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THE FUTURE OF MISSILE DEFENSE TESTING

HEARING

BEFORE THE

STRATEGIC FORCES SUBCOMMITTEE

OF THE

COMMITTEE ON ARMED SERVICES
HOUSE OF REPRESENTATIVES

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THE FUTURE OF MISSILE DEFENSE TESTING

HOUSE OF REPRESENTATIVES,
COMMITTEE ON ARMED SERVICES,
STRATEGIC FORCES SUBCOMMITTEE,
Washington, DC, Wednesday, February 25, 2009.

The subcommittee met, pursuant to call, at 1:00 p.m., in room 2212, Rayburn House Office Building, Hon. Ellen Tauscher (chairman of the subcommittee) presiding.

OPENING STATEMENT OF HON. ELLEN O. TAUSCHER, A REPRESENTATIVE FROM CALIFORNIA, CHAIRMAN, STRATEGIC FORCES SUBCOMMITTEE

Ms. TAUSCHER. The committee will come to order. The Strategic Forces Subcommittee meets today to gather testimony on the future of missile defense testing programs. We are expecting a series of votes at around 1:30.

So what I would like to do is: I will do my opening statement; the ranking member will do his opening statement; and the best we can, our first panel, generals and Dr. McQueary, if you could summarize your statements in five minutes or less, then I expect that we will be about the time that that will be called; and then we will come back and then we will have our questions, if that will work for you.

During the past eight years, there has been a vigorous debate over the Bush Administration's approach to testing and deploying missile defense systems. Many, including myself, have expressed concerns about the previous Administration's approach to testing. Those expressions don't come from naïveté or confusion. It is because we all want an operationally effective, suitable, and survivable system.

However, the objective of today's hearing is not to debate what the Bush Administration did or did not do. We are well past that point. Instead, our objective today is to look forward and to see what specific actions need to occur to make sure that the missile defense systems we have deployed are operationally effective, suitable, and survivable.

The United States, its deployed forces, and its friends and allies around the world face real threats from ballistic missiles. That is why I voted for the Missile Defense Act of 1999, which made it the policy of the United States "to deploy, as soon as technologically possible, an effective national missile defense system capable of defending the territory of the United States against limited ballistic missile attacks."

So far, the testing record for missile defense systems is mixed. According to the Director of Operational Test and Evaluation's

(DOT&E's) fiscal year 2008 Annual Report to Congress, theater missile defense systems, such as Aegis Ballistic Missile Defense (BMD) and Terminal High Altitude Area Defense (THAAD), continue to make significant progress in the fiscal year 2008.

For example in 2008, the Navy's operational test and evaluation command declared Aegis BMD to be "operationally effective and suitable." This is a major accomplishment that we should all take pride in.

The same cannot be said of the long-range, Ground-based Midcourse Defense (GMD) system. For the third year in a row, the Office of the Director of Operational Test and Evaluation stated in its annual report, "GMD flight testing will not support a high level of confidence in its limited capabilities. Additional test data under realistic conditions is necessary to validate models and simulations and to increase confidence in the ability of these models and simulations to accurately predict system capability."

I would also note that, due to technical challenges, the Missile Defense Agency (MDA) was unable to conduct any GMD intercept tests in the fiscal year of 2008. This situation needs to improve. Better testing must be the foundation of our forward progress on a ground-based missile defense. It is in this context that Congress has said the proposed expansion of the GMD system in Europe cannot move forward without more testing, so that we can have the highest level of confidence in the system's capabilities.

We have two distinguished panels of witnesses for today's hearing. Panel one includes Dr. Charles McQueary, the Pentagon's Director of Operational Test and Evaluation; Lieutenant General Patrick O'Reilly, the Director of the Missile Defense Agency; and Major General Roger Nadeau, Commander of the Army Test and Evaluation Command.

Panel two includes Mr. Philip Coyle, the former Director of Operational Test and Evaluation; Mr. Paul Francis, Director of Acquisition and Sourcing Management at the Government Accountability Office (GAO); and Dr. Donald Mitchell, chief engineer for the ballistic missile defense at Johns Hopkins University Applied Physics Laboratory. Thank you for agreeing to testify, gentlemen.

At today's hearing, I am particularly interested in having our witnesses address the following issues. For all of our witnesses, I need you to answer one fundamental question: What specific actions need to take place during the next several years to make sure that we have a high degree of confidence that the Ballistic Missile Defense System (BMDS), especially the long-range, Ground-based Midcourse Defense system, will work in an operationally effective, suitable, and survivable manner?

Furthermore, General O'Reilly, welcome. Welcome to your first hearing as the new director.

General O'REILLY. Thank you, ma'am.

Ms. TAUSCHER. I understand that you have begun a review of the Missile Defense Agency's entire testing program to determine your long-term data requirements and testing needs. I would like you to provide the committee with an update on that effort and share with us any initial results that you have at this point. I look forward to an interesting and thoughtful discussion.

On that note, let me turn the floor over to our distinguished Ranking Member, Mr. Turner of Ohio, who is here at his first hearing as the new ranking member of the subcommittee.

Mr. Turner, we are interested in any opening comments you might have. And the floor is yours.

STATEMENT OF HON. MICHAEL TURNER, A REPRESENTATIVE FROM OHIO, RANKING MEMBER, STRATEGIC FORCES SUBCOMMITTEE

Mr. TURNER. Thank you, Madam Chair. And I am very honored to be serving with you as the ranking member of this important subcommittee.

We are going to be dealing with very complex and challenging national security issues, and I look forward to working with you on these. We have had a very good bipartisan relationship, as you and I have served on this committee and also traveled abroad to discuss the important issues of missile defense, and bipartisan support is so important.

What is unfortunate about the topic that we are going to discuss today is, while many of us will dive into the issue of technical satisfaction, of requirements, and the importance of how we verify what our systems are capable of, there are those who are outright opposed to these systems and will use the concept of testing to undermine the concept of the United States having an active missile defense system.

It is so important that we get it right, so that we have the ability to have credible answers, and that we have a system in place where we can defend against those that would use the lack of testing to try to undermine our systems.

And with that, I want to discuss a little bit about where I understand that we are. As we begin our discussion on missile defense testing, we should start by establishing a baseline of where we are today. The missile defense capability our Nation has fielded today consists of 26 ground-based interceptors (GBIs) in Alaska and California, 18 Aegis missile defense ships, 13 Patriot battalions, 5 radar tracking system and command and control systems.

As I have learned from intelligence analysts at the National Air and Space Intelligence Center (NASIC), which is in my home district, the threat doesn't wait for us to perfect our defenses. If, for example, North Korea were to launch a long-range Taepodong missile today, we could use this system to protect the American people, our forces abroad, and our allies.

As Secretary Gates recently suggested, the Pentagon was prepared to use its missile defense capabilities to bring down a North Korean missile if necessary. Having this missile defense capability today as an option is the direct result of U.S. leadership and the hard work and dedication of a strong Government and industry team.

For the chairman and I agree that our missile defense assets must be effective and credible. I was particularly interested in Mr. Mitchell's written statement that our Nation's ballistic missile defense capability cannot be disregarded today, and will provide an even more effective defense in the future. Therefore, continued testing to increase the effectiveness, credibility, and flexibility of an al-

ready deployed system against evolving threats is a commitment we all make.

A common misconception about missile defense is that the technology doesn't work, and that the tests are not realistic. Even today, you can find news stories, and we will hear about some even in this hearing, where people attempt to misconstrue testing with the issue of whether or not the system doesn't work.

A good starting point for us here today is to better understand the progress made to date. What is the state of our missile defense capabilities? As I understand it, the Missile Defense Agency is reviewing their test plan. And there is good alignment between them and the test community in this process. I am interested in hearing more about what our test objectives are, how assessments are made, where gaps and shortfalls exist, and how the rebaseline testing program should address these.

Flight tests tend to get the most attention. However, ground tests and modeling and simulation play equally important roles in the test program. How are we progressing in these areas? Are there limiting factors in testing? I am particularly concerned about targets being the pacing item for testing. And I am interested in an update on the targets program.

Our missile defenses are designed to counter limited threats from North Korea and Iran. We need a better understanding of the threats we are likely to see from these countries, so we even know what level of countermeasures, salvo launches, and multiple engagement launches MDA should address in their test plans.

Testing should not be used as an impediment. On the contrary, I worry about the impact that potential cuts may have on testing. As we all know from experience, testing is always the first to go when cuts are made to defense programs. I hope the chairman and I can work together to ensure that this does not happen. This is too important for the safety of the people of the United States.

Lastly, let us look at the testing history. Since 2001, 37 of 47 tests have resulted in hit-to-kill intercepts, a nearly 80 percent success record. However, as the threat continues to evolve and we evolve our missile defense capabilities, we will continue to need more tests.

Madam Chair, I look forward to working with you and our witnesses to manage these challenging issues to the benefit of the protection of the American people. Thank you.

Ms. TAUSCHER. Thank you, Mr. Turner.

Now we will go off to our first panel. Dr. McQueary, thank you for your thoughtful statement. It is part of the record. If you can summarize for us, we would appreciate it. Dr. McQueary, the floor is yours.

STATEMENT OF HON. DR. CHARLES E. MCQUEARY, DIRECTOR, OPERATIONAL TEST AND EVALUATION, U.S. DEPARTMENT OF DEFENSE

Dr. MCQUEARY. Thank you very much.

Madam Chairman, Congressman Turner, distinguished members of the committee, good afternoon. I am pleased to be here to have this opportunity to speak to you about the testing of the Ballistic Missile Defense System, or BMDS as we will refer to it.

As requested in Chairman Tauscher's letter, I will address three areas: my assessment of the missile defense testing programs as described in my annual report submitted on January 28; my assessment of the Missile Defense Agency's three-phase review of BMDS; and three, test evaluation actions I see as needed to ensure that BMDS and its elements will work in an effective, suitable, and survivable manner.

But before I get into my prepared statement, I would like to address a news article from Bloomberg that came out yesterday, if I may. And I will do that very briefly. That article fundamentally misconstrued my position on ballistic missile testing. And I would like to set the record straight.

Specifically, the article stated, "According to McQueary, the U.S. defense probably wouldn't be effective, even without the distraction of decoys." This is a complete distortion of anything I have said to date on this subject. In my annual report, I said Ground-based Midcourse Defense has demonstrated a limited capability to defend against a simple, long-range ballistic missile threats launched from North Korea toward the United States. And I stand by that wording, both this year and in the past year.

So if I may, I will get back to my main statement.

Ms. TAUSCHER. Yes, sir.

Dr. MCQUEARY. First, my assessment of missile defense testing programs to date. Overall, the MDA experienced a good year with its ground and flight test programs, notwithstanding the continuing challenges with targets. Aegis Ballistic Missile Defense demonstrated the capability to detect, track, and engage simple short- and medium-range ballistic missile targets for a variety of mission scenarios.

The Navy's Operational Test Agency, as you observed, indicated that the program was effective and suitable. And that was good news. And I completely agree with you. I have already commented upon the BMD, so I won't belabor that point.

Terminal High Altitude Area Defense, or THAAD, demonstrated the capability to detect, track, and engage realistic short-range targets. The Command, Control, Battle Management, and Communication element, or the C2BMC, demonstrated the capability to provide situational awareness (SA) to warfighters worldwide and to control the Army Navy/Transportable Radar Surveillance (AN/TPY–2) radar in its forward-based mode.

The MDA continued to increase operational realism in its testing. The ground-test program is robust, although the MDA is still using unaccredited models and simulation. The targets, availability and performance limitations continue to impact both the pace and productivity of the MDA flight testing. Even with MDA's target program improvements, there remains significant risk in this area.

Second, my assessment of the MDA's three-phase review of BMDS. The MDA, General O'Reilly, has embarked on a process to develop a revamped Integrated Master Test Plan, or IMTP, that will document planned testing through the Future Years Development Plan. A principal focus is to ensure that the future testing will provide sufficient validation data to anchor the models and simulations.

This effort directly addresses the concerns I raised last year in my testimony before you. The three-phased review offers a logical, well-engineered approach. And although I must caution it will be a challenging test, I do applaud General O'Reilly's personal commitment to the initiative.

Future test and evaluation (T&E) actions, the third item, a combination of flight and ground testing together with verified, validated, and accredited models and simulations are needed to characterize the capabilities of the BMDS and its elements. The approach being developed by MDA in the three-phased review, if fully resourced and executed as planned, could provide a solid foundation for an independent assessment of the operational effectiveness, operational suitability, and survivability of each capability block.

I see the operational test community participating in all phases of testing to the degree that is appropriate for the stage of development. An integrated approach that leverages combined developmental and operational testing to the maximum extent feasible is essential. I anticipate that much of the data needed for the Operational Test Agency's evaluation will be collected during the developmental phase, and from the use of models and simulations that are validated and accredited based upon developmental flight tests.

As we all recognize, the complexity of the systems and the physical constraints on flight testing will necessitate examination of much of the system's capability in ground tests that leverage modeling and simulation.

As I discussed in my written testimony, once the MDA has completed its developmental test objectives for a given block of capability—and this is a key point, I believe—I would foresee a dedicated operational test, led by the Operational Test Agency, that would be confirmatory in nature and would exercise the plan capability in an end-to-end fashion against a realistic portrayal of the threat. A concurrent assessment of training and supportability will ensure delivery of an operationally suitable block capability.

And in conclusion, the MDA has experienced a good year, as I said. The renewed commitment to a rigorously engineered, disciplined and event-driven approach to flight and ground testing is welcome. I look forward to the development of an integrated test campaign that will ensure the delivery of operationally effective, suitable, and survivable capabilities to our warfighter. This concludes my remarks.

[The prepared statement of Dr. McQueary can be found in the Appendix on page 49.]

Ms. TAUSCHER. Thank you, Dr. McQueary.

General O'Reilly, it is an honor to have you before the committee. Welcome.

General O'REILLY. Thank you, ma'am.

Ms. TAUSCHER. It is your maiden voyage in front of the committee. And let me tell you that in the few months that I have got to know you as the new director of MDA, I am very, very impressed by your willingness to work with the committee and to be responsive. And I hope we have been equally responsive back to you.

