

July 31, 1986

# DOD ACQUISITION

## Case Study of the Air Force Small Intercontinental Ballistic Missile



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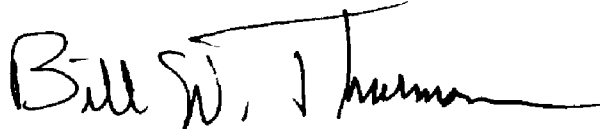
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# Preface

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The Chairmen of the Senate Committee on Governmental Affairs and its Subcommittee on Oversight of Government Management asked GAO to examine the capabilities of the program manager and contracting officer in weapon systems acquisition. As part of this study, GAO examined 17 new major weapon system programs in their initial stages of development. These case studies document the history of the programs and are being made available for informational purposes.

This study of the Small Intercontinental Ballistic Missile Program focuses on the role of the program manager and contracting officer in developing the acquisition strategy. Conclusions and recommendations can be found in our overall report, DOD Acquisition: Strengthening Capabilities of Key Personnel in Systems Acquisition (GAO/NSIAD-86-45, May 12, 1986).

  
for Frank C. Conahan, Director  
National Security and  
International Affairs Division

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# Small Intercontinental Ballistic Missile

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## Background

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 underway to improve the capabilities of U.S. strategic forces. The Small Intercontinental Ballistic Missile is one component of the ICBM modernization program.

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## Origin of Program

Upon taking office in January 1981, President Reagan initiated a review of U.S. strategic forces and the alternatives to modernize the forces to meet the deterrent needs of the late 1980s and beyond. In October 1981, the President announced his program to revitalize U.S. strategic forces, including modernization of the ICBM force. The President's ICBM modernization program called for

- continued development of the Peacekeeper missile with interim deployment in Titan or Minuteman silos modified to increase silo hardness,
- cancellation of multiple protective structure basing development, and
- deactivation of the Titan II missiles

The Congress, while supporting the Peacekeeper missile's development, rejected the President's proposal for interim Peacekeeper missile deployment, expressing concern about the feasibility and desirability of such a temporary program from technical, military, arms control, and cost points of view.

In January 1983 the President established the Commission on Strategic Forces (Scowcroft Commission) to review the Strategic Modernization Program announced in October 1981. It was to focus on the future of the ICBM forces and to recommend basing alternatives. The Commission issued a report in April 1983 which recommended:

- placing 100 Peacekeeper missiles in existing Minuteman silos,
- developing a new small ICBM, and
- investigating hardened silos, shelters, and mobile launchers.

The underlying logic of the Commission's recommendations to develop a new small ICBM was that such a missile would be very flexible in terms

of basing and, therefore, potentially more survivable than current systems. The Commission reasoned that 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 recommended beginning engineering design of the missile, leading to full-scale development in 1987 and an initial operating capability in the early 1990s.

President Reagan endorsed the recommendations of the Scowcroft Commission on April 19, 1983

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### Congressional Action

Congress endorsed the ICBM modernization program on May 26, 1983. In the Department of Defense Authorization Act of 1984, Public Law 98-94, the Congress linked the Peacekeeper deployment schedule with the Small ICBM development as well as limited the weight of the missile. Specifically:

a No more than 10 Peacekeeper missiles may be deployed until:

(1) Demonstration of subsystems and testing of components of the small mobile ICBM system (including missile guidance and propulsion subsystems) have occurred

(2) Nuclear effects tests on the components and subsystems of the prototype mobile transporter-launcher basing system and fixed basing system for the small missile have been carried out using full-scale tests, when practicable, and otherwise using scaled tests.

b No more than 40 Peacekeeper missiles may be deployed until:

(1) The major elements (including the guidance and control subsystems) of a mobile missile weighing less than 33,000 pounds as a part of an ICBM system have been flight-tested

(2) The major elements of the prototype small mobile ICBM system (including the missile, the prototype mobile transporter-launcher basing system and fixed basing system, and the command, control, and communications system) have been designed and functionally integrated and the system has been validated.

(3) Contractors for the full-scale development of such a missile system have been selected and contracts have been awarded to those contractors

(4) Full-scale development of such a missile system has begun.

The Congress also expressed its commitment to the small missile program in the Glenn Amendment to the Fiscal Year 1984 Authorization Act which stated.

