Lieutenant General Patrick J. O'Reilly, USA
Director, Missile Defense Agency
Before the
House Armed Services Committee
Subcommittee on Strategic Forces
February 25, 2009

Good afternoon, Madame Chairman, Mr. Turner, distinguished Members of the Committee. It is an honor and a greatly appreciated opportunity to testify before you today on the Department of Defense's Ballistic Missile Defense System (BMDS) testing program. The Missile Defense Agency (MDA) recently initiated a systematic review of BMDS testing in partnership with the Army, Navy, and Air Force Operational Test Agencies and with the support of the Director for Operational Test and Evaluation. Our objective is to establish a new convention for setting test objectives that go beyond simply exercising newly delivered elements of the system and give primary emphasis to demonstrating the specific functions necessary for successful missile defense operations. Additionally, instead of establishing test planning for the next two years, this review will result in an event-oriented plan that extends out as many years as necessary to collect all data required to demonstrate specific missile defense functions. Today, I will address the need for the review processes and emerging results of the review's first phase.

Role of Testing in BMDS Development Management and Oversight

To understand the context in which MDA testing is being reviewed, it is important to understand how the BMDS test results are used. The results of testing, which are measured against a series of "knowledge points" established to inform our programmatic decisions, enable MDA to manage the overall development of the BMDS. However, as our missile defense development processes have matured MDA's oversight by senior Department of Defense officials and collaboration with Combatant Commands and the Services have become more defined, and the equities of all missile defense stakeholders, including Congress, must be considered when reviewing the content of BMDS testing.

In September 2008, the Deputy Secretary of Defense established "business rules" that outline the institutional roles and relationships between the Missile Defense Agency and the Services. Subsequently, the Services and MDA embarked on the development of Memorandums of Agreement (MOAs) to define the management and interrelationship of MDA's research, development, testing and manufacturing responsibilities to align them with the Services' Title 10 Operations and Support responsibilities. The Army/MDA MOA was signed on January 21, 2009, and drafts of the Navy and Air Force MOAs are under consideration by their respective staffs. Thus, BMDS testing will enable the Service's development of doctrine, training, logistics, force structure and facility planning to support decisions necessary to field BMDS elements.

Furthermore, the Deputy Secretary of Defense established the Missile Defense Executive Board (MDEB), chaired by the Under Secretary of Defense for Acquisition, Technology and Logistics (AT&L) and comprised of the following members: Assistant Secretary of State for International Security and Nonproliferation; Under Secretary of Defense for Policy; Under Secretary of Defense for Intelligence; Vice Chairman, Joint Chiefs of Staff; Commander, U.S. Strategic Command (USSTRATCOM); Director of Operational Test & Evaluation (DOT&E); Director of Defense Research & Engineering; Vice Chief of Naval Operations; Assistant Secretary of the Army for Acquisition, Logistics and Technology; Deputy Under Secretary of the Air Force for Space Programs; Director of Program Analysis & Evaluation; and Director, Missile Defense Agency. The MDEB uses BMDS test results to determine program progress and inform missile defense budget decisions.

As the advocate for missile defense, USSTRATCOM, in collaboration with the other Combatant Commands and Joint Staff, uses the BMDS test results to assess and prioritize development of future missile defense capabilities. Additionally, USSTRATCOM uses these results to perform Military Utility Assessments (MUAs) to determine the capabilities and limitations of our systems under development when they are considered for contingency deployments by the Combatant Commanders. Finally, BMDS test results send a very credible message to the international community on our ability to defeat ballistic missiles in flight, thus reducing their value as weapons to threaten our friends and Allies. Contribution to U.S. non-proliferation goals is one of the most important benefits of robust and comprehensive missile defense testing.