We are anxious to hear your summarization of your testimony. I have read your testimony. I think it is excellent. And the floor is yours.

STATEMENT OF LT. GEN. PATRICK J. O'REILLY, USA, DIRECTOR, MISSILE DEFENSE AGENCY, U.S. DEPARTMENT OF DEFENSE

General O'REILLY. Thank you, ma'am.

Good afternoon, Madam Chairman, Mr. Turner, distinguished members of the committee. It is an honor and greatly appreciated opportunity to testify before you today on the Department of Defense's (DOD's) Ballistic Missile Defense System, or BMDS, testing program.

The Missile Defense Agency, or MDA, recently initiated a systematic review of BMDS testing in partnership with the Army, Navy, and Air Force Operational Test Agencies, with the support of the Director for Operational Test and Evaluation, Dr. McQueary.

Our goal is to set test objectives that measure the performance of critical functions necessary for robust missile defense operations and create an event-oriented plan that extends out as many years as necessary to collect sufficient data to determine the operational effectiveness, suitability, survivability, and supportability of the system.

First, I would like to describe the challenges in our approach to testing the BMDS. Given the unique characteristics of short-, medium-, intermediate- and long-range ballistic missiles that threaten our deployed forces, our friends, our allies and our Nation, no one missile defense interceptor or sensor system can effectively counter all ballistic missile threats.

Warfighters are not only faced with the challenge of intercepting small objects at great distances and very high velocities, but they have to simultaneously counter large raid sizes involving combinations of threat missile types, and in the future countermeasures associated with ballistic missile attacks.

Since it is difficult to develop countermeasures that degrade fundamentally different missile interceptor systems operating in different phases of a threat ballistic missile's flight, the most effective missile defense architecture to handle the large missile raid sizes is a layering of endo-atmospheric and exo-atmospheric missile interceptors with a network of sensors connected and managed by a robust command and control and communications system.

Consequently, a comprehensive test program must not only measure the operational effectiveness of individual sensors and interceptors, but also must measure the performance of an integrated Ballistic Missile Defense System.

Evaluating the BMDS is likely one of the most challenging 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 Ballistic Missile Defense System.

The hardware and software configurations of the BMDS change as the system continues to be developed. There are many significant uncertainties surrounding the nature and specifics of missile defense threats. And the creation of operational doctrine for simultaneous theater, regional, and homeland defense continues. More-

over, the cost of each missile defense flight test ranges between $40 million and $200 million, making the repetition of flight tests cost-prohibitive.

In light of these challenges, our strategy is to develop models and simulations of the BMDS and compare their predictions to comprehensive flight and ground test results to validate the accuracy of those models and simulations. However, due to the complex phenomena associated with missile launches and associated environments, some performance measures cannot be predicted and must be measured in flight.

I will now summarize the status of this ballistic missile defense testing to date. Although we have had three intercepts and three attempts in the currently deployed hardware, configuration of the Ground-based Midcourse Defense flight testing, to date, has been limited to the performance of the most basic Block 1 capability against intermediate-range ballistic-class threats.

On 5 December, 2008, we were able to demonstrate a significant milestone by integrating space-, land- and sea-based sensors to form a common track and intercept a 4,000-kilometer threat-class missile. However, we were not able to demonstrate capability against simple countermeasures due to the failure of a component of the target. Significantly more GMD testing is needed when considering the tremendous potential capability of this system designed to destroy intercontinental ballistic missiles (ICBMs).

In fiscal year 2008, THAAD intercepted target missiles, in space and inside the Earth's atmosphere, in demonstrated queuing to the Aegis system. THAAD testing to date has been highly successful, with five intercepts in five attempts against short-range ballistic missiles, four of which were actually foreign-threat missiles. But more testing is needed against salvo and medium-range threats.

The Aegis BMD element has successfully tested against seven short-range ballistic missiles, one an actual threat missile. In eight launches of the SM–3 Block IA missile, including a successful salvo test, simultaneously destroying two short-range ballistic missiles conducted November 2007.

As we continue to pursue the root cause of the failure of an SM–3 Block IA missile last November, we are preparing to test again against an intermediate-range ballistic missile class this spring, once the root cause of the failure has been identified and corrected. The sensor's element, which consists of our early-warning radars, four base radars, and SPX has demonstrated its capability in July 2008, when they all worked together to create a common track. And that architecture also supported the intercept of the GMD interceptor last November.

Finally, I would like to describe our current test process and emerging results. The BMDS test review is being conducted in three phases. Phase 1, we determine the body of data necessary to validate the BMDS models and simulation and the data needed to evaluate operational effectiveness, suitability, and survivability. In Phase 1, we identified 85 critical variables and parameters that must be tested to validate our simulations, and 31 additional variables that we cannot model adequately and can only be measured in flight and ground tests.

We are currently in Phase 2 of our test review, where we determine the test venues and scenarios to acquire the data associated with those 116 variables identified in Phase 1. An advantage to developing a campaign of test objectives rather than developing objectives one test at a time is that we don't always have to test those objectives that have previously been tested. This will reduce the cost and increase the frequency of BMDS testing.

In Phase 3, we will identify the resources and planning infrastructure, including targets and test ranges, to execute those scenarios identified in Phase 2. Our goal is to complete this work by the end of May.

In conclusion, I greatly appreciate your support as we address issues associated with testing the Ballistic Missile Defense System. 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 to potential adversaries using ballistic missiles as a strategy to threaten our Nation, our deployed forces, our friends, and our allies.

Contribution to U.S. non-proliferation goals is one of the most important benefits of robust and comprehensive missile defense testing. With your permission, I would like to submit the remainder of my remarks in written testimony and look forward to answering your questions.

Ms. TAUSCHER. Without objection, so ordered.

[The prepared statement of General O'Reilly can be found in the Appendix on page 59.]

Ms. TAUSCHER. Thank you very much, General O'Reilly.

General Nadeau, this is also your first time before the subcommittee. We thank you very much; very comprehensive testimony that you submitted to us. The floor is yours, sir.

STATEMENT OF MAJ. GEN. ROGER A. NADEAU, USA, COMMANDING GENERAL, TEST AND EVALUATION COMMAND, U.S. ARMY

General NADEAU. Thank you, ma'am.

Good afternoon, Chairwoman Tauscher, Ranking Member Turner, distinguished members of the subcommittee. Thank you for the opportunity to appear before you today. In my invitation to appear, you asked me to address three specific questions, which I have done in my written statement to the subcommittee.

I would like to take this opportunity to describe the independent, multi-service, Operational Test Agency team that assesses Ballistic Missile Defense System performance, the Army Test and Evaluation Command's role as the lead Operational Test Agency and how our team works with the Missile Defense Agency, the Office of the Director, Operational Test and Evaluation, and the warfighter community.

The Ballistic Missile Defense Systems development cuts across multiple service lines. It is only natural that a multi-service operational test team was formed to assess performance at the comprehensive systems level. While individual service operational test and evaluation agencies focus on the equipment being developed in that particular service, the lead Operational Test Agency's mission is to provide independent, collective operational assessments of the

total integrated Ballistic Missile Defense Systems performance capabilities and limitations.

In our role as the lead Operational Test Agency for the Ballistic Missile Defense System, we establish an Operational Test Agency team that interfaces with the test planning and execution cell within the Missile Defense Agency on a daily basis. Members from the other service operational test agencies, as well as the Joint Interoperability Test Command (JITC) are also part of that team.

To better facilitate a close working relationship between us and our Missile Defense Agency counterparts, we have positioned significant personnel resources in Huntsville, Alabama, and Colorado Springs, Colorado to enable daily contact and coordination with the Missile Defense Agency test planners, modeling and simulation developers, and the warfighter. This enables our participation in all facets of test planning and execution among the various agencies.

We essentially sit and work side-by-side with our Missile Defense Agency counterparts every day. We have found this operating relationship to be extremely productive and the best use of our collective resources. The communication flow among agencies is greatly enhanced through the co-location of personnel, while the independent integrity of the Operational Test Agency is preserved through separate reporting chains.

In addition to the daily operational contact we have with the Office of the Director, Operational Test and Evaluation, the warfighter represented by the United States Strategic Command (USSTRATCOM) and the service operators, and the Missile Defense Agency—the multi-service operational test team produces an annual operational assessment report, co-signed by the service Operational Test Agency commanders. This document is the Capstone Operational Test Agency document for that year.

The Army Test and Evaluation Command, as the lead Operational Test Agency, approves the report for release to the Director, Operational Test and Evaluation. It is used as one of the source documents from which they prepare their annual report to Congress.

Another activity worth mentioning is our participation in the Missile Defense Agency's post-test reviews. At the invitation of the Missile Defense Agency, we are able to provide performance feedback from our perspective that assists in identifying performance issues early, allowing for corrective action, which saves time and money in the long run.

Madam Chairwoman, I thank the subcommittee for the opportunity to testify today. I look forward to answering your questions.

[The prepared statement of General Nadeau can be found in the Appendix on page 73.]

Ms. TAUSCHER. Thank you, General Nadeau.

Members, we have two votes, a 15 and a 5. The subcommittee will be in recess. The hearing will be in recess until the subcommittee returns in approximately 25 minutes. I ask members to come back as quickly as we can. We will go into questions of this panel, and then we have a second panel, as you know. We are in recess.

[Recess.]

Ms. TAUSCHER. Members are making their way back over from votes. And we expect another series of votes in perhaps about an hour. So I am going to start with our questions of our first panel, so that we can have enough time to assess the second panel and be sure to ask questions there too.

I had a question for General O'Reilly and Dr. McQueary. Several of our potential adversaries have demonstrated the capability to conduct coordinated missile attacks—and this is something we could face in a real-world situation. Several missile defense systems, such as Aegis BMD and Patriot Advanced Capability–3 (PAC–3), have demonstrated the capability to conduct both salvo launches and multiple simultaneous engagements.

In your opinions, is a salvo test, firing two or more interceptors at a single target, necessary to understand the operational performance of GMD and to provide confidence that the system works as we intended to operate it? Additionally, what are your thoughts on the need for the GMD system to conduct a multiple simultaneous engagement by firing multiple GMD interceptors at multiple targets?

Dr. McQueary or General O'Reilly, whoever.

Dr. MCQUEARY. Let me——

General O'REILLY. Well, ma'am if——

Ms. TAUSCHER. General O'Reilly.

General O'REILLY [continuing]. I may, I support that the testing of all of our systems, including GMD, must include salvo launches, because that is our doctrine. And we have a lot of theoretical estimations on the impact of one intercept on another interceptor flying in that area. But the phenomenology is very complex. And there would be a tremendous amount of empirical data gathered if we did that.

I also support a multiple simultaneous intercepts, including GMD. However, I will need some assistance because of the amount of telemetry at Vandenberg Air Force Base and the safety considerations. I don't believe in their history they have launched two interceptors at once. I do know that they have not handled four missiles in flight at one time, which that would require.

So ma'am, I do believe it would very beneficial to do that. It is important. But moving beyond the salvo, there will need to be some investment, or some commitment from national resources in order to accomplish that.

Ms. TAUSCHER. Well, I appreciate that very much, General O'Reilly. Perhaps in a subsequent conversation, you can give us a sense for what that will entail. And——

General O'REILLY. Yes, ma'am.

Ms. TAUSCHER[continuing]. As the budget is going to be coming up soon, we can try to figure out how we can accommodate something like that.

Dr. McQueary.

Dr. MCQUEARY. I fully agree with what the general just said. I think a salvo launch's multiple-target issues are a phenomenology that absolutely must be examined as a part of the program.

Ms. TAUSCHER. Right. Let us see.

General O'Reilly, the classified version of DOT&E's 2008 assessment for the Ballistic Missile Defense System raised a number of

concerns about the BMDS. I know that you are working with DOT&E to address these concerns outlined in the report. Can you just, once again, aside from what you had in your testimony, can you kind of give us a more detailed summary on exactly how that cooperation is folding out, and just give us some more detail on that?

General O'REILLY. Yes, ma'am. With the DOT&E report, it covered what had been tested, and emphasized what has not been tested, in order to validate the models and simulations. So I work very closely, and my staff does, with the operational test agencies. But Dr. McQueary has been very generous in providing his staff to observe every one of those meetings and provide us assistance or assessments, primarily, on where there are areas in their models and simulations that they believe we need to go re-look. And we have done that.

So I believe that the results of this first phase are very comprehensive, because of the fact that we have had the benefit of DOT&E supporting us onsite, in the meetings, instead of us just trying to interpret what was missing from the reports. And all indications I have had from Dr. McQueary and his staff is we are addressing those areas that we need data to be collected in.

Ms. TAUSCHER. I appreciate that, General O'Reilly.

Dr. McQueary, you know, I think that there has been a significant change in the level of cooperation between MDA and DOT&E. And I am very appreciative of it. This subcommittee weighed in very seriously over the last three years about that. And I think these are very good results.

Can you give us a sense for your expectations? Let me restate that. Can you give us a sense for the reality of that and how that is accruing to our expectations of having the testing regime be much more robust going forward?

Dr. MCQUEARY. Well, I think the relationship is very good. The relationship began to improve, from my standpoint, when General Obering was here. We worked out some issues with him.

I am particularly pleased, as I mention in my oral statement, about the approach that General O'Reilly has taken toward his three-phase approach of deciding what the test program really needs to be. And we are participants in the discussion thereof, because there is no such thing as the test that identifies everything. These are highly technical, complex kinds of things.

And having discussions with the various parties who have an interest in seeing that we do the right thing, I think is very—right testing, I should say—is really the right thing to do. And so I don't have anything that I would add to it.

I would also point out one other thing I would add, excuse me—General O'Reilly and I try to meet once a week, although that is very difficult to do, as you might be. But we do have a time on the calendar. But we each know that we can cancel out if we need to do so, in order to just be able to go over issues that might be there. We meet for about 30 minutes. But I think that is an important way of keeping the communication channel open, because the issues are large, but they are not insurmountable.

Ms. TAUSCHER. Well, the committee very much appreciates that new level of cooperation and the congruency of your effort to work

together. And that I think is really accruing very significantly to the program.