“It is the sense of the Congress that the design, development, and testing of small, mobile, single warhead intercontinental ballistic missiles (ICBMs) be pursued as a matter of the highest national priority. Program emphasis should be consistent with past top national priorities such as Polaris, Minuteman, and Apollo, and program management structure should also reflect such priority.”

The Glenn Amendment asked for the earliest possible initial operating capability date, at or before 1992.

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## Formation of the Program Office

Work on the Small ICBM concept was started under the Peacekeeper program office. In May 1983, the Small ICBM program office was established as part of the Air Force's Ballistic Missile Office, Norton Air Force Base, California. This office is responsible for development and acquisition of the Small ICBM and basing technology. The Defense Systems Group of the TRW Corporation supports the Ballistic Missile Office with systems engineering/technical assistance. To develop and procure weapon systems, the Ballistic Missile Office uses an “associate contractor” concept whereby the Missile Office integrates the activities of major contractors (associate contractors) who develop and build components of the weapon system.

An Air Force colonel was appointed the Small ICBM's first program manager in May 1983. His background included bachelor's and master's degrees in engineering, the Defense Systems Management College's 20-week program management course, and over 17 years experience in the acquisition of missile systems. He was succeeded in July 1984 by a brigadier general whose background included a bachelor's degree in physics, a master's degree in political science, the Defense Systems Management College's program management course, operational and combat pilot experience, and 13 years acquisition experience at the Aeronautical Systems Division and the air staff. He had previously served as program manager of the F-15 Program.

The Small ICBM contracting officer who was assigned at the start of the program, is a GM-13 with 11 years of contracting experience (7 years at Air Force Logistics Command and 4 years' experience at the Ballistic Missile Office working on both the Peacekeeper and the Small ICBM program)

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## Development of the Acquisition Strategy

In May 1983 the Small ICBM program office first proposed a prototype fly-off acquisition strategy. The Commander, Air Force Systems Command, and the air staff approved the prototype fly-off approach, however, it was rejected by the Office of the Secretary of Defense. The Office of the Secretary of Defense was concerned that because of the nature of the fly-off competition, the guidance and control subsystem would be selected prematurely and promising technologies would not be considered.

In July 1983 the Air Force convened the Small Missile Independent Advisory Group (often referred to as the Schriever Commission) to recommend the best acquisition strategy and management approach. The Advisory Group concluded and recommended that:

- Small missiles deployed in hard mobile launchers made operational and technical sense.
- Performance and operational requirements pose significant technical, operational, and logistical challenges that require a streamlined management approach to achieve a 1992 initial operating capability.
- The main thrust of the small missile program should be the development, production, and deployment of a "baseline" system which derives its configuration from selected designs from the system definition phase

In developing the acquisition strategy, the Advisory Group considered a pre-full-scale development fly-off of missile prototypes but concluded that the available resources would be better spent on technology development and risk reduction. The Advisory Group was also concerned that a prototype fly-off prematurely eliminated guidance and control technology and subsystem alternatives.

The Advisory Group determined that an associate contracting strategy with the Ballistic Missile Office performing the role of weapon system integrator was the best management approach. Under the associate contractor approach, the Ballistic Missile Office would contract with industry for components of the system. Major components of the system included

- weapon system integration,<sup>1</sup>
- propulsion (booster) systems,
- guidance and control systems, and
- hard mobile launchers.

The Small ICBM acquisition strategy, as proposed by the Advisory Group, would focus on innovation, competition, dual sourcing, and “good business.” This was to be achieved by a three-phased approach, starting with several competing contractors and resulting in selection of one or two contractors in full-scale development.

(1) System definition phase. Maximum contractor competition and participation in defining propulsion, guidance, and hard mobile launchers systems and overall system definition and integration.

(2) Pre-full-scale development Down select to at least two missile integration contractors and two contractors on each subsystem. Where only one contractor is available, a second source would be developed during the pre-full-scale development phase if appropriate.

(3) Full-scale development Down select to one missile integration contractor Where desirable and affordable, retain two suppliers for subsystems The Advisory Group recommended a management approach that emphasized a streamlined review process, experienced personnel, and firm requirements.

The Air Force is implementing the recommendations of the Advisory Group, and the Group’s report serves as the program’s acquisition strategy. The acquisition strategy proposed by the Advisory Group was acceptable to top DOD and Air Force management

As recommended by the Advisory Group, the Small ICBM requirements group, chaired by a three star general, was formed to provide experienced people early in the program and to determine the baseline requirements.