Role of Testing in the BMDS Development Strategy

The mission of the Missile Defense Agency is to develop defenses to protect the U.S. homeland, deployed forces, Allies and friends against ballistic missiles of all ranges and in all phases of flight. Given the unique characteristics of short-, medium-, intermediate-, and long-range ballistic missiles, no one missile defense interceptor or sensor system can effectively counter all ballistic missile threats. War fighters are not only faced with the challenge of intercepting relatively small objects at great distances and very high velocities, but they may have to counter large raid sizes involving combinations of SRBMs, MRBMs, IRBMs, and ICBMs and, in the future, countermeasures associated with ballistic missile attacks. While countermeasures can be developed to degrade the performance of individual missile interceptor systems, it is much more difficult to develop countermeasures that degrade fundamentally different missile defense interceptor systems operating together in different phases of a ballistic missile's flight. Thus, the most effective missile defense architecture is a layering of endo-atmospheric and exo-atmospheric missile interceptor systems with a network of sensors connected and managed by a robust command and control, battle management and communication (C2BMC) infrastructure. Consequently, a comprehensive test program must not only measure the operational effectiveness of individual sensors and autonomous interceptors, but it also must measure the performance of an integrated BMDS comprised of a combination of these individual interceptor and sensor systems.

Testing of the BMDS must account for its being developed in blocks of operational capability. The first BMDS development block delivers capabilities to defeat a limited attack against the United States from one or two simultaneously launched Intercontinental Ballistic Missiles (ICBMs) originating from Northeast Asia. The second BMDS development block delivers initial regional capability against short- and medium-range ballistic missiles (SRBMs and MRBMs) originating in any theater of operation. The third developmental block provides defense of the U.S. homeland against ICBMs originating in the Middle East. The fourth developmental block delivers defenses for Europe against IRBMs and for the U.S. homeland from ICBMs originating in Southwest Asia. The fifth developmental block provides advanced regional defense against MRBM and IRBM in large raid sizes and with countermeasures. While all blocks of capability are still in development and some blocks have been activated for limited, contingency deployments, the BMDS test review is currently focusing on the first three blocks, which are much more mature than the later two blocks.

Unique Challenges of Testing the BMDS

Evaluating the BMDS is likely one of the most challenging test endeavors ever attempted by the Department of Defense. Ideally, comprehensive and rigorous testing is enabled by a stable configuration of the system being tested; a clearly defined threat; a consistent and mature operational doctrine; sufficient resources to repeat tests under the most stressing conditions; and a well-defined set of criteria of acceptable performance. Unfortunately, none of these situations apply to the BMDS. The hardware and software configurations of the BMDS frequently changes since the system elements are still under development. There are many significant uncertainties surrounding the nature and specifics of the ballistic missile defense threat. Moreover, the operational doctrine for simultaneous theater, regional, and homeland defense is immature. Finally, costs range between $40M to $200M per BMDS flight test, making the repetition of a very elaborate flight test using flight conditions similar to previous tests cost-prohibitive.

In light of these challenges, the BMDS performance evaluation strategy is to develop models and simulations of the BMDS and compare their predictions to empirical data collected through comprehensive flight and ground testing to validate their accuracy, rather than physically testing all combinations of BMDS configurations, engagement conditions, and target phenomena. Thus, the focus of our test review has been to determine how to validate our models and simulations so that our war fighting commanders have confidence in the predicted performance of the BMDS, especially when those commanders consider employing the BMDS in ways other than originally planned or against threats unknown at this time. Despite this desire to rely on models, the complex phenomena associated with missile launches and associated environments mean that some performance measurements can only be investigated through flight and ground testing of the operational BMDS.

BMDS Test Review Approach and Phase 1 Results

The BMDS test review is being conducted in three phases. In Phase 1, we determined the body of data necessary to validate BMDS models and simulations and the data needed to evaluate operational effectiveness, suitability, survivability and supportability. In Phase 2, we will determine test venues and scenarios to acquire the data identified in Phase 1. In Phase 3, we will identify the resources and the planning infrastructure, including targets and test ranges, to execute those scenarios identified in Phase 2. Unlike the MDA’s previous convention of limiting test planning to a two-year period, the results of this review will be an event-oriented plan that extends until the collection all identified data is complete. Additionally, we are engaging with war fighters to ensure we test the BMDS using operational doctrine and real-world constraints, so that, as much as possible, we test the system in a manner similar to how we will employ it in combat.