General O'Reilly and Dr. McQueary, a key sensor critical for defense of the United States from a Northeast Asia attack is the upgraded COBRA DANE radar in Alaska. We have flown at least one missile across COBRA DANE for data collection, but have never performed an intercept flight test using the primary sensor and the fire control loop.

Why have we not performed a GMD intercept test engagement using the upgraded COBRA DANE radar? Are we planning to do so? And what test range issues need to be dealt with, if any, to perform such a test?

Dr. MCQUEARY. I support you.

General O'REILLY. Ma'am, we are looking at that in the next phase. It is my expectation that we will do that. However, when it was done last time in September 2005, we required, or we needed the cooperation of the Russian Government, because the launch was an air-launch target in the Russian flight information region, it is referred to, within 12 miles. To have an operationally realistic trajectory does require to skirt very closely to Russian airspace.

At the time, President Putin had provided agreement and concurred with us doing the test, with us exchanging and allowing their Russian officers to observe the test. So that is one issue that has to be addressed for any test up in that region. I would look forward to that engagement with the Russians, because I do believe that would be a very informative test.

I believe the infrastructure and the other issues associated with a test over the North Pacific could be addressed straightforward through our normal processes.

Ms. TAUSCHER. Thank you.

Mr. MCQUEARY. In the event that we could not do the test, which we fully agree that it is desirable to do a real test, DOT&E still feels, as we have reported before, that there needs to at least be a target fly-by to test the software that was changed as a result of the last test that was conducted. There were some changes made, and we have not actually been able to run an operational test.

Ms. TAUSCHER. Right.

Dr. MCQUEARY. And a target fly-by would help gain information that the system does work as it is supposed to in target tracking.

Ms. TAUSCHER. Thank you.

Thank you, gentlemen.

Mr. Turner.

Mr. TURNER. Thank you, Madam Chair.

Dr. McQueary, I would like to get back to, just for a moment, your initial comment that you made about the news article that we saw where you were misquoted, and it really leaves the impression that the system doesn't work. And that is not at all your message, even in your written testimony. Can you speak again about your reaction to this article and the gap between what the article portrays as your position and your position?

Dr. MCQUEARY. I found out about this article at about 5 minutes of 6:00 last evening, just before I was going to the Kennedy Center, which was not a good time to prepare oneself to go listen to the

orchestra. But Admiral McCarthy, who had sent me the message letting me know what was there, I had sent a response back to him. And what he tells me is that his Blackberry died after he received my message. Now, so I will let you infer from that what it might have said.

I was very disturbed because it was—I don't mind talking with reporters. I don't mind having discussion about what we do, because I try to run a very transparent organization. I do feel, though, that when reporters have uncertainty about how they are going to report what someone says, particularly if it is almost a direct quote, then they have the responsibility of making sure that that information is correct.

And this was simply blatantly incorrect and inconsistent totally with what I have said in the last two annual reports that we have put out about where we are in the testing. We have consistently said that we need more modeling and simulation. There is nothing new in that. And we all understand why that is an important aspect of this.

But we have demonstrated, through flight testing, some capabilities that are important. And I believe I would characterize it, if the North Koreans launched an attack against us this afternoon, we wouldn't say we need more test data before we decide whether we are going to launch against and try to intercept that. We would see how the system works, and we would find out.

Mr. TURNER. Excellent. And that is really the whole heart of, I think, all of this discussion, is the need for systems in place in the case where something might occur, like you just described.

And I would like to deal with just a little bit of terminology. On page three of your testimony, you give us a list of where we are on a few of these. And you say the Ground-based Midcourse Defense, GMD, demonstrated a limited capability to defend against simple, long-range ballistic missile threats launched from North Korea toward the United States. Next sentence, "Terminal High-Altitude Area Defense, THAAD, demonstrated the capability to detect, track and engage both short-range, non-separating and single-separating targets."

Then on the Command Control Battle Management Communication element, you indicate again, using the word demonstrated, the capability to provide situational awareness to warfighters worldwide. And you go on.

And I am going to focus this for just a moment on the word "demonstrated," because you are all about testing, telling us what we know from what we have tested. But the word "demonstrated," I believe you are not indicating to me that it is the limitation of the system, it is a limitation of the testing. In other words, the testing has demonstrated that this system has this capability, but it might have greater capability. Is that correct?

Dr. MCQUEARY. It might have greater capabilities. There might be capabilities that the system couldn't respond to as well in that. So what it does—I was referring to in those words specifically about what we showed as a consequence of the test that was conducted. And indeed, we did intercept, "kill," a target to demonstrate that the GMD did work in that particular testing that we

had. So to me, that was a demonstration that the system has the capability to work.

Mr. TURNER. Excellent. That is why I wanted to ask the question, because when I read this page, I was afraid that someone might read it as saying, you know, it only does this, it only does that. But in reality, it is just it has only demonstrated it in the testing scenarios that we had. It might have greater capability. It might even perform better than what we have currently been able to test.

Dr. MCQUEARY. May I, just one point: when we talk about confidence, I want to be very clear that when we refer to confidence, you can always assume if we don't say it, we are talking about statistical confidence. I am not in the mode of saying, "I don't have confidence in you or you." We are talking about, from a statistical standpoint, how many tests does one have to run in order to demonstrate mathematically, if you will, through data, that you have a certain level of confidence that the system is going to work.

And when I speak of confidence, that is what I mean. And that is all I mean. I am not rendering a subjective view at all. I am trying to convey what we need to know. And that is why we say, over and over, we need the models and simulation, because we will never be able to run enough real tests to prove, with high statistical confidence, that the system can do what it is intended to do. But with models and simulation, verified by real testing, we can accomplish that objective.

Mr. TURNER. Thank you.

And to get back to your comment on North Korea, and this is my question next for the three of you, you know, currently the system that we have is intended to be integrated. Each of these individual components have unique capabilities. And the threat that it is designed against, we know that none of those individuals that are developing those threats, they are not abandoning missile systems. They are not abandoning seeking missile technology or missile capability. If we abandoned a capability or an element of our overall system that is integrated, we will open ourselves up to a vulnerability.

But what I am concerned about, and what I would like you each to speak about, if we were to, based on lack of testing, lack of completion of testing, to stop or discontinue the advancement in any one of these areas or systems, I fear that we might lose some capability, because we have three different components basically. You have the development and innovation phase; you have the testing phase; you have procurement phase.

And if you are to stop along the way, you are going to lose institutional intellect. You are going to lose some industry capability. Could you speak to a moment of concerns that you might have of ceasing to progress in any one of these integrated systems that we are looking at to protect us, and what might happen if we later go back and try to reengage, what gap would occur?

Dr. MCQUEARY. Could I defer to General O'Reilly——

Mr. TURNER. Absolutely.

Dr. MCQUEARY [continuing]. First, since he has a broader view of the whole system, because he lives it every day.

General O'REILLY. Sir, from an acquisition point of view, once we decide to stop, if we decided to stop developing one of these areas, you are exactly right, sir. The first area we would be very careful to look at was the industrial base and the intellect that you were referring to.

The missile defense area is a very unique developmental skill in the sciences, in the material sciences, in the production and so forth. Our country has been successful. But I would say that we are one of the few countries with the type of resources that could do what we have already accomplished. And to ensure that we maintain and protect that competency in developing missile defense interceptors, where you are not just worried about launching the missile, but you are more worried about what happens to that missile at the very end of its flight, is very difficult.

So that is an area, and that is one of my greatest responsibilities, is to ensure that we continue to develop that competency in the United States in those areas, both in industry and in the government team. And that is why I spend so much time in universities and engineering schools in order to continue to grow that competency.

Second is the supply chain. A lot of small companies out there provide very unique items that apply just to missile defense interceptors and missile defense systems. And we have to be very careful about their ability to endure a transition from supporting missile defense applications to having it so that it could apply to other commercial ventures. And a lot of that is a very difficult transition for them, because of the nature of their work.

If we did stop one of these production lines, requalification is very expensive. Typically, it runs on the order of a line, such as GMD, would be over $400 million, an estimate if a line stopped for over a year before you had to go requalify and find new vendors. That is at the second.

And unfortunately, this business—and I guess it is a strength of the United States that most of these systems involve almost every aerospace company in the United States, providing some sort of expertise or capability. So it is a far-reaching impact that has to be carefully weighed.

One benefit of continuing testing is to produce the interceptors themselves, which are the most difficult of these items—producing interceptors, so that we can continue to make decisions and keep a warm production line until we make a final decision that we have enough capability, or we have a capability by some other means.

Mr. TURNER. Thank you.

And on that, Dr. McQueary, in your opinion, two-stage interceptors that are proposed. It is not as if we are completely designing a new system; it is a modification of a system. And so my guess would be, since it is a modification of a system, you are testing that modification and not having to retest everything all over again. Later this year, if the two-stage flight test that is planned, if it is successful, would you recommend that we proceed with long-lead procurement?

Dr. MCQUEARY. We have previously said that, with a successful test, that we could support the idea of long-lead procurement for items, yes. If that is what the Congress decides upon.

Mr. TURNER. And that is because it is—explain to me why that would be the case.

Dr. MCQUEARY. Because there are great similarities. And we could show you that in detail, not easily here, but show a great similarity between the two-stage and three-stage interceptor. But nevertheless, there are changes. And therefore, it is important to verify that those changes did not introduce something anomalous in the behavior.

In fact, we have gone on record before saying we thought we needed three tests, a total of three tests, in order to verify that the change from three-stage to two-stage was a satisfactory change. However, we have also said that we could, if someone chose to fund the operation, we would be all right. We would be all right in supporting the idea of going ahead with long-lead items, because the long-lead items, most of them, are usable in the three-stage vehicle in any event.

Mr. TURNER. Excellent.

And I have just one more question, Madam Chair. Thank you for your tolerance of time.

Another thing that I am concerned of, if we abandon the advancement in any area or the pursuit of any area, is that what it says to our adversaries or those that are developing missiles.

Gentlemen, could you comment on, do you believe our missile defense system has a deterrent effect, because if it does have a deterrent effect, then abandoning any portion of it, we would lose that deterrent effect. People would see a vulnerability that we have, or an area in which we are conceding, but that we are not going to be seeking a defensive posture. Do you guys have thoughts as to if you believe that the pursuit of our missile defense system and its deployment acts as a deterrent internationally?

General O'REILLY. Well, if I may, sir, yes, I do from two regards. One is when you are looking at the inventories and the numbers you were talking about for ICBM defensive systems, you have to look at how many ICBMs could be launched at any one time. And you have to assume that the United States would respond some way if, in fact, ICBMs were launched against it, and the missile defense system intercepted and took out those ICBMs.

So you have to look at what the inventory around the world of ICBM launch points are, and there is only a few of them. But there are others being built today. And so there is that operational judgment on how much do we need, not a material developing judgment.

However, I would say to the direct point on your question is that I believe it is the most compelling way to devalue these missiles is to show that they are ineffective, because we keep intercepting them in different ways. And that is a great strength of a robust test program, is to keep intercepting in all the different fashions in which I believe our adversaries are looking at ways to defeat it. And testing against countermeasures and so forth, again, strengthens the deterrence. And it is welcome in our approach to testing.

Mr. TURNER. Excellent.

Madam Chair, thank you.

Ms. TAUSCHER. Thank you, Mr. Turner.

Mr. Andrews of New Jersey.

Mr. ANDREWS. Thank you, Madam Chairman.

Ms. TAUSCHER. For five minutes.

Mr. ANDREWS. Thank you, gentlemen, for your testimony and for your service to our country. I think it is very important that the discussion not bring false choices. And the choice is not deployment or abandonment. The choice is strategic, intelligence, effective deployment versus other options. I just want to ask anyone on the panel, has anyone here asked you to plan for the abandonment of the system?

General O'REILLY. Well, as a material developer, I can tell you, no.

Dr. MCQUEARY. And as head of DOT&E, that isn't the way we operate. We are charged with testing the systems that the——

Mr. ANDREWS. Right.

Dr. MCQUEARY [continuing]. Government decides to——

Mr. ANDREWS. So the abandonment is sort of a metaphysical discussion. I would like to switch to one I think is a little more focused.

In January of 2002, Secretary Rumsfeld created a new world in testing. And that world exempted the BMD products prior to Milestone C. And in the context of that world, it is interesting to see the result that occurs in your 2008 report, which we mandated, between the Aegis system and the GMD.

That language that you used on the Aegis system, it was declared "operationally effective and suitable." Got very good grades. The GMD, on the other hand, the quote is, "GMD flight testing to date will not support a high level of confidence." And I understand, Doctor, what you mean by confidence; not subjective term, but will not support a high level of confidence in its limited capabilities. It is apparent first one, on Aegis, sounds like an A. And the second one, to me, sounds like a C-minus, D-plus.

Here is a hypothesis, Dr. McQueary, I would like you to consider. The main difference in the pre-Milestone C testing and activities between Aegis and GMD was that the testing that was done for Aegis looks an awful lot like the traditional testing that would have happened anyway without the exemption, the legacy testing, legacy documents; whereas the testing of the GMD looks very different. It looks like something that did not go through the same degree of rigor and scrutiny. Would you agree or disagree with that hypothesis?

Dr. MCQUEARY. I don't think I am qualified to be able to comment upon what you have just said, because I have not looked at that program from that standpoint. The GMD is clearly at an earlier stage of development than what the Aegis is.

Mr. ANDREWS. But it is correct, isn't it, that the testing protocol, the date on the GMD, has not followed the orthodox traditional path that other systems have followed. Isn't that true?

Dr. MCQUEARY. That is——

Mr. ANDREWS. It is very different from the Aegis testing.

Dr. MCQUEARY. The entire program was put together that way. That is correct.

Mr. ANDREWS. Would you characterize the testing as less robust than the Aegis testing?

Dr. MCQUEARY. I wouldn't characterize it as less robust. I would characterize it as being in a much earlier stage of development than the Aegis. And I think one of the things that we bear responsibility to do is to assure that the GMD is tested to a sufficient.

Mr. ANDREWS. But General, there is more than just a time differential. Isn't there? Isn't there a qualitative differential in the nature of the tests that have been done on Aegis versus the GMD? Don't the Aegis tests look an awful lot like more of the pre-Rumsfeld rule?

