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BALLISTIC MISSILE DEFENSE

Current Status of Strategic Target System

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The Honorable Cardiss Collins
Ranking Minority Member
Committee on Government Reform and Oversight
House of Representatives

The Honorable Bill Zeliff
Chairman , Subcommittee on National Security,
International Affairs, and Criminal Justice
Committee on Government Reform and Oversight
House of Representatives

As requested by the former Chairman of the Legislation and National Security Subcommittee, this report presents information on the Ballistic Missile Defense Organization's (BMDO) Strategic Target System (STARS). Specifically, we present information on the (1) status of the STARS program, (2) planned launches through fiscal year 2000, (3) program costs, and (4) status of major hardware acquisition and refurbishment.

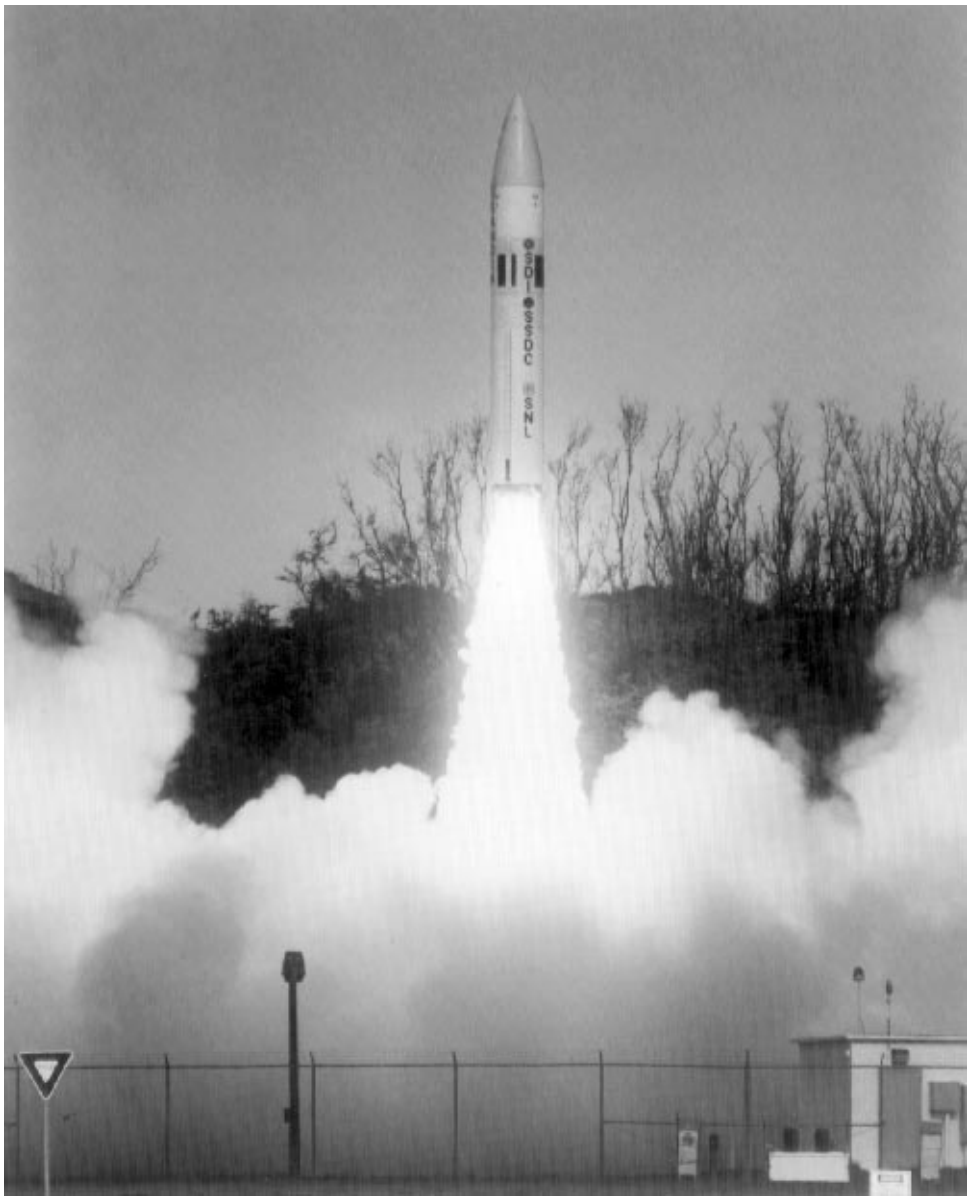
Background

STARS is a BMDO program managed by the U. S. Army Space and Strategic Defense Command (SSDC). It began in 1985 in response to concerns that the supply of surplus Minuteman I boosters used to launch targets and other experiments on intercontinental ballistic missile flight trajectories in support of the Strategic Defense Initiative would be depleted by 1988. SSDC tasked Sandia National Laboratories, a Department of Energy laboratory, to develop an alternative launch vehicle using surplus Polaris boosters. Two STARS booster configurations were developed, STARS I and STARS II.

STARS I consists of refurbished Polaris first and second stages and a commercially procured Orbus I third stage (see fig. 1). It can deploy single or multiple payloads, but the multiple payloads cannot be deployed in a manner that simulates the operation of a post-boost vehicle (PBV).[1] To meet this specific need, Sandia developed an Operations and Deployment Experiments Simulator (ODES), which functions as a PBV. (See app. I, fig. I.1.) When ODES is added to STARS I, the configuration is designated STARS II.

[1]The portion of a missile payload that carries multiple warheads and has the maneuvering capability to independently target each warhead on a final trajectory toward a target. It is also referred to as a "bus."

Figure 1: STARS I Booster



Source: Sandia National Laboratories.

The development phase of the STARS program was completed in fiscal year 1994, and BMDO provided about $192.1 million for this effort. The operational phase began in fiscal year 1995.

