discussed that legislation with Members of the Congress.

RESOURCES

The MX weapon system will require large amounts of electricity, water, and building materials for construction and operations. As the MX weapon system progresses into full-scale engineering development, the program office has yet to demonstrate that sufficient resources can be made available at the appropriate time. Water, in particular, is a scarce commodity in the deployment areas being considered for the MX system.

The usage of large amounts of resources for construction and operations could have a significant adverse impact on local and state economies. To date, no socioeconomic analyses have been done, but some are underway. In our opinion, such analyses are necessary to identify any adverse impacts and to develop mitigating measures.

Water

Water is a scarce commodity in all of the current preferred MX siting areas. Most present and future supplies of surface water are fully allocated and will force the Air Force to use underground water to satisfy its requirements. The Governor of Nevada has publicly stated that he is concerned about the amount of water the MX system

will require if located in Nevada, both during and after construction.

According to the program office, the MX system will require the use of about 90 billion gallons of water during the period 1979-99: 37 billion for construction and 53 billion for operations. The total annual usage will range from 35 million gallons to 10 billion gallons, leveling out after achievement of full deployment to about 4 billion gallons annually.

The availability of sufficient underground water is uncertain. It is not known with any degree of certainty how much water is available and what the impact of its drawdown will be. Further, legal rights to the underground water could develop into a controversial issue with potential program delays.

The program office has conducted literature searches to determine the availability of ground water in Nevada and Utah. Also, tests were carried out to determine the depth of the shallow ground water. In addition, work is presently underway to more adequately determine the legal rights of the ground water. The program office does not expect to know precisely where it will get its water or the impacts of usage until October or November 1980.

Electrical power

It has not been determined if commercial power will be available to satisfy MX requirements. Current plans assume the MX system will operate under normal conditions from commercial power. The Air Force's most recent estimate for the peak electrical power requirement for the MX system, plus the needs of the support base, is 180 megawatts, approximately the electrical requirements of a city with a population of 180,000.

The Air Force recently surveyed commercial power companies in the southwestern United States to determine if sufficient commercial power will be available for MX operations. That effort was completed in December 1979, but a final report has not yet been prepared. If adequate supplies of commercial power are not available, the Air Force would have to provide its own generating capacity. Normal commercial power generation additions are estimated to take 6 to 10 years for planning, studies, environmental impact reviews, final design, and construction. Therefore, the MX system may not have sufficient electrical power for early operation. The Air Force does not expect

commercial power to be available for construction activities and plans to use diesel generators as a temporary source of electrical power.

The feasibility of renewable energy sources (geothermal, solar, and wind) as a supplement to commercial power is being studied. An Air Force official stated that the use of renewable energy would require administration support and Department of Energy cooperation.

Cement

To attain initial deployment in 1986, the MX construction program needs adequate and timely supplies of cement. In recent years, however, construction projects in the western United States have experienced cement shortages resulting in schedule delays, increased prices, and the need to transport cement from distant locations.

The MX construction program will require the use of about 2.7 million tons of cement, or twice the amount used to construct the Hoover Dam. It is not yet known whether sufficient supplies of cement will be available in the western United States or if there are sufficient rail cars to transport the cement from other locations. Further, the impact of the use of such a large amount of cement on future construction activities in the western United States, and the country as a whole, has not yet been determined. The program office recently conducted studies to determine the availability of all construction materials. This effort was completed in December 1979, but a final report has not yet been prepared. An analysis of the socioeconomic impact of the usage of cement for MX will be included in the environmental impact statement to be issued in October 1980.

MISSILE LOCATION UNCERTAINTY

Survivability of the MX weapon system is based on a high degree of mobility and the ability to hide the location of the missiles. As noted in appendix III, a high degree of mobility is provided by periodically changing the location of the missiles; placing the missiles, or a portion of them, in constant motion around the closed-loop roadway; or dashing on tactical warning to reposture some designated percentage of the force during the 30 minute flight time of attacking ICBMs.