General O'REILLY. One of the purposes, sir, of the test review that I have conducted since I came on board was in fact to lay out all the data that is required to be collected. My predecessors have shown the planning for the next two years, two-year increments.

Mr. ANDREWS. Yes.

General O'REILLY. And it is more traditional, because what we are approaching now is to lay out the entire test program, so you can identify what is going to be tested and when, rather than having to assume that something is going to be tested.

Mr. ANDREWS. And that looks an awful lot like, doesn't it, the DOT&E process that would have been followed? Doesn't it sort of echo that?

General O'REILLY. As far as from a planning point of view, yes, sir.

Mr. ANDREWS. Yes.

General O'REILLY. Because in the DOT&E——

Mr. ANDREWS. Kind of wish we had those seven years back in the billions and billions of dollars we spent since then? You don't have to answer that question. I do.

On your testimony, you list a whole laundry list of things that are going to have to be done for the GMD, both in the Critical Engagement Conditions (CEC) and Empirical Measurement Events (EME) categories. If I read correctly, there are nine Critical Engagement Conditions and six Empirical Measurement Events that have to take place.

And you list a whole laundry list of key factors that have to be looked at: solar and lunar backgrounds, low intercept altitudes, timing between salvo launches, long times of flight, high closing velocities for ICBM-class targets, correcting for varying booster burnout velocities, and responding to countermeasures. That is a pretty significant list.

How long would it take to do all those things to your—degree of confidence that we need? How long would it take?

Ms. TAUSCHER. Gentleman's time has expired.

But General O'Reilly, you can finish that answer.

General O'REILLY. Sir, honestly, sir, that is why I am working in the—I am. Right now, we have identified what we need. And what you have asked is exactly what we are doing over the next couple months with these two agencies, and us——

Mr. ANDREWS. With that, thank you. Just add one thing, Madam Chair. That is an answer I think the committee would really like to hear before this year's bill is written, because when we make funding priority decisions, I think it makes a big difference as to what we do.

General O'REILLY. And, sir, our plan is to complete this plan by May.

Mr. ANDREWS. Thank you very much.

Ms. TAUSCHER. Thank you, Mr. Andrews.

Mr. Franks of Arizona for five minutes.

Mr. FRANKS. Well thank you, Madam Chair.

Madam Chair, our ranking member here asked questions that reached the goal that my own question had. And I thought he did an excellent job. So at the risk of sounding a little redundant here, let me just try to put some context by focusing again on the threat.

And again, at the risk of being redundant, on July 4 of 2006, North Korea tested an ICBM and our GMD system was put on alert. And now, of course, there have been reports that North Korea may be testing an advanced Taepodong-2.

And considering General Cartwright, Commander of Strategic Command, he said that the July 4, 2006 North Korean missile launch has spurred a limited operational activation of the Ballistic Missile Defense System. "We learned that the Ballistic Missile Defense System, procedures, and personnel performed well, and demonstrated a credible operational missile defense capability for homeland defense."

And I think that is a pretty profound statement on the part of General Cartwright. And so my first question, General O'Reilly, is do you share General Cartwright's level of confidence? Are you confident that this capability that we have today, that we have today, can provide a defense to the American people from the current North Korean threat?

General O'REILLY. Yes, sir, based on the scenarios that we have tested three times, although it is limited and it is in the beginning, those scenarios overlay a launch from North Korea and a response out of Alaska. And so we have tested three times that scenario first for obvious reasons. And that is the source of my confidence.

Second of all, our firing doctrine is that we have a significant number of missiles. So we can put a significant number of missiles in the air at once. And that each time significantly increases the overall probability that you are going to be successful.

Mr. FRANKS. So let me ask the blooming obvious question here. Forgive me. Do we have a system that is more mature than GMD to defend against the current ICBM threat? And what are the implications of delaying GMD production and fielding?

General O'REILLY. Well, sir, we do have a more mature system now than we did then, particularly in our redundancy. And we have multiple redundant capabilities throughout the system now. And we have more interceptors. And we have learned in flight.

Mr. FRANKS. Beyond GMD, General. I mean, do we have something beyond GMD that is a more mature system to defend us against ICBM threats currently?

General O'REILLY. No, sir. That is the only system that has been tested against threats of 4,000 kilometers or greater.

Mr. FRANKS. Well, thank you.

Now, you know, I think it is clear that even if our systems haven't given us 100 percent assurance through testing, and of course I believe in testing as much as any of you do. And I know that you would like to have more capability to do additional test-

ing. But it is the only system that we have for this particular ICBM threat at the moment.

And to cut or delay funding and fielding, in my judgment, Madam Chair, would send a tremendously dangerous message to the North Koreans, not just in terms of the actual ICBM threat to us, but I think it encourages them and other nations across the world, Iran and others, to develop nuclear programs that potentially could be passed, the technology could be passed along to terrorists. And I think the coincidence of jihadist terrorism and nuclear proliferation represents one of the greatest dangers facing us as a free people today.

And so, I am going to run out of time it looks like here. But I will try one more here with Mr. McQueary. As a current test evaluator, would you say that, just because the strategic BMD received a less-than-perfect test score, that this necessarily means that it does not provide the warfighter with an operationally effective capability?

Dr. MCQUEARY. It does not provide the warfighter with an operationally effective——

Mr. FRANKS. So let me ask——

Dr. MCQUEARY [continuing]. Capability that I can say with high confidence. I think it is important. Our job is testing and to deal with the facts at hand. And there has simply not been enough testing done in order to be able to state——

Mr. FRANKS. But the less-than-perfect score does not necessarily mean that it does not provide the warfighter with an operationally effective capability.

Dr. MCQUEARY. The statement is not intended to imply that at all.

Mr. FRANKS. Right.

Well, Madam Chair, I just think it is important that, you know, I don't know of any system that we have that is proven 100 percent effective. I am not even sure that we could say that about the baseball bat. But it is still pretty effective at close range. And so I just hope that we don't, in the face of not being able to test all that we could and all that you gentlemen would like to test, and certainly I think we have a responsibility to facilitate that, to do things that would endanger our national security.

And so with that, Madam Chair, I don't know why that yellow light has been on so long. But I will yield back. Thank you.

Oh, the light is stuck. I should have taken advantage of that.

Ms. TAUSCHER. This is not a baseball bat, but it is a gavel.

Mr. Heinrich.

Mr. FRANKS. Has it been tested?

Ms. TAUSCHER. Mr. Heinrich of New Mexico.

Mr. HEINRICH. Thank you, Madam Chair.

I have a couple of questions for Lieutenant General O'Reilly. And one is more general and one is more specific. But it goes back to some of the same issues that Mr. Franks has raised. And I will start with the more general one. And I would just ask, do we have any hard evidence to show that our missile defenses have actually deterred North Korea or Iran from deploying this?

General O'REILLY. Sir, I am not in a position to answer that. I think that might be more of an intel question.

Mr. HEINRICH. Okay.

General O'REILLY. But I don't know, sir.

Mr. HEINRICH. Well, on a more specific return to the issue of the GMD system, if I understand correctly, Taepodong-2 is a liquid-fuel system, is that correct?

General O'REILLY. Yes, sir.

Mr. HEINRICH. And most of our tests are against solid-fuel targets? Is there a qualitative difference in, you know, testing against a solid-fuel target versus a liquid-fuel target? And is that something that is relevant to future testing? Do we need to be testing something that is more analogous to, you know, basically to the Taepodong-2?

General O'REILLY. Well, sir, we test both threat categories. As I said earlier in my discussion, we actually test frequently actual threat missiles that are the liquids. Most of our liquids are actual missiles which we have obtained. And we have tested them off the coast and asymmetric. I mean, we really want to ensure we have the confidence that Dr. McQueary says.

Against our longer-range threats, we have the challenge that these targets are almost ICBMs themselves. And so we rely on our fleet of ICBMs in a lot of cases, which are mainly solids.

Mr. HEINRICH. Right.

General O'REILLY. But when you qualitatively compare between the two, the solid actually presents much more difficulty in intercepting, because as it burns, it actually produces chunks, if you will, of solid material that is burning. And so it clutters the scene.

Mr. HEINRICH. Which could be mistaken for—okay.

General O'REILLY. Yes, sir. And when a kill vehicle looks at a liquid, it sees primarily the objects or the debris and the hard objects, especially if you are looking with an infrared camera, which most of our systems have.

But when you are looking at a solid system, you are seeing all this other. So it actually makes it more complex, harder, at times more difficult for an intercept to occur.

Mr. HEINRICH. I yield back.

Ms. TAUSCHER. Gentleman yields back his time.

Mr. Lamborn of Colorado.

Mr. LAMBORN. Thank you.

Dr. McQueary, of Ground-based, Midcourse Defense, the analysis indicates the U.S. is more capable of defending itself against a single long-range—even though we haven't reached the level of high——

Dr. MCQUEARY. It is more capable, but I can't let you walk me into some kind of numerical amount, because we had no capability before. We now have capability. And therefore, by—and we demonstrated it.

Ms. TAUSCHER. Majority will stipulate that we are more capable than we were before we had nothing.

Dr. MCQUEARY. Seems like a logical way——

Ms. TAUSCHER. I think so too.

Mr. LAMBORN. Can you put high confidence into a percentage count? Are you able to——

Dr. MCQUEARY. Well, we typically speak——

Mr. LAMBORN [continuing]. Is not a subjective term.

Dr. MCQUEARY. It is not a subjective term. But typically when we talk about performance of systems, we will be in the range of having reliabilities that might be in the range of 80 percent to 90 percent reliability for missile systems, if you look at that.

And then we talk about having a confidence generally in the 70 percent to 90 percent range as being in the high realm. And the higher, the more, the higher the number when you go through and examine the test data and look at various test scenarios using modeling and simulation again. The higher the number, the more confidence you have in how the system will work. It is pretty straightforward.

Mr. LAMBORN. Okay, so if you have a missile interceptor that is not the high-confidence performance level, operational level. But let us say it is 70 percent. But you fire that at an incoming threat, and it misses. And you fire another one. And that also has a 70 percent chance. When you put those two together, aren't you left with 91 percent?

Dr. MCQUEARY. That, I wouldn't attempt to do the arithmetic in my head. But that doesn't sound too far off. Yes, the——

Mr. LAMBORN. Or a third one would then decrease the——

Dr. MCQUEARY. In fact, that is why the doctrine calls for firing multiple missiles to accomplish just what you are talking. Yes.

Mr. LAMBORN. Okay, thank you.

Dr. MCQUEARY. But it can get to be an expensive proposition if the missiles are very expensive. That is——

Mr. LAMBORN. That is right. Of course, the alternative is expensive also.

Dr. MCQUEARY. This is true.

Mr. LAMBORN. And also, I would like to shift gears to ask this: where do we stand with regard to the validation, verification—excuse me, I am going to shift to Lieutenant General O'Reilly at this point—where do we stand with regard to the validation, verification, and accreditation of the BMDS element level model? And when do we hope to be in a position to validate, verify, and accredit the element level models?

General O'REILLY. Do you want to start?

General NADEAU. Okay. I would start by telling you that the Operational Test Agency lead and other services are huge fans of this three-phase test review that the Missile Defense Agency is undergoing now which, when completed, will allow us to answer that question very, very specifically, as we were discussing, to break out of the two-year window into the entire program.

And with the data and inputs and work that we all collectively put into the Phase 1 piece of identifying the number of ground and flight tests or flight tests necessary to get to the point where you have the ability to validate and verify (V&V) the models and then accredit them, and then start using those models for the greater good, and then also adding flight tests that will be required to do things you can't pick up in the models.

It will end up being a very good process. It has been a very good process to this date. And I applaud, in spades, the effort to get down this road, because from the test agency's perspective, this is exactly the right thing to do.

Mr. LAMBORN. Anything to add to that?

General O'REILLY. No, sir.

Well, one result that we actually found as we went through Phase 1 is there are other areas in our infrastructure and our modeling that need improvement and need investment. It is not just the testing. It is also the modeling of our threats from areas such as NASIC and others. We need investment in that area, so we can have the digital models of the threats that are more precise, and the hardware in the loop and the other infrastructures.

So we have learned a lot from this process, I would say, and not just the accreditation of the models, but the entire infrastructure to give us the confidence that we do have the results that the warfighters and the combatant commanders can use to make a judgment on the capabilities and limitations of the system.

And Dr. McQueary, you may want to address that.

Dr. MCQUEARY. I am with you.

Mr. LAMBORN. I thank you all for your answers.

Ms. TAUSCHER. Gentleman's time has expired.

The gentleman from South Carolina, Mr. Spratt, for five minutes.

Mr. SPRATT. Thank you very much, indeed.

And General O'Reilly, we are glad to see you in the position you are in—sitting at the table, we are grateful to have your service in this connection.

When Mr. Reagan, in 1983, announced the Strategic Defense Initiative, he said its object was to "render nuclear weapons impotent and obsolete." I think we would have to agree that we are a long way from that goal, are we not?

Let the record show everyone nodded his compliance. [Laughter.]

General O'REILLY. Yes, sir.

Mr. SPRATT. I am not trying to diminish what you have done. I am simply trying to emphasize the great difficulty of achieving the goal that the President set down when he launched this.

General O'Reilly, you said that we need this testing, because among other things, you did not want to place complete reliance, confidence, in simulators, which have inherent limitations. What are the doubts or concerns you are trying to dispel as you undertake this testing regimen?

General O'REILLY. Well, sir, first of all, the simulations do have limitations in the fact that most of our flight-test failures that have occurred in this agency were due to quality control. And quality control is not revealed through simulations. You need to be doing actual testing in order to get that confidence and quality control testing on the ground. So that is one thing we are addressing is a comprehensive set of testing—not just flight testing, but the ground testing.

And second of all, sir, it is associated with your opening comment, we are often referred to as a shield. We are not developing a shield. We are developing more of a multi-layered net, I think is a much better analogy. It puts a lot of uncertainty into the adversary. Is he going to be successful with attacking? But the best we can do is get the probability of engagements very high. But it is not an absolute shield.

And so we need to be addressing, in our testing program, multiple systems working together to, in fact, show that something "doesn't fall between the seams," between GMD or Aegis, or Aegis

or THAAD, or THAAD or Patriot. And so that is another major area we must address is, how do they work together? And it requires a combination, because of the expense, of models and simulation. But those actual flight tests are very critical.