The first STARS I flight, a hardware check-out flight, was launched in February 1993, and the second flight, a STARS I reentry vehicle experiment, was launched in August 1993. The third flight, a STARS II development mission, was launched in July 1994. All three were considered successful by BMDO.

Results in Brief

The Secretary of Defense's 1993 comprehensive review of the nation's defense strategy drastically reduced the number of STARS launches required to support National Missile Defense (NMD)[2] and BMDO funding. Due to the launch and budget reductions, the STARS office developed a draft long-range plan for the STARS program. The study examined three options: (1) place the program in a dormant status, but retain the capability to reactivate it; (2) terminate the program; and (3) continue the program. BMDO is currently evaluating STARS as a potential long-range system for launching targets for development tests of future Theater Missile Defense (TMD)[3] systems. The final decision, which may not be made for 6 to 9 months, will be based on factors such as the cost to maintain STARS and Anti-Ballistic Missile (ABM) Treaty issues associated with testing TMD systems.

Since July 1993, the planned level of test launches has decreased. One firm STARS launch is scheduled to support NMD in fiscal year 1995. BMDO has identified another 11 potential launches through fiscal year 2000. Ten of these 11 launches would support TMD and are dependent on the successful resolution of ABM Treaty issues. The remaining launch would support NMD.

The estimated annual cost of operating STARS varies depending on how many launches are conducted. In fiscal year 1995, BMDO plans to spend approximately $22.7 million on STARS and will conduct one launch. Of this amount, $15.1 million is the cost to maintain the capability to launch STARS. This cost would be incurred whether or not any launches occur in a fiscal year. For future years, it is estimated that the annual cost to maintain the capability to launch STARS would remain at about $15 million. Beginning in

[2]The term NMD refers to defending the United States from limited ballistic missile attacks whether deliberate, accidental, or unauthorized.

[3]The term TMD refers to defending U.S. forces deployed overseas and allies and friends from theater ballistic missile attacks.

fiscal year 1996, project offices that use STARS to launch experiments or targets will be charged from $2.8 million to $4.1 million for each STARS I launch and from $6.7 million to $9.1 million for each STARS II launch.

