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BY THE COMPTROLLER GENERAL

Report To The Congress

OF THE UNITED STATES

Status Of The Intercontinental Ballistic Missile Modernization Program

The Department Of Defense is taking three major actions to modernize the intercontinental ballistic missile component of the U.S. strategic forces. Specifically, DOD is

--developing a small ICBM and its hard mobile launcher,
--researching other basing technology, and
--deploying Peacekeeper (MX) missiles in Minuteman silos.

Potential major issues of the small ICBM can now be identified. For instance, for a 500 missile force on hard mobile launchers

--life cycle costs would be about $44 billion in 1982 dollars,
--personnel requirements would be about 20,000 people, and
--up to 28,000 square miles of land would be required for wartime operations.

The Peacekeeper program is in production while development testing continues. Results to date have been positive. Current congressional action to limit the number of missiles deployed will affect program cost and schedule.

GAO/NSIAD-85-78
JULY 8, 1985

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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 major issues concerning the Air Forces' ICBM modernization program. This program is comprised of three elements, (1) deploying Peacekeeper missiles in existing Minuteman silos; (2) developing a small, about 15 ton, single-warhead ICBM; and (3) research to resolve uncertainties regarding silo or shelter hardness.

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

Charles A. Bowsher

Comptroller General
of the United States

COMPTROLLER GENERAL'S
REPORT TO THE CONGRESS

STATUS OF THE INTERCONTINENTAL BALLISTIC MISSILE MODERNIZATION PROGRAM

D I G E S T

In April 1983 the President's Commission on Strategic Forces recommended restructuring the intercontinental ballistic missile (ICBM) modernization efforts. A program was established consisting of three elements to

--develop a small ICBM, weighing about 15 tons, and a hard mobile launcher designed to survive a nuclear attack;

--research follow-on basing technology, primarily related to hardened silos; and

--deploy 100 Peacekeeper (formerly termed the MX) missiles in existing Minuteman missile silos.

The House and Senate, in considering their 1986 Defense authorization bills, limited Peacekeeper missile deployment. The House limited the number of deployed missiles to 40. The Senate limited the number of missiles to 50 in Minuteman silos and made future procurement of deployable missiles contingent on congressional approval of an alternate basing mode. The difference had not been resolved as of late-June 1985.

The small ICBM program is in the early development phase, with full-scale development scheduled to begin in October 1986. The hard mobile launcher concept, based on a missile transporter/erector/launcher capable of withstanding nuclear blast pressure of 30 pounds per square inch, has been selected as the primary basing mode for the system. Preliminary requirements and operational concepts have been developed for the small ICBM.

The Air Force is requesting $625 million in fiscal year 1986 for small ICBM and mobile launcher development.

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JULY 8, 1985

A basing technology program to develop super hardened silos to withstand blast pressures far in excess of what was previously thought possible, which could be applicable to either small ICBM or Peacekeeper, is being actively pursued. Scale model tests of super hard silos have been conducted and contracts awarded to develop candidate silo designs and to construct a test facility. The Air Force is requesting $152 million in fiscal year 1986 for follow-on work in this area.

The Peacekeeper weapon system is progressing toward deployment of the first 10 missiles by December 1986. Design of the missile is essentially complete and flight worthiness of the missile has been demonstrated in the seven test flights accomplished by March 1985. An additional 13 developmental test flights are planned to evaluate and verify the total system.

The Air Force's plan is to procure 223 Peacekeeper missiles--100 for deployment, 108 for operational testing, and 15 to monitor the effects of aging on the missile. Funds were appropriated in fiscal year 1984 for production of the first 21 missiles and in fiscal year 1985 for an additional 21 missiles. The Air Force requested $4.02 billion in fiscal year 1986 for the procurement of 48 missiles, continued development, and related construction. However, the Senate reduced the quantity to be procured to 12 missiles and the House deleted all funds for procuring Peacekeeper missiles in fiscal year 1986.

GAO reviewed the ICBM modernization program as a part of its continued monitoring of major Department of Defense weapon acquisition programs. With respect to the Peacekeeper program, GAO followed up on cost, performance, and system development issues presented in a prior report (GAO/NSIAD-84-112, dated May 9, 1984). With respect to the small ICBM, GAO examined the progress being made by the Air Force in developing the small ICBM and survivable basing modes.

RESULTS OF THE REVIEW

The ICBM modernization program, as established in April 1983, appeared at the time of GAO's

review to be progressing as planned. No major deviations to cost, schedule, or performance milestones were evident. However, various issues, summarized below, have surfaced on the small ICBM. In addition, current congressional action to limit the number of Peacekeeper missiles to be deployed will affect the program's cost and deployment schedule.

Small ICBM

Preliminary data available on the small ICBM weapon system indicates that life-cycle costs, technical aspects, and operational effectiveness issues must be resolved before the success of the small ICBM and survivable basing proposals can be assured.

--Preliminary program office life-cycle cost estimates for some of the candidate basing options give an indication of the cost involved in deploying the small ICBM. For example, for a force of 500 small ICBMs, the preliminary life-cycle cost estimate in 1982 dollars for basing in optimally spaced super hardened silos is $49 billion; the estimate for deploying on hard mobile launchers is $44 billion; and, the estimate for deploying on soft mobile launchers, which are designed to withstand a lower level of blast pressure and depend on wide dispersal for survivability, is $43 billion. (See p. 7.)

--Operating and maintaining a force of small ICBMs in one or more basing modes could require a large personnel force. For a force of 500 missiles, for example, 20,000 people would be needed for randomly dispersed hard mobile launchers or 34,000 people would be needed for a wide area (soft) mobile system. (See p. 8.)

--The life-cycle cost of the small ICBM can not be accurately estimated until a number of decisions are made. They include deciding on whether more than one basing mode must be employed and the number of small ICBMs to be deployed. (See p. 8.)

--Preliminary estimates on the small ICBM assume deployment of 100 Peacekeeper

missiles with 1,000 warheads. If the Peacekeeper program is curtailed, additional small ICBMs may be requested by DOD. (See p. 8.)

--Defense identified several engineering and technological challenges that must be overcome in developing a small ICBM capable of mobile basing. This includes developing a missile that meets range requirements but does not exceed weight limitations, developing an affordable guidance and control system which can meet accuracy requirements in a mobile environment, conducting scale model tests to verify the feasibility of silo hardening, developing a cost-effective hard silo design, and developing a command and control system for a mobile small ICBM deployed over a large area. (See pp. 9 and 10.)

--There are potential operational effectiveness issues associated with the primary basing mode, hard mobile launcher. It may be necessary to deploy the small ICBM in more than one basing mode to satisfy all mission requirements. (See pp. 11 and 12.)

--Securing sufficient suitable land for deployment of a hard mobile based small ICBM weapon system on existing Defense and Department of Energy land could be challenging and time consuming. For example, environmental concerns will have to be resolved before a hard mobile ICBM can be deployed. Defense officials are aware of the difficulties and are working on their resolution. (See pp. 12 and 13.)