The purpose of having the multiple-protective structure basing concept is to be able to hide the location of the

missile among the 23 shelters in each cluster. If the location of a substantial number of missiles is unknown to an attacker, he is forced to attack all possible locations to ensure destruction of any one missile. However, if he is able to distinguish between full and empty structures, survivability of the MX would be impaired. Since this issue is critical to survivability of the MX system, the Air Force has devoted considerable effort to what it calls preservation of location uncertainty.

Preservation of location uncertainty is maintained by periodically moving the transporter-erector-launcher vehicle from one shelter to another in such a way that an observer cannot determine which shelter contains the transporter. Since the movement of the transporter from shelter to shelter occurs out in the open, a visibility shield will be used to cover it. After the transporter is relocated in a new shelter, the shield vehicle will continue to visit all the other shelters and to replicate the procedures associated with transporter entry into a shelter. Thus, an enemy should be unable to identify the specific shelter in which the transporter was inserted.

In addition to the transporter being shielded, the many signatures associated with the movement of a million pound vehicle, which includes the 190,000 pound missile, need to be simulated or masked. In-shelter and in-transit signatures such as electromagnetic, acoustic, and thermal emissions will be simulated by a combination of countermeasures placed either in the shelter or carried by the vehicle. The identification of signatures and the development of countermeasures will continue over the life of the program.

Of particular concern is the signature caused by a large concentration of mass created by the transporter vehicle. The most effective countermeasure known is duplication, which is possible by the use of a mass simulator in the shield vehicle when moving without a transporter. The Air Force plans to retain the option to include mass simulators should the need be established. The use of mass simulators would add about $1.3 billion (1978 dollars) to the procurement cost of the weapon system.

To complicate an enemy's attempt to observe and/or measure many of the system's signatures, the Air Force will employ a point security concept in which the area immediately around the shelter will be fenced to limit access and the entire deployment area will be under continual surveillance to detect the implantation of sensors or enemy

agency operations. Although area security (fencing off the entire deployment area) would have been preferred to preclude observation and measurement of signatures, the Air Force chose to use point security because of potential public opposition to fencing off the entire deployment area.

Whether the Air Force can maintain preservation of location uncertainty is an unresolved issue because (1) a sufficient understanding of signatures and necessary countermeasures will not be available until a prototype system is developed and (2) the potential threats to preservation of location uncertainty in the mid-1980s cannot be accurately predicted.

STRATEGIC ARMS LIMITATION MATTERS

A major objective of the MX program is to develop a basing system consistent with verification provisions of the proposed SALT II treaty, which will also serve as a precedent for future agreements. The primary verification technique is monitoring the number of missiles assembled. Verification is enhanced by deploying each missile in its own physically isolated cluster. Removable roof sections, called view ports, reduce the difficulty of monitoring by satellite.

SALT considerations have had a major impact on the design of the MX weapon system. Compatability with SALT provisions was a major consideration in the decision to go with the verifiable horizontal basing mode rather than the Air Force's preferred vertical shelter basing mode. Vertical shelters were associated with the silo/launcher concept used in Minuteman, compounding the problem of developing a mutually acceptable definition of a launcher. With the horizontal concept, DOD contends that the protective structure is not a launcher since its only function is to provide nuclear blast and shock protection for the canister, missile, and launch essential equipment. In addition, DOD believed that there was more potential for SALT violations with the vertical shelter concept since missiles smaller than the MX could possibly be hidden deep in the shelters below a satellite's viewing angle.

Ratification of the SALT II treaty, as proposed, is currently being held in abeyance. Treaty limitations on the number of Soviet warheads is a critical element in assuring that the MX weapon system with 200 missiles and 4,600 shelters spaced 7,000 feet apart will have the desired level of survivability. Administration officials have

indicated that the Soviets could probably build enough weapons to neutralize the current MX system, thus requiring expansion of the U.S. system to assure the needed survivability of missiles. However, expansion would raise questions on funding, resource availability, and land usage.