The STARS program has a substantial inventory of STARS hardware. When the STARS program was started in 1985, four launches were anticipated each year. Because of the large number of anticipated launches and an unknown defect rate for surplus Polaris motors, the STARS office acquired 117 first-stage and 102 second-stage surplus motors. As of December 1994, seven first-stage and five second-stage refurbished motors were available for future launches. Also, 13 third-stage new motors were on-hand and 1 PBV was being built for the STARS launch scheduled in fiscal year 1995.

Plans for Continuing STARS Program

In March 1993, the Secretary of Defense initiated a comprehensive "Bottom-Up Review" of the nation's defense strategy. He believed that a departmentwide review needed to be conducted "from the bottom up" because of the dramatic changes that had occurred in the world as a result of the end of the Cold War and the dissolution of the Soviet Union. This review provided the direction for shifting America's focus away from a strategy designed to defend against a global Soviet threat to a strategy oriented toward the dangers of aggression by regional powers, a theater missile threat. Based on the nature of the present and projected threat from ballistic and cruise missiles armed with weapons of mass destruction, the Secretary of Defense decided to proceed with a more robust TMD program to emphasize protection of forward-deployed U.S. forces in the near term. Additionally, he decided to limit the NMD effort to a technology program, which drastically reduced the number of STARS launches to support NMD.

In May 1994, based on declining launches for STARS and budget reductions resulting from the "Bottom-Up Review," BMDO requested SSDC to develop a long-range plan for the STARS program. The SSDC STARS project office developed a draft long-range plan that included management options for (1) continuing the STARS program; (2) placing it in a dormant status, retaining the capability to reactivate it; and (3) terminating it. BMDO is currently evaluating STARS as a potential long-range system for launching targets for development tests of future TMD systems. The final decision, which may not be made for 6 to 9 months, will be based on factors such as the cost to maintain STARS and ABM Treaty issues associated with testing TMD systems.

STARS project office officials cite several reasons related to treaty implications for not terminating the program. The Strategic Arms Reduction Treaty I (START) limits other strategic ballistic missiles' use of telemetry encryption,[4] but STARS is exempt from this restriction. In addition, the START II Treaty after its ratification and formal entry into force would require the total elimination of land-based multiple warhead intercontinental ballistic missiles by January 2003. This means that the launching of land-based multiple warhead intercontinental ballistic missiles, even as research and development target boosters, would cease. Because STARS is exempt from the START II Treaty, it would be the only land-based multiple warhead booster that the United States can use as a target or for research and development. The STARS II PBV carries multiple warheads and has the maneuvering capability to independently target each warhead on a final trajectory toward a target.

STARS project office officials also cite other reasons for not terminating the program. STARS can deliver payloads at various reentry speeds and trajectories to the vicinity of Kwajalein Missile Range located about 4,000 kilometers from the Kauai Test Facility. STARS is also the only U.S. target missile system that operates in the 1,500 to 3,500 kilometer range. Additionally, the relatively large diameter of the STARS launch vehicle, the shape of the nose shroud, and the flat payload plate make STARS suitable as a carrier vehicle for a variety of experiments and scientific payloads. Also, STARS has demonstrated a real-time reporting capability to accurately predict target positions for experiments throughout its trajectory. These are important features for evaluating the capabilities of both theater and strategic missile defense sensors and weapons.

Estimated Requirements for STARS Launches

In July 1993, BMDO had plans to launch 12 more STARS boosters from Kauai that would deliver experiments into near space and targets to Kwajalein through fiscal year 2003. All of these launches were to support NMD objectives. Two were conducted, but as a result of the "Bottom-Up Review," all but one of the remaining 10 NMD launches were canceled.

BMDO now has only one firm launch scheduled. Additionally, BMDO has 11 potential[5] launches identified through fiscal year 2000. Ten would support TMD and 1 would support NMD. Table 1 provides the schedule by fiscal year for the STARS launches.

[4]Telemetry is a stream of data that is transmitted to the ground for analysis and display. Encryption is encoding data so that only authorized personnel can interpret and use the data.

[5]Potential launches: launches that are not yet funded but are STARS capable.