Peacekeeper

As of March 1985 the Peacekeeper developmental flight test program was 35 percent complete, and 13 more flight tests remained to conclusively demonstrate the operational effectiveness and suitability of the Peacekeeper weapon system.

--One continuing concern which could affect performance is the failure of the Stage III rocket motor's extendable nozzle during the third and seventh test flights. The

extension of the nozzle in flight enhances rocket performance permitting greater range. (See pp. 15 to 18.)

--The 123 Peacekeeper missiles planned for testing and aging will be needed regardless of the number of missiles the Air Force deploys. (See p. 18.)

--The accuracy achieved by the first six Peacekeeper test missiles has been significantly better than the operational requirement. Final accuracy results will not be available until testing of the missile with all operational components is completed. (See p. 20.)

--The final four development test flights, originally scheduled to verify missile operational performance before deployment, will now be flown after the first 10 Peacekeeper missiles are deployed. (See p. 16.)

--The cost for the Peacekeeper program, as estimated by the Air Force as of December 31, 1984, was $16.5 billion in 1982 dollars, or $21.6 billion in then year dollars. The Air Force projected a $141.6 million program cost increase due to the congressional action reducing missile procurement quantities in fiscal year 1985. Congressional actions on the 1986 Defense authorization affecting the Peacekeeper program will impact missile unit cost and program cost estimates. (See p. 21.)

--As GAO pointed out in a prior report, costs of $4.6 billion incurred before April 1983 are not included in the current estimate of $21.6 billion. (See p. 21.)

CONCLUSIONS

The Air Force has made progress in defining the small ICBM system with primary emphasis on hard mobile basing. Although system acquisition efforts are still in the preliminary stages, major issues on the small ICBM program are emerging concerning cost, technical feasibility,

land availability, and operational effectiveness. These are significant issues in relation to the timely deployment of an effective small ICBM.

The Peacekeeper weapon system is proceeding toward deployment of the first 10 missiles by December 1986. Positive progress has been made in developing the Peacekeeper missile and testing is continuing to provide added assurance that the deployment missiles will meet operational requirements. During the balance of the flight test program, the missile design will transition from a developmental to an operational configuration. This testing will be done concurrently, however, with missile production and deployment activities with a corresponding risk of not meeting cost, schedule, or performance goals if unforeseen problems do occur.

AGENCY COMMENTS

The Department of Defense reviewed a draft of this report and concurred with its contents. (See app. I.)

Contents

ABBREVIATIONS

DOD	Department of Defense
GAO	General Accounting Office
ICBM	Intercontinental Ballistic Missile
OSD	Office of the Secretary of Defense

GLOSSARY

Aging
: To become old; with respect to ICBMs, the propellent may deteriorate over time, adversely affecting missile performance.

Advanced Inertial Reference Sphere (AIRS)
: A floated sphere inertial reference designed to provide highly accurate velocity and attitude measurements for the Peacekeeper's guidance and control system.

Ballistic Missile
: A missile whose propulsion system consists of rockets which burn early in the flight of the missile. After the rockets burn out, the payload coasts on to the target on a "ballistic trajectory," like a bullet fired from a rifle.

Dash
: To move with sudden speed.

Determined attack
: An attack where the attacker vigorously attacks, using attack resources liberally to assure destruction of the target.

Disperse
: To separate and move apart in different directions without order or regularity.

Dormant
: Temporarily inactive.

Endurance
: The ability, over a protracted period of time to operate as desired and cause the specified damage to the enemy.

Extendable nozzle exit cone
: A truncated cone-like device designed to control the exhaust gases from the burning missile propellent. On stages subsequent to the first stage the cone is packaged in a collapsed form and extends before the motor fires.

Follow on basing technology
: Generic term encompassing items within a recommendation of the President's Commission on Strategic Forces. The Commission recommended a program to resolve uncertainties regarding silo or shelter hardness and investigation of different types of land-based vehicles and launchers, including particularly hardened vehicles.

Hard Mobile Launcher
: A missile transporter, erector, and launcher designed for the small ICBM. The hard mobile launcher is to be designed to withstand pressure of 30 pounds per square inch.

Hardness
: The resistance of a possible target to the effects of enemy nuclear weapons. The often discussed hardness of missile silos is usually measured in pounds-per-square-inch (psi) of blast pressure.

Hardening
: Designing missile silos or protective structures to withstand higher blast pressure.

Intercontinental Ballistic Missile (ICBM)
: A long-range missile based in the continental United States which has sufficient range to attack most or all of the Soviet Union, or a Soviet missile with corresponding capability.

Inertial guidance
: Gyroscopes and other instruments which guide the missile without any communication between missile and ground in either direction after the moment of launch. Inertial guidance is in virtually universal use on ICBMs at this time.

Long lead
: Parts, components, or subsystems which take a long time to obtain. Funding for long lead items may be budgeted 1 year in advance of the fiscal year in which the total system is budgeted.

MK 21 Reentry Vehicle (see Reentry Vehicle)
: An improved reentry vehicle to be used on Peacekeeper and small ICBM missiles, designed to be more accurate than the MK 12A reentry vehicle used on Minuteman ICBMs.

MX (Missile X)
: Missile experimental, earlier nomenclature for the Peacekeeper missile.

Modified Advanced Inertial Reference System (see Advanced Inertial Reference System)
: A modification of the inertial reference system designed for the Peacekeeper system.

Off base
: To move from a designated area, in the case of small ICBM usually a military installation, to the surrounding countryside.

Peacekeeper (see Intercontinental Ballistic Missile)
: A large (195,000 pound) intercontinental ballistic missile being developed by the Air Force. The Peacekeeper is designed to carry 10 reentry vehicles (warheads) and to be more accurate than existing Minuteman missiles. Higher accuracy of the Peacekeeper will enable it to destroy harder targets than Minuteman could destroy.

Penetration aids
: Equipment, such as decoys, carried on a missile, specifically to assist the reentry vehicle(s) to get through ballistic missile defenses.

Reentry Vehicle (RV)
: The shell around a warhead, generally in the shape of a cone or modified cone, which protects the missile warhead during its reentry through the earth's atmosphere. When the weight of a reentry vehicle is discussed, it usually means the total weight of the warhead, protective shell, and any other equipment carried inside that shell.

Readiness
: The condition of being completely prepared or in a condition for immediate action or use. The level of readiness for the missile force is usually the percent of missiles available for use.

Requirement
: An explicit level defining performance or quantity. Usually the requirement defines the minimum acceptable level.

Small ICBM
: As defined by the President's Commission on Strategic Forces, the small ICBM would be a single-warhead missile weighing about 15 tons.

Soft Mobile Launcher
: A transportor/erector/launcher for the small ICBM that would be designed to withstand a relatively low level of overpressure. The soft mobile launcher would rely on wide dispersal for survivability.

Super hard
: The capability of structures to withstand blast pressures or over pressures far in excess of what previously was thought possible.

Survivable
: The ability of a missile force to survive a Soviet nuclear attack and carry out its mission regardless of the size of the Soviet attack, the sequence, or the amount of warning.