CHAPTER 3

STATUS OF THE MX PROGRAM

This chapter provides information on the cost, schedule, and performance characteristics of the MX program.

Full-scale development began on September 7, 1979, and the program office is now reassessing and revising its cost estimates and developing a detailed schedule of events necessary to achieve initial deployment of the MX weapon system in July 1986. In our opinion, it is questionable whether the MX weapon system can be deployed by July 1986 because the land necessary for deployment may not be obtained soon enough. The Air Force's current estimate of $33 billion (1978 dollars) for MX weapon system life-cycle costs may not be a meaningful representation of costs because of uncertainties concerning the size of the missile force, the number of required surviving ICBM warheads, and the design of the weapon system.

COST

Through the end of fiscal year 1979, $603 million had been provided for MX research and development effort--$453 million for concept development and validation efforts and $150 million for full-scale development.

According to Air Force estimates, the life-cycle costs of developing, acquiring, and operating the MX weapon system from the beginning of full-scale development until fiscal year 1999, 10 years after achieving full operational capability, is $33.2 billion (1978 dollars), categorized as follows:

	Estimated Cost (billions)	
Development		$ 6.5
Acquisition:		
Aircraft procurement	$ .3	
Missile procurement	10.7	
Facility design and construction	10.8	21.8
Subtotal of development and acquisition		28.3
Operations and maintenance		4.9
Total life-cycle cost		$33.2

The above costs have not been adjusted to reflect inflationary increases. Applying DOD inflation indices to the estimates for development and acquisition increases costs from about $28 billion to $51 billion. 1/ The $51 billion estimate represents the future funding that will be required for the MX weapon system assuming no change in estimated costs or inflation indices.

The high cost of MX--almost $60 billion--raises a serious issue of affordability. Approved programs included in DOD's long-range plans already exceed expected procurement funding levels by about 100 percent. Other high priority programs may have to be either terminated or significantly delayed unless there is a substantial increase in the defense budget to cover MX costs. The Secretary of Defense, in his report to the Congress on the fiscal year 1981 budget, stated that the issue of affordability will be a part of the regular Defense Systems Acquisition Review Council process at each decision milestone to assure that program decisions are consistent with funding projections in the Planning, Programing, and Budgeting System process, and this has been discussed with the Congress as recently as February 1980.

1/ At the time we completed our fieldwork, the program office had not adjusted operations and maintenance costs for inflationary increases using DOD inflation indices. Therefore, the $56 billion cited first on page 1 is the $28 billion adjusted for inflation plus unadjusted operations and maintenance costs of $5 billion.

In view of current budget limitations, DOD is faced with determining what is affordable in terms of a large number of weapons systems, and it seems that DOD has not established priorities in case all planned programs are not fully funded.

The amount of development and acquisition funding that will be required on an annual basis using DOD inflation rates is illustrated below:

	Costs estimates adjusted for inflation using DOD rates			
	Development	Procurement	Construction	Total
	(billions)			
1979/1980	$ .8	$ -	$ .1	$ .9
1981	1.6	-	.1	1.7
1982	2.0	-	.3	2.3
1983	2.0	1.4	1.1	4.5
1984	1.6	4.0	3.9	9.5
1985	.9	4.8	5.0	10.7
1986	.5	4.6	5.0	10.1
1987	-	4.1	4.0	8.1
1988	-	1.4	1.0	2.4
1989	-	.2	.1	.3
1990	-	.1	-	.1
To completion	-	.1	-	.1
Total	$9.4	$20.7	$20.6	$50.7

The current estimated cost of MX weapon system development and acquisition may not be meaningful because:

--The program office estimate assumes the need for a certain surviving ICBM force with a force of 200 MX missiles based in 4,600 shelters. DOD, however, has not expressed its policy relative to the specific size of the MX force or the surviving ICBM force, and MX costs will vary with the assumptions used.