Table 1: STARS Future Launch Schedule by Fiscal Year

Missions supported	STARS launches						Status
	1995	1996	1997	1998	1999[a]	2000[a]	
NMD/STARS II Midcourse Space Experiment	F[b]						Scheduled in 3rd quarter 1995
TMD STARS I Theater Critical Measurements Program		P[c]					Preliminary planning & coordination
TMD/STARS I Boost Phase Intercept				P	P	P	Requirements being developed
NMD/STARS II Space and Missile Tracking System					P		Requirements document received
TMD/STARS I Long-range threats					P P	P P	Requirements being developed
TMD/STARS I Space and Missile Tracking System					P	P	Requirements document received

[a]The current program could support only two launches annually.

[b]"F" represents firm launch.

[c]Each "P" represents a potential launch.

The firm launch scheduled for 1995 involves launching a STARS II that will deploy numerous objects for the Midcourse Space Experiment (MSX) satellite to observe. The MSX satellite is scheduled to be launched into orbit from Vandenberg Air Force Base on a Delta II booster during the second quarter of fiscal year 1995 to conduct a variety of experiments, one of which will involve observing different types of target objects deployed from the STARS PBV. Although this experiment will support work being conducted in a number of areas, the data will primarily support the Space and Missile Tracking System (formerly called Brilliant Eyes) demonstration and validation program.

The targets for the MSX satellite to observe are scheduled to be launched on a STARS II in the third quarter of fiscal year 1995. The MSX's sensors are to view the numerous objects deployed from the PBV during sunrise conditions, and the objects are to be representative of various targets and

deployment techniques. Other mobile and ground-based sensors will provide trajectory identification, definition, stereo viewing, and dynamic motion verification of the test objects.

Until the ABM Treaty is clarified, the use of STARS to support TMD testing, including the 10 potential TMD missions shown in table 1, is in question. The 1972 ABM Treaty prohibits mobile, land-based systems that can counter strategic missiles. However, it does not define the characteristics of either a strategic or theater missile. Some theater missiles now approach the capabilities of the older, shorter range strategic missiles in terms of maximum range. Congress has continuously urged the administration to pursue discussions on amending the ABM Treaty to clarify the distinctions between theater and strategic missiles. The United States and Russia and some of the states of the former Soviet Union are currently involved in discussions seeking a demarcation that would clarify the treaty in such a way that would allow TMD systems such as the Theater High Altitude Area Defense and other advanced concepts to be developed in compliance with the ABM Treaty.

Estimated Future Cost of Operating STARS

As shown in table 2, the STARS operational budget will be about $22.7 million for fiscal year 1995. Of this amount, $15.1 million is the cost to maintain the capability to conduct launches, and the remaining cost of about $7.6 million primarily represents costs to be incurred for the scheduled launch in fiscal year 1995. For future years, it is estimated that the annual STARS operating budget would also be about $15 million (excluding inflation) to maintain the capability to launch. The $15 million does not include the additional costs that would be charged to STARS customers for launches.

Table 2: Estimated STARS Budget for Fiscal Year 1995[a]

Description	Costs
Sandia STARS baseline level of effort at Albuquerque (program infrastructure)	$8,360,000
Booster refurbishment and mission support contracts to maintain industrial base	3,470,000
Kauai Test Facility range support	2,500,000
Logistics/propulsion support (specialized contractor technical assistance)	130,000
First-stage booster storage	70,000
Second-stage booster storage	40,000
System engineering and technical assistance contract for STARS project office	390,000
SSDC personnel travel	130,000
Total for maintaining capability to launch	**$15,090,000**
Additional costs associated with MSX launch in 1995	7,380,000
Destruction of first- and second-stage motors	260,000
Total	**$22,730,000**

[a]This budget does not include salary and other administrative costs of the STARS project office.

Annual Infrastructure Cost

The $8.36 million for program infrastructure includes a full-time STARS staff of about 40 to 45 Sandia engineers and technicians, Sandia part-time staff for the STARS program, Sandia overhead costs, and a Department of Energy surcharge of 4.3 percent. According to a Sandia official, in years when there are no launches, the engineers and technicians would be used to provide technical support for the STARS booster system, plan for future STARS launches, upgrade system documentation, correct anomalies noted on past launches, and perform other tasks assigned by the STARS office. The Sandia official also told us that under Sandia's personnel practices if the 40 to 45 full-time Sandia personnel were to be assigned to other programs because of a termination or extended suspension of the STARS operation, it is highly unlikely that they would later be returned to the STARS program.

