

## Technology Programs

### Executive Summary

- The Missile Defense Agency's (MDA) four major technology programs made progress this past year.
- After completing its 2005 Knowledge Points in December 2005, the Airborne Laser (ABL) completed the optics subsystem refurbishment and test – one of its 2006 Knowledge Points. Delays are likely in the completion of the two remaining 2006 Knowledge Points (the low-power active ground test and the first in-flight atmospheric compensation test).
- Ground testing of the two Space Tracking and Surveillance System (STSS) spacecraft in FY06 discovered payload hardware issues that slipped the tandem launch of the two spacecraft from 2QFY07 to 1QFY08.
- The Kinetic Energy Interceptor (KEI) program completed separate static firings of both the first and second stages of the booster as well as wind tunnel tests of the nose cone design.
- The Multiple Kill Vehicle (MKV) program completed a System Concept Review.

### Systems

Airborne Laser (ABL) is a prototype missile defense weapon system consisting of:

- A modified Boeing 747-400F commercial aircraft
- A megawatt-class chemical oxygen-iodine laser
- A laser turret on the aircraft nose and two illuminator lasers on a bench in the fuselage
- Optical benches with highly sensitive cameras, sensors, and mirrors
- Hardware and software for battle management, command, control, communications, computers, and intelligence
- Ground support equipment for storing, mixing, handling, and loading laser chemicals

Space Tracking and Surveillance System (STSS) is a research and development system that will consist of:

- Two flight test satellites in low-earth orbit
- The Missile Defense Space Experimentation Center (MDSEC), Colorado Springs, Colorado (the primary control center)
- The Low Satellite Operations Center, Redondo Beach, California (the backup control center)

Kinetic Energy Interceptor (KEI) is planned as a land-based, air-transportable battery with the following components:

- Transportable erector launcher
- High acceleration and high burnout-velocity booster rocket
- High divert velocity kill vehicle that can identify the threat re-entry vehicle in the presence of a bright plume during boost phase and among countermeasures during midcourse phase



- KEI fire-control/communications (KFC/C) suite that includes a KEI Interceptor Communications System

Multiple Kill Vehicle (MKV) plans for many small kinetic kill vehicles to be carried aboard a Carrier Vehicle. Key features of the Carrier Vehicle include:

- Kill vehicle restraints and dispense mechanisms
- Communications with kill vehicles and endgame management
- Command and control of the kill vehicles, especially assignment of targets and prevention of fratricide
- Infrared and visible sensors

### Missions

Airborne Laser (ABL) - Combatant commanders will use the ABL to destroy threat ballistic missiles in the boost phase before they have an opportunity to deploy reentry vehicles, submunitions, or countermeasures. ABL accomplishes this by:

- Using passive infrared sensors to autonomously acquire and track threat ballistic missiles
- Using the illuminator lasers to establish precise track on the missile nose and an aim point on the propellant tank
- Placing laser thermal energy on the tank or motor case to weaken the casing, allowing internal pressure to rupture the tank and destroy the missile

Space Tracking and Surveillance System (STSS) - U.S. Strategic Command will use the STSS, a space-based sensor element of the Ballistic Missile Defense System (BMDS) to:

- Acquire, track, assess, and report ballistic missile and intercept events from lift-off to reentry
- Provide a space node to support data fusion, over-the-horizon radar/sensor cueing, interceptor handover, and fire control

# BALLISTIC MISSILE DEFENSE SYSTEMS

Kinetic Energy Interceptor (KEI) - U.S. Strategic Command will use the KEI as a primary intercept missile in the BMDS to:

- Intercept threats in boost, ascent, and midcourse phases of flight
- Intercept medium-, intermediate-, and long-range ballistic missiles
- Independently exercise command, control, battle management, and communications at the battery level, access sensor data, and communicate with the kill vehicle
- Boost alternate kill vehicles toward the interception point

Multiple Kill Vehicle (MKV) – The U.S. Strategic Command will use the MKV as the primary kill mechanism for the interceptors deployed in the BMDS to:

- Intercept long-range ballistic missiles and countermeasures in the midcourse phase of flight
- Mitigate the target discrimination problem by destroying all major objects in the field of view using many small kill vehicles

## Knowledge Point Progress

For the technology programs, MDA uses knowledge points to measure development progress by focusing on the set of critical activities that define each program's risk. This approach allows MDA to make informed decisions on advancement of a development activity.

### ABL

- Knowledge Point #1: Complete Low Power System Integration-Active Ground Test. MDA did not achieve the commit date of August 31, 2006, because of unanticipated difficulties encountered during integration of beam control/fire control software and hardware.
- Knowledge Point #2: First in-flight atmospheric compensation with the tracking illuminator laser beam on the ABL and a beacon illuminator laser beam on the NKC-135 Big Crow diagnostics-equipped aircraft. MDA cannot accomplish this flight test series until Knowledge Point #1 is completed. It is unlikely MDA will meet the November 30, 2006, commit date.
- Knowledge Point #3: Complete laser optics subsystem refurbishment and test. MDA completed this knowledge point on September 28, 2006, which was well before the commit date of December 31, 2006.
- Transition Knowledge Point: System Demonstration (negate a threat representative ballistic missile during the boost phase). This year, MDA slipped the date for this event about one month to December 2008.

### STSS

- Knowledge Point #1 - Ground Acceptance Test. MDA qualified Build 2.4 of the ground software. MDA delayed Acceptance Test 2 from May 2006 to January 2007 due to funding pressures.
- Knowledge Point #2: Space Vehicle Integration. MDA delayed Space Vehicle 1 Integration from March 2006 to November 2006. MDA has concerns with Space Vehicle 1 Integration and Thermal Vacuum tests. MDA is investigating excessive gimbal friction in the Space Vehicle 2 sensor.
- Transition Knowledge Point: Successful Flight Tests. MDA will conduct these tests in 2008 using dedicated strategic and theater targets after the tandem launch of the two spacecraft in December 2007. MDA is considering canceling the second strategic test due to target cost overruns.

### KEI

- Knowledge Point #1: Direct Downlink and Sensor Fusion. MDA successfully completed a second demonstration of this capability in April 2006. The demonstration involved direct downlink from overhead and terrestrial sensors; extraction of data from the Joint National Integration Center; message exchange with the Command, Control, Battle Management, and Communications system at the Joint National Integration Center; and data fusion and computation of fire control solutions, including uplinks of the solutions to a simulated interceptor.
- Knowledge Point #2: Static Firings. MDA completed a static firing of the second stage of the booster in January 2006, wind tunnel tests of the nose cone design in March 2006, and a static firing of the first stage of the booster in August 2006.
- Transition Knowledge Point: Booster Flight. Scheduled for 4QFY08. Based on this test, MDA will assess whether to pursue KEI as a boost phase system, either as a supplement or an alternative to the ABL.

### MKV

- There are no Knowledge Points scheduled for MKV in the near term. MKV completed a System Concept Review in August 2006.
- Knowledge Point #1: Ability to Manage the Engagement. Details are classified. Completion date is 4QFY09.
- Knowledge Point #2: Ability to Build and Deploy Kill Enhancement Devices. MDA must develop requirements for the devices, design and build prototypes, and conduct processor-in-the-loop testing. Completion date is 4QFY09.

## Recommendations

- Status of Previous Recommendations. MDA has taken actions on all of the FY05 DOT&E recommendations.
- FY06 Recommendation.
  1. MDA should include tests of the KEI kill vehicle plume-to-hard body capability (i.e., finding the aim point on the threat payload during its boost phase) in its long-range test plans.