--The program office has assumed that the shelters would be spaced 7,000 feet apart, but a final decision has not been made. A change in spacing could influence such requirements as shelter hardness and the size of the deployment area with a corresponding effect on cost.

--It is planned that the launcher would break through the top of the shelter in order to launch the missile. Consideration is being given to moving the missile

outside the shelter for launch with a resulting decrease in life-cycle costs.

--In order to keep the location of the missile unknown when it is being transferred, it may be necessary to use simulators. The program office estimates that use of simulators would increase procurement costs by about $1.3 billion (1978 dollars).

--The size of the transporter-erector-launcher vehicle, the dimensions of the shelter, and the number of removable sections in the roof of each shelter have not yet been finalized.

--The number of base support facilities has not been finalized. For cost estimating purposes, the program office assumed there would be one main base with a complete complement of facilities and one smaller base with fewer facilities. However, the Strategic Air Command has suggested various combinations of base support facilities, such as two main bases with one smaller base or one main base with two or more smaller bases.

SCHEDULE

Deployment of the MX weapon system has been delayed about 4 years. When the program began, initial deployment was expected in calendar year 1982. Now, initial deployment of the MX weapon system is planned for July 1986, with full deployment to be accomplished by 1989. Key milestones are:

Deployment site selection	October 1980
Begin site preparation	January 1982
First flight test	January 1983
Production decision	July 1983
Initial deployment	July 1986

PERFORMANCE

The Strategic Air Command has revised the MX required operational capability document and submitted it to Air Force Headquarters in February 1979 for review and approval. In commenting on our report, DOD officials stated that the requirements document submitted by the Strategic Air Command will be approved without substantial change by Air Force Headquarters in early 1980.

OTHER MATTERS

Other matters creating uncertainty about the capability of the Air Force to meet cost, schedule, and performance goals are:

--Cost growth relative to the construction of facilities at Vandenberg Air Force Base to support the MX flight test program.

--Uncertainty about the development of the MX missile's reentry system and propulsion system.

--Uncertainty about acquiring additional program office personnel.

Construction of facilities at Vandenberg Air Force Base

The MX weapon system flight test program will be conducted from Vandenberg Air Force Base, with 128 missile launches planned. Before initial deployment, 20 missile flights will be conducted to test the MX missile and demonstrate weapon system capability. After initial deployment, 108 missile flights will be conducted during the estimated 15-year life of the weapon system to verify the system's operability and effectiveness, including accuracy and reliability.

The MX flight test activities will require road and utilities improvements, construction of 14 new facilities, and modification of an existing facility. (Facility requirements are listed in appendix II.) The facility construction program at Vandenberg Air Force Base will cost about 83 percent more than the $56.3 million initially projected, as illustrated below.

Funding year	Original estimate	Current estimate	Amount of change
	----------(millions)----------		
1980	$35.4	$ 57.0	$21.6
1981	20.9	16.9	-4.0
1982	-	16.1	16.1
1983	-	13.2	13.2
Total	$56.3	$103.2	$46.9

Reasons for the changes in the cost estimates are as follows:

--The cost growth for the 1980-funded facilities resulted from preliminary estimates being too low and more precisely defined design requirements.

--The Air Force had originally planned to construct two operationally configured vertical shelters, but now plan to construct four operationally configured horizontal shelters. Because of the delay in reaching a MX basing decision, two nonoperationally configured interim facilities will be needed to support the first five flights. As a result of these changes, funding requirements were decreased for fiscal year 1981 and increased for fiscal years 1982 and 1983.