According to a STARS project office official, plans are to spend about $3.47 million in fiscal year 1995 to maintain the industrial base for refurbishing first- and second-stage Polaris motors. A Sandia official provided the following general comments about maintaining the industrial base. Initially, plans are to (1) modify the existing contract with Aerojet General Corporation to start assembling refurbished first-stage motors,

(2) consolidate facilities to save money, and (3) send first-stage motors to the Navy's China Lake facility for screening. Also, Sandia plans to provide Hercules, Inc., Aerospace Division, with funds to recertify the second-stage flight motor for the fiscal year 1995 flight and assemble a second-stage component refurbished motor as a flight spare. Plans are to award new 2-year contracts in April 1995 to Aerojet and Hercules for work in fiscal years 1995 and 1996. Aerojet is to refurbish up to three first-stage motors. Hercules is to continue assembling second-stage component refurbished motors. These contracts will contain provisions for paying fixed termination costs to these contractors if the decision is made to cancel the contracts in fiscal year 1996. Plans are to also award new contracts in April 1995 to Lockheed Missile and Space Company, Inc., and the Navy. Lockheed is to provide technical assistance, and the Navy's facilities at China Lake and Corona, California, are to screen and static fire STARS motors and calibrate and recertify motor nozzles and assembly gauges.

The Kauai Test Facility range support cost of $2.5 million is primarily for a facility maintenance contractor; Sandia personnel supporting STARS; and maintaining range technical capabilities such as electronic communications equipment, computers, and recording equipment used to gather flight data.

Other Fiscal Year 1995 Costs

The additional cost associated with the launch to support the MSX mission, $7.38 million, is for work to be performed by Sandia, support of the Pacific Missile Range Facility, and logistics' maintenance and transportation support. Sandia is to perform work (1) related to the third stage of the STARS launch vehicle that houses the Orbus motor and (2) support of launch-field operations. This effort involves (1) mission specific software modifications and validation; (2) assembly and construction of specialized parts and equipment, to include components for the PBV; and (3) final system checkout and testing. The Pacific Missile Range Facility is to provide uprange support of the STARS booster launch activities. It is also to provide miscellaneous range tracking, telemetry, range safety, and other support requirements. The logistics' transportation support is primarily for transportation supporting the MSX mission. In addition, funds are to be used for a nonrecurring effort to move and consolidate first- and second-stage motors, thus reducing storage costs. The logistics' maintenance support primarily involves Hill Air Force Base's effort. This work involves attaching components and performing system checks and validation for first- and second-stage motors.

The booster destruction cost of $260,000 is for the destruction of older first- and second-stage motors no longer required for the STARS program. The Sierra Army Depot in California is to destroy the motors.

Charges to Users for a Launch

In September 1993, we reported that STARS users would pay an estimated $5.9 million for each STARS I launch and an estimated $10.9 million for each STARS II launch.[6] These cost estimates have decreased because the STARS program has already paid for equipment such as electronic components, mechanical equipment, stage 1 and 2 refurbished motors, and Orbus motors. Another reason future STARS users will pay less is because the MSX and other programs have paid for long lead hardware to be used on STARS launches that were canceled. Even though these launches were canceled, the STARS office had already acquired the assets.

Beginning in fiscal year 1996, the costs to future STARS I and II customers will vary. Specifically, for the next three STARS launches, the cost to STARS I customers is estimated to be about $2.8 million, and the cost to STARS II customers is estimated to range from $6.7 million to $9.1 million. Beyond the next three launches, the cost to STARS I customers is estimated to be about $4.1 million, and the cost to STARS II customers is estimated to range from $8.1 million to $9.1 million. These estimates include costs for hardware refurbishment, Sandia launch support, booster transportation, and costs associated with ODES hardware and related integration of ODES with the STARS I booster. These estimates do not include transportation and payload and range support costs associated with specific launches.

