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United States General Accounting Office
Washington, DC 20548

May 8, 2003

The Honorable Bill Nelson
Ranking Minority Member
Subcommittee on Strategic Forces
Committee on Armed Services
United States Senate

Subject: *Information on Cancelled Integrated Flight Test-16 for Ground-based Midcourse Defense Element*

Dear Senator Nelson:

At your request, we are providing information on a Ground-based Midcourse Defense (GMD) element flight test known as Integrated Flight Test (IFT)-16. This test was planned for the third quarter of fiscal year 2004 but was recently cancelled by the Missile Defense Agency (MDA), the agency within the Department of Defense (DOD) responsible for developing the ballistic missile defense system and its elements. Specifically, you asked that we determine the original purpose of IFT-16, how the test differed from IFT-14 and -15, and what new information IFT-16 would have provided had it been conducted.

We found that the primary objective of IFT-16 was similar to that of past flight tests. The test was planned to assess the ability of GMD components to work together as an integrated element, capable of engaging and destroying a mock warhead. However, as described in the enclosure to this letter, IFT-16 engagement conditions and components differ from those in earlier tests.

Had the Missile Defense Agency conducted IFT-16, it would have accomplished the following:

- Increased the agency's knowledge regarding the feasibility and effectiveness of GMD's initial defensive capability, which DOD still plans to begin fielding in September 2004.
- Provided an opportunity to assess GMD's capability under new engagement conditions. Also, IFT-16 would have tested the GMD element in another intercept region, designated as R15 (see the attachment for a depiction of the intercept regions). A test in this region will now be delayed until IFT-17.

- Offered the first opportunity to flight test the radar at Beale Air Force Base, California, in an upgraded early warning radar configuration, and to flight test a new version of the battle management software. Flight tests of both the battle management software and the radar will be delayed until the radar certification flight—a non-intercept flight test denoted IFT-16A—which is scheduled for the fourth quarter of fiscal year 2004.

Additionally, with the cancellation of IFT-16, MDA expects to have a 13-month gap between IFT-15, planned for January 2004, and IFT-17, scheduled for February 2005.

Our analysis of the near-term flight test program provided in this report and its enclosure is based on the system-level GMD test document, *Development Master Test Plan for the Ground-Based Midcourse Defense Element* (draft), 15 November 2002. We also received MDA's comments on our analysis and have incorporated them where appropriate. We conducted our review during May 2003 in accordance with generally accepted government auditing standards.

We are sending copies of this report to the Secretary of Defense; the Chairman, Subcommittee on Strategic Forces, Senate Armed Services Committee; and the Chairmen and Ranking Minority Members of the Senate Appropriations and Armed Services Committees. We will also make copies available to other interested parties upon request. In addition, this correspondence will be available at no charge on the GAO web site at http://www.gao.gov.

Please contact me at (202) 512-4841 or Barbara Haynes at (256) 922-7535 if you or your staff have any questions concerning this report. Randy Zounes was a key contributor to this report.

Sincerely yours,

R E Levin

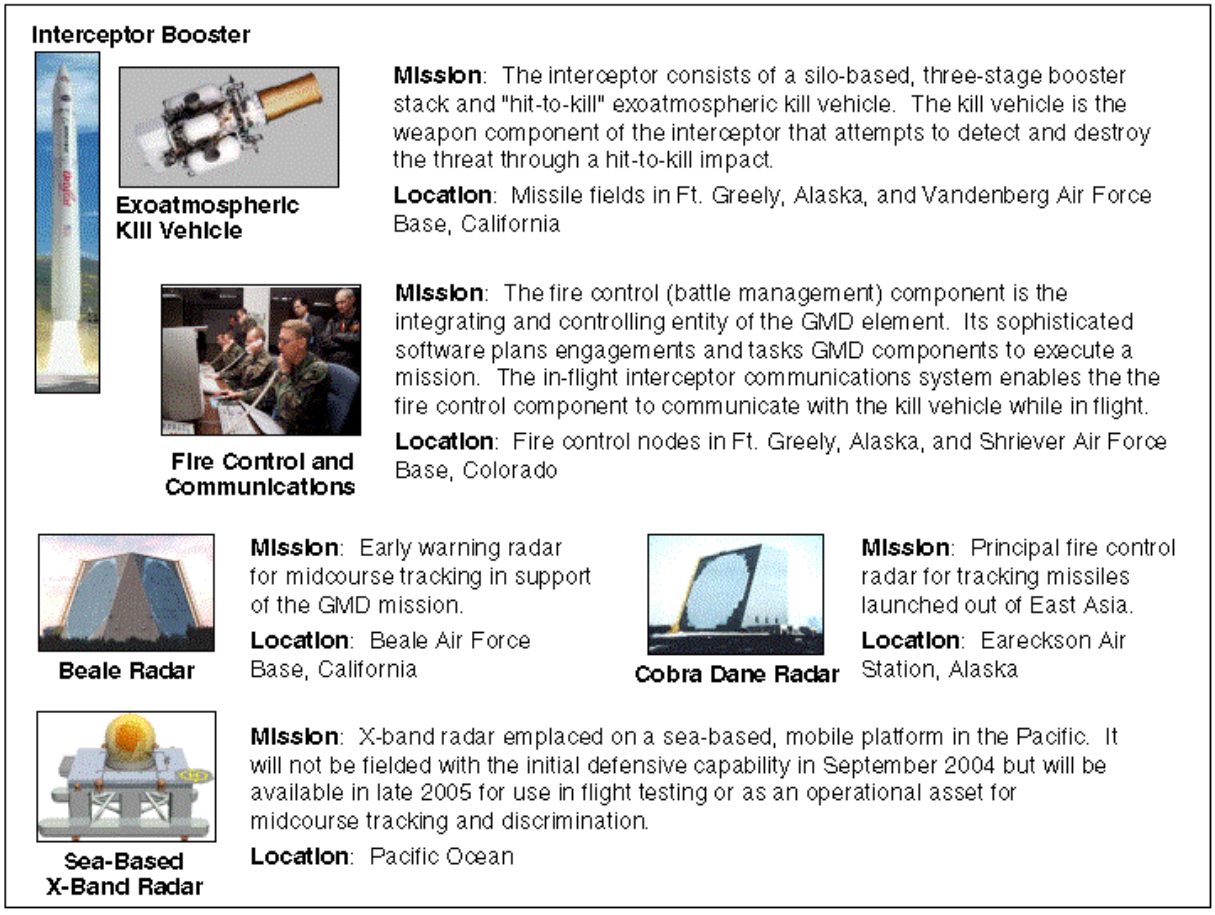
Robert E. Levin
Director
Acquisition and Sourcing Management

Enclosure

Background

The Missile Defense Agency within the Department of Defense is developing and testing components of the Ground-based Midcourse Defense (GMD) element, which is intended to defeat long-range ballistic missile threats in the midcourse phase of flight.[1] When fully deployed, the GMD element will include (1) space- and ground-based sensors to provide early warning and tracking of missile launches; (2) ground-based radars to identify and refine the tracks of threatening reentry vehicles and associated objects; (3) ground-based interceptors, each consisting of a three-stage booster and exoatmospheric kill vehicle, to destroy enemy missiles through "hit-to-kill" impacts outside the atmosphere; and (4) fire control nodes for battle management and execution of the GMD mission. Figure 1 depicts the principal components of the GMD element.

Figure 1: Components Of The Ground-Based Midcourse Defense Element



Source: GAO, based on MDA documents.

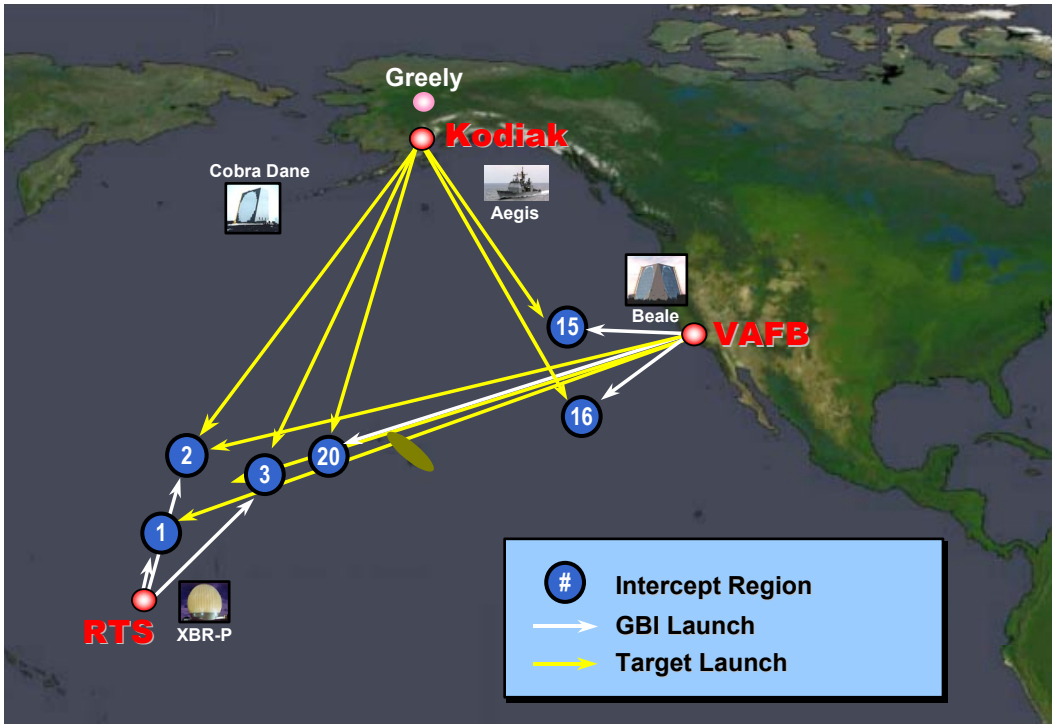
[1] The midcourse phase of flight refers to that portion of a ballistic missile's trajectory between the boost phase and reentry phase when the warheads and decoys travel on ballistic trajectories above the atmosphere.

Integrated Flight Tests

To assess its progress in the development of the GMD element, MDA conducts integrated flight tests (IFTs). These tests are demonstrations of system performance during which an interceptor is launched to engage and intercept a target reentry vehicle (mock warhead) above the atmosphere. Currently, integrated flight tests are limited to target launches out of Vandenberg Air Force Base (VAFB), California, and interceptor launches out of Reagan Test Site (RTS) in the western Pacific.[2] The Missile Defense Agency is progressing with the development of the Ballistic Missile Defense System (BMDS) Test Bed so that future integrated flight tests can be tested under new engagement conditions—different closing velocities, crossing angles, and interceptor flyout ranges.

Building on the existing infrastructure, the BMDS Test Bed adds an interceptor launch site at Vandenberg Air Force Base; target launch facilities at Kodiak Launch Complex, Alaska; a GMD fire control node at Fort Greely, Alaska; upgraded communication links between test bed components; and test infrastructure to support five new intercept regions (see Figure 2). In parallel, the early warning radar at Beale Air Force Base, California, and the Cobra Dane radar at Eareckson Air Station in Shemya, Alaska, are being upgraded for the missile defense mission. Finally, the ship-based Aegis AN/SPY-1 radar is available as a forward-deployed asset for early target tracking.

Figure 2: Intercept Regions Of Integrated Flight Tests



Source: Missile Defense Agency.

[2] Reagan Test Site (RTS) was formerly known as Kwajalein Missile Range (KMR).

Near-Term Integrated Flight Tests

To address how IFT-16 differed from earlier flight tests, we compared IFT-16 to past and near-term GMD flight tests. The results of our analysis are shown in Table 1 at the end of this enclosure, which contrasts the engagement conditions and hardware / software configuration of IFT-16 with those of IFT-10, IFT-14, and IFT-15. To better understand the table, we have defined its terms below.

Engagement Conditions

- **Target Launch Location.** The location from which the target missile, which deploys the mock reentry vehicle and decoys, is launched. The test bed will enable target launches out of VAFB, California, and Kodiak Launch Complex (KLC), Alaska. In all flight tests to date, the target launch location has been VAFB.
- **Interceptor Launch Location.** The location from which the ground-based interceptor, which deploys the kill vehicle to engage the threat, is launched. The test bed will enable interceptor launches out of either RTS or VAFB. In all flight tests to date, the interceptor launch location has been RTS.
- **Intercept Region.** The area over which an intercept is to occur. (Refer to Figure 2 for a pictorial representation of defined intercept regions.) In all intercept flight tests to date (IFT-3 through IFT-10), the intercept region has been "R1", which is about 700 kilometers from RTS.
- **Closing Velocity.** The relative speed at which the kill vehicle approaches the designated target (mock warhead). In early integrated flight tests (e.g., IFT-3), the closing velocity was roughly 7 km/sec (15,600 miles/hr). The closing velocities of recent and future integrated flight tests are classified.
- **Crossing Angle.** The geometric angle between the velocity vectors of the kill vehicle and designated target. A head-on collision has a crossing angle of 180 degrees, whereas a "tail-chaser" is any engagement with a crossing angle less than 90 degrees. In early flight tests (e.g., IFT-3), the crossing angle was roughly 100 degrees. The crossing angles of recent and future integrated flight tests are classified.
- **Weapon Task Plan / Engagement Category.** A weapon task plan consists of pre-launch instructions for generating an interceptor flyout solution that guides the interceptor toward the target. Associated with the weapon task plan is the type of engagement category, either "A", "B", or "C", under which the mission will be executed.[3] A weapon task plan is required before an interceptor is launched, and in all flight tests to date, the mission was conducted under a Category-A engagement.