Additional Ballistic Missile Office personnel requirements

The Ballistic Missile Office has requested 98 additional military and civilian personnel for fiscal year 1980 to manage the MX and Minuteman programs. Obtaining those personnel in a timely manner is, however, uncertain. The Office first requested additional personnel for managing the MX full-scale development program in June 1978. We were advised by Air Force officials that no action was taken on that request because full-scale development for the MX weapon system had not yet been approved. The Ballistic Missile Office next submitted a request for additional staff in June 1979 after the President approved the MX full-scale development. The number of additional military and civilian personnel requested was as follows:

	Officers	Airmen	Civilians	Total
Positions required in FY 1980	208	26	236	470
Authorizations as of 06/14/79	160	23	189	372
Additional positions required	48	3	47	98

The above request was approved by Air Force Headquarters in October 1979. In approving the request, the Air Force authorized 108 additional personnel, 10 more than requested. The Ballistic Missile Office expects if normal practices are followed, it will take 9 to 12 months to fill the additional positions. However, we have been advised by program office and other Air Force officials that it may require a longer time period to obtain additional staff because

of an Air Force shortage of officers with engineering skills and a competitive civilian aerospace job market.

If it does take 9 to 12 months to fill vacancies, the Ballistic Missile Office would have to manage their assigned programs during the first 9 months of fiscal year 1980 with as few as 70 percent of their authorized strength. This is well below the 90-percent level which the Office feels is the minimum staffing necessary to effectively perform their mission. Program officials said this is a crucial period when several contract actions will be taken to negotiate new contracts for full-scale development efforts or to modify existing contracts. Accordingly, an adequate number of qualified personnel will be needed to evaluate the technical aspects of the contracts and to negotiate a fair and reasonable price. Further, according to program officials, it is imperative to establish a strong posture at the beginning of full-scale engineering development to maintain oversight over contractor activities, and effective aggressive surveillance cannot be accomplished without adequate numbers of qualified personnel.

In commenting on our report, DOD officials acknowledged the critical needs for an adequate number of qualified personnel during the early stages of full-scale development. They stated that it may not be possible, however, to obtain sufficient personnel until the latter part of fiscal year 1980 because of the personnel issues involved.

Missile development

According to the Air Force, MX missile technologies were sufficiently demonstrated to warrant advancement into full-scale development in late 1978. The postponement of development to September 1979 has allowed the program office to complete systems definition and to explore alternate propulsion system technologies planned to be used to enhance missile performance and reliability. Some additional work remains to fully demonstrate alternate propulsion technologies. In December 1979 the MX reentry vehicle was selected, but uncertainty remains concerning the capability of the arming and fuzing subsystem to satisfy requirements. Air Force officials, however, do not feel that the remaining missile uncertainties are of sufficient magnitude to warrant further delays.

Capability to produce carbon/carbon materials for the Stage I propulsion motor nozzle

Postponement of full-scale development until September 1979 permitted the Air Force additional time for the design, fabrication, and analyses of carbon/carbon material for use as a component of the Stage I nozzle. Carbon/carbon material is a relatively lightweight material which retains strength at high rocket motor temperatures. This material had been previously used for small propulsion motors, but it is not known if it can be used for the MX Stage I nozzle. According to Air Force officials, the use of carbon/carbon materials in the design of a component for the Stage I nozzle could improve motor performance and reliability.

Since June 1978 the Air Force Rocket Propulsion Laboratory has been conducting a program (1) to extend existing applications of carbon/carbon materials to the MX Stage I nozzle size with resulting improvements in performance and reliability, (2) to obtain information on the potential manufacturing capability to produce large standardized nozzle materials in adequate numbers to support the MX production schedule, and (3) to reduce the risk associated with entering full-scale development with carbon/carbon materials. The Laboratory's program involves the only three vendors capable of manufacturing the material in the required size. These vendors will each design and manufacture the carbon/carbon component for a prime contractor who will analyze and rank the products. As the MX program entered full-scale development in September 1979, only one of the three vendors had delivered a carbon/carbon component for analyses and ranking.

Accordingly, the successful application of carbon/carbon material to the Stage I nozzle has not yet been conclusively demonstrated. However, since the Laboratory's program began, other parallel programs examining similar carbon/carbon applications were initiated. Laboratory personnel were sufficiently satisfied with the results of those programs and believe a failure in developing the material for use in the Stage I nozzle is highly unlikely. Also, there is still uncertainty concerning the available capacity to produce a standardized carbon/carbon product in sufficient quantities to meet the MX deployment schedule. The final technical report on the carbon/carbon material program, now due in June 1980, will address the three vendors' design and fabrication expertise and their capability to produce the carbon/carbon material.