Acquisition Hardware and Refurbishment Status

The STARS program acquired surplus Navy Polaris first- and second-stage boosters starting in the mid-1980s through 1991. The STARS program's only cost for those boosters was for transportation to storage facilities. The STARS program purchased third-stage Orbus I motors from United Technologies. Sandia builds ODES PBVs only as needed for STARS II launches. First- and second-stage Polaris motors have to be refurbished before being used on missions. Orbus I motors and ODES do not need to be refurbished. One ODES has been built and flown. Currently, a second ODES is being built for the launch scheduled in fiscal year 1995. Table 3 shows the status of STARS hardware acquisition and refurbishment as of December 1994.

[6]Ballistic Missile Defense: Strategic Target System Launches from Kauai (GAO/NSIAD-93-270, Sept. 13, 1993).

Table 3: STARS Hardware Assets and Refurbishment Status as of December 1994

STARS major components	Total motors acquired	New or refurbished motors	Motors used	Refurbished or new motors available
First-stage Polaris motors	117	14	7	7[a]
Second-stage Polaris motors	102	10	5	5[b]
Third-stage Orbus motors	20	20	7	13

[a]Of the seven motors refurbished, four are flight ready, and three have been refurbished but are not flight ready because the components have not been assembled.

[b]Of the five motors refurbished, one is flight ready, and four have been refurbished but are not flight ready because the components have not been assembled.

When the STARS program was begun, four launches a year were anticipated. Now, no more than two launches a year are anticipated or even considered possible without increasing the number of Sandia personnel supporting the STARS program. According to a STARS official, there were two reasons the STARS office acquired such a large number of surplus Polaris first- and second-stage boosters. First, a large number of launches was expected when the STARS program was started. Second, the defect rate for these 1960s vintage motors was not known.

Scope and Methodology

To determine the cost of the STARS program through fiscal year 1994, we obtained funding data from BMDO, STARS program office, and Sandia National Laboratories. STARS officials also provided funding estimates for fiscal year 1995 and beyond.

To determine planned launches, BMDO and STARS officials discussed and provided documents showing firm and potential launches. Air Force and TMD officials also provided information about their launch needs. BMDO and STARS officials and the SSDC treaty advisor provided information about how U.S. treaties may affect the future of the STARS program.

To determine the status of STARS hardware, we reviewed relevant documents such as inventory records and refurbishment contracts. Additionally, Sandia and STARS officials provided detailed information about the status of the hardware program.

We performed our work at BMDO in Washington, D.C.; SSDC in Huntsville, Alabama; and Sandia in Albuquerque, New Mexico. Our work was conducted from August through December 1994 in accordance with generally accepted government auditing standards.

As requested, we did not obtain fully coordinated agency comments on a draft of this report. However, we did discuss the results of our work with SSDC and BMDO officials and have incorporated their suggestions. In general, they agreed with the information in this report.

We are sending copies to the Chairmen of the Senate and House Committees on Appropriations; the Senate Committee on Armed Services; the House Committee on National Security; the Secretaries of Defense, the Air Force, the Army, and the Navy; and the Directors of BMDO and the Office of Management and Budget. Copies will also be made available to others upon request.

If you or your staff have questions concerning this report, please contact me at (202) 512-4841. The major contributors to this report are J. Klein Spencer, Assistant Director; Bobby D. Hall, Evaluator-in-Charge; and Thomas L. Gordon, Evaluator.