Then year dollars
: Program cost expressed in terms of when funds will be expended thereby taking into account future years inflation.

CHAPTER 1

INTRODUCTION

The U.S. strategic nuclear forces consist of submarine launched ballistic missiles, manned bombers (some armed with cruise missiles), and land-based intercontinental ballistic missiles (ICBMs). Since the 1960s, this triad of nuclear forces has contributed to the primary objective of the nation's strategic forces--deterrence of nuclear war. For several years, national leaders have been concerned that the deterrent value of the triad has been eroded by Soviet improvements to their strategic forces. To correct this condition, several modernization programs are in process to improve the capabilities of the U.S. strategic forces. This report deals with current ICBM modernization initiatives--the Peacekeeper, the large (195,000 pound) 10 warhead missile formerly termed the MX; the small ICBM, a new 30,000 pound single warhead missile; and the follow-on basing programs to develop harder silos and shelters as well as hardened vehicles.

ICBM MODERNIZATION INITIATIVES

The ICBM modernization program, recommended by the President's Commission on Strategic Forces, was announced by President Reagan in April 1983 and endorsed by the Congress in May 1983. Subsequently, a program was established to

--develop a new small ICBM and hard mobile launcher,

--investigate follow-on basing technologies, and

--place 100 Peacekeeper missiles in existing Minuteman silos.

The Commission believed the Peacekeeper missile, which had been in full-scale development since September 1979, was needed promptly to remove the Soviet advantage in ICBM capability and to encourage the Soviets to seek arms control agreements.

The underlying logic of the Commission's recommendation to develop a new small ICBM was that a small ICBM would be very flexible in terms of basing and, therefore, potentially more survivable than current systems. Consequently, since it could survive a Soviet attack it would not be viewed as a first strike weapon. The Commission believed the less vulnerable small ICBM would be stabilizing and enhance the arms control process. Further, a small ICBM with a single reentry vehicle, having one warhead, would be less subject to attack since an attacker would expend more warheads in attacking the small ICBM than he would destroy.

The Commission concluded that having several different modes of deployment (basing) would serve the U.S. objective of stability. The U.S. objective, according to the Commission, should be to have an overall program that will so confound, complicate, and

frustrate the efforts of Soviet strategic war planners that, even in moments of stress, they could not believe that an attack on U.S. ICBM forces would be effective.

Following congressional approval of the Commission's recommendations in May 1983, the Secretary of Defense directed production of the Peacekeeper missile. In addition, the Air Force began structuring a program consisting of Peacekeeper deployment, small ICBM and hard mobile launcher development, and follow-on basing technologies. That program received formal approval from the Office of the Secretary of Defense (OSD) in September 1983, and serves as the direction for current ICBM modernization activity.

FUNDING FOR ICBM MODERNIZATION

According to the Air Force, about $21.6 billion will be required for the Peacekeeper program through the 1980s. With the small ICBM, the total funds for ICBM modernization will be about $5 to $6 billion annually. Annual funding needs, as estimated by the Air Force at the time of our field work, by program, are shown below:

ICBM Modernization Funding Requirements[a]

Fiscal year	Peacekeeper	Small ICBM and follow-on basing	Total
	(000,000 omitted)		
1983	$ 1,930	$ 0	$1,930
1984	4,146	467	4,613
1985	4,296	641	4,937
1986	4,020	797	4,817
1987	3,218	b	b
1988	2,456	b	b
1989 to complete	1,581	b	b
Total	$21,647	$ b	$ b

[a] Then year dollars.
[b] To be determined.

The funding estimates will change when House and Senate differences as to the future of the Peacekeeper program are resolved.

PROGRAM MANAGEMENT

System program offices within the Air Force's Ballistic Missile Office, Norton Air Force Base, California, are responsible for managing the ICBM modernization initiatives. The Defense Systems Group of the TRW Corporation supports the Ballistic Missile Office with system engineering/technical assistance. To

develop and procure weapon systems, the Ballistic Missile Office uses an "associate contractor" concept. Under this concept, the Ballistic Missile Office integrates the activities of major contractors (associate contractors) who develop and build components of the weapon system. The Peacekeeper associate contractors are as follows:

Associate Contractors Developing
Peacekeeper Weapon System Components

Weapon system component	Contractor
Propulsion system:	
Stage I	Morton Thiokol, Wasatch Division*
Stage II	Aerojet Strategic Propulsion Company*
Stage III	Hercules, Aerospace Division*
Stage IV	Rockwell International, Rocketdyne Division
Ordnance initiation set	Lockheed Missile and Space Company
Guidance and control system:	
Flight computer and systems integration	Rockwell International, Autonetics Division*
Inertial measurement unit	Northrop, Electronics Division*
Third generation gyro	Northrop, Precision Products Division*
Specific force integration receiver	Honeywell, Avionics Division*
Reentry vehicle system:	
MK 21 Reentry vehicle and reentry system integration	AVCO, Systems Division*
Arming and fusing assembly	General Electric, Reentry Systems*
Canister	Westinghouse, Marine Division
Launch control system	GTE, Strategic Systems Division
Missile transporter, ground equipment, and flight test support	Martin-Marietta, Denver Aerospace*
Basing support equipment	Boeing Aerospace Company*

* Contractors also involved in the small ICBM program.

OBJECTIVE, SCOPE, AND METHODOLOGY

Our objective was to review selected aspects of the ICBM modernization program and to examine the Air Force's ability to meet acquisition goals. With respect to the Peacekeeper program, we followed up on cost, performance, and system development issues presented in a prior GAO report[1] to determine current status. We also examined the progress being made in beginning production of the first 21 missiles. Our review was limited to an examination of the Peacekeeper missile's development and production. It did not include a review of Peacekeeper basing hardware development and production or facility construction. Also, we did not address Peacekeeper survivability in existing Minuteman silos.

With respect to the small ICBM, we examined the progress being made by the Air Force in developing the small ICBM and survivable basing modes. In performing our review, we obtained and reviewed pertinent documents, including program directives, financial records, cost estimates, system specifications, contracts and related materials, test plans and related materials, statements of operational needs, threat reports, and descriptions of operational concepts. We held discussions with cognizant officials for the Peacekeeper and small ICBM missiles, the follow-on basing technology programs, and the Air Force Operational Test and Evaluation ICBM Test Team. These discussions were held at Norton Air Force Base, California; Strategic Air Command Headquarters, Offutt Air Force Base, Nebraska; Air Force Headquarters and the Office of the Secretary of Defense, Washington, D.C.; and selected Peacekeeper contractors.

We used the results of our interviews and reviews of ICBM modernization documentation to assess the status of the Peacekeeper, small ICBM, and survivable basing programs. Where possible, information was obtained from the office of primary responsibility, for example, operational needs statements were received from the Strategic Air Command. To obtain added assurance of the accuracy and consistency of our data, we compared the results of our analyses with congressional hearings; reports provided by the Office of the Secretary of Defense to the Congress, such as the Peacekeeper Selected Acquisition Report and the ICBM Modernization Program Annual Progress Reports; and the President's Report on Continuing the Acquisition of the Peacekeeper (MX) Missile.