Development of an improved Stage III extendable nozzle exit cone

The design of the extendable nozzle exit cone for the MX missile's Stage III propulsion motor was changed from the more mechanically complex folding petal cone to the nested cone nozzle because of cost considerations. Since November 1977 the Air Force Rocket Propulsion Laboratory has sponsored a program to design, produce, and demonstrate a full-scale, lightweight, carbon/carbon nested exit cone for the Stage III extendable nozzle that should result in greater reliability and improved performance. The primary concern of the program was to pursue the technical feasibility of large-scale applications of existing technology to the Stage III nested cone. Emphasis was also placed on determining the capability of fabricating standardized carbon/carbon cones in the quantities needed to meet the MX production schedule.

As the MX system enters full-scale development, Air Force personnel are sufficiently satisfied with the current results of the nested cone program to believe that application to the MX Stage III will be a low-risk area. However, it has not yet been conclusively demonstrated that potential manufacturers currently have the ability to fabricate quality nested cones in the quantities necessary to meet the MX deployment schedule.

Feasibility of a liquid fuel tank for Stage IV

A feasible liquid propellant fuel tank design for Stage IV of the MX missile's propulsion system has not yet been conclusively demonstrated. The Air Force Rocket Propulsion Laboratory has been conducting a program since September 1977 to design, fabricate, and test such a tank. This effort has resulted in a tank concept that the Laboratory feels can be applied to Stage IV specifications. However, additional testing is needed to conclusively prove its feasibility.

Despite the confidence of the Laboratory in its tank design, the program office has selected a different tank concept as the baseline configuration for Stage IV. This tank was developed for various space applications, such as the Space Shuttle and Viking orbiter, and was selected as the baseline in lieu of less costly tank alternatives because of its apparent performance advantages. At the time the tank was selected, no work had yet been done to demonstrate the capability of the design to meet MX requirements.

The baseline tank design, the Rocket Propulsion Laboratory tank design, and a third design (an existing concept not developed for MX) will undergo parallel testing during full-scale development. Although a Stage IV tank design has not been decisively demonstrated, the Air Force feels that liquid fuel tank technology has progressed sufficiently that a viable concept can be proven during MX full-scale development.

In commenting on our draft report, program officials said the baseline configuration selected has been dropped from further considerations based on a reassessment of cost and performance characteristics. As a result, only two tank designs are currently being considered with the Rocket Propulsion Laboratory design representing the baseline.

Reentry vehicle selection

DOD officials stated that a decision was made in December 1979 to equip the MX missile with the baseline MX-12A reentry vehicle and warhead. A solution to a problem with the arming and fuzing subsystem, however, is still under development.

CHAPTER 4

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

Uncertainty still exists concerning the MX basing mode. While the President has announced his MX basing mode preference, other alternatives are being considered. DOD plans to present those alternatives to the Congress and a final decision on MX basing is planned to be made during fiscal year 1980.

Extraordinary actions by the Congress or the administration may be necessary if the land and resource issues become significant obstacles to timely deployment of the MX weapon system. These measures, however, must be a part of, and not a substitute for, timely and decisive actions and well-developed plans. The need for legislative relief to expedite land withdrawal cannot be conclusively determined until DOD and BLM have established a formal working agreement and jointly identified the statutory requirements which need to be relaxed. Legislative relief should be requested only after all alternatives have been thoroughly examined.