Brad Hathaway
Associate Director, Systems
Development and Production Issues

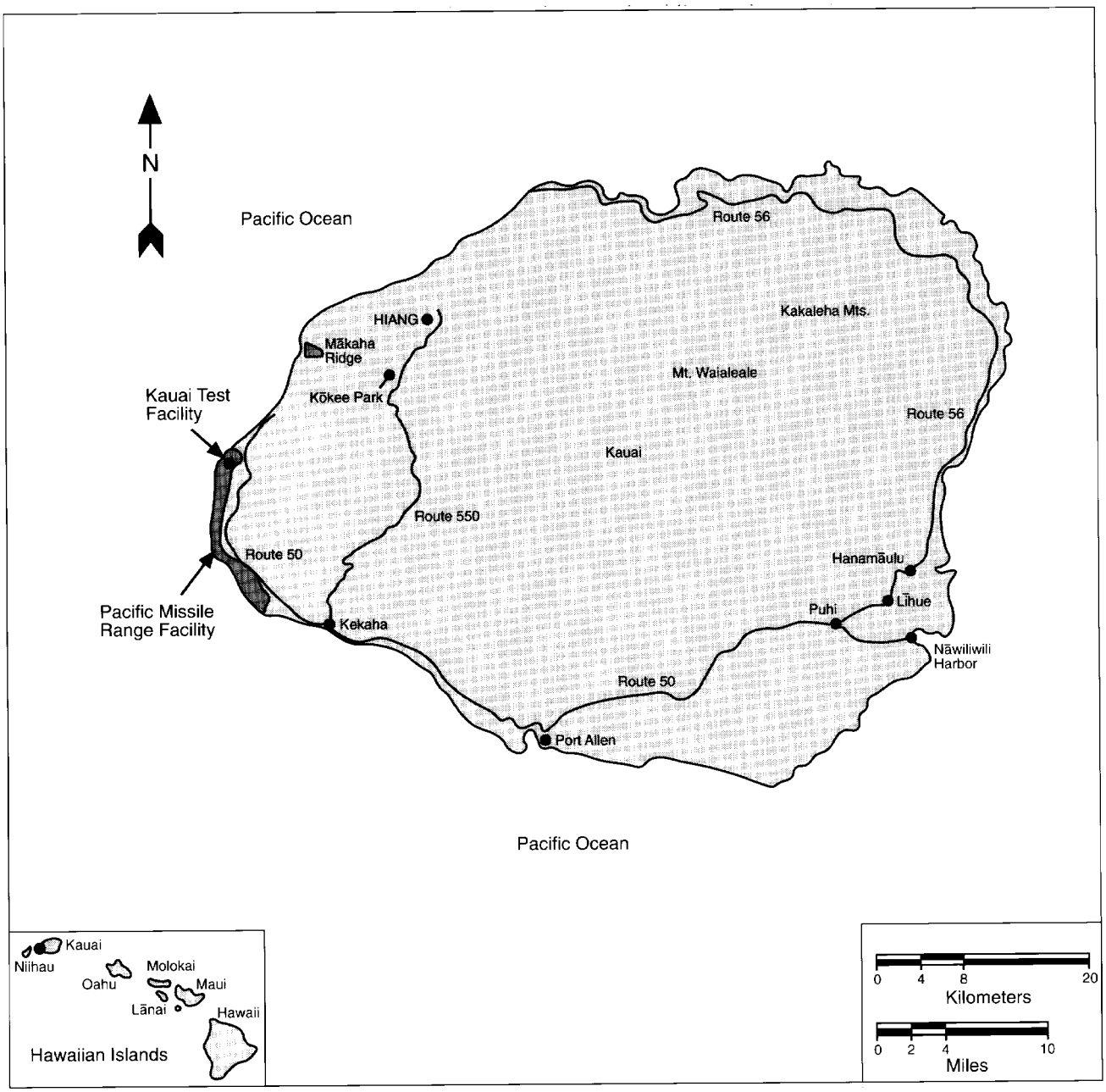
Pictures and Maps of STARS and Launch Sites

Appendix I contains pictures and maps of STARS and launch sites. A picture of ODES with its multiple reentry vehicles is shown in figure I.1. The STARS launch facility is located on Kauai, Hawaii (see figs. I.2 and I.3). The booster's range, about 4,000 kilometers, is about the same as the distance from Kauai to the Kwajalein Atoll in the Marshall Islands, the intended destination. Kwajalein, where sensing and other tracking devices are located (see fig. I.4), is one of the two designated test ranges under the ABM Treaty. The other, White Sands Missile Range, is not suitable for the types of tests planned for STARS.

Figure I.1: ODES PBV and Payloads

Source: Sandia National Laboratories.