Mr. SPRATT. At the same time that Mr. Reagan made his speech, Paul Nitze, I believe, said that—and he is quoted in Mr. Coyle's testimony—that laid down three ground rules for judging success, and the last of which was that missile defense should be cost-effective at the margin, so that the cost of deploying one additional defensive system would be less than the cost of an offensive system that might overcome it.

Do you think you have achieved that criterion, so that the cost of defense is less than the cost of offense?

General O'REILLY. Sir——

Mr. SPRATT. Yes, sir.

General O'REILLY. I will address that the cost of our interceptors are much more expensive than the cost of the threat missiles which we see. In fact, we are often surprised at how those missiles are built, and what it takes in order to produce a missile that could threaten, not only your contiguous neighbor, but threaten a region. They are showing we have 1,000 more missiles in the 19 countries other than the United States, Russia, and China than we had just 5 years ago.

So they are much more inexpensive than our interceptors. But taking into account the area which you are trying to protect and the cities you are trying to protect from it, I believe that might change the calculus some.

Mr. SPRATT. Mr. Coyle, noting the flight test, says that MDA, over the past five years, has launched just two successful GMD flight-intercept tests. MDA still must carry out successfully about 20 more, perhaps 25, flight-intercept tests of different types before the system can fully demonstrate effectiveness in realistic operational tests. Would you agree with that statement? Either one? Anyone.

Dr. MCQUEARY. I don't know off the top of my head whether it is 25, or whether it is 30, or whether it is 15.

Mr. SPRATT. It is in that range.

Dr. MCQUEARY. I think the key element is working with General O'Reilly on the path he is on, on this three-phase program in order to ascertain what tests have to be conducted. And from that, we can count, at that point, and then have data to look at. But I don't know how to answer the question then, as you have posed it.

Mr. SPRATT. But it is in the range of 20 to 25 additional tests?

Dr. MCQUEARY. Well, if you want it in a simple mathematical sense, if you wanted to have a 90 percent probability of something working and have a 90 percent confidence that it would be what you want, we would have to run 28 successive tests in order to demonstrate—28 successive tests that are identical in nature—in order to prove that confidence level. So that may be the origin of the comment.

But I believe Mr. Coyle is going to be on later. So he will be able to answer the question himself.

Ms. TAUSCHER. The gentleman's time has expired.

Gentlewoman from California, Ms. Sanchez, for five minutes.

Ms. SANCHEZ. Thank you, Madam Chair. It is a pleasure to be back on the subcommittee after taking a couple years off. Obviously I came back because I think this is an incredibly important issue for our Nation. There are lots of threats out there. As you know, I chair on Homeland Security and in particular the subcommittee that handles the global counterterrorism for our Nation.

So I just want to put to the record that, you know, it is always an issue about scarce resources. We are in a time, especially today, of scarce resources. There are a lot of demands here in Washington of what we are going to do with money that, quite frankly, most of us know we don't even have.

And so, you know, I just want to put for the record that I never have believed that this was an issue of wanting to stop or not having the capability that many of us think at some point we do need. But it is about how do we get there? And how do we most effectively get there?

So I am very, actually, very proud of the gentlewoman from California, my friend, who has now chaired this for a couple of years. And I think you have been doing a great job to talk about how we reassess what we have out there, because we know that we put billions into this long-range missile defense system. And the confidence, I think, is really not there that it will stop something from coming in to our shores or other places that we want to protect.

My question today is to General Nadeau. You expressed our limited capability against a launch from Northeast Asia. It seems to me, even in recent days when we have taken a look at what North Korea may or may not be doing, but most likely may, in continuing to expand its missile capability, how does the Department of Defense address our limited capability at this point, when we are looking at what North Korea may be doing, for example?

General NADEAU. Yes, ma'am. Thank you for asking that question. The limited nature, as we have described that capability, is confined only to the fact that the flight tests that have been run have not been over an expanded series of scenarios. So against a narrow set, you end up with the assessment of limited capability.

And so through, whether it is continued flight testing or use of modeling and simulation, when you can expand the envelope, and you see more, limited turns into a different assessment of capability. So again, limited nature, in its most simplistic form, is only because we have looked at it only in a very finite window so far.

Ms. SANCHEZ. So if I am getting this correct—I mean, I used to work for Booz Allen & Hamilton. And we used to calibrate, you know, we used to put together our algorithms and figure out what we thought would happen. And then we would calibrate it with some real tests.

Sometimes we couldn't calibrate everything out. Maybe it is sort of like trying to land a person on the moon. You do the algorithm. But until you really land them, you really don't know whether it is all going to work out. But you try to do or simulate as much as you can those critical pieces, especially keeping your people alive, or what have you.

So what I am understanding from you is, we can't account, in a real test manner, for every single possibility to give us 100 percent confidence that we are going to have—that we are going to test ev-

erything that may come at us. But we do that through calculation, through algorithm, through modeling. And then where we can in the specific areas, we do these other tasks to get a better calibration of whether our system will work, or how to tweak the system so it works for us getting most of what is coming at us, or what we believe will come at us. Is that correct?

General NADEAU. Yes, ma'am. I agree with that and would add a couple of points. You get through modeling and simulation the ability to more quickly go into different test scenarios and most certainly more economically, because of the cost involved. And if there is a belief, in discussion with the Missile Defense Agency or DOT&E, that we need to take a look at a test scenario that we do not have confidence in the model's ability to do that assessment, then the dialogue turns to an actual flight.

Ms. SANCHEZ. So it is not that we have stopped funding this particular area that we are interested and believe, because a lot of us, I think, I believe, are interested in this. It is that some—I don't necessarily put myself in that category, but many have said that the systems that we have are what we built, what we actually have on hand, may be more of a facade, that it doesn't have that confidence to take out whatever may come at us. We don't know yet what they really have and how it will come at us.

But I think most of us are just interested, or at least this side, under this chairwoman that I have seen, are interested in continuing to test and continuing to figure out how we make this system really work for what may come at us.

Is that sort of putting words in your mouth, Chairwoman?

Ms. TAUSCHER. I think those are words that came out of my mouth.

Ms. SANCHEZ. So, in your opinion, how concerned should we be at what North Korea is doing, given what we currently have, given that we are not continuing to build the same system all over the place, that we think isn't handling the job necessarily, but rather wanting to test and improve and really build something, or add on to what we already have, something that would really stop what may be happening.

Ms. TAUSCHER. The gentlewoman's time has expired. But you can answer the question.

General NADEAU. From the test community's perspective, one of the variables to consider is not concern over the performance of a potential adversary, if I can state it that way. And so where I turn our attention from the test perspective is to provide as much information to General O'Reilly and his team to be helpful to them to advance the performance confidence in the system.

One of the luxuries of a test operation like mine is I am not pressured by cost, performance and schedule; meaning that in all of the right parameters, because I can look back and deal only with the facts and not get concerned about the shortness of schedule or perhaps the absence of other resources.

So our function is to be that independent voice to General O'Reilly to help him and his agency make the right decisions and help alleviate, perhaps, either some of those concerns, or the terminology from our world is risk, ma'am.

Ms. SANCHEZ. Thank you.

Ms. TAUSCHER. Thank you very much, gentlemen. We would like to get on to our second panel. We very much appreciate your appearance before the subcommittee. We know that we will see you again.

General O'Reilly, we are looking very much into getting you back after the results of your test review is ready for us to have some testimony from you. So we look forward to doing that later in the spring.

If we could take a 60-second recess and change out our panels, I would appreciate it. Thank you.

We are honored to have our second panel with us today. We have experts and academics. And I think we are going to begin with Mr. Coyle. Just for the record, I want to state that Mr. Coyle and his wife are former constituents of mine and old friends.

But I am glad to have you back.

And all of your testimony has been submitted for the record. If you could summarize in five minutes or less, I would appreciate that. We are expecting some votes again. So we will have to recess when those votes are called. But we would like to get through as much as we can on the panel as possible.

So Mr. Coyle, welcome back again to the committee. Thank you for your service. And the floor is yours.

STATEMENT OF HON. DR. PHILIP E. COYLE, III, FORMER DIRECTOR, OPERATIONAL TEST AND EVALUATION, U.S. DEPARTMENT OF DEFENSE

Dr. COYLE. Thank you very much, Madam Chairman. I appreciate the opportunity to be with you before you today to support your examination of the future of missile defense testing. Ranking Member Turner, I appreciate being here with you also.

In my view, there is a troublesome lack of clarity in public discourse regarding both the rationale for, and the technical progress toward, an effective U.S. missile defense network. Quite simply, the public statements made by Pentagon officials and contractors have often been at variance with the facts at hand. I am referring to the past, not under General O'Reilly.

It is difficult to separate a programmatic spin from genuine progress. In particular in the past, the program has made claims that have not been demonstrated through realistic testing.

In my prepared testimony I outline the steps that I believe the Missile Defense Agency must take. These include tests to establish operational criteria, such as how good is the system. You had questions earlier about that, and, as you saw, they were not able to be answered. Tests to demonstrate that the system can withstand attacks involving multiple missiles, not just one or two; testing to demonstrate that the system can be operationally effective in the presence of realistic decoys and countermeasures; and four, test to eliminate the gaps from past flight intercept tests, including years of kicking the can down the road on basic operational questions, like can the system work at night, in bad weather or in likely battlefield conditions?

In my prepared testimony, I make an analogy about the different scientific and technical issues that a program can face. And I make the analogy with an imaginary Pentagon program to demonstrate

human flight. And I am not trying to be funny there. The Missile Defense Agency faces many very daunting scientific and technical problems, and they have not been addressing those questions. It appears that Lieutenant General O'Reilly is beginning the process to do that.

Our military often observes that the enemy has a vote. In missile defense, this means that if the enemy is bound and determined to attack us, they will do whatever they can to overwhelm and confound our missile defenses. This means that the enemy may launch many missiles, not just one or two; may make their warheads stealthy and hard to detect and track; and may use decoys and other types of countermeasures to fool or confuse our defenses.

They may attack us at night or in bad weather, or may use electronic jamming or stealth. Recently the White House said about National Missile Defense, the ground-based system as it is called now, "The Obama-Biden Administration will support missile defense, but ensure that it is developed in a way that is pragmatic and cost-effective and, most importantly, does not divert resources from other national security priorities until we are positive the technology will protect the American public."

How will the Administration and Congress be positive that missile defense will protect the American public? It is going to take testing far beyond what we have seen to date.

The easiest ways for an enemy to overwhelm our defenses are to, number one, build more missiles, more offensive missiles, to attack us; number two, use decoys and countermeasures to fool the defenses; and three, attack us in ways that our missile defenses are not designed to handle, such as with cruise missiles, or through terrorism or insurgency.

The Missile Defense Agency does not have a charter to counter terrorism. But it is responsible to address the ways that an adversary might try to overcome or fool our missile defenses. The testing program must put those issues front and center. But that has not been happening.

My perspective on the threat may be different from yours. In my view, Iran is not so suicidal as to attack Europe or the United States with missiles. To me, it is not credible that Iran would be so reckless as to attack Europe, or the United States for that matter, with a single missile, and also by the way, with no decoys or countermeasures to fool us, and then sit back and wait for a massive retaliation. As we know, ballistic missiles have return addresses.

I don't believe that the launch of a small satellite by Iran earlier this month changes this situation.

But if you believe that Iran is bound and determined to attack Europe or America, no matter what, then I think you also have to assume that Iran would do whatever it takes to overwhelm our missile defenses, including using decoys to fool the defenses, launching stealthy warheads, and launching many missiles, not just one or two.

The Missile Defense Agency admits it can't handle that situation today. And accordingly, their testing program must begin to address these challenges soon.

Ms. TAUSCHER. Mr. Coyle, can I ask you to sum up? We have about 10 minutes before we have another series of votes. And I would like to get the other two witnesses to give their statements.

Dr. COYLE. Certainly, I can stop right there.

[The prepared statement of Dr. Coyle can be found in the Appendix on page 82.]

Ms. TAUSCHER. Thank you, sir.

Mr. Francis.

STATEMENT OF PAUL L. FRANCIS, DIRECTOR, ACQUISITION AND SOURCING MANAGEMENT, U.S. GOVERNMENT ACCOUNTABILITY OFFICE

Mr. FRANCIS. Thank you, Madam Chair.

Mr. Turner and members of the subcommittee, I appreciate your having me here to participate in the discussion of missile defense testing.

Ms. TAUSCHER. Thank you.

Mr. FRANCIS. I will attempt to answer the three questions that I got in my invitation letter as well. The first was what are conclusions from our annual report that will be issued next month on missile defense. I would first like to recognize the uniqueness of missile defense testing and the challenges it faces in complexity, cost, safety, the fact that development and operational testing has to be combined, and the fact that modeling and simulation is really important for this program. So it makes every test event really important.

Now, during fiscal year 2008, which we looked at in our review, we found that the testing itself, while there were many things done well, testing—particularly flight testing—was less productive than planned. None of the missile defense elements conducted all the testing they had planned. And only one achieved all its key objectives. In a number of cases, tests were either cancelled, deferred or achieved less than planned. And this was particularly true for the GMD element.

Targets have been a persistent problem across all the elements that are flight testing. There are a number of consequences, in my opinion, associated with less productive testing. One of those does relate to anchoring models and simulations, which are absolutely key for this program. And there was a question earlier about how many models there were.

There are 40 models; about six of them fully accredited, nine have been partly accredited. That leaves 25 to be done yet, before you can assess the full performance of the system. And I don't believe that will be done until 2011. So quite a bit of work to do there; quite a bit of understanding yet about the fielded systems' performance against countermeasures.

Another consequence that we have observed is production fielding is beginning to get ahead of testing, so that some assets are being produced and fielded before they are tested. And finally, declarations of capability—that is when you say an asset is ready to be operational—some of those have been postponed. And some declarations have been made on the basis of less information than planned.

The second question you had asked me to address was our views on the three-stage review that General O'Reilly is conducting. We think that is something that is needed, and we welcome it. And I think General O'Reilly's experience as the THAAD program manager is especially relevant in this review, because he has kind of been through this before.