In Phase 1 MDA and the Army, Navy, and Air Force Operational Test Agencies (OTAs) studied the BMDS models and simulations and determined the variables most sensitive to the predicted results. We called these variables key factors. We then combined sets of key factors with test conditions that provide the greatest insight into the BMDS models' predictive capability, when compared to test results, and called them Critical Engagement Conditions (CECs). However, as previously noted, not all conditions of a missile defense engagement and intercept can be modeled due to the lack of precise phenomenology data associated with the launch of a threat missile and interceptor and the high closing velocities attained before they collide in space. Thus, while many missile defense engagements can be simulated and replicated on the ground, there are many cases where the only practical way to measure performance is by ground or flight testing under operationally realistic conditions. We call these tests Empirical Measurement Events (EMEs). Much of the data needed for the Operational Test Agency Critical Operational Issues (COIs), such as survivability, reliability, performance in extreme natural environments, and supportability, can only be collected through the conduct of EMEs.

I will now address Phase 1 findings related to the specific BMDS elements. Although we have had three for three intercepts in its production hardware configuration, Ground-based Midcourse Defense (GMD) flight testing to date has been limited; only the performance of its most basic Block 1 capability has been successfully demonstrated against IRBM-class targets. Madame Chairman, as you personally observed in GMD Flight Test 5 on December 5, 2008, we were able to demonstrate a significant milestone by integrating space-, land-, and sea-based sensors to form a common track and successfully intercept a 4,000 km missile. However, we were not able to demonstrate capability against simple countermeasures due to a target failure, and more testing is needed when considering the large number of operating parameters associated with a system designed to destroy ICBMs. Phase 1 results of our test review indicated that nine CECs and six EMEs are required to examine the accuracy of GMD models and simulations.   These CECs include measuring the effect of varying the following key factors affecting a kill vehicle’s ability to see a target and adequately maneuver in time to collide with it: solar and lunar backgrounds; low intercept altitudes; timing between salvo launches; long times of flight; high closing velocities (ICBM class targets); correcting for varying booster burnout velocities; and responding to countermeasures. While GMD has repeatedly intercepted re-entry vehicles in the IRBM regime, testing is needed against ICBM-class targets. GMD EMEs include measuring the Ground Based Interceptor’s ability to correct for booster burnout guidance errors, and assessing the ability to discriminate reentry vehicles from other objects using data provided by the Sea Based X-band radar and other external sensors to assist with discrimination of multiple objects in the Ground-Based Interceptor kill vehicle seeker’s field of view.

THAAD testing to date has been highly successful with five intercepts in five attempts against SRBMs, but more testing is needed against separating, salvo and MRBM targets. In FY 2008, THAAD intercepted its first separating reentry vehicle and demonstrated cuing to the Aegis element of the BMDS. The THAAD element has seven CECs and six EMEs. THAAD CECs include intercept times of flight, MRBM closing velocities, constrained seeker viewing angles, high lateral accelerations, and countermeasures. THAAD empirical measurement events include: measuring the impact of threat re-entry phenomenology on THAAD's seeker; measuring the impact of salvo launches and intercepts in defeating threat missile raids; and proving integrated weapon system performance at the edge of the performance envelope against both MRBM and IRBM threats.

The Sensors element (Upgraded Early Warning Radars (UEWRs), AN/TPY-2 forward based radar, and the Sea Based X-band radar (SBX)) testing in FY 2008 was highlighted by FTX-03 in July 2008, where the AN/TPY-2 forward based radar in Juneau, AK, Beale UEWR near Sacramento, CA, SBX off the Baja Peninsula, Mexico, and two Aegis ships successfully produced a single, correlated track of a IRBM target launched from Kodiak, AK. We again successfully produced a correlated system track during FTG-05 in December 2008. The Sensors element has 17 CECs and 4 EMEs. Many of the sensor CECs deal with tightly coupled sensor and modeling uncertainties associated with maneuvering targets, electronic countermeasures, post-intercept debris, multiple objects, raid sizes, cued acquisition and track, low and high elevation tracks, and solid fuel debris. Sensor EMEs include focused search plan and cued acquisition from the C2BMC BMDS element. Due to Cobra Dane UEWR model inaccuracies discovered in a 2005 flight test, we also need to validate UEWR model adjustments in the future.