SALT and system survivability concerns have not only influenced the selection of the basing mode, but could have a major impact on the MX system. Until final agreement on a SALT II treaty is reached, the amount of land and the number of shelters for the MX weapon system cannot be conclusively determined. Preservation of the uncertainty of the missiles' location for its survivability is also not a foregone conclusion because of the many signatures that need to be masked and the unknown future threat. Efforts are continuing to identify signatures and develop countermeasures. Depending upon the results of those efforts, it is conceivable that the Air Force may be forced to revert to area security, or at least place some restrictions on the public's activities within the deployment area. In commenting on our report, DOD officials emphatically stated that under no circumstances, either now or in the future, does DOD intend to place any restrictions on the public's activities in the deployment area outside the fenced sites. Considering the work which remains relative to identifying signatures and developing countermeasures, we feel DOD's position is questionable.

Because of the uncertainties that exist on the size of the missile force, the required number of warheads needed to launch a retaliatory strike after an attack on the

United States, and the design of the weapon system, it is questionable whether the Air Force can meet its cost, schedule, and performance goals. We recognize that as development of the MX weapon system progresses, many of the problems will be resolved. This does not, however, preclude the need, at the very beginning of full-scale development, for a complete disclosure of program uncertainties and the potential impact on cost, schedule, and performance goals. We feel that disclosure of such information for the MX program is especially important because of the large commitment of financial and other resources that will be required.

If the Air Force's assessment of Ballistic Missile Office personnel needs is accurate, it appears that there will be a shortage of qualified civilian and military personnel to effectively manage the MX program during the first year of full-scale development. In view of the magnitude of the MX program, it may be necessary to take extraordinary measures to obtain sufficient personnel with the necessary qualified skills.

RECOMMENDATIONS

We recommend that the Secretary of Defense:

--Identify the potential increases or decreases in program cost due to the many uncertainties which must be resolved. Related potential impact on schedule and performance goals should also be known.

--Assure that the high cost of the MX system is adequately analyzed in the context of the overall DOD budget to determine if the MX is affordable and whether or not any other major weapon system programs would have to be terminated or delayed.

--Expedite efforts to establish a memorandum of agreement with the Secretary of the Interior setting forth a time-phased action plan which will allow public land to be withdrawn for the MX weapon system in accordance with Federal regulations and in support of scheduled deployment dates. This information should include a listing of statutory requirements which cannot be satisfied within prescribed time frames and, therefore, may require special congressional action.

--Identify the changes to the MX weapon system that may be required without arms control agreements. If these changes involve construction of more

shelters, information should be provided identifying (1) the additional land, electricity, water, and construction materials needed and (2) the availability of those resources.

This report was reviewed by agency officials associated with the management of the program, and their comments have been incorporated as appropriate.

LISTING OF CONTRACTORS DEVELOPING SOME OF THE MAJOR MX WEAPON SYSTEM COMPONENTS

Weapon system component	Contractor
Propulsion System:	
Stage I	Thiokol
Stage II	Aerojet
Stage III	Hercules
Stage IV	Rockwell International (Rocketdyne)
Guidance and control system:	
Flight computer and systems integration	Rockwell International (Autonetics)
Inertial measurement unit	Northrop
Reentry vehicle system:	
Reentry system	AVCO
Reentry vehicle	To be determined
Transporter-erector-launcher vehicle:	
Launcher	Martin-Marietta
Transporter/erector	Boeing
Assembly, test, and systems support	Martin-Marietta