Figure I.2: Location Map of Pacific Missile Range Facility and Kauai Test Facility on Kauai, Hawaii

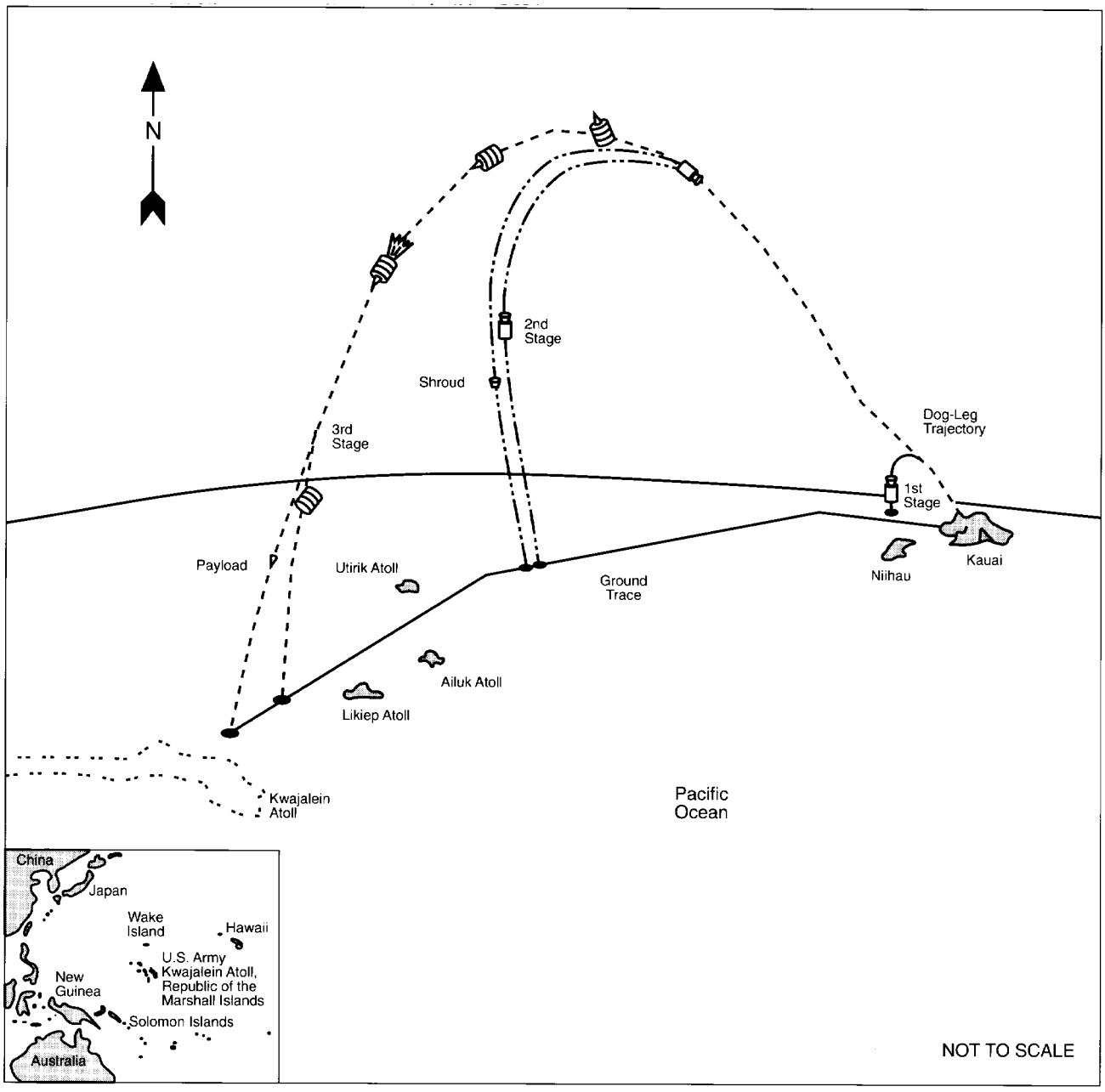


Source: SSDC.

Figure I.3: Aerial View of Kauai Test Facility

Source: Sandia National Laboratories.

Figure I.4: Representative STARS Launch Profile



Source: SSDC.

Appendix I
Pictures and Maps of STARS and Launch Sites

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