The Aegis BMD element has successfully intercepted SRBMs in 7 of 8 launches of the SM-3 Block IA and conducted one successful salvo engagement (destroying two SRBM targets) in 2008. We continue to pursue the root cause of failure of an SM-3 Block IA in November 2008 and prepare for the first test against an IRBM class target in 2009, assuming the root cause has been identified by that time. The Aegis BMD element has nine critical CECs (most coupled to integrated sensor-threat modeling uncertainties) and four EMEs for the 4.0.1 Aegis Weapon System baseline. Examples of Aegis BMD CECs are closing velocity, threat signatures, raid sizes, and countermeasures. Aegis BMD EMEs include multiple element engagement coordination (Aegis BMD, THAAD, and Patriot), third stage operational mode testing, and launch/engage-on targets with remote sensors.

The BMDS ground and flight test program repeatedly demonstrated successful operation of the BMDS C2BMC during 2008. Since the C2BMC model is 90 percent tactical software, almost all modeling uncertainty for the C2BMC element resides in the source inputs from other BMDS elements (particularly Sensors). Examples of C2BMC CECs are threat raids, debris, launch spacing, and communication latencies.

During 2008, the integration functions of BMDS elements, such as track correlation, were repeatedly tested in GMD, Aegis and THAAD flight and BMDS-level ground testing. The BMDS systems engineering team defined seven CECs and two EMEs for testing the integrated BMDS. The system CECs focus on verifying and validating integrated BMDS functionality (integration of multiple element baselines) and performance. Examples of system-level CECs are track correlation through varying sensor gaps, system level discrimination (multi-sensor, C2BMC, and element fire control) versus countermeasures, and integrated element engagements (sensor, C2BMC, and weapon) of advanced threats with new capabilities and associated phenomena. BMDS-level EMEs include THAAD and Aegis launch- and engage-on-remote sensors and system-wide communication loading and latencies.

In sum, during Phase 1 of our test review, we identified CECs necessary to validate our models and simulations and EMEs to gain insight into the character of the BMDS that cannot be modeled.

Scope of the Remainder of the BMDS Test Review

In Phase 2 of our test review, we are combining CECs and EMEs into test objectives and developing scenarios to accomplish those objectives over a campaign of flight and ground tests. We intend to complete this phase by the end of March 2009. These test objectives will not only address data necessary to validate the models of individual missile defense interceptor systems, but will also demonstrate the performance of the BMDS working as an integrated system. An advantage of developing a campaign of test objectives, rather than developing objectives for one test at a time, is that many CECs and EMEs that have been previously tested, or are planned to be tested in future, will not have to be tested repeatedly. This will reduce the cost and increase the frequency of BMDS testing. Additionally, we will prioritize the resulting test scenarios according to the need to determine BMDS capabilities and limitations and the Combatant Commanders' urgency of need for a specific block of missile defense capability.

During Phase 3, which we intend to complete by the end of May 2009, we will determine the funding and infrastructure necessary to implement the test campaigns identified in the second phase. A key cost driver will be our ability to establish an inventory of reliable target configurations that will satisfy the CECs and EMEs over a variety of BMDS flight tests. While several SRBM targets have flown against operational configurations of THAAD and Aegis SM-3 Block IA missiles over the past two years, we currently have only one viable target configuration for testing these systems against MRBMs. We have initiated a request for information from industry to consider all sources and concepts for target missiles and are exploring how to expand the variants of the Trident C4 booster, no longer in operational use by the Navy, called the LV-2 target, to obtain an affordable set of MRBM and IRBM targets.

An additional emerging result of our BMDS test review to date indicates our need to significantly improve the rigor of digital models of threat missiles and the environmental phenomenology associated with intercepts inside and outside the atmosphere. More investment is necessary to conduct the technical measurements of the threat, record environmental phenomenology, and convert those measurements into digital models. The plans for upgrading our modeling and simulation environments will be addressed, along with infrastructure and other test review results, in the BMDS Integrated Master Test Plan (IMTP) to be delivered at the end of May 2009.

Again, I greatly appreciate your support as we address issues associated with testing the BMDS, and I look forward to answering your questions.