The review and evaluations were made between February 1984 and March 1985. Consequently, we did not evaluate the possible

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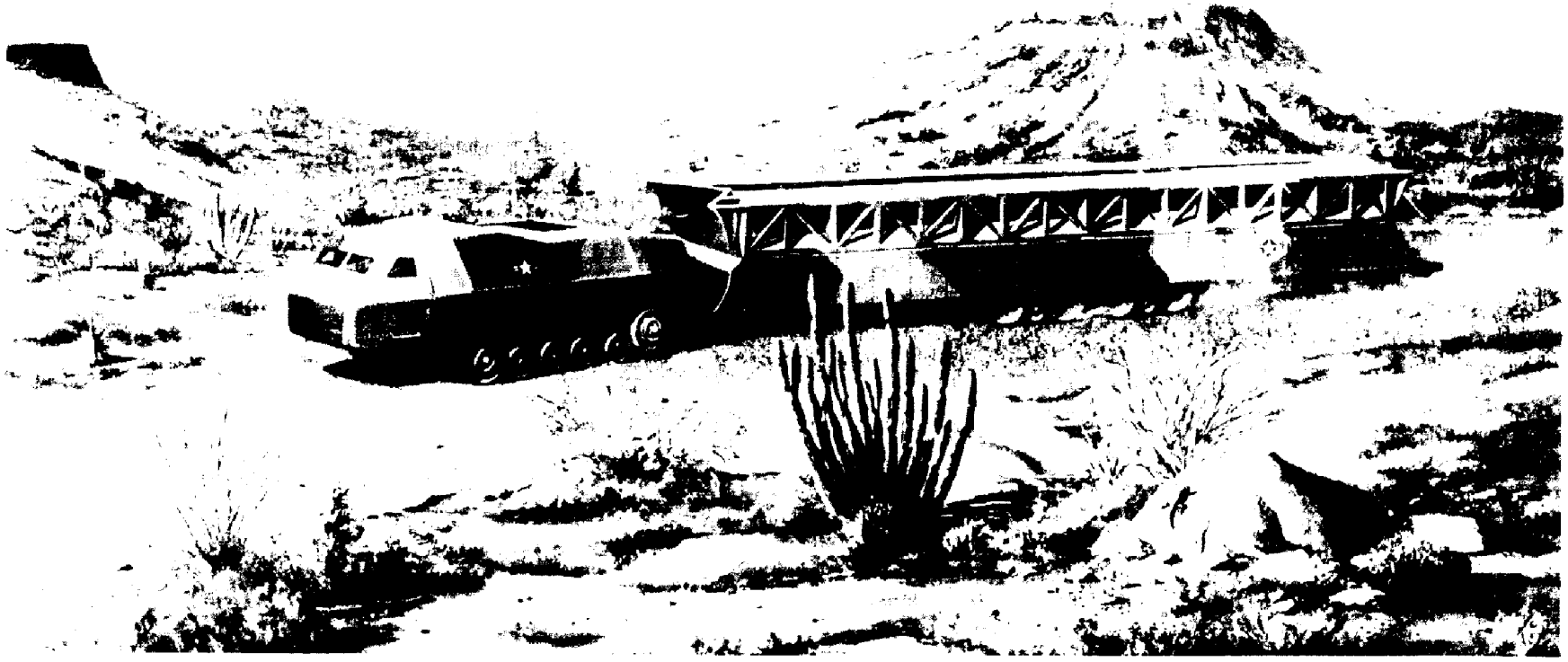
[1] Status of the Peacekeeper (MX) Weapon System (GAO/NSIAD-84-112, May 9, 1984).

impacts that may result from congressional actions to reduce the Department of Defense's (DOD's) proposed fiscal year 1986 Peacekeeper budget.

Our review was performed in accordance with generally accepted government audit standards.

Hard Mobile Launcher Concept



Courtesy Martin Marietta Aerospace

CHAPTER 2

STATUS OF THE SMALL ICBM AND SURVIVABLE BASING

Design and development of a small ICBM and mobile basing options is progressing towards a full-scale development decision in October 1986. Concept definition is nearly complete and pre-full scale development, which began in early 1985, will continue through 1986. According to OSD officials, successful scale model tests of super hardened silos have been conducted and contracts have been awarded to develop candidate silo designs and to construct a silo test facility.

The preliminary data available on the small ICBM weapon system indicates that life cycle costs, technical aspects, and operational effectiveness issues must be resolved before the success of the small ICBM and survivable basing proposals can be assured. In addition, securing sufficient suitable land for deployment of a hard mobile based small ICBM weapon system on existing DOD and Department of Energy land could be challenging and time consuming.

Preliminary requirements, operational concepts, and designs have been established for the small ICBM and hard mobile launcher. To continue work on the small ICBM and hard mobile launcher development, the Air Force for fiscal year 1986 is requesting $625 million. To continue work on hardened silo technology, the Air Force is requesting $152 million.

LIFE CYCLE COSTS ISSUES

Missile quantities, basing characteristics, and other factors that influence program cost are still uncertain for the small ICBM. However, preliminary estimates of costs for some concepts have been developed. These preliminary estimates suggest that high life cycle costs could be a major issue on the small ICBM program.

Preliminary program office life cycle cost estimates for some of the candidate basing options give an indication of the cost involved in deploying the small ICBM. For example, for a force of 500 small ICBMs, the preliminary life cycle cost estimate in 1982 dollars for basing in optimally spaced super hardened silos is $49 billion, for deploying on hard mobile launchers, the estimate is $44 billion; and for deploying on soft mobile launchers (or wide area mobile systems), the estimate is $43 billion. The hard mobile launcher is to be designed to withstand moderate nuclear effects, about 30 pounds per square inch blast pressure, while the soft mobile launcher will be designed to a much lower level of hardness and will rely on wide dispersal for survivability.

A number of decisions remain to be made before the life cycle cost of the small ICBM weapon system can be precisely estimated. They include the following:

--The number and type of basing modes to be employed. According to the report of the President's Commission on Strategic Forces, several different basing modes may be needed to achieve stability. For example, it may be desirable to deploy the small ICBM in hard silos as well as a mobile basing mode.

--The number of small ICBMs to be deployed. The Air Force has not yet determined how many small ICBMs are needed. Force size estimates range from 250 to over 1,000. Among the future unknowns that could affect force size are the threat, national guidance, quantitative and qualitative military requirements, means to offset the threat, and arms control policies or agreements.

--The future of the Peacekeeper missile program. The preliminary estimates cited above assume deployment of a force of 100 Peacekeeper missiles with 1,000 warheads. If this quantity of Peacekeepers is not deployed and the Air Force has a 1,000 warhead requirement, additional small ICBMs may be requested.

