Director, Operational Test and Evaluation

FY 2003 Annual Report

DoD Programs

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DIRECTOR'S INTRODUCTION

In 1983, Congress legislated in Title 10 the creation of the office of Director, Operational Test and Evaluation (DOT&E). Since then, the cold war ended and a global war on terrorism began. These developments have led to far-reaching changes in the way we fight and procure weapons. They have necessitated a rethinking of how we organize and structure our military forces, how we man and train them realistically to face these new threats, and how we equip them in a timely and effective manner with the best systems that rapidly advancing technologies can offer.

In support of these objectives, DoD has undertaken a major transformation of its acquisition process, codifying the latest changes in May 2003. In parallel, significant changes in the regulation governing requirements generation eliminated the term "requirement" in all the documentation, and replaced it with "capability" for new weapons programs.

These innovations have not altered the core mission of DOT&E. This is largely attributable to the original legislation being so clear, focused, and close to the core mission of the acquisition system. Our maxim remains one of determining whether systems will be effective, suitable and survivable in combat, and providing that information to decision makers before commitment to full-rate production or deployment with our combat forces. Congressional establishment of DOT&E was, and remains, the embodiment of the "fly before you buy" philosophy.

Critical to the transformation of how our forces fight with their systems is their growing interdependence. Systems now depend on "jointness," system-of-systems operations, network-centric warfare, and the complexity of precision attack interlinking intelligence, surveillance, reconnaissance, and weaponry. To create realistic operational test opportunities with the required links and relevant environments is expensive. The Services are often reluctant to dedicate the resources required for such testing. Accordingly, some operational tests, especially major command and control tests, tend to become secondary efforts to training exercises, as was the case for the Army's Stryker Brigade Operational Evaluation. The difficulty, simply put, is that test objectives often compete with training objectives. We will need a more integrated planning and execution approach in order to assure test adequacy. The Services must give adequate priority and resources to testing done in conjunction with exercises.

DOT&E will respond to an acquisition system no longer structured around a traditional research, development, test, and evaluation process that leads to a full-rate production Milestone. DoD will likely continue to buy more systems in low-rate initial production than are needed for testing. Given these substantial expenditures, DOT&E's early and continuous involvement prior to IOT&E and full assessment of effectiveness and suitability will be critical.

There are two new acquisition styles: *evolutionary acquisition* (which includes incremental development and spiral development) and *capabilities-based acquisition.* Neither necessarily produces a fixed configuration with which to judge a system's operational effectiveness and suitability or survivability against criteria based on military mission requirements. To address this potential problem, a significant feature of this year's update to regulations was the clear articulation of the acquisition system's purpose: to provide systems "that meet user needs with a measurable improvement to mission capability and operational support...." This is an important criterion for evaluation, no matter what other criteria are used. To meet the challenges of increasing complexity and movement away from articulated requirements, DOT&E is emphasizing two strategies:

- Comprehensive evaluation based on determining a new system's effect on mission capability rather than merely measuring its compliance with specifications.
- Objective evaluation based on direct comparison of the current system against the proposed new ways of conducting a mission. Such comparative evaluation provides the most direct answer to the question "Does the system provide a measurable improvement to mission capability or operational support?"

The F-22 IOT&E, planned for FY04, exemplifies a major system test and evaluation with a mission capability focus. The Air Force will evaluate the F-22's fighter escort mission capability by flying F-22s as escorts for attack aircraft and assessing the level of the attack mission accomplishment, and will also compare that to results of F-15s flying similar missions. This approach will demonstrate whether the F-22 is effective in carrying out required combat missions and whether it provides a measurable improvement over the existing F-15 fighter force.

Comparative evaluations have been useful in other critical ways. In the past, systems sometimes failed to meet specified requirements. By comparing it with the current way of doing a mission, DOT&E was able to evaluate the new system more meaningfully. For example, the Army's M270A1 Multiple Launch Rocket System failed to meet its requirement to be able to move within a certain number of seconds after firing (rapid movement after firing helps survivability by moving before the enemy can respond with counterfire). Even though it failed the specified time requirement, it provided a significant improvement over the current capability, and to survivability.

Comparative evaluation also gives us a means to calibrate the difficulty of a test. A comparison base allows analysis to overcome significant inadequacies in test instrumentation and execution. Cases where comparative evaluations have proved useful include IOT&Es of: F-18 E/F, Longbow Apache, and Stryker.

Nevertheless, the realities of the high operational tempo of our forces in the war on terrorism, combined with the desire to get new capabilities into these forces as quickly as possible, increase the potential for systems to circumvent a rigorous acquisition process. Worse yet, our warfighters may get weapons without knowing their operational capabilities and limitations as demonstrated by adequate operational test and evaluation.

This concern has translated into action by the T&E community to inform warfighters about systems recently used in combat, and their effectiveness, such as the Patriot PAC-3.