We have only gotten initial briefings on it, but I like the overall approach. I think identifying those critical variables that are going to be in the models and simulations and cross-walking those to testing, I think that is important and should close some of the gaps that we see today between modeling, simulation, and testing. I think the involvement of the test community has been very important.

That third phase is going to be really critical. That is where General O'Reilly will address resourcing, the flight test program, and the ground test program with assets. And that gets to the third question that you had asked me to address is what actions do we think missile defense should take in this new approach? And I think there are five.

One is continued involvement of the testers in the process. The second is the test program that emerges has to be robust in terms of targets, test assets, allowing time to analyze after a test and do post-flight reconstruction. And I think that is really important.

The third thing is the fiscal year 2009 test plan is very ambitious now, because a lot of the fiscal year 2008 testing has been pushed into it. So I think that has to be looked at to see if it is still rational and achievable.

The fourth thing is synchronizing, or re-synchronizing, I would say, production and fielding decisions with modeling and testing information, so that the modeling and testing comes before the production and fielding. And the last thing is I think it will take about two years for the new test plans to be fully implemented. So we are looking at 2010, 2011.

So the MDA will be in a transitional period. I think that is going to be a time for careful management and some prudent decisions about production and fielding while we are waiting for a really sound test plan to emerge. So——

Ms. TAUSCHER. Thank you, Mr. Francis.

Mr. FRANCIS. I am ready for any questions.

[The prepared statement of Mr. Francis can be found in the Appendix on page 113.]

Ms. TAUSCHER. I appreciate that very much.

Mr. Mitchell.

STATEMENT OF DONALD C. MITCHELL, CHIEF ENGINEER FOR BALLISTIC MISSILE DEFENSE, AIR AND MISSILE DEFENSE SYSTEMS DEPARTMENT, APPLIED PHYSICS LABORATORY, JOHNS HOPKINS UNIVERSITY

Mr. MITCHELL. Thank you, Chairwoman Tauscher, Ranking Member Turner, distinguished members of the subcommittee. Thank you for the privilege of appearing before you today on the topic of Ballistic Missile Defense.

I have served the Missile Defense Agency since 2005, first as a member of the Mission Readiness Task Force, and now as Director

for Readiness Assessment. In those assignments, I worked closely with the test and evaluation communities of GMD, Aegis BMD, and THAAD as they prepared for firing exercises in order to develop an independent assessment of their readiness to conduct those missions. The written testimony that I provided to the subcommittee is based upon that experience these last four years.

The firing histories for those three elements indicate that there is a military capability against simple separating targets, and that upcoming flight tests will demonstrate a capability against more challenging threats. Though important, flight tests are not sufficient to accurately understand the operational effectiveness and operational suitability of a system.

A test and evaluation plan that integrates the results from flight tests, ground tests, and high-fidelity models and simulations is required to understand the effectiveness and suitability of the BMDS. High-fidelity models and simulations are used first to predict the outcome of a flight test under various conditions, and second, to replicate the outcome of the flight test using the conditions as experienced during the mission.

This technique, called anchoring, is part of the verification, validation, and accreditation (VV&A) for the models and simulations that allows one to believe the predictions produced by them. Models and simulations that are VV&A-ed can be used to produce a believable, statistically significant, cost-effective estimate of the effectiveness of the system.

Ground tests can be used to demonstrate the operational suitability by showing the deftness with which the elements of the BMDS interact with one another. Thoughtful planning can produce complementary results from flight tests and ground tests. By emphasizing suitability in ground tests, the simplest set of flight tests can be defined with which to anchor the models and simulations. This approach provides flexibility in making fielding decisions of the BMDS.

MDA has embarked on a three-phase effort to define a set of flight tests that will anchor the high-fidelity model in use in MDA, and ground tests that will demonstrate the suitability. An oft-asked question is, how many flight tests are necessary to demonstrate that a system is effective? That question is now properly reframed as how many flight tests are necessary to anchor high-fidelity models?

The answer to that question is being developed using the critical engagement conditions and empirical measurement events. From this review, MDA will know what portions of the models can be anchored by measurements on the ground, and what portions should be anchored in flight. I look forward to a conclusion that presents the Director, Lieutenant General O'Reilly, with an efficient plan that demonstrates effectiveness and suitability of the BMDS.

I would like to make a brief comment on GMD, if I may. That program has made significant strides in improving its test discipline and has adopted a quality improvement program that bear fruit in the future. I respectfully request that the subcommittee continue to support GMD in these efforts.

I welcome the opportunity to speak with you today and will be pleased to answer any questions that you have.

[The prepared statement of Mr. Mitchell can be found in the Appendix on page 128.]

Ms. TAUSCHER. Thank you, Mr. Mitchell.

We are about to be called for votes, but I am going to actually yield my time to Mr. Larsen for five minutes.

Mr. LARSEN. Thank you.

Perhaps Mr. Francis can answer a question that I wasn't able to ask. Sorry I wasn't here for the whole panel. But it is still relevant to the panelists here, because it is a question that I will explore with Dr. McQueary as well.

But from the GAO's perspective, the idea that General O'Reilly has to lay out a, call it a lifetime testing plan, or just a longer-term testing plan for us, and then not conduct full tests each time in order to save money on a test. That is making a determination that, on any one test, you may not have to start from the very beginning and then go all the way through to the element that they want to test. That saves money.

But in your view, will anything be lost doing it that way as well? The benefit is perhaps saving money on a test. But is there anything lost on the test from doing it that way?

Mr. FRANCIS. It would depend on how the plan is laid out. So for example, if there is a very rigorous, say, ground test plan that is anchoring models and simulations, I think a—I haven't seen the specifics of what General O'Reilly is proposing—but I would say then a more limited flight test might be okay, as long as it has that kind of a foundation.

I think where you run into trouble is where you have a very success-oriented schedule set out that is predicated on everything going just fine. At the same time, we are producing. And when something happens and things don't go well, then we end up loading up a test, for example.

So the current approach was what I would call a crawl-walk-run approach.

Mr. LARSEN. Right.

Mr. FRANCIS. And we have got a little bit away from that. So instead of each test, flight test for example, demonstrating one new variable or one new capability, they are starting to load up. So I think it is Flight Test 6 that is coming up. It is going to have a new Exoatmospheric Kill Vehicle (EKV) in it. It will be the first test against a complex threat scene. And it is only going to be the second test of a new target.

So that is my caveat. As long as the plan is laid out to anticipate some contingencies that it can react to, I think that would work out. If it is success-oriented, then we might end up loading up that flight test.

Mr. LARSEN. Yes.

Mr. Mitchell, do you have a view on that?

Mr. MITCHELL. I have a view that——

Mr. LARSEN. On my question.

Mr. MITCHELL. Yes, I have a view very similar to Mr. Francis. Models and simulations represent three things: the functional behavior of the system; the performance attributes associated with the system; and the error sources within the system. Many of those can be adequately understood on the grounds of ground test. And

it is the purpose of a flight test to then fully anchor those things we really can't get at on the ground.

With that approach to VV&A of the model, I don't think we will lose anything in these flight tests, so long as they are carefully planned, sequential in nature, and don't try and rush to a complicated, complex test that we haven't walked up to, as Mr. Francis suggested.

Mr. LARSEN. Yes.

Mr. Coyle, do you have any thoughts on that? Do we lose anything by testing just the element that we wanted to test as opposed to starting from the beginning and testing through the element that we have added?

Dr. COYLE. Well, I would recommend that there wouldn't ever be any test that you hadn't attempted to model and simulate beforehand. But there are some things that models will always be mysterious about those things. And it is just going to take a flight test.

For example, Dr. McQueary, in his report to Congress, points out that the GMD system, the ground-based system, has not demonstrated its performance throughout, and I quote, "the expected range of adverse natural environments." He is not talking about what the enemy might do to fool you. He is talking about, at night, when the sun is shining in your eyes, things like that.

And so Dr. McQueary points out in his report to Congress that there are some issues like this that just haven't been addressed yet.

Mr. LARSEN. Madam Chair, that has been the main question I have been exploring. And so that is fine. So I yield back my time.

Ms. TAUSCHER. Thank you, Mr. Larsen.

Gentlemen, can we ask for your forbearance for about a half an hour. We have three votes, a 15, a 5, and a 15. But that doesn't mean that we will be gone for that entire 15 minutes. So if you don't mind, we will recess for about a half an hour. We thank you very much. Be right back.

[Recess.]

Ms. TAUSCHER. Witness line warm, as they say? [Laughter.]

I think we want to just go and talk about the successes of theater missile defense, for example. DOT&E's Fiscal Year 2008 Annual Report noted that theater missile defense systems, such as Aegis BMD and THAAD, continue to make significant progress, although the long-range GMD system continued to face challenges. Are there lessons we have learned from the theater missile defense testing that should be applied to the GMD system, first?

And second, if so, what specific recommendations would you make to the Department of Defense? Let me start with Mr. Coyle and go right down the line. If you can keep your answers brief, I think we are going to see Mr. Turner pretty soon.

Dr. COYLE. Thank you.

Yes, the services do have an approach toward testing, which I think is very healthy. Publicly, in other forums, I have given the Navy credit for the approach that they have taken with the Aegis system. They have a tradition of doing quite realistic tests at sea. And that tradition has carried over to their missile defense work. Analogies like that could be made with respect to the Army in both Patriot and THAAD.

However, I have to add, for all their good successes, I continue to be concerned that Congress is not fully and currently informed about the ways in which these tests are scripted. And I think that is something that probably General O'Reilly is going to try to change. And that will be good.

Ms. TAUSCHER. Mr. Francis.

Mr. FRANCIS. Yes. I think some of the things—I agree certainly with what Mr. Coyle said about the testing. I think both in THAAD and Aegis, there is I think a wider range of targets being presented. I think the operators know less in advance about what is going to happen. And I think that they are engaging in a broader flight regime, if you will, not as narrow as GMD.

If you go back, though, both Aegis and THAAD are self-contained. They own the missiles. They own the fire control. They own the radar. So I think it is a little less complex. And GMD didn't own that.

But having said that, I think if you turn the clock back, it would be interesting to ask General O'Reilly, I think THAAD was in this very situation in early development. And they were trying to do a lot of testing and gang up on a single test. And they had to stop and remap the test program. So I am hoping that is what they are doing with GMD now.

Ms. TAUSCHER. It is not just a coincidence that it was General O'Reilly that did that.

Mr. FRANCIS. No. Yes.

Ms. TAUSCHER. Mr. Mitchell.

Mr. MITCHELL. Yes, ma'am. The points are well-taken. But there is something else about Aegis and THAAD that you need to understand. It is the way they prepare for flight tests.

They are very disciplined. They have a primary objective. They work hard to understand what the probability of success is against that primary objective. And they work equally hard at knowing what the risks are against attaining that probability of success in the mission. That is why they have been successful. And again, it is a wide variety of targets.

GMD has adopted that precise mentality. It has caused them to postpone some missions: FTG–04 was canceled because of a problem in the telemetry system. It was very likely we would not get any telemetry data. And so we wouldn't be able to reconstruct what happened. That was, in my mind, a correct decision, given the cost of these exercises and represents discipline that I am talking about.

Ms. TAUSCHER. Thank you.

I was just trying to keep the witnesses warm for you, Mr. Turner. I am happy to yield to you.

Mr. TURNER. That is very kind of you. Thank you.

Thank you, all, for participating first off and for bringing your expertise.

Mr. Coyle, am I pronouncing that correctly?

Dr. COYLE. Yes, sir.

Mr. TURNER. Coyle, okay, thank you.

One of the great aspects, I think, of any of these hearings, when you bring diverse views together, how much you can learn from the different perspectives and the advice that they give. Mr. Coyle, I

was really interested in your testimony because, besides your admission that you cannot fly, there was some revelation there.

And on page six, you say: "In my view, Iran is not so suicidal as to attack Europe or the United States with missiles. To me, it is not credible that Iran would be so reckless as to attack Europe or the United States with a single missile, no decoys and the like. Similarly, North Korea isn't so suicidal as to attack Japan or the United States."

And this hearing is about testing. But I took from your statement a belief that there is an exaggeration of the threat, a lack of a view which I think is different, and I would like you to expound upon, that Iran and North Korea really don't pose the type of threat that everyone is saying that they do.

Dr. COYLE. Actually, my point is just the opposite, that if you believe that Iran would be suicidal enough to attack Europe or the U.S., then you have to also believe that they would do whatever they would, they could, to overwhelm our defenses. And that would mean firing more than one or two missiles. And as General O'Reilly acknowledges in his testimony, that is not something the Missile Defense Agency can handle.

For example, there is only supposed to be 10 interceptors in Poland. And it was pointed out by the first panel that the doctrine is to shoot as many as five missiles at each one. So if Iran launches two missiles, those 10 are all gone. And if Iran launches a third one, you have got no interceptors left. So if you want to take the threat from Iran seriously, then I think you have to look where they might go with it.

Mr. TURNER. Okay. And I absolutely agree with you, with your point of you must, in your evaluation, think about, you know, that they would do whatever they could. Similarly, we should do whatever we can. And in that, then, should I take your comments to be an advocacy for more deployment of missile defense; because if you think that what we have is going to be insufficient for an ever-increasing threat, wouldn't the logical conclusion of your testimony then be that we should deploy more, not less?

Dr. COYLE. I support research and development (R&D) in missile defense and have for my whole life, if for no other reason than we should avoid technological surprise. What I would not support is deploying a bunch of hardware that we either know wouldn't work in the situations we would face, or which have——

Mr. TURNER. But we don't have that situation, right? Because no one has ever testified that we have something that we know does not work. No one has, I think, ever testified before this committee that we have things that we know don't work.

Dr. COYLE. Actually, the——

Mr. TURNER. They might not work as well, or they might not be perfect. But no one has said we have things that don't work.

Dr. COYLE. But what the Missile Defense Agency itself has said is that they cannot handle attacks with multiple missiles. That is an example of something they have said that they do not know how to do right now. Hasn't been tested, and they don't know how to do it. So if you believe that Iran would attack Europe or the United States, I think you have to take that seriously.