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<sup>1</sup>Beginning with pre-full-scale development, this component was called assembly test and system support (ATSS)



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**Acquisition Strategy  
Modified**

The program office determined that a change in the Advisory Group's recommended acquisition strategy was desirable. Although the Ballistic Missile Office is the weapon system integrator, it uses the missile ATSS contractor to provide control of interface requirements. The Small Missile Independent Advisory Group originally planned to continue competition for the missile ATSS contract until the start of full-scale development. However, the program office believed that after the flight proof design review, which occurs 2 years before the first flight, the subsystem suppliers should have only one ATSS contractor to interface with. According to the first program manager, the Advisory Group did not recommend down selecting to one ATSS contractor at the time of the flight proof design reviews because they did not consider the problem that subsystem suppliers would encounter in complying with interface requirements of more than one ATSS contractor.

The ATSS contractor controls the interface requirements with which the subsystem suppliers must comply. At the time of the flight proof design reviews, the interface requirements must remain fixed in order for the subsystem suppliers to manufacture the subsystems in time for the first flight. If competition for the missile ATSS contract continued past the flight proof design review, the subsystem suppliers would have different interface requirements for each of the competing ATSS contractors. The second program manager also stated that if two contractors were carried through full-scale development, this would double the Ballistic Missile Office's and subcontractors' interface work load.

Although the program office wanted to reduce the planned competition for the missile ATSS, they also wanted to benefit as much as possible from the existing competition. With the assistance of the Air Force System Command's Competition Advocate and other air staff personnel, a modified strategy was developed. The new strategy called for extending the four system definition (ATSS) contracts for 6 months in order to benefit from any additional work the four competing contractors could come up with. At the end of the 6-month period, the program office selected one ATSS contractor. The chairman and other members of the Advisory Group and the Small ICBM steering group approved the change in strategy.

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**Contractual Actions**

Between 1983 and 1985, contracts for concept definition and pre-full-scale development were awarded, as shown in table 1.

**Small Intercontinental Ballistic Missile**

**Table 1: Contract Awards**

Component	Concept definition		Pre-full-scale development		Full-scale development (planned)
	Contractor	Date of contract award	Contractor	Date of contract award	
<b>Weapons system integration/ATSS</b>	Boeing	December 1983	Martin Marietta	June 1985	Fall 1986
	Martin Marietta				
	General Dynamics				
	McDonnell Douglas				
<b>Hardened mobile launcher</b>	Martin Marietta	February 1984	Martin Marietta	January 1985	Fall 1986
	Textron		Boeing		
	Boeing				
	General Dynamics				
<b>Booster</b>	Aerojet	December 1983			
	Morton Thiokol				
	United Technologies				
	Hercules				
<b>Booster stage 1<sup>a</sup></b>			United Technologies	February 1985	December 1986
			Morton Thiokol		
<b>Booster stage 2<sup>a</sup></b>			Hercules	February 1985	December 1986
			Aerojet		
<b>Booster stage 3<sup>a</sup></b>			United Technologies	February 1985	December 1986
			Hercules		

<sup>a</sup>For pre-full-scale development, there was a separate booster competition for each stage of the missile

In addition, contracts for guidance and control were also awarded. In May 1984, Rockwell started work on the contract for the Small ICBM guidance and control integration. Rockwell's responsibilities under the contract include the integration of the guidance and control system as well as building the computer to handle the data interfaces. Work was started on alternate guidance technology contracts by General Electric, Litton, and Honeywell, in May 1984. These technologies include ring laser gyro, stellar inertial, and terminal fix. In August 1984, a guidance technology contract was awarded to Northrop for the baseline modified advanced inertial reference sphere recommended by the Advisory Group.

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## Program Costs

Total program costs are yet to be determined because missile quantities, basing characteristics, and other factors that influence program costs are still uncertain. However, the program office's preliminary 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, as reported in our 1985 report,<sup>2</sup> 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.

Congress appropriated \$328.3 million for research and development for fiscal year 1984, \$458.5 million for 1985, and \$607.9 million for 1986. For 1987, DOD has requested \$1,375.5 million. Total research and development costs to completion (fiscal years 1984 to 1993) are estimated at \$12.7 billion in then-year dollars.