- The Patriot PAC-3 completed its IOT&E prior to deployment but failed to demonstrate a ripple fire capability (which is the doctrine for ballistic missile threats). An early failure to salvo two missiles during testing was linked to a software problem that was corrected. During deployment the system successfully engaged two ballistic missile threats with ripple fired PAC-3 missiles.
- The ATFLIR lasers in the first Engineering Demonstration Models (EDMs) were not reliable enough to use in targeting laser-guided weapons. Operational commanders decided to not use those ATFLIR pods, deployed by the Navy to provide an early operational capability, in combat operations over Afghanistan. A second deployment of improved EDM pods in Iraq supported dozens of laser-guided weapons during combat operations with a 100 percent success rate.
- Joint Global Positioning System Combat Effectiveness (JGPSCE) field tests discovered potential weapon systems vulnerabilities to GPS degradation. The quick-look test results concerning these vulnerabilities provided valuable and timely information to warfighters during Operation Iraqi Freedom (OIF).
- To support an impending Stryker deployment to Iraq, the Live Fire Test and Evaluation armor-testing program was intensive. The objective was to verify that the armored vehicle system provides crew protection against munitions up to 14.5mm and reduces system vulnerability to rocket propelled grenades. The Army conducted limited testing of every armor configuration on the brigade vehicles and applied interim mitigation measures to those armor configurations that failed.
- The Joint Technical Coordinating Group for Munitions Effectiveness (JTCG/ME), which is part of DOT&E's Live Fire responsibility, published two interim versions of their Air-to-Surface Weaponeering System joint munitions effectiveness manual in direct support of Operation Enduring freedom (OEF) and OIF. Details are in the live fire section.

Missile defense provides another example of how the operational test and evaluation community is adjusting to the new acquisition environment of capabilities-based acquisition, and spiral development. In close coordination with the Missile Defense Agency (MDA), the Operational Test Agencies (OTAs), and the Joint Staff, a joint assessment team oversees development, review and approval of test plans, and provides input to military utility studies. Details are in the missile defense section.

Last year's annual report stated that T&E needed to serve the development process better by changing how it dealt with *people, processes,* and *facilities*. Developments on each account occurred during this past year. DoD put forward, and Congress enacted, a number of recommendations on *people* that will help maintain a flexible, expert workforce. These include a recommendation in the DOT&E report that would allow increased use of pay banding initiatives. The size of the T&E workforce remains a major concern.

With respect to *process* improvements, last year DOT&E recommended increasing the tempo of testing (related to the workforce size), develop common instrumentation, provide earlier involvement of operational military personnel, test before deployment, make testing more valuable, and address the shortfall in methodologies of Information Assurance and Interoperability.

- To increase the tempo of testing, we need to increase test resources and the means to move, share, analyze data and improve test design. Details are in the resources section.
- The Central T&E Investment Program (CTEIP) stresses the need for common solutions to instrumentation and other test capability problems.
- To make early involvement more effective, DOT&E has begun to apprise the Services at Milestone A of T&E information needs with evaluation plans.
- Early involvement of DOT&E should help the warfighters with respect to deployment before testing. This makes information available before the need to use a system in combat. It requires the early and sustained involvement of the Service OTAs, which continue to be understaffed. For example, the Air Force Operational Test and Evaluation Center will lose 68 military and 11 civilian personnel authorizations in FY04.
- A major finding noted last year was the need to test the way we fight. To do that, DOT&E recommended creating a Joint test and evaluation capability (Joint TEC). In 2003, our efforts to establish this capability evolved to address a Joint Forces Test Capability. Details are in the resources section.
- Congress directed DOT&E to assist Combatant Commanders in testing and evaluating fielded systems with respect to computer attack and other forms of information warfare, an effort known as Information Assurance (IA). This effort will focus on providing evaluations conducted in conjunction with major Combatant Commander training exercises. Details are in the IA section.
- DOT&E assumed management of the Joint Test and Evaluation (JT&E) Program in 2003. We have redirected that program to ensure joint tests provide quick and more relevant information to warfighters. An initial effort, undertaken at the suggestion of the Army, Air Force, and Marine Corps OTA Commanders, will evaluate the causes of battle damage to platforms in Iraq. The JT&E Program also served our forces well in preparation for OIF. Details are in the JT&E Program section.

Last year, legislation established a Defense Test Resource Management Center (DTRMC), responsible to the Under Secretary of Defense for Acquisition, Technology, and Logistics. The DTRMC is tasked with developing a strategic plan for infrastructure investment and with certifying the adequacy of budgets for test infrastructure and test programs. DOT&E will transfer both the CTEIP and the T&E Science and Technology Program to the DTRMC once it is fully established and staffed. In last year's annual report, DOT&E outlined the needs of T&E infrastructure. It included specific recommendations for improvement in *facilities* by warfare area. We believe the DTRMC, when it produces its strategic plan, must address these needs.

In the twenty years since the establishment of DOT&E by Congress, much has changed. This office has relied on its well-defined role as prescribed in the law. This has worked well, producing systems that improve mission capability such as those demonstrated in OIF. However, due to changing acquisition regulations and the growing complexity of combat, DOT&E will bolster its role, while maintaining our focus on evaluation of mission capability, adequate testing, and timely information that comes from early and continuous involvement.