Life cycle cost estimates are affected by personnel and other factors. Operating and maintaining a force of small ICBMs in one or more mobile basing modes could require a large personnel force. For example, preliminary program office information indicates that 20,000 people would be needed to operate and maintain a randomly dispersed force of 500 small ICBMs in hard mobile launchers. The preliminary estimate for 500 small ICBMs in a wide area mobile system is about 34,000 people.

Program officials are working to reduce the personnel requirements for operating and maintaining hard mobile launchers below 20,000 people and believe that number represents a maximum requirement. For example, the 20,000 person estimate includes a 4,000 person ground mobile security force. By using an air mobile security force, program officials estimate they could reduce security staffing to 2,500 people.

Achieving adequate security using either a 4,000- or a 2,500-person force will require the use of innovative technologies and changes to existing policies and procedures. According to program officials, these new technologies and policy changes could include development of state-of-the-art delay and denial devices on the hard mobile launcher and changes to policies permitting reductions in the number of people assigned to guard the nuclear warheads. Program officials are confident that the necessary technologies

can be developed and that the needed changes to policies and procedures can be made. However, these officials stated that without such changes, security personnel requirements would be several thousand people greater.

TECHNICAL ISSUES

Progress has been made in designing the small ICBM, hard mobile launcher, and hard silos. OSD and Air Force officials are confident that these systems can be built to meet existing requirements. However, before their success can be assured, engineering and technological challenges must be overcome.

Missile challenges

OSD has identified the following challenges in developing the small ICBM.

--Developing a small ICBM with a low gross weight. The 30,000 pound weight goal strains today's missile technology, but low missile weight is needed to ensure successful mobile basing. The major area of focus for weight reduction is motor technology, specifically the use of advanced, lighter weight materials for motor cases and rocket nozzles. Additionally, the Air Force is planning to use high energy propellants in the propulsion stages. If higher energy propellants are used, less propellant would be required, thereby saving on weight.

--Developing an affordable guidance and control system which can achieve high accuracy in a mobile environment. Guidance and control systems used in a mobile environment must be capable of calibrating and aligning quickly to maintain high accuracy. Program officials are confident that a modified version of the advanced inertial reference sphere used in the Peacekeeper will meet these requirements and be available in time for deployment. However, the system is expensive and would be costly to operate and maintain for a force of 500 small ICBMs. In an attempt to reduce cost, the Air Force is examining alternate guidance systems which have the potential for lower costs as well as a faster response and high reliability.

The degree of success of the Air Force in resolving these challenges and the engineering and performance trade-offs that may have to be made in designing the small ICBM may affect its operational effectiveness.

Hard mobile launcher challenges

To be survivable, the hard mobile launcher needs the mobility to rapidly disperse over large areas of land with a minimum of

warning time and the hardness to survive a nuclear attack over its dispersal area. OSD has identified the following technical challenges associated with developing a survivable hard mobile launcher weapon system.

--Achieving the balance between weight, mobility, and hardness that ensures survivability. Early industry estimates were that a vehicle with the required hardness and mobility would weigh about 120,000 pounds. Current program office estimates are that such a vehicle would weigh between 150,000 and 180,000 pounds, with an upper limit of 200,000 pounds.

--Developing an effective, reliable, and enduring command, control, and communications system. New ground mobile launch control centers would need to communicate with the mobile small ICBMs dispersed over a large area. The communications system must operate during and after an attack and must be operable for a prolonged period of time. This presents communication problems not previously faced by the Air Force's fixed ICBM forces.

Availability and adequacy of roads could pose an additional challenge for the hard mobile launcher system. If road networks at potential deployment locations are not adequate to support hard mobile launcher operations or to provide the needed dispersal area, the hard mobile launcher concept may have to be modified. DOD reported in its 1985 ICBM Modernization Progress Report that the hard mobile launcher's off-road capability may have to be improved.

Feasibility and the affordability of hard mobile basing for the small ICBM will not be assured until challenges such as those above are resolved.

Hard silo challenges

Program officials are convinced that silo hardening, that is, developing silos that can withstand nuclear blast pressures far in excess of what was previously thought possible, is feasible. Successful scale model tests of hard silos have been conducted. To further demonstrate the feasibility of silo hardening, additional small scale model silo tests and a large scale model silo test are planned before a full scale development decision is made. Contracts have been awarded to develop candidate silo designs and to construct a hard silo test facility near Yuma, Arizona. Officials told us that the primary challenges remaining are determining the upper practical limits of silo hardening and developing a cost effective hard silo design.

OPERATIONAL EFFECTIVENESS ISSUES

The Air Force is confident that it can build a mission capable small ICBM weapon system. As discussed in the report of the President's Commission on Strategic Forces, it is uncertain whether a single basing mode will satisfy all operational requirements. Therefore, unless multiple basing modes are developed, some sacrifice in desired mission capability may be necessary, as described below.

--Accuracy versus time urgency. The current operational concept for small ICBMs deployed on hard mobile launchers calls for the entire force to be kept in a fully mission capable status at all times. Some hard mobile basing concepts being considered would, in order to reduce costs, keep a part of the force dormant with guidance systems inactive. However, the warm-up time needed before the modified Peacekeeper guidance and control system can reach maximum accuracy exceeds the response times stated in the operational requirements. If the Air Force decides to keep some small ICBMs dormant, it can either accept the slow response or choose other options, such as deploying additional small ICBMs in other basing modes that allow prompt response or developing alternative guidance systems.

--Range. The small ICBM is being designed to carry a 1,000 pound payload 6,000 nautical miles. This range is needed to achieve target coverage from potential southwest basing areas. Additionally, the missile is being designed to carry penetration aids, devices such as decoys designed to thwart an anti-ballistic missile system, should they be needed in the future. However, the missile's 1,000 pound payload capacity is not sufficient to carry both a reentry vehicle and penetration aids without a degradation in range. To maintain range while carrying both packages will require modifications to the missile or basing in northern locations.

--Endurance. None of the basing options being actively pursued (hard mobile and soft mobile) are likely to provide the required level of readiness, i.e., a specific number of missiles ready for firing at all times, over a protracted period. Achieving a relatively long period of endurance would require additional basing modes, such as hardened silos.

--Reliance on warning. Preliminary operational concepts indicate that to achieve survivability against an attack where the enemy is willing to expend a significant portion of its resources, a hard mobile based small ICBM force will require adequate advance warning time to allow dispersal of

the missiles over a large area. This is more critical than in the past since silos provided survivability that was independent of advanced warning.

LAND AVAILABILITY ISSUES

Securing sufficient suitable land for deployment of a hard mobile based small ICBM weapon system on existing DOD and Department of Energy land could be challenging and time consuming. Access to large amounts of suitable land is needed to assure survivability of an acceptable percentage of the hard mobile systems. For example, Air Force siting criteria require that each mobile launcher have 8 square miles of suitable land for daily operations and 16 square miles of suitable land for periods of increased alert. For a force of 500 hard mobile launchers that would translate to 4,000 square miles of suitable land for daily operations and 8,000 square miles of suitable land for periods of increased alert. In the event of imminent attack, the mobile launchers would dash at high speed off the military bases where normally deployed to adjacent countryside, expanding the dispersal area from the 8,000 square mile area described above, to 28,000 square miles.

Potential issues with deploying the small ICBM on hard mobile launchers are identified in DOD's March 1983 Strategic Forces Technical Assessment Review. In that document DOD stated that random movement of hard mobile launcher's on existing DOD land would require the use of portions of six specific installations in the southwest United States. This report cited the following as factors to be considered in deployments on these locations:

--Joint use would impact existing missions at the six installations requiring major alterations in mission activity.

--Deployment would necessitate changes in land use because of road construction and modification and construction of new facilities.

--Most of the installations are biologically and/or archeologically sensitive and impacts could be large.

--Operations and maintenance support at each base would require several thousand people. Because the majority would be military, substantial facility construction for military housing at each installation would be required.

Small ICBM operational concepts, vehicle design and siting requirements, changed since 1983. The changes added other potential deployment locations. However, because of their large amounts of suitable land, the six installations in the southwest United States are still being considered by the program office as optimum candidates for hard mobile launcher basing. Because other

locations being considered have much smaller amounts of suitable land, failure to gain access to any of the six optimum locations could increase the number of bases needed to deploy an equivalent number of missiles.

OSD and Air Force officials are aware of the difficulties in obtaining land for small ICBM deployment. The joint use and mission conflict concerns of military commands are being handled at the highest levels in OSD and the Air Force. However, according to these officials, timely resolution of the mission conflict concerns is needed to keep them on schedule.

An Air Force approved siting plan and schedule for addressing the other small ICBM siting issues, such as environmental issues and land acquisition, have been developed and are being updated to reflect the latest direction. At the direction of the Secretary of Defense, the program office will initiate a legislative environmental impact statement for candidate basing modes and locations being considered for full scale development.

A legislative environmental impact statement differs from the normal environmental impact statement in that participation of the public and governmental bodies in determining the scope and significant issues to be included in the statement is not necessarily required. In addition, subsequent public comments are directed to the Congress. Program officials are confident that this approach will simplify and shorten the land acquisition process and enable them to secure the necessary land while adhering to program milestones and the requirements of the National Environmental Policy Act. The program office plans to have the impact statement drafted by September 1986.

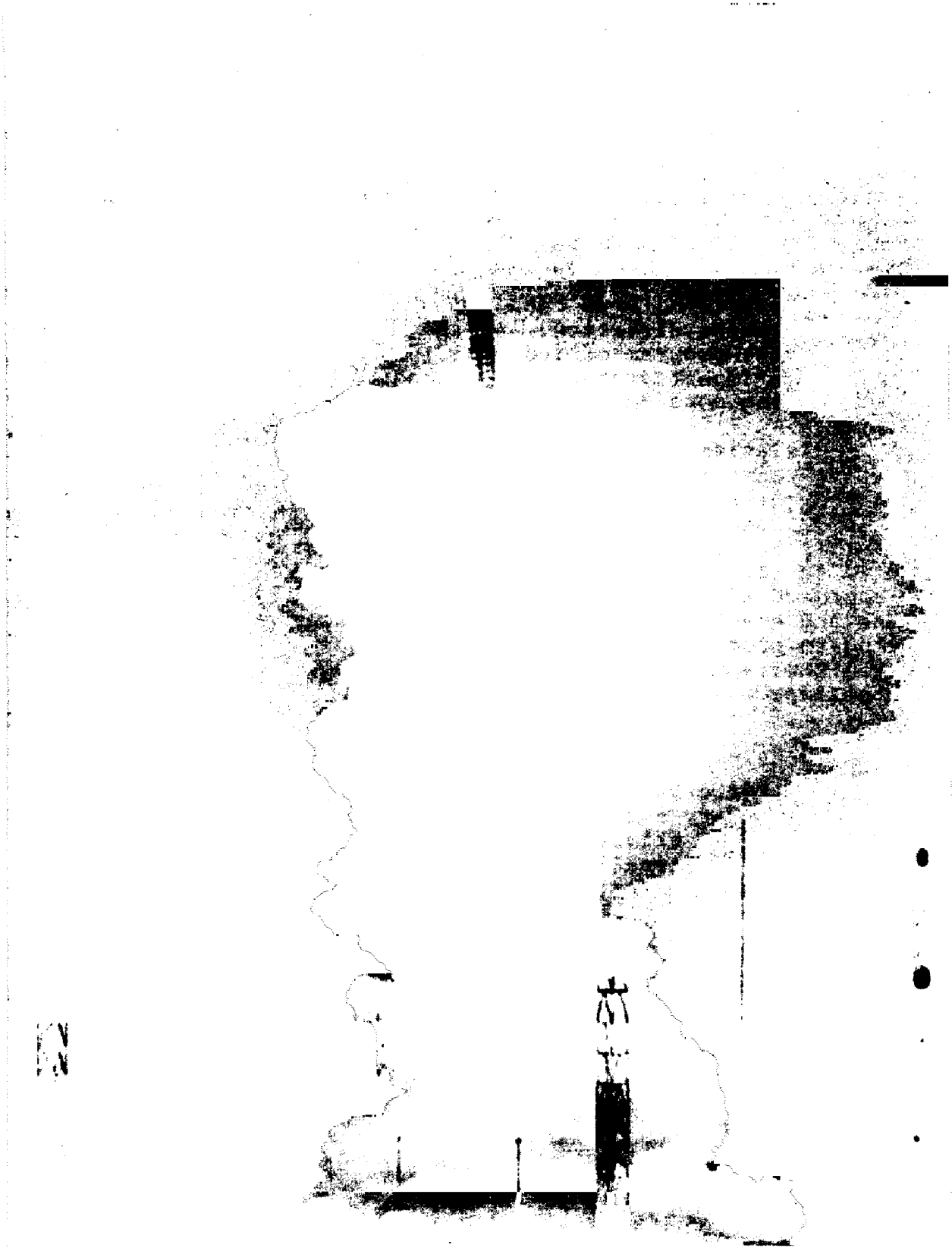
CONCLUSIONS

The Air Force has made progress in defining the small ICBM system with primary emphasis on hard mobile basing. Although system acquisition efforts are still in the preliminary stages, major issues on the small ICBM program are emerging concerning cost, technical feasibility, land availability, and operational effectiveness. While data may be preliminary, these are significant issues in relation to the timely deployment of an effective small ICBM.

AGENCY COMMENTS

DOD, in its comments on a draft of this report, agreed that the concerns we raised relative to the small ICBM are valid.