Mr. TURNER. I appreciate that.

Mr. Francis, Mr. Mitchell, one of the things that I have been very impressed with in all of the testimony, is the secondary issue of you test, flight test, you get obviously a specific response from that. But you also get an incredible amount of data. And that data, in part, is used for simulation, modeling, computer work on, not only just improving the system, but on determining later how the system might perform or what are the uses it could be.

I mean, one of the things that I think of when I hear them talk about that, is the Aegis system. You know, we never tested it to take out a satellite that was falling out of the sky. No one would argue that we should have never pressed the button to have it take a satellite out of the sky once the satellite is falling from the sky, just because it had not been tested.

But we had computer modeling and simulation that aided us in determining whether or not this was something that was possible. And we had, obviously, a situation that we needed to act. And then we did.

Could you speak a moment about the importance in testing of the data that is generated in the computer simulation and modeling, because I am very interested in your opinion and thoughts on that process.

Mr. FRANCIS. Yes, well, I will start off and then turn over to Mr. Mitchell. But the data is very important, because after you have a flight test, they do what is called a post-flight test, a post-test reconstruction, where you actually try to replicate what happened in the real test through the modeling. And there is kind of a symbiotic relationship between the two.

If you can get your data from the flight test to make the model better and to anchor it in reality, then when you are presented with a new situation or you are about to do another flight test, you can run the model and get some idea as how you are likely to do in a real flight test. So it is very important. And they build on each other.

So when we are looking at a performance assessment, which is basically a way to look at how the missile defense system, as it is in the field, will work today, that is an aggregation of models. There is no one grand model that does that. So each one of these models, Aegis and THAAD and so forth, would get aggregated to give you some kind of prediction of the overall system. So there is, like I say, a symbiotic relationship, very important.

Mr. MITCHELL. In addition to what Mr. Francis said, the data has another very important issue. And that is the system can behave in unexpected ways that didn't threaten the flight. You may have had a success. But there is something peculiar, that data, that leads you to an investigation about what did this function do? Why did it do it? Why was the tracking accuracy the way it was and would you expect it to be a little bit better than that that occurred in flight?

That data is a rich field with which to really poke at, not only your understanding of the system, but the way it is physically implemented, to determine whether or not it was intended to be that way. That is a second-level—a very important use of that data.

Mr. TURNER. Thank you very much.

Madam Chair.

Ms. TAUSCHER. I think the issue of validation of the models and simulations is one of the first things that General O'Reilly is moving vigorously to mitigate.

The analogy I think is like if you have a patient appear in the emergency room. And you don't take down their temperature and their vital signs, but you decide that they have a critical issue where they may need surgery. Nobody is going to go into surgery without figuring out whether the person, you know, has a heartbeat that is going, and a temperature that is okay, and whether they can manage the anesthesia or not.

And I think that what is clear to me is that the lack of verification of these models and simulations, some number north of 40, creates, for Dr. McQueary, this question of confidence.

And Mr. Francis, this is a specific area that you have talked about in the GAO report. Could you just expand a little bit on the novelty of the fact that this hasn't been done, the fact that this is an underpinning of, not only "fly before you buy," but the kind of assurances and surety that systems are meant to have?

Mr. FRANCIS. Sure. I do review a number of different programs, shipbuilding programs and Army programs. And we just did some work looking at testing of body armor. And in a test of a system like that, you can run repeated tests and get all the data you need, whether or not you have a model. You fully understand everything that vest can do.

I think what is unique here about the missile defense is testing cannot achieve that. We can't know everything about the system, because just the physical limitations of testing as it relates to the BMDS system. So modeling in some cases is a nice-to-have. But in missile defense, it is a must-have.

And so one of the things that missile defense has been trying to do—and I think it is General Nadeau's responsibility—is to do an annual performance assessment, which is an attempt to use modeling and simulation to say, "What do we know about the system that is in the field today," because testing can't tell us enough. You have to have your models accredited, part of which means being anchored in ground and flight test to be able to say that.

And as I had said earlier, we are quite a ways from that. We have 40 models right now that would have to be aggregated in some form to say "Do we understand how the system in the field today works?" Twenty-five have yet to be accredited.

So the significance of that is you can't say how the fielded system is going to perform without the modeling and simulation. So it is a must-have.

Ms. TAUSCHER. Thank you.

I am not sure who came in first, Mr. Franks or Mr. Lamborn.

Mr. Franks for five minutes.

Mr. FRANKS. Well, thank you, Madam Chair.

Madam Chair, I was just listening to the responses by Mr. Coyle. I guess related to the European site with the 10 interceptors suggestion that, you know, as many as five of the interceptors might be launched against one potential incoming missile. Even if that scenario was true, I guess that there are a couple of conclusions there.

First of all, that would mean perhaps at least two cities would be saved. Secondarily, given Iran's present, at least what we believe is their present amount of fissile material that they have, there is a limit to the number of warheads that they might have, which might give us a chance to respond with greater numbers of interceptors, if that becomes clear.

I think that my greatest hope is that the presence of a ground-based system in Poland and in the Czech Republic would, as it has been said so many times today, to devalue the Iranian nuclear program, to the hope that somehow many of the other things that we are trying to do would dissuade the program entirely and, again, try to keep that technology from the hands of terrorists.

That is just a comment. But I wanted to ask you, Mr. Mitchell, a question. You stated in your written testimony, and I am going to quote. It says, "I conclude from this evidence that a fundamental useful defensive capability based on an autonomous operation of Aegis BMD, THAAD and GMD elements is available to our armed forces. But I cannot state that BMDS has reached maturity." And I think that is a very erudite statement.

And you raise an important point. Even though that BMDS hasn't reached complete maturity, that it is still a useful defensive capability. And you are certainly an expert in this area. Can you comment on a few of the factors within the system and the testing mechanisms, as they are now, that give you the confidence to say that there is a useful defensive capability here?

Mr. MITCHELL. Well, I have to be careful about the use of the word "confidence," as Dr. McQueary schooled us earlier today. So——

Ms. TAUSCHER. You can say it is subjective confidence.

Mr. MITCHELL. I am going to try and use the word only when I am talking about statistical significance. GMD, in its last three firing missions, has essentially successfully detected a re-entry vehicle (RV), targeted it, and the EKV has destroyed that warhead. They were simple, separating targets, as General O'Reilly said, much like the trajectories we might have to engage from North Korea, using——

If you look at that, there have been three chances. It has done it three times. There is something there that is useful. Now, I also am aware of the models that they use to predict their performance prior to these missions. And they are very detailed. And playing data back through, they were able to replicate what happened in flight.

So I am beginning to believe that, if we finish the work started by General O'Reilly and use those models to arrive at a true understanding of the probability of success, we will have a credible defense. But that is yet to be proven. Now, that is solely for simple separating targets, as you——

Mr. FRANKS. No, that is a great answer, Mr. Mitchell. And I appreciate the analogy that you use of flipping the coin. You described in your testimony where statistics describe increasing confidence as a result of more flips of the coin or a greater number of testing trials in the case of BMDS.

And while we absolutely need to conduct flight and ground testing, you said in you testimony, "the cost to conduct a firing mission

makes it prohibitively expensive to develop a high degree of confidence for the performance of the system for any one scenario, much less full battle space using only live-fire events." In other words, it takes a lot to do all of these things. It costs a lot.

Based on that, can you discuss the importance of high-fidelity models and simulations in order to achieve the type of statistical credibility and reliability in BMDS that you describe in your analogy? And what is the confidence level in high-fidelity models and simulations when testing BMDS? And I want you to hold that thought, if you could.

There is one voice that I have heard in the crowd here. And I think it is the most compelling voice that I have heard on missile defense today. I think he is about seven-and-a-half months old. And I appreciate him being here. And I want you to know, my purpose for being on this panel is to make sure that he walks in the sunlight of freedom like the rest of us do.

So please, I hope that he didn't distract you here.

Mr. MITCHELL. Oh no, not at all. The key to using models and simulations is that you have to be able to believe the results that you get from a model. That belief is what we have been calling VV&A, anchoring. We have used several terms, several different things that go into building a belief in the output.

If you can believe that output, you can conduct any number of trials you want just using computer. You can do 250 and do 1,000 against a scenario and get a very narrow range in which the real probability of success lies with a high degree of statistical confidence. You can then repeat that for any other scenario you wish to use. And by that technique, you can develop a sense of what the operational effectiveness of the system is.

Mr. FRANKS. Thank you, all, very much.

Thank you, Madam Chair.

Ms. TAUSCHER. Isn't it true that the reason we can use stockpile stewardship, which is simulation of testing using high-speed computers and other means, putting the largest laser in the world that is in my district in California, is because we had 1,000 tests at the Nevada Test Range and other places?

Isn't it true that one of the reasons why there is a question of anchoring and certifying the simulation and the testing and the modeling of the long-range system is that there hasn't been that number of tests that actually go back and say what you are projecting in the modeling and simulation which, by the way, are projections, or is not grounded in the reality of enough tests? Is that true? Yes.

Mr. MITCHELL. That is true. But I would like to expand upon the observation, if I may.

Ms. TAUSCHER. Sure.

Mr. MITCHELL. Tests come in a number of different types. Much of the things that are represented in models can be verified by conducting experiments underground. You can measure what the drift rate in an inertial measurement unit (IMU) is and have that replicated in a model as a statistical draw. You can do a lot of that.

You will need flight tests for some things to do. The 1,000 tests, if I were to draw that analogy, would encompass all of these things, including flight tests, and say yes, we have to do that. But I don't

want to leave the suggestion that we have to conduct 1,000 flight tests or 100 flight tests.

Ms. TAUSCHER. Well, my point wasn't that we have to do 1,000 tests. But my point is that the reason why we have such confidence in the science-based stockpile stewardship management of the weapons, particularly the weapons now, is that we tested 1,000 times. We have such a body of tests that you are not stretching the algorithm to try to get yourself to a place, because you have a significant body of live tests.

Mr. MITCHELL. That is correct.

Ms. TAUSCHER. And I am not suggesting that the long-range system has to go through 1,000 tests. But I think that what General O'Reilly—the point that he is approaching, is that we have not had enough live tests to be able to certify enough of the models and simulations.

We have 25 out of the 40 that cannot be anchored. And that there is no credibility, perhaps—maybe not the right word, but a significant piece of it is credibility. There is no credibility to the projections that these simulations and these modelings have, because you cannot ground them. You cannot anchor them in live tests.

Mr. Francis.

Mr. FRANCIS. At this point, that is true. So you can't use the models to predict the performance of the system. I think one of the things that is different, and I will defer to my colleagues here on the panel, is, in the case of the long-range system, I don't think it is possible to physically test everything about it.

Ms. TAUSCHER. That is right.

Mr. FRANCIS. And that is where the models and simulations are actually going to have to do things that we can't do physically.

Ms. TAUSCHER. That is right.

Mr. Lamborn for five minutes.

Mr. LAMBORN. Is that working?

Ms. TAUSCHER. I can hear you.

Mr. LAMBORN. Thank you.

Thank you, Madam Chairman.

Mr. Coyle, I would like to ask you a question about your three over-arching points, especially point number one on page six. And to me, I am going to give you some scenarios. And I think you will have—I hope you would agree that we have to question your first over-arching point when you consider the following.

You say that Iran or North Korea would not be suicidal and would not do a launch against the U.S., because ballistic missiles have return addresses. But I can think of—just sitting here—right off the top of my head, I can come up with four different scenarios where that would not be true.

For instance, if they secretly armed a terrorist organization thinking that they could get away with it and leave no fingerprints; or if there was theft by some breakaway group within the country; or launch by rogue officials, rogue officers; or even accidental launch. I mean, in none of those four scenarios is the threat of retaliation by the U.S. an effective deterrent.

So even if your point is true that they are not suicidal, and I am not sure I even buy that point. But even if that is true, these other

alternative scenarios show that we should have some kind of protection if it is technologically possible. Even if the risk is slight, the consequence are so serious—it is a threat that has to be taken seriously.

So when I look at that way of looking at it, Mr. Coyle, I just can't buy your first point. What is your response to that?

Dr. COYLE. Well, of course, the first two scenarios you mention, terrorism and theft, missile defense isn't effective against those things. So perhaps we could put those aside, we would agree about those two.

The other two that you mention, a rogue launch, accidental or unauthorized launch, those were exactly the criteria that the Clinton Administration had for missile defense during the Clinton Administration.

In those days, of course, we were talking about an accidental or unauthorized launch from Russia or China—not from North Korea or Iran—but similar. And the reason that President Clinton didn't decide then to go ahead with missile defense for that mission, because that was the only mission. It was not to try to stop an all-out attack of missiles——

Mr. LAMBORN. Understood.

Dr. COYLE. It was because, when his second term was finished, there had only been three tests. And two of them had failed. So there wasn't much of an argument that the system would be effective.

A good question that you are asking is, "Okay, what has changed since then?" And one of the difficulties that President Clinton faced was that both Russia and China do use decoys and countermeasures. And so the—the regional commanders, the CINCs as they were called in those days, advised him that chances are that our missile defense system wouldn't work against an accidental or unauthorized launch from Russia or China, because those decoys would deploy, countermeasures would work. There would be, you know, these kinds of problems.

And so that is what I am trying to bring out in my testimony is, one way or the other, if you think that this could happen, you have got to deal with the possibility of multiple, simultaneous launches or launches with decoys and countermeasures. And that has been something which, until General O'Reilly, the Missile Defense Agency has been kicking down the road.

Mr. LAMBORN. Well, and I agree with you. I think this testing is going to be stepped up and beefed up and made more comprehensive. And I am very happy about that. But you said that that is in the context of Russia and China. North Korea and Iran, I think we would agree, are not nearly as technologically advanced.

And as far as your earlier point, you said that those first two scenarios somehow didn't apply. But my understanding is that, as missile technology becomes more advanced, even in lesser countries, lesser technological countries, like Iran and North Korea, they are developing a mobile capability. I mean, these tend to be mobile launchers.

So acquisition by terrorists, whether it is deliberate or not, becomes easier the more that mobile technology for ballistic missiles,

is available. So I think all these scenarios are valid. And I am sure there are others that we haven't discussed.