Thomas P. Christie

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Director

DOT&E PROGRAM OVERSIGHT

DOT&E is responsible for approving the adequacy of plans for operational test and evaluation and for reporting the operational test results for all major defense acquisition programs to the Secretary of Defense, Under Secretary of Defense (Acquisition, Technology and Logistics), Service Secretaries, and Congress. For DOT&E oversight purposes, major defense acquisition programs were defined in the law to mean those programs meeting the criteria for reporting under section 2430, Title 10, United States Code (Selected Acquisition Reports (SARs)). The law (sec.139(a)(2)(B)) also stipulates that DOT&E may designate any other programs for the purpose of oversight, review, and reporting. With the addition of such "non-major" programs, DOT&E was responsible for oversight of a total of 256 acquisition programs during FY03.

Non-major programs are selected for DOT&E oversight after careful consideration of the relative importance of the individual program. In determining non-SAR systems for oversight, consideration is given to one or more of the following essential elements:

- Congress or OSD agencies have expressed a high level of interest in the program.
- Congress has directed that DOT&E assess or report on the program as a condition for progress or production.
- The program requires joint or multi-Service testing (the law (sec. 139(b)(4)) requires the DOT&E to coordinate "testing conducted jointly by more than one military department or defense agency").
- The program exceeds or has the potential to exceed the dollar threshold definition of a major program according to DoD 5000.1, but does not appear on the current SAR list (e.g., highly classified systems).
- The program has a close relationship to or is a key component of a major program.
- The program is an existing system undergoing major modification.
- The program was previously a SAR program and operational testing is not yet complete.

This office is also responsible for the oversight of LFT&E programs, in accordance with 10 USC 139. DoD regulation uses the term "covered system" to include all categories of systems or programs identified in 10 USC 2366 as requiring live fire test and evaluation. In addition, systems or programs that do not have acquisition points referenced in 10 USC 2366, but otherwise meet the statutory criteria, are considered "covered systems" for the purpose of DOT&E oversight.

A covered system, for the purpose of oversight for LFT&E, has been determined by DOT&E to meet one or more of the following criteria:

- A major system, within the meaning of that term in Title 10 USC 2302(5), that is:
  - User-occupied and designed to provide some degree of protection to the system or its occupants in combat.
  - A conventional munitions program or missile program.
- A conventional munitions program for which more than 1,000,000 rounds are planned to be acquired.
- A modification to a covered system that is likely to affect significantly the survivability or lethality of such a system.

DOT&E was responsible for the oversight of 94 LFT&E acquisition programs during FY03.

AIR FORCE PROGRAMS (continued)

Space-Based Infrared System Program High Component (SBIRS-HIGH)

Space Based Radar (SBR)

Sensor Fuzed Weapon (SFW) P3I (CBU-97/B)

Small Diameter Bomb (SDB)

Secure Mobile Anti-Jam Reliable Tactical Terminal (SMART-T)

Strategic Warfare Planning System (SWPS)

Ultra High Frequency (UHF) Follow-on Satellite

Unmanned Combat Aerial Vehicle - Air Force

Wideband Gapfiller

OTHER DoD PROGRAMS

Ballistic Missile Defense Program
- Ground Based Midcourse Defense Segment (Includes Ground Based Interceptor [GBI], Ground Based Radar [GBR], and Battle Management C3 [BMC3])
- Medium Extended Air Defense System (MEADS)
- Navy Theater-Wide Ballistic Missile Defense (incorporates AEGIS BMD and SM-3 BLOCK II)
- Space-Based Infrared System-Low (SBIRS-L)
- Theater High-Altitude Area Defense (THAAD)
- YAL-1 Airborne Laser (ABL)

Business System Modernization (BSM)

Chemical Biological Defense Program (CBDP)
- Artemis (Chemical Agent Standoff Detection System)
- Joint Biological Agent Identification and Diagnosis System (JBAIDS)
- Joint Biological Point Detection System (JBPDS)
- Joint Biological Standoff Detection System (JBSDS)
- Joint Chemical Agent Detector (JCAD)
- Joint Service Family of Decontamination Systems (JSFDS)
- Joint Service Light NBC Reconnaissance
- Joint Service Lightweight Standoff Chemical Agent Detector (JSLSCAD)
- Joint Service Sensitive Equipment Decontamination (JSSED)
- Joint Warning and Reporting Network (JWARN)

Chemical Demilitarization

Composite Health Care System II (CHCS II)

Defense Medical Logistics Standard Support (DMLSS)

Defense Message System (DMS)

Defense Procurement Payment System (DPPS)

Defense Travel System (DTS)

DFAS Corporate Database/Warehouse (DCD/DCW)

Fuels Automated System (FAS)

Global Information Grid Bandwidth Expansion (GIG-BE))

Global Command & Control System – Joint (GCCS-J)

High Performance Computing Modernization (HPCM)

Joint Tactical Radio System (JTRS) Cluster II (Multi-Band Intra Team Radio)

Joint Tactical Radio System Waveform (JTRS Waveform)

Net- Centric Enterprise Services (NCES)

Public Key Infrastructure (PKI)

Teleport

Theater Medical Information Program (TMIP)

BALLISTIC MISSILE DEFENSE SYSTEM (BMDS)

This report provides an unclassified assessment of the adequacy and sufficiency of the Ballistic Missile Defense System (BMDS) element test programs during FY03. Classified discussions of these topics will be included in the annual Operational Test & Evaluation Assessment of the BMDS Test Program submitted in February 2004.