APPENDIX II

SCHEDULE IDENTIFYING THE FACILITIES NEEDED

AT VANDENBERG AIR FORCE BASE

TO SUPPORT THE MX WEAPON SYSTEM FLIGHT TEST PROGRAM

Funding year	Facility name	Purpose of facility	Estimated cost Per facility	Estimated cost Per year
			(millions)	
1980	Missile assembly building	Assembly and checkout of the missile	$26.3	
	Mechanical maintenance facility	Service the missile transporter and transportation equipment	5.5	
	Integrated test facility	Launch control, data processing, laboratories, instrumentation, flight safety component processing, and program administration	14.5	
	Roads and utilities	Roads and utilities needed to serve the MX test area	10.7	
	Total cost			$ 57.0
1981	Rail transfer facility	Rail spur and loading dock for receipt/shipment of missile motors and other system components	1.5	
	Payload assembly building	Processing of MX reentry systems (modification of existing facility)	.4	
	Stage processing buildings (2)	Receive, inspect, and process missile motors	3.2	
	Stage IV installation and checkout facility	Receive and process Stage IV and associated hardware	3.6	
	Stage storage facility	Contains four storage pads for missile stages	2.2	
	Interim launch facilities (2)	Interim launch facilities to be used for the first five flights	6.0	
	Total cost			$ 16.9
1982	Horizontal shelters (2)	Operationally configured structures	13.2	13.2
1983	Horizontal shelters (2)	Operationally configured structures	16.1	16.1
Total				$103.2

MX WEAPON SYSTEM DESCRIPTION

The MX weapon system 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) spaced 7,000 feet apart.

The MX missile will be the largest new missile permitted under proposed SALT II provisions. 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 costs estimates have been computed assuming that MX missiles would replace Minuteman III missiles, the only missile in the current U.S. ICBM force capable of delivering multiple independently targetable reentry vehicles. A comparison of some MX and Minuteman III missile characteristics follows:

Characteristic	Minuteman III	MX
Length	60 ft.	71 ft.
Weight	78,000 lbs.	190,000 lbs.
Diameter	66 in.	92 in.
Number of reentry vehicles	3	10
Throw weight	2,400 lbs.	7,900 lbs.

Each MX missile will be encased in a canister and mounted on a transporter-erector-launcher vehicle. Each vehicle with its missile will be housed in 1 of a cluster of 23 horizontal shelters which are connected by a closed-loop road system. Since only one vehicle with its missile will be located in each cluster, 200 separate clusters will be required.

Unlike the silos presently used to house U.S. ICBMs, the horizontal shelters are protective structures only and do not contain the auxiliary equipment necessary to launch a missile. Instead, the launch equipment moves with the missile on the transporter-erector-launcher vehicle. That vehicle will have the capability to push the canister through the roof of the shelter after which a gas ejection system will eject the missile from the canister. Shortly after clearing the canister, the main engine of the missile is to ignite and propel the missile on its projected flight. Since the vehicle rather than the shelter contains the equipment necessary to launch the missile, DOD contends the vehicle and not

the shelter should be counted for purposes of determining compliance with SALT launcher limits.

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. Consequently, 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 three different modes of operation. First, the location of all 200 missiles can be changed within a few hours. This operating practice might be useful if some concern about location uncertainty develops or if an international crisis appears to be developing. Second, if missile location uncertainty becomes in grave doubt, then some or all vehicles could be placed in constant motion around the closed-loop roadways; if tactical warning indicated an attack, the transporter could then drive into the nearest shelter. Third, as an alternative to constant motion, the transporter could be poised to dash on tactical warnings to reposture some designated percentage of the force during the 30 minute flight time of attacking ICBMs.

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 ensure 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.

(951511)

Single copies of GAO reports are available free of charge. Requests (except by Members of Congress) for additional quantities should be accompanied by payment of $1.00 per copy.

Requests for single copies (without charge) should be sent to:

U.S. General Accounting Office
Distribution Section, Room 1518
441 G Street, NW.
Washington, DC 20548

Requests for multiple copies should be sent with checks or money orders to:

U.S. General Accounting Office
Distribution Section
P.O. Box 1020
Washington, DC 20013

Checks or money orders should be made payable to the U.S. General Accounting Office. NOTE: Stamps or Superintendent of Documents coupons will not be accepted.

PLEASE DO NOT SEND CASH

To expedite filling your order, use the report number and date in the lower right corner of the front cover.

GAO reports are now available on microfiche. If such copies will meet your needs, be sure to specify that you want microfiche copies.

AN EQUAL OPPORTUNITY EMPLOYER

UNITED STATES
GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE,$300

POSTAGE AND FEES PAID
U. S. GENERAL ACCOUNTING OFFICE

THIRD CLASS