[3] The detailed definitions of Category A, B, and C engagements are classified.

- **Fire Control Radar.** The primary radar for providing the necessary targeting data to the fire control node that are used for generating a weapon task plan. Pending the outcome of ongoing analysis, the use of the Aegis SPY-1 radar in future flight tests for engagement planning (fire control) is under consideration. In all flight tests to date, the fire control radar had been a surrogate midcourse "radar", which was a combination of a C-band transponder and the FPQ-14 radar.[4]
- **Midcourse Radar.** The midcourse radar provides refined targeting track data to the fire control node for the generation of in-flight target updates.

Configuration

The configuration of an integrated flight test refers to the description of hardware and software assets used during a particular test. The GMD element tested to date has been a functional representation of the GMD element, but all tests included some surrogate and prototype components.

- **Exoatmospheric Kill Vehicle (EKV).** The kill vehicles used in flight tests so far have been prototype articles. Beginning with IFT-14, a production-representative kill vehicle will be flown that is similar to the configuration to be fielded as part of Block 2004.
- **Booster.** The payload launch vehicle (PLV), a two-stage booster system consisting of modified Minuteman II motors and supporting subsystems, has been the surrogate for the interceptor booster in all integrated flight tests to date. It is scheduled to be replaced with two operationally representative test bed boosters that are currently under development – the Orbital Sciences Corporation (OSC) booster and the Boost Vehicle plus (BV+). These boosters will first be used in intercept attempts in IFT-14 and IFT-15, respectively.
- **Fire Control Node.** The fire control software is evolving to achieve more functionality and to address interfacing issues (i.e., linking the fire control component with other GMD components).
- **Beale Radar.** The early warning radar at Beale Air Force Base has participated in integrated flight tests in a missile-defense role using legacy hardware and developmental software. The conversion of the early warning radar (EWR) at Beale to an upgraded early warning radar (UEWR), which consists of hardware and significant software upgrades, is planned for completion sometime during the middle of fiscal year 2004.
- **X-Band Radar.** The Ground Based Radar Prototype (GBR-P), located at RTS, is a prototype of an X-Band radar that supports integrated flight tests. A sea-based X-band radar is under development to support flight-testing as a midcourse tracking and discrimination radar and is planned to become available in late 2005.

[4] A C-band transponder was placed on the target reentry vehicle during previous flight tests. It was essential for the execution of flight tests, because in conjunction with the FPQ-14 radar located on Oahu, Hawaii, there were no other non-artificial options available to track the reentry vehicle with sufficient accuracy for executing the mission.

- **Cobra Dane Radar.** Cobra Dane is a phased array radar located at Eareckson Air Station in Shemya, Alaska. After planned software and hardware upgrades, which are scheduled to be completed in fiscal year 2004, Cobra Dane will have the additional mission of performing real-time acquisition and tracking—functions critical for ballistic missile defense, especially for engagements out of northeast Asia. There are currently no plans to demonstrate the capabilities of the Cobra Dane radar during an integrated flight test.

TABLE 1: GMD INTEGRATED FLIGHT TEST INFORMATION

Integrated Flight Test	IFT-10 (Conducted 12/02)	IFT-14 (Planned 10/03)	IFT-15 (Planned 01/04)	IFT-16 (Previously Planned 4/03)
ENGAGEMENT CONDITIONS				
Target Launch Location	VAFB	VAFB	KLC	KLC
Interceptor Launch Location	RTS	RTS	RTS	VAFB
Intercept Region	R1	R2	R2	R15
Closing Velocity[5] (km/sec)	—	—	—	—
Crossing Angle[6] (degrees)	—	—	—	—
Engagement Category	A	B	B	B
Fire Control Radar	FPQ-14	Beale Radar	Aegis SPY-1	Aegis SPY-1
Midcourse Radar	GBR-P	GBR-P	GBR-P	Beale Radar
CONFIGURATION				
Exoatmospheric Kill Vehicle	Prototype	Production Representative	Production Representative	Production Representative
Booster	PLV	OSC	BV+	OSC / BV+
Fire Control Node (Battle Management)	BI-2L	V4.0	V4.0	V4.1
Beale Radar	EWR	EWR	EWR	UEWR
X-Band Radar	GBR-P	GBR-P	GBR-P	GBR-P
Cobra Dane Radar	N/A	N/A	N/A	N/A

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[5] Closing velocities of listed flight tests are classified.
[6] Crossing angles of listed flight tests are classified.