The BMDS is intended to provide a layered defense for the entire United States, deployed U.S. forces, friends, and allies from all ranges of threat ballistic missiles during all phases of flight. The BMDS will consist of land-, sea- and space-based sensors (both optical and radar), battle management systems, communications networks, long- and short-range interceptors, and directed-energy weapons.

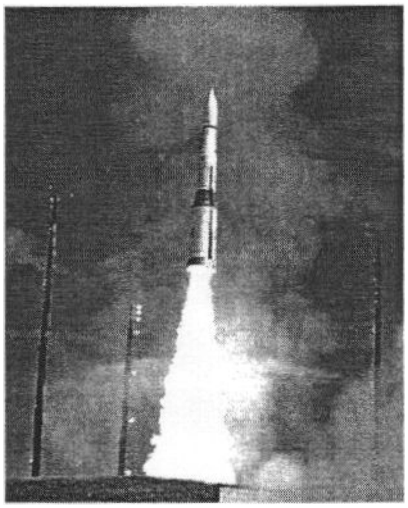
On December 17, 2002, the President directed the Secretary of Defense, "...to proceed with plans to deploy a set of initial missile defense capabilities beginning in 2004." The Missile Defense Agency (MDA) is working to develop a set of Initial Defensive Capabilities (IDC), which can be deployed to conduct Initial Defensive Operations (IDO), using Ground-based Midcourse Defense (GMD), Aegis Ballistic Missile Defense (Aegis BMD), and other BMDS elements. Each of these elements' support of the IDO is discussed in its respective section.

It is prudent to identify and exploit defensive capabilities inherent in the BMDS infrastructure during the development phase. However, it is important to understand that assessments of these capabilities are based primarily on modeling and simulation, developmental testing of components and subsystems, and analyses – not end-to-end operational testing of a mature integrated system. Due to the immature nature of the systems they emulate, models and simulations of the BMDS cannot be adequately validated at this time. Confidence in assessed capabilities will improve as more system performance data is gathered to anchor the simulations or directly demonstrate these capabilities.

Planned operational assessments of IDO capability will focus on system performance against nation specific threats, as documented in a series of Defense Intelligence Agency (DIA) threat assessments. MDA is designing BMDS based on the capabilities of broad threat classes. MDA and the operational test agencies (OTAs) are working to connect the MDA threat capability document to the DIA threat assessment. IDO capability will be assessed for four engagement sequence groups consistent with North Korean Intercontinental Ballistic Missile (ICBM) attack scenarios. The Command and Control, Battle Management and Communications (C2BMC) element will integrate the other BMDS elements into a system capable of providing integrated, layered defenses against all types of ballistic missile threats. For Block 2004 and IDO, C2BMC is planned to provide enhanced situational awareness for the warfighter. Specifically, this will consist of a common operating picture that provides early launch warning and impact point predictions to the warfighter and voice authorization for weapons release provided through an appropriate concept of operations. Plans call for enhancing C2BMC capabilities in Block 2006.

Due to immature BMDS elements, very little system level testing was performed by the close of FY03. Therefore, BMDS capabilities assessed for IDO will be based on test events planned for FY04. The OTAs are involved in the planning of these events and DOT&E is reviewing and approving operational test objectives for combined developmental test/ operational test events. These tests will be executed using simulated or theoretical performance characteristics for some elements. Scenarios are still being developed for the system level integrated ground-test (IGT-2), planned to support the initial deployment of BMDS. Flight tests planned to support validation of the ground-testing and modeling efforts have slipped to the point that data will not be available prior to IGT-2. Data from flight testing and ground testing is needed to support extensive validation, verification, and accreditation efforts currently underway. Without the results of the flight testing, the ground-testing efforts are at risk. If models accurately reflect flight test performance, IGT-2 results will be validated after the fact. At this point in time, it is not clear what mission capability will be demonstrated prior to IDO.

GROUND-BASED MIDCOURSE DEFENSE (GMD)



The Ground-based Midcourse Defense (GMD) element is an integrated collection of components that perform dedicated functions during an ICBM engagement. As planned, the GMD element includes the following components:

- GMD Fire Control and Communications. The communications network links the entire element architecture via fiber optic links and satellite communications. For IDO, all fire control will be conducted within the GMD element.
- Long-range sensors, including the Upgraded Early Warning Radar, the COBRA DANE radar, and the Ground-Based Radar Prototype. In December 2005, a sea-based X-band (SBX) radar is to be incorporated.
- Ground Based Interceptors and emplacements, consisting of a silo-based ICBM-class booster motor stack and the Exoatmospheric Kill Vehicle (EKV). The plan for the 2004 Test Bed plan places six Ground Based Interceptors at Fort Greely, Alaska, and four at Vandenberg Air Force Base, California. In 2005, plans are to place ten more at Fort Greely.

GMD soon plans to interface with other BMDS elements and existing operational systems through external system interfaces. Through FY06, these plans include GMD interfacing with the Aegis SPY-1B radars and satellite-based sensors and communications.

To date, the GMD program has demonstrated the technical feasibility of hit-to-kill negation of simple target complexes in a limited set of engagement conditions. The GMD test program in FY03 was hindered by a lack of production representative test articles and from test infrastructure limitations. Delays in production and testing of the two objective booster designs have put tremendous pressure on the test schedule immediately prior to fielding. The most significant test and infrastructure limitations and mitigation plans are described in the table below.

Major GMD Test Limitations and MDA Mitigation Plans

Limitation	Comments	MDA Mitigation Plan
Lack of a deployable boost vehicle	The Orbital booster has been tested in developmental flight tests without attempted intercepts. The Lockheed booster testing has slipped such that it may not be available for IDO.	MDA is proceeding with deployment plans emphasizing the Orbital booster. Testing will continue with both designs as Lockheed booster production resumes.
Lack of a realistically placed midcourse sensor	The GMD test radar is collocated at the interceptor launch site. The FPQ-14 radar, a non-deployable asset that tracks a transmitter attached to the test target, currently accomplishes the midcourse tracking and discrimination functions.	GMD is developing a mobile, sea-based radar. The scheduled employment of this radar in the GMD Test Bed occurs in the post-2005 time frame.
Fixed intercept point	All of the flight tests to date have had similar flyout and engagement parameters. This limitation includes range constraints and a requirement not to create space debris.	The 2004 Test Bed expands the flyout range and engagement conditions. Space debris creation remains a problem.[a] Transitioning between testing and operations is a concern.

Intercept Flight Test - 9 (IFT-9) took place on October 14, 2002, resulting in a successful intercept. The target suite consisted of a mock warhead and a number of decoys launched from the Vandenberg Air Force Base, California, towards the Reagan Test Site. IFT-9 (largely a replay of IFT-8) was designed to increase confidence in the GMD capability to execute hit-to-kill intercepts. Overall, the test execution was nominal although the EKV experienced the track gate anomaly previously observed in IFT-7 and IFT-8. The software changes incorporated in IFT-9 to mitigate this problem were not successful. Further changes were made prior to IFT-10.

In December 2002, GMD attempted a night intercept in IFT-10. In this test, the EKV failed to separate from the surrogate boost vehicle and therefore the ability to intercept the target could not be tested. The failure to separate was attributed to a quality control failure combined with shock and vibration loads on the EKV. As a result, corrective measures taken to fix the track gate anomaly found in previous tests could not be tested.

GMD suspended intercept flight testing after the EKV failed to separate from the surrogate booster in IFT-10. IFT-11 and IFT-12 that employed the problematic surrogate booster were eliminated from the schedule. This decision was reasonable given the increased risk of surrogate boost vehicle failure, the resources that would have to be diverted from tactical booster development to fix the problems, and the limited amount of additional information to be gained in IFT-11 and IFT-12 over that available from previous flight tests. It does, however, leave very limited time for demonstration of boost vehicle performance, integration of the boost vehicle to the new, upgraded EKV, and demonstration of integrated boost vehicle/interceptor performance. IFT-13A and IFT-13B remain in the schedule as non-intercept flight tests to confirm booster integration and performance. IFT-13C was added to the schedule and represents a significant exercise of the Test Bed infrastructure. It will be the first system-level flight test to use the Kodiak, Alaska, facility to launch a target missile. While it is not a planned intercept attempt, it will fully exercise the system and may result in an intercept. IFT-13C also addresses a long-standing concern over target presentation that has not yet been tested. IFT-14 and IFT 15 are the next official intercept attempts and are scheduled for May 2004 and July 2004, respectively.

The Orbital Sciences Corporation booster was successfully tested with a mock EKV on August 16, 2003. Shock and vibration environments were measured and compared to previous test levels. Preliminary analyses suggest that the new booster produces lower than expected vibrations at the EKV. Performance of the real EKV mated with the Orbital booster will be demonstrated in IFT-14 prior to IDO. Similar demonstration flights for the Lockheed Martin booster design are slipping due to technical difficulties and several explosions at the missile propellant mixing facility.
Silos and related construction projects at Fort Greely, Alaska; Kodiak, Alaska; and Vandenberg Air Force Base, California, are proceeding on schedule. Due to safety considerations, no tests are currently planned to launch interceptors from the operational missile fields.

To date, EKV discrimination and homing have been demonstrated against simple target complexes in a limited set of engagement conditions. Demonstrations of EKV performance are needed at higher closing velocities and against targets with signatures, countermeasures, and flight dynamics more closely matching the projected threat. In addition, system discrimination performance against target suites for which there is imperfect a priori knowledge remains uncertain.
GMD is developing a SBX radar mounted on a semi-submersible platform. The SBX radar, scheduled for incorporation into the GMD element in December 2005, is designed to be a more capable and flexible midcourse sensor for supporting GMD engagements. This radar will improve the operational realism of the flight test program by providing a moveable mid-course sensor.

A flight demonstration of the BMDS capability using Aegis SPY-1B data (particularly for defense of Hawaii) is planned for IFT-15 in FY04. A flight demonstration of COBRA DANE is currently not planned, and its capability will need to be demonstrated by other means until an air-launched target is developed. IFT-14 and IFT-15, scheduled for FY04, are intended to provide demonstrations of integrated boost vehicle/EKV performance. Even with successful intercepts in both of these attempts, the small number of tests would limit confidence in the integrated interceptor performance.

AEGIS BALLISTIC MISSILE DEFENSE (AEGIS BMD)

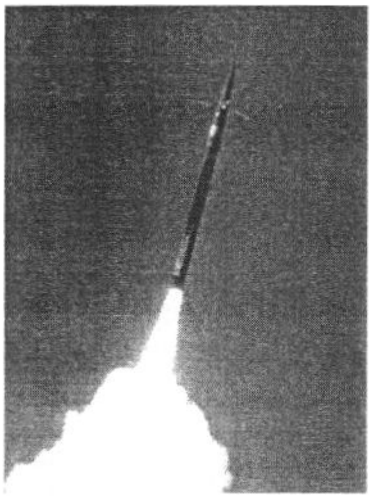
The Aegis Ballistic Missile Defense (BMD) element is intended to provide U.S. Navy surface combatants with the ability to defeat short-range (less than 1,000 kilometers), medium-range (1,000 to 3,000 kilometers), and long-range (greater than 3,000 kilometers) ballistic missiles during exoatmospheric flight. The Aegis BMD element consists of two major components: the shipboard Aegis Weapon System (AWS) and the Standard Missile-3 (SM-3) missile. The AWS detects and tracks the threat and provides midcourse uplink information to the SM-3 missile. The SM-3 missile is a four-stage hit-to-kill missile launched from an Aegis ship.

The Aegis BMD flight test program has achieved four successful intercepts in five attempts. These flight tests have demonstrated the capability to intercept short-range, simple unitary targets in both descent and ascent phases of flight, and in the case of FM-6, have shown the capability to destroy the target warhead. In FY03, two intercept attempts of a unitary target in its ascent phase were conducted. In the first test, the Aegis BMD element successfully intercepted the target. Using a newly designed divert system onboard the SM-3 missile, the Aegis BMD failed to intercept the target in the second test. The cause of the failed intercept has been attributed to a malfunction in a divert valve in the attitude control system onboard the kinetic warhead. Testing is continuing based on the consistent performance of the sustained pulse mode, while mitigation options are evaluated.

In FY03, the operational robustness of the Aegis BMD Block 2004 test program was enhanced by increased operational realism in the test strategy. Efforts to add operational realism as part of the developmental test strategy provide significant risk reduction in advance of operational testing and potential deployment of the element. The planned growth in flight test realism is consistent with the maturity of the system. Although the Block 2004 flight test plan includes many operationally realistic aspects, some important operational scenarios will remain untested by the end of the Block 2004 test program. These include multiple simultaneous engagements and separating targets. Development and integration of critical technologies pertaining to threat discrimination (e.g., AWS discrimination logic, radar and infrared seeker upgrades) and missile propulsion (e.g., kinetic warhead divert system, SM-3 booster propulsion) could improve operational capability as they are introduced in Block 2004 and subsequent upgrades.

Initial assessments of the Aegis BMD Surveillance and Track (S&T) capability to support integrated BMDS missions were also conducted as part of the FY03 flight test program. The goal of the Aegis BMD S&T effort is to allow GMD to use Aegis tracking data to generate search cue commands for the Ground Based Radar Prototype in order to acquire and track ICBM class targets. As part of this effort, Aegis BMD is participating in the GMD IFT program. Depending on the accuracy of Aegis track data, the Block 2004 Aegis BMD S&T capability could contribute to GMD detection and tracking. Aegis BMD participated in both IFT-9 and -10 to evaluate its capability to support more integrated missions in future flight tests.

THEATER HIGH ALTITUDE AREA DEFENSE (THAAD)



The Theater High Altitude Area Defense (THAAD) is an element of the terminal defense segment of the BMDS and is a mobile ground-based missile defense element designed to protect forward-deployed military forces, allies, and population centers from short- and intermediate-range ballistic missile attacks. THAAD uses kinetic energy "hit-to-kill" technology to intercept incoming ballistic missiles in the late mid-course or terminal phases of their trajectories, at either high endoatmospheric or exoatmospheric altitudes.

The THAAD radar has progressed in maturity and is now in manufacturing and integration testing. Assembly of the first radar is nearly complete, with end to end testing of subarrays completed. Radar component hardware has successfully completed reliability testing and accelerated life testing of critical transmit/receive assemblies. The first radar component is on schedule for a spring 2004 delivery to White Sands Missile Range, New Mexico, for final integration, calibration, and ground testing.

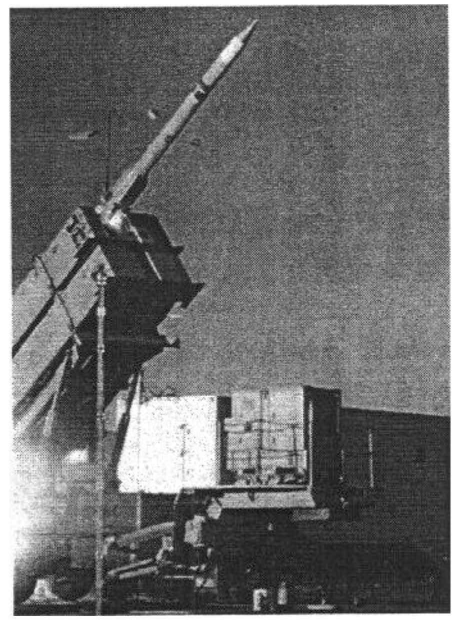
The production facility in Troy, Alabama, has been activated and is preparing to produce the first THAAD missiles this fiscal year. Recent safety incidents at propellant mixing facilities of the Pratt & Whitney, Chemical Systems Division booster manufacturer are causing a revision to the missile development schedules. The Missile Critical Design Review (CDR) was completed in FY03 and developmental testing supports the mission controls flight test in late-CY04.

No integrated system-level testing occurred in FY03. However, during FY03 the THAAD contractor test program completed several successful assembly/subassembly level tests and simulated interoperability exercises. Although some failures and anomalies associated with the missile design were encountered during this testing, mitigation strategies are sufficient to address the problems with little or no impact on the flight test schedule.

Flight safety analyses for testing at the Pacific Missile Range Facility are taking longer than expected. It is unclear if all range safety constraints can be met with current targets. Debris from intercept events or flight termination is a serious safety concern. If unresolved, this could limit the use of a long-range target, forcing testing to the Reagan Test Site (RTS). This would likely conflict with GMD testing at RTS.

Budget adjustments caused the ground and flight test programs to be repeatedly restructured over the past year. The flight test schedule emerged from these changes with minimal deferments, with the first intercept against a threat-like target planned for 2005. The government's ground-test program, which includes system safety and performance qualification, has been delayed. This could impact plans for deploying interim hardware buys. Mobility, logistics, climatic and dynamic environments, reliability, and maintainability will all be tested between 2007 and 2009. If this acquisition concept is implemented, Block 2004 and Block 2006 THAAD systems will be procured and fielded with little or no government performance qualification or operational testing.

At this time, the THAAD element has no deployable hardware, except for the prototype radar. The THAAD radar technology is being developed by the Sensor Directorate at MDA for a forward-deployed, mobile, X-band radar to enhance early launch detection and tracking capability.



PATRIOT ADVANCED CAPABILITY-3 (PAC-3)

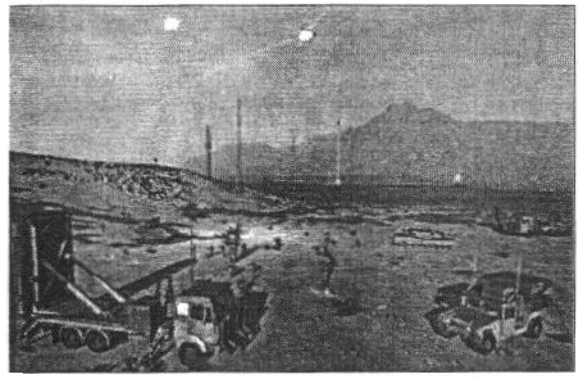
The PATRIOT air defense system is designed to detect, track, engage, and destroy air-breathing threats (ABTs) and tactical ballistic missiles (TBMs). PATRIOT Advanced Capability-3 (PAC-3) Configuration-3, the latest version, completed an eight-month IOT&E in September 2002. The Army manages the PAC-3 program and interfaces with the BMDS through data and communications exchange. The PATRIOT system is designed to defend against multiple hostile TBMs and ABTs in electronic countermeasures and clutter environments. The ABTs include fixed-wing and rotary-wing aircraft, cruise missiles, tactical air-to-surface missiles, anti-radiation missiles, and unmanned aerial vehicles.

In December 2002, DoD approved the limited production of 100 PAC-3 missiles during FY03 and 109 missiles during FY04 to equip PAC-3 battalions and support ongoing military actions. PATRIOT battalions with PAC-3 fire units were employed in Operation Iraqi Freedom (OIF) against TBMs. In OIF, PAC-3 interceptors were ripple-fired against ballistic missile threats, a user requirement that was not demonstrated during operational testing. This eliminated the need for a follow-on test to demonstrate this capability. All PATRIOT engagements were conducted in a complex operational environment. Three instances of erroneous engagements between PATRIOT batteries and friendly aircraft are under investigation and are not discussed here. System performance against TBMs appears to have been highly effective and consistent with expectations documented in DOT&E's beyond low-rate initial production report submitted to Congress in October 2002. PATRIOT performance during OIF is detailed in the classified FY03 BMDS annual report.

System shortcomings identified in the IOT&E require a Follow-On Test Program, which is not yet fully defined. There are three flight tests scheduled in FY04, twelve in FY05, five in FY06, and seven for FY07. The adequacy of this testing cannot be fully assessed because the detailed objectives for most of the flight tests in FY05 and beyond are not yet defined. The Mobile Flight Mission Simulator Hardware-in-the-Loop facility provided much of the data to assess PAC-3 system performance during IOT&E, but it has significant limitations and needs improvement. In order to conduct an integrated battalion-level test, two additional Mobile Flight Mission Simulator systems should be procured. It is essential that the Army provide the funding resources needed to properly execute this program.

PATRIOT PAC-3 provides the only BMDS operational capability that can be assessed with high confidence at this time. PAC-3 demonstrated effectiveness, suitability, survivability, and lethality against a limited set of threats during the IOT&E in 2002. PAC-3 successfully engaged missiles that threatened defended assets during OIF. As with all defensive systems, significant improvements are needed in our capability to positively identify "friend or foe."

MEDIUM EXTENDED AIR DEFENSE SYSTEM (MEADS)



The Army manages the Medium Extended Air Defense System (MEADS) program, which is intended to be a highly mobile air defense system for the protection of maneuver forces and fixed assets. PATRIOT will either evolve to the MEADS capability or be replaced by the MEADS system, depending on the acquisition strategy adopted for the program. The system should provide area and point defense capabilities against multiple, simultaneous, 360-degree attacks by ballistic missiles, large caliber rockets, fixed-wing and rotary-wing aircraft, unmanned aerial vehicles, cruise missiles, tactical air-to-surface missiles, and anti-radiation missiles. It should be strategically deployable by C-130 roll-on/roll-off, and tactically mobile to keep up with maneuver forces. MEADS has not yet entered the System Design and Development phase and currently has no operational capability. Testing has been limited to demonstrations using prototype software in digital simulations.

MEADS is an international program that DoD is reevaluating to determine if it can be integrated with the PATRIOT product improvement program. The evaluation is ongoing with the international community.

AIRBORNE LASER (ABL)

The Airborne Laser (ABL) program is employing a spiral development concept. The Block 2004 effort develops, integrates, and tests the initial weapon system on a Boeing 747 aircraft. ABL is intended to engage and destroy enemy ballistic missiles during their boost phase. The ABL engagement concept places laser energy on the threat missile booster motor casing. This energy damages the casing, causing the missile to rupture or lose thrust and flight control, falling short of its target. Engagement in the boost phase negates the missile before decoys, warheads, or submunitions are deployed.

Three different Block configurations are planned. Blocks 2004 and 2008 are on Boeing 747 transport aircraft modified to accommodate ABL subsystems. Block 2006 continues testing the Block 2004 aircraft, with minimal hardware and software update, against a wider variety of ballistic missile targets. Also, during this spiral, deployable ground support equipment will be developed to support early operational capability and MDA test activities.

To date, the program has been concentrating on activities associated with getting "first light" through six fully integrated laser modules, and integrating the beam control system. All Block 2004 efforts are focused on achieving a successful, live shoot-down of a ballistic missile during FY05.

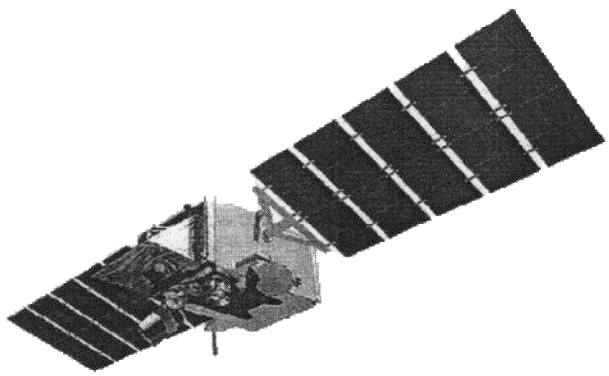
In order to demonstrate system performance as soon as possible, the Block 2004 program will delay some integration and testing until after the ballistic missile shoot-down. For example, integration and testing of the Active Ranger System is now scheduled to occur after the shoot-down.

The program has also reorganized the High Energy Laser (HEL) Lethal Edge Irradiance characterization, reducing the number of tests and engagement geometries occurring prior to the ballistic missile shoot-down. This limits the amount of data available through FY05, for extrapolating ABL's negation capabilities against other missile threat classes. HEL beam characterization flight tests will be re-planned to the degree possible after the shoot-down event. Characterization of the HEL beam should continue in the Block 2006 test program to increase understanding of ABL lethality.

A thorough lethality test program is planned in the Block 2006 program but is not completely funded. The plan addresses primary negation parameters and includes the procurement of about a dozen targets, their engagement flight tests, and the necessary preliminary lab and flight testing. The execution of this plan, combined with good HEL beam characterization, should result in a thorough understanding of ABL's negation capabilities under a range of conditions and threats.

SPACE TRACKING AND SURVEILLANCE SYSTEM (STSS)

The Space Tracking and Surveillance System (STSS) is planned as a low Earth orbit satellite constellation with cross-link capabilities, and is a sensor element of the BMDS. The STSS is intended to acquire, track, discriminate, assess, and report ballistic missile events from lift-off through intercept using multi-spectral sensors and stereo tracking. The STSS may eventually consist of a large constellation (up to 27 spacecraft) to provide continuous coverage of most of the globe.



Block 2004 STSS test activities will consist of ground-based tests, simulations, and rehearsals using the STSS Surrogate Test Bed (SSTB). Communications protocols and procedures will be evaluated, including the ability for STSS data to be disseminated through C2BMC to other BMDS elements. Other pre-launch tests include system and software integration tests, which are scheduled to begin in FY04.

The STSS is currently at the Block 06 CDR stage. STSS currently has no operational capability. The earliest feasible capability will occur during FY07 if the first two satellites are launched as planned. Early STSS capability will have significant onboard power constraints and coverage limitations. A STSS Development Master Test Plan and a GMD/STSS Integration Test Plan have been drafted. STSS participation in BMDS tests during Block 2004 involves the SSTB to resolve C2BMC interface issues. The full capabilities of the STSS cannot be tested until Blocks 2006 and 2008.