Peace Keeper Missile Test Firing



Courtesy U.S. Air Force

CHAPTER 3

STATUS OF THE PEACEKEEPER (MX)

MISSILE PROGRAM

The Peacekeeper (MX) weapon system continues to progress toward deployment of the first 10 missiles by December 1986. The design of the missile is essentially complete, flight worthiness of the missile has been demonstrated, and production of components for the first operational missiles has begun. As the missile transitions from a development to an operational configuration, ground and flight testing is scheduled to provide a level of confidence that operational requirements will be met. This testing will be done concurrently with missile production and deployment activities. While concurrent testing, production, and deployment offers the benefit of earlier operational status for the missile, there is also a risk of not meeting cost, schedule, or performance goals if unforeseen problems do occur. To date, no major deviations to cost, schedule, or performance milestones are evident. Given the successful program progress, the Air Force is confident of deploying 10 fully mission capable Peacekeeper missiles at Francis E. Warren Air Force Base, Wyoming, by December 1986. The Air Force is requesting, in fiscal year 1986, $4.02 billion for Peacekeeper development, procurement, and related construction.

The House and Senate, in considering the 1986 Defense authorization bill, limited Peacekeeper missile deployment. The House limited the number of deployed missiles to 40. The Senate limited the number of missiles to 50 in Minuteman silos; future procurement of deployable missiles would be contingent upon approval of an alternate basing mode. The difference had not been resolved as of late-June 1985.

MISSILE DEVELOPMENT STATUS

The design of the Peacekeeper missile is essentially complete. Results of ground testing provides confidence in the integrity of the missile design with added assurance to be provided through remaining tests. In addition, flight worthiness of the missile has been demonstrated by the results of the Peacekeeper test flights. Most problems experienced during the flights have been corrected. As of March 1985, the Peacekeeper missile had completed seven, or 35 percent, of the planned test flights. Thirteen flight tests remained in the development program to conclusively demonstrate the operational effectiveness and suitability of the Peacekeeper weapon system. The objectives of the flight test program, by phase, are as follows:

Phased Flight Test Program

	Flights	Time period (calendar year)	Objectives and related events
Phase I	1-5	2nd Qtr. 1983 through 2nd Qtr. 1984	To provide a reasonable assessment of the performance of the canister and missile propulsion stages and an early indication of the accuracy of the missile. These flights were from an above ground launch pad. The program office began awarding contracts for the initial production of missile components in January 1984, shortly before this phase was completed.
Phase II	6-13	4th Qtr. 1984 through 3rd Qtr. 1986	To provide a reasonable understanding of missile system capabilities and performance characteristics. Beginning with flight test 9, in the third quarter of 1985, all remaining flights will be launched from a silo. The assembly of deployment missiles is scheduled to begin at Warren Air Force Base in June 1986, prior to this phase being completed.
Phase III	14-16	3rd Qtr. 1986 through 4th Qtr. 1986	To confirm that the deployment configuration will work as a weapon system to support operational requirements. The Air Force expects to have achieved initial operational capability with 10 missiles deployed by December 1986, coincidental with the conclusion of this phase.
Phase IV	17-20	1st Qtr. 1987 through 2nd Qtr. 1987	To provide a reasonable assessment of how well Peacekeeper works as an operational weapon system. The tests will also validate operational test and evaluation instrumentation required in the 1988 testing. These four flights will occur after initial deployment.

As the remaining 13 test flights are performed, the configuration of the missile will transition with developmental components being replaced with operational components. Examples of some changes to be made in subsequent test flights are as follows:

--The Stage IV propellant storage assembly tank used for the early test flights is not suitable for operational use and a new propellant tank designed for operational use will be flown on flight test 9 in the third quarter of 1985.

--Development software used for the early test flights will be replaced with operational ground and flight software beginning with flight test 9.

--The capability of the low airburst warhead fuse to detonate at the altitude necessary to optimize target damage will be first tested on flight test 9. The production design of the fuse will be first flown on flight test 10, in the fourth quarter of 1985.

--The composite substructure used on the MK 21 reentry vehicle, the part of the missile that carries the nuclear warhead, will be replaced with an aluminum substructure on flight test 9.

--The reentry system operational configuration will first be flown on flight test 12, in the second quarter of 1986.

--Several redesigned components of the guidance and control system will be first flown on flight test 9. The first operationally configured inertial measurement unit incorporating several producibility improvements will be flown on flight test 11, in the first quarter of 1986. While most of the individual components of the guidance system will have already been flight tested, a fully operational configuration guidance and control system will not be flown until flight test 14, in the third quarter of 1986.

The Peacekeeper flight test program to date has shown good performance, and the Air Force's plan to phase in operational components during development flight testing is not unusual. Considering the success to date, the program office feels the potential for problems is low. However, as of March 1985, there were nine flight tests remaining before initial deployment in December 1986 and, given the overlap between flight test activities and deployment activities, there could be little time for corrective action if unforeseen problems occur. In essence, 10 fully capable missiles are to be deployed by December 1986 and, if the Air Force is to have confidence in their performance, the relative success experienced in flight testing to date must be maintained. One continuing flight test problem is determining the cause(s) of the failure of the Stage III rocket motors extendable nozzle exit cone during the third and seventh test flights. The nozzle of the stage III motor is collapsed until the motor is used, at which time it is deployed or extended. The purpose of the extendable nozzle is to provide added range by more efficiently controlling the thrust of the rocket motor.

The extendable nozzle exit cone cannot be completely tested using ground tests. Further, more than one test flight may be required to fully demonstrate that the anomaly has been corrected. The program office made repairs to the extendable nozzle exit cone after the third test flight and the component performed satisfactorily during the next three flights but failed on the seventh flight. Thus, it appears that additional testing is needed to conclusively demonstrate that the problem has been corrected. There is, however, only about a year, and five flight tests, before assembly of operational missiles begins at the deployment site in June 1986.

If within the remaining tests it cannot be demonstrated with a sufficient level of confidence that the problem has been corrected, it may be necessary to remove the extendable nozzle exit cone from Stage III, which would reduce range, and thereby, targeting flexibility.

MISSILE PRODUCTION STATUS

The Air Force's plan is to procure 223 Peacekeeper missiles--100 for deployment, 108 for operational test and evaluation, and 15 to monitor the effects of aging. As solid rocket motors get older, some elements of the propellent deteriorate. The Air Force's planned procurement by fiscal year is shown below; however, this plan will change as a result of recent congressional actions.

Planned Procurement of Peacekeeper Missiles

	Fiscal year						
	1984	1985	1986	1987	1988	1989	Total
Deployment	21	21	36	22	0	0	100
Operational test and evaluation	0	0	11	25	47	25	108
Aging	0	0	1	1	1	12	15
Total	21	21	48	48	48	37	223

The 108 missiles needed for operational test and evaluation is statistically derived independent of the number of missiles to be deployed. Thus, regardless of whether the initial operational quantity of 10 missiles, or the 42 which have been funded, were deployed, the 108 test missiles would still be needed. The 108 missiles are for the flight tests to show that the Peacekeeper missiles continue to meet accuracy and flight reliability requirements. Initially, the Air Force planned to fly 8 test flights in each of the first 3 years after initial deployment and 7 test flights in each of the next 12 years. The Congress reduced

the number of missiles to be procured in fiscal years 1984 and 1985, some of which had been planned for operational test and evaluation. As a result, the missiles planned for the test program will not be available as scheduled and first operational test and evaluation flight will now be made in 1988, about 1 year later than planned.

As of mid-June 1985, the Senate had authorized procurement of 12 Peacekeeper missiles in fiscal year 1986. The House, however, authorized procurement of no Peacekeeper missiles in fiscal year 1986. As a result, the future test and evaluation program is uncertain at this time.

Fiscal year 1984 production funding

Production of components for the first 21 operational missiles began in fiscal year 1984. The program office awarded production contracts for missile components from January to December 1984, and it is expected that components will be delivered on schedule.

The Congress appropriated $2,102 million for the fiscal year 1984 Peacekeeper procurement program, and $2,076 million was allocated to the program office. As of February 28, 1985, $1,661 million, or 80 percent of the program office allocation, had been obligated. The program office plans to obligate an additional $281.5 million during fiscal year 1985 for weapon system components, support equipment, and general support. The remaining $133.4 million will be obligated in fiscal year 1986 for engineering changes, warranties, and contingent liabilities.

Fiscal year 1985 production

The Air Force requested funds to buy 40 operational missiles in 1985, but the Congress appropriated $2.5 billion for 21 operational missiles and spare parts. Of that total, $1 billion was available to be obligated. The Air Force plans to use $852 million for procurement of missile long lead materials--items which must be purchased well in advance of production--and for basing and support for the 21 missiles funded in fiscal year 1984. The Air Force will use the remaining $148 million for missile spare parts. As of February 28, 1985, the Air Force had obligated about $205 million for missile long lead materials and basing/support activities and expected to obligate an additional $73 million for spare parts.

The remaining $1.5 billion, planned for fabrication and assembly of missile components, could not be obligated until a joint resolution of approval was enacted by the Congress. This occurred on March 28, 1985.

MISSILE PERFORMANCE STATUS

To be an effective deterrent, the Peacekeeper missile must be able to successfully attack the full spectrum of Soviet targets, including the hardest targets. This requires the missile to deliver warheads to intended targets and to inflict the desired level of damage.

The Peacekeeper missile, with 10 MK 21 reentry vehicles, deployed near Warren Air Force Base in Wyoming, has the range needed to reach the most distant planned targets. As discussed in a prior GAO report (GAO/NSIAD-84-112, dated May 9, 1984), reductions in missile range capability had occurred because of a change from the MK 12 to the MK 21 reentry vehicle. We subsequently found that missile range capability declined slightly due to propulsion system anomalies. However, based on our calculations, about 1 percent excess range capability still exists.

Program officials remain confident that the Peacekeeper missile with 10 MK 21 reentry vehicles will have the desired range. They state that the design of the missile is essentially complete and proven through flight testing with added assurance to be provided by scheduled test flights. Successful repair of the Stage III extendable nozzle exit cone which failed on the third and seventh test flights is necessary, however, if the missile with 10 MK 21 reentry vehicles is to have the maximum range and flexibility.

The accuracy achieved by the first six Peacekeeper test missiles was significantly better than the requirement directed by the Secretary of Defense. The program office is confident that the accuracies achieved to date will continue to be attained.

Several factors could impact on the Peacekeeper achieving the higher level of accuracy. The accuracy achieved to date was attained primarily with the MK 12A reentry vehicle and not the new MK 21 reentry vehicle. Also, the accuracy estimates are based mainly on test range impact data and not air burst accuracy data, the preferred mode of warhead detonation for destruction of the hardest Soviet silos. Assessments of air burst accuracy are ongoing but not complete. In addition, accuracy has been achieved with guidance and control system hardware and software which is not fully representative of the operational configuration.

Conclusive demonstration that Peacekeeper will have the higher accuracy awaits future test flights, some at extended ranges, with the MK 21 reentry vehicle, an operationally configured arming and fuzing assembly, and an operationally configured guidance and control system.

MISSILE COST STATUS

The estimated cost for the Peacekeeper program, as of December 31, 1984, was $16.5 billion in 1982 dollars, or $21.6 billion in then year dollars, that is, when the expenditures are expected to occur. A breakdown of the estimate into missile and basing categories follows

Estimated Peacekeeper Program Acquisition Costs[a]

	Missile	Basing	Total
	----------(billions)----------		
Research and development	$ 4.4	$1.6	$ 6.0
Procurement	8.2	2.1	10.3
Construction	0	.2	.2
Total	$12.6	$3.9	$16.5

[a] In 1982 dollars.

The Air Force estimates program cost increased $141.6 million (then year dollars) due to congressional action reducing missile procurement quantities in fiscal year 1985.

We did not evaluate the impact that reductions in fiscal year 1986 procurement quantities, as set out in amendments to the Senate and House authorization bills, would have on program and unit missile cost.

As we pointed out in a previous report on the Peacekeeper program (GAO/NSIAD-84-112), missile costs of $3.2 billion incurred before April 1983 and earlier basing mode costs of $1.4 billion are not included in the current estimate.

We did not attempt to verify the Peacekeeper program acquisition cost estimate; however, it was reviewed by an Air Force Independent Cost Analysis team in early 1984. Its estimate was 2 percent less than the program office's estimate, and the team concluded that the Peacekeeper program cost estimate met the test of reasonableness.

CONCLUSIONS

The Peacekeeper weapon system is proceeding toward deployment of the first 10 missiles by December 1986. Positive progress has been made in developing the Peacekeeper missile and testing is continuing to provide added assurance that the deployment missiles will meet operational requirements. During the balance of the flight test program, the missile design will transition from a

developmental to an operational configuration. This testing will be done concurrently, however, with missile production and deployment activity. There is some risk of not meeting cost, schedule, or performance goals if unforeseen problems do occur. Current congressional action to limit the number of missiles deployed will affect program cost and schedule.

AGENCY COMMENTS

DOD agreed that this chapter accurately reflected the status of the Peacekeeper program.

APPENDIX I

THE UNDER SECRETARY OF DEFENSE

WASHINGTON, DC 20301-3010

RESEARCH AND
ENGINEERING

19 APR 1985

Mr. Frank C. Conahan, Director
National Security and International
Affairs Division
U.S. General Accounting Office
441 G Street, N.W.
Washington, D.C. 20548

Dear Mr. Conahan:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report entitled, "Status of the ICBM Modernization Program," dated March 18, 1985 (GAO Code 392035/OSD Case 6712).

The Department of Defense has reviewed the draft report and concurs with its contents. The DoD is in particular agreement with the GAO conclusion that:

> "The overall ICBM modernization program appears to be progressing as planned. To date, no major deviation to cost, schedule, or performance milestones are evident."

In addition, the issues raised relative to the small ICBM are valid and the Congress should evaluate them carefully as it reaches decisions on the MX program. The GAO observations on the cost of the small ICBM program, if 100 Peacekeepers are not approved, are particularly pertinent.

Your staff was separately provided corrections to the report data. A few technical/clarifying changes were also offered for consideration. The Department of Defense appreciates the opportunity to comment on this draft report.

Sincerely,

James P. Wade, Jr.

James P. Wade, Jr.
Acting

(392025)

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