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## Evaluation of Roles and Acquisition Strategy

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### Roles and Responsibilities

The first program manager had a lead role in developing the prototype fly-off acquisition strategy and the contracting officer was an influential advisor to the program manager. However, neither the program manager nor the contracting officer had a significant role in developing the Advisory Group acquisition strategy that was approved for the Small ICBM program.

The program manager and contracting officer participated in varying degrees in the source selection process. The source selection process generally involves reviewing the mission need statement, exploring alternative design solutions, planning for competition, determining the type of contract to be used, developing the statement of work and specifications, determining the business terms and conditions, developing the evaluation criteria, grading the technical and cost proposals, setting the competitive range, holding pre-award discussions, negotiating the contract, and awarding the contract.

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<sup>2</sup>Status of the Intercontinental Ballistic Missile Modernization Program (GAO/NSIAD-85-78, July 8, 1985)

Generally, the program manager had the lead role and the contracting officer acted as a key advisor during source selection. For example, in planning for implementation of the contracting strategy, the program manager determined how to break the program into component parts, with the contracting officer providing input. Formulating the Small ICBM's evaluation criteria was a shared responsibility, with the contracting officer working with the program office in tandem with the engineering support group. For contract negotiations, the Small ICBM contracting officer and his buyer conducted negotiations; the program manager approved the contracting officer's negotiating position.

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### The Design Competition

DOD Directive 5000 1 (Major System Acquisitions, March 29, 1982) calls for competition through the first two program phases, concept exploration and demonstration/validation, and into the full-scale development and production phases if cost effective. Air Force policy is to carry competition even further. Its policy is to continue competition up to critical design review, an advanced stage in full-scale development.

The Advisory Group's acquisition strategy, based on an associate contractor approach, called for competition among contractors for the various components of the system up to at least the start of full-scale development. However, the strategy was altered slightly during implementation. While the Advisory Group envisioned competition between the ATSS contractors to continue until the start of full-scale development, the program office discontinued the competition at the flight proof design review in order to address subsystem suppliers' interface requirements with the ATSS contractor.

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### The Production Competition

The Advisory Group felt that the number of operational missiles deployed would probably not justify competition throughout full-scale development and production, although it believed the option of dual sourcing of subsystems or components should be left open. The program managers stated that options for production competition are still open, although there are currently no plans for subsystem competition in production.

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### External Influences

Limitations imposed on the Small ICBM weight, limit the design trade-offs available to the program manager and contractors. The Congress has mandated a weight limit of 33,000 pounds for the Small ICBM and this has the effect of limiting the choice of components that can be used in

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its construction. The main area that is affected by the weight limit is the motor case design

Due to the Advisory Group recommendation to use the lightweight advanced inertial reference sphere as part of the Small ICBM baseline—which, in part, dictates the throw weight—the Small ICBM requires the development of light weight motor case designs in order to be within the overall missile weight limit. This weight restriction, placed on the program office by Congress, has—according to an Air Force official—required the development of high-cost, technical-risk motor case designs. The official believed that without the weight limit, a less costly motor design could have been developed which would have met the mission requirements of the Small ICBM. Further, he stated that if an overall weight limit was needed, weight reduction could have been made in other parts of the system such as the hardened mobile launcher.

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## Present Status

The Small ICBM program is currently in pre-full-scale development

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# Chronology of Events

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October 1981	President's strategic modernization program announced.
January 1983	Scowcroft Commission established.
April 1983	Scowcroft Commission report endorses Small ICBM. President endorses Small ICBM.
March 1983	Contracting officer appointed.
May 1983	Program office formed. First program manager appointed. Fly-off contracting strategy proposed. Congress endorses Small ICBM Congress links Small ICBM and Peacekeeper deployment
July 1983	Small Missile Independent Advisory Group convened.
September 1983	Advisory Group recommends acquisition strategy.
December 1983	Four weapons system integration contracts awarded for concept definition Four booster contracts awarded for concept definition.
February 1984	Four hardened mobile launcher contracts awarded for concept definition.
May 1984	Modification in acquisition strategy approved.

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**Chronology of Events**

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**May-August 1984**

Five guidance and control contracts awarded.

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**July 1984**

Second program manager appointed.

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**January 1985**

Two hardened mobile launcher pre-full-scale development contracts awarded

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**February 1985**

Six booster pre-full-scale development contracts awarded.

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**June 1985**

Assembly test and system support contract awarded

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**August 1985**

Third program manager appointed





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