Dr. COYLE. Well, I would agree with you. The difficulty is that the systems that are planned and being developed, the systems in Alaska, for example, and proposed for Europe are very focused on two countries, Iran and North Korea, not on other countries or, you know, terrorist groups such as you are positing. If that is the threat we have to worry about—I hope it isn't, but if it is—I think that would argue for the more mobile kinds of systems, shorter-range and more mobile kind of systems, which as I understand it is where your chairwoman is going also.

Mr. LAMBORN. Thank you for your answers. And I think all of the kinds of defenses we can field are all valuable.

Ms. TAUSCHER. I don't think we disagree.

Mr. LAMBORN. I would agree with you on that.

Thank you, Madam Chairman.

Ms. TAUSCHER. Thank you. Thank you, sir.

We want to thank the panelists very, very much. We are just beginning our hearings. This was our first subcommittee hearing of this year. We specifically wanted to talk about missile defense and testing. We obviously believe that it is very important that we have the system, the suite of systems in its best capability as possible. We appreciate your efforts to illuminate the debate. And we will probably be calling on you again.

Our working relationship with General O'Reilly is very, very good. And we expect that we are going to be hearing from him later in the spring as we move on toward doing the mark for the full committee for the defense bill.

So this hearing is adjourned. The committee offers its thanks to the panelists very, very much for your hard work, for your patriotism and for your willingness to be before us. Good afternoon.

[Whereupon, at 4:42 p.m., the subcommittee was adjourned.]

A P P E N D I X

February 25, 2009

PREPARED STATEMENTS SUBMITTED FOR THE RECORD

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COMMITTEE ON ARMED SERVICES
U.S. HOUSE OF REPRESENTATIVES

STATEMENT

BY

DR. CHARLES E. MCQUEARY

DIRECTOR, OPERATIONAL TEST AND EVALUATION

OFFICE OF THE SECRETARY OF DEFENSE

BEFORE THE

HOUSE ARMED SERVICES COMMITTEE

STRATEGIC FORCES SUBCOMMITTEE

FEBRUARY 25, 2009

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COMMITTEE ON ARMED SERVICES
U.S. HOUSE OF REPRESENTATIVES
HASC – FEBRUARY 25, 2009

Dr. Charles E. McQueary
Director, Operational Test and Evaluation (DOT&E)
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Madam Chairman, Congressman Turner, distinguished Members of the Committee, good afternoon. I am pleased to have this opportunity to speak to you about the testing of the Ballistic Missile Defense System, or BMDS. As requested in Chairman Tauscher's letter, I will address three areas:

First, I will give you a brief synopsis of my assessment of missile defense testing programs as described in my annual report submitted to you on 28 January.

Second, I will discuss my assessment of the Missile Defense Agency's three-phase review of BMDS which emphasizes the need for basing BMDS test planning and test design on critical factors.

Finally, I will discuss future test and evaluation actions that I see as needed to ensure that the BMDS and its elements – particularly the Ground-based, Midcourse Defense system – will work in an effective, suitable, and survivable manner.

First: My assessment of missile defense testing programs to date.

Overall, the MDA experienced a good year with its ground and flight test programs, notwithstanding continuing challenges with targets.

Aegis Ballistic Missile Defense (Aegis BMD) demonstrated the capability to detect, track, and engage simple short- and medium-range ballistic missile targets for a variety of mission scenarios. The Navy's Commander, Operational

Test & Evaluation Force completed the operational test and evaluation of the AEGIS BMDS 3.6.0.1 program leading to the transition of that capability to the Navy. Ground-based Midcourse Defense (GMD) demonstrated a limited capability to defend against simple, long-range ballistic missile threats launched from North Korea toward the United States. Terminal High Altitude Area Defense (THAAD) demonstrated the capability to detect, track, and engage both short-range non-separating and simple-separating targets. The Command, Control, Battle Management Communications element (referred to as C2BMC) demonstrated the capability to provide situational awareness to warfighters worldwide and control the AN/TPY-2 radar in its forward-based mode.

The MDA continues to make progress acquiring, testing, and fielding the elements of the BMDS. Progress has been steady across all elements with the greatest progress seen with Aegis BMD, THAAD, and C2BMC. While GMD experienced some delays, it achieved a significant milestone with the successful integration of multiple sensors in the FTG-05 intercept test in December. The MDA continued to increase operational realism in all its testing. The ground test program is robust, although the MDA is still using unaccredited models and simulations. The MDA has identified the need for the investment in a comprehensive set of models for threats, environmental conditions and post intercept debris. I strongly endorse this effort as these models are fundamental to any assessment of operational effectiveness. From an element perspective, test program data are not yet sufficient to validate and accredit BMDS models and

simulations at the system or element level. Validated models are essential to make a quantitative assessment of BMDS capabilities. This limitation is particularly evident in GMD testing as all intercepts have occurred within a small portion of the threat battlespace and under nearly identical intercept conditions. Although the MDA has plans to test over a wider range of intercept conditions and threat battlespace, until this is accomplished, there will be insufficient data to accredit the models and simulations needed to assess GMD operational effectiveness.

Target limitations of both availability and performance attributes continue to impact both the pace and the productivity of MDA flight testing. It is important that we provide both the ground based sensors and the exo-atmospheric kill vehicle with the most realistic target presentation possible. The operational realism of recent GM tests has been limited in part by the targets' characteristics. Even with the MDA's target program improvements, there is significant risk in this area. Additionally, both Aegis BMD and THAAD need advanced targets to demonstrate expanded capabilities.

Second: My assessment of the MDA's three-phase review of BMDS.

The MDA has embarked on a process to develop a revamped Integrated Master Test Plan or IMTP that will document planned testing through the Future Years Defense Plan (FYDP). A principal focus is to ensure that future testing will provide sufficient validation data to anchor the models and simulations. This effort directly addresses the concerns I raised last year in my testimony before you. I applaud General O'Reilly's obvious personal commitment to this initiative.

The three-phased review process began with an agency wide effort to identify the critical factors for each element and the overall BMDS. My assessment is that this is a prudent approach, one which begins with the end -state in mind. The process began by identifying the critical factors necessary to examine system capability. The goal is to build a foundation of models and simulations that will allow us to understand performance at the system, element or sub-element level. In addition, both the developmental and operational test communities are identifying the other data, such as reliability and maintainability data, that need to be captured to support their respective evaluations. Phase 1 began in December and is rapidly coming to closure. This review has been particularly useful in highlighting common gaps across the elements such as modeling of threats, debris and general environmental conditions. The next step is to design tests that ensure that critical data are collected throughout the various types and phases of testing, including both ground and flight tests. To ensure that the required data are collected to validate the models and simulations, the test design team will integrate the accreditation criteria with other test requirements as they develop the revised Integrated Test and Evaluation Master Plan. This is Phase 2. Experience has shown that the effort to integrate the myriad of test requirements is the most challenging step. This will be the largest and most diverse program to undertake this process. While the challenge is daunting, it is a worthy effort. Finally, the best test design is of little value if it is not adequately resourced. Phase 3 is performed to ensure that all funding and required range and test assets, including

targets, come together in time and space as needed to achieve successful test outcomes. This is a rigorous and promising approach and I fully support it.

Third: Future T&E actions that I see as needed to ensure that the BMDS and its elements – particularly the Ground-based, Midcourse Defense system – will work in an effective, suitable, and survivable manner.

Current BMDS test program progress varies depending on which mission the MDA is testing, the long-to-intermediate-range threat strategic mission or the intermediate-to-short-range threat regional/theater mission. Flight testing at the strategic level has only examined a small and confined portion of the potential battlespace while testing at the regional and theater level has examined a larger portion of the battlespace. As a result, there are more data available to verify, validate, and accredit models and simulations for both the THAAD and AEGIS Ballistic Missile Defense elements.

A combination of flight and ground testing together with verified, validated, and accredited models and simulations are needed to characterize the operational effectiveness, suitability, and survivability of the BMDS and its elements. A carefully designed, rigorous flight test program that exercises BMDS capabilities across the battlespace under selected, representative conditions is required to anchor ground tests and models and simulations. High fidelity ground testing is required to examine additional areas of the battlespace that are either not physically or politically feasible (or too costly) to test. Both flight and ground test

venues provide opportunities to conduct operationally realistic tests using trained warfighters employing actual tactics, techniques, and procedures. They also generate operating hours on the system that produce reliability and availability data used to assess suitability measures such as Operational Availability, Mean Time to Repair, and Mean Time Between System Abort. Finally, verified, validated, and accredited models and simulations can generate large amounts of data to predict performance across the entire battlespace that includes the full compliment of threats, defended areas, mission scenarios, and environmental conditions.

Survivability environments include nuclear; chemical, biological, toxic industrial chemicals, and radiological; physical security; information operations; electromagnetic environmental effects; hostile natural; and electronic warfare. The multi-service Operational Test Agency (OTA) Team has been working with the MDA to characterize the impact of these environments on the performance of the BMDS elements and components and has been assessing BMDS survivability. To accomplish this, the OTA Team uses component survivability plans, specialty engineering data, component test data, ground and flight test data, and analyses to determine capabilities and limitations of the BMDS in hostile natural and man-made environments.

The approach laid out by General O'Reilly, if fully resourced and executed as planned will provide a solid foundation for an independent assessment of the

operational effectiveness, operational suitability and survivability of each block of capability.

I see the operational test community participating in all phases of testing to the degree that is appropriate for the stage of development. An integrated approach that leverages combined developmental and operational testing to the maximum extent feasible is essential. I fully anticipate that much of the data needed for the operational test agency's evaluation will be collected during the developmental phase and from the use of models and simulations that are validated and accredited based upon developmental flight tests. As we all recognize, the complexity of the systems and the physical and fiscal constraints on flight testing will necessitate the examination of much of the system's capability in ground tests that leverage modeling and simulation.

When the MDA has completed its developmental test objectives for a given block of capability, including a demonstration of the appropriate maturity of the reliability, availability and maintainability program, and has provided validated models that support accreditation for operational testing, I would expect the Agency to conduct an operational test readiness review. Once the MDA decides it is ready to proceed to a dedicated operational test, the OTA Team will develop and execute a plan for a flight test that exercises the capability in an end to end fashion against a realistic portrayal of the threat to be countered. This test would be a confirmatory test within the envelope previously validated during development testing as well as modeling and simulation. While this would be an

independent operational test, the OTA would share all data collected with the agency and the developer to ensure the prudent use of the taxpayers' money. This approach ensures the independent confirmation of the operational effectiveness of the block capability developed by the MDA. The OTA would simultaneously assess the essential elements of training and supportability to ensure delivery of an operationally suitable block capability to the warfighter.

In conclusion,

The MDA experienced another good year with its ground and flight test programs, notwithstanding continuing challenges with targets. The challenge in the months ahead will be to complete a re-structured Integrated Master Test Plan to ensure that future testing will lead to validated models and simulations while demonstrating system capabilities with increasing operational realism. We are working closely with the MDA and the OTA Team to define the critical engagement conditions for flight testing that will ultimately lead to increased statistical confidence in their models and simulations. We are also working to ensure that hit-to-kill missile defenses are tested against increasingly complex target scenes that include not only target deployment artifacts but appropriate countermeasures as well. This will be included in future test plans.

Through individual element successes and system tests, the BMDS continues to demonstrate its maturing capabilities. We still have a long way to go to reach the objective end state, however, we are closer to meeting our objectives than we were a year ago. The MDA's renewed commitment to a rigorously

engineered, disciplined, event driven approach to flight and ground testing is already realizing dividends. It will ultimately lead to more rigorous and operationally realistic flight and ground testing and validated and accredited models and simulations.

This concludes my remarks and I welcome your questions.

Unclassified Statement of

Lieutenant General Patrick J. O'Reilly, USA

Director, Missile Defense Agency

Before the

House Armed Services Committee

Subcommittee on Strategic Forces

Regarding the

"The Future of Missile Defense Testing"

Wednesday, February 25, 2009

Embargoed Until Released by the
Armed Services Committee
United States House of Representatives

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.

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STATEMENT

BY

MAJOR GENERAL ROGER A. NADEAU

COMMANDING GENERAL, ARMY TEST AND EVALUATION COMMAND

BEFORE THE

HOUSE ARMED SERVICES COMMITTEE

SUBCOMMITTEE ON STRATEGIC FORCES

25 FEBRUARY 2009

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COMMITTEE ON ARMED SERVICES
U.S. HOUSE OF REPRESENTATIVES
HASC – FEBRUARY 25, 2009

Major General Roger A. Nadeau, USA

Commander, Army Test and Evaluation Command

Before the

House Armed Services Committee

Subcommittee on Strategic Forces

February 25, 2009

Madame Chairman, Ranking Member Turner, distinguished Members of the Committee, thank you for the opportunity to appear before you this afternoon. In my invitation to appear before the committee, three questions were asked concerning assessments of missile defense programs to date as well as my thoughts as to what future actions are needed to occur for the missile defense program to work in an effective, suitable, and survivable manner.

Ballistic Missile Defense System Operational Test Agency Team and role in Ballistic Missile Defense System Test and Evaluation

This response to the subcommittee's questions provide the view of the multi-service Operational Test Agencies that comprise the Ballistic Missile Defense System Operational Test Agency team. This team is an independent organization, funded and supported by Missile Defense Agency to provide Operational Assessments of the Ballistic Missile Defense System. It is involved in all facets of the test program for the Ballistic Missile Defense System block development. Early operational tester involvement during this developmental program provides significant feedback to the developer, the supported military commands, and the Director, Operational Test and Evaluation.

Question 1: Assessment of Ballistic Missile Defense testing program

Our assessment of the test program to date will examine test planning/execution, increased operational realism in test venues, and the successful support of models and simulations and threat representative targets to provide valid sources of assessment data. Our comments on these facets of the test program follow.

Test design/planning/coordination/execution

Collocation of our test planners with their program counterparts allows for increased collaboration in test planning, coordination, and execution. Future test design efforts will be significantly improved as a result of the emphasis on data needs, identified as part of the ongoing systematic three-phased review of test planning. This effort is fully supported by the Service operational test and evaluation organizations and it will result in a comprehensive test program.

Operational realism

Flight and ground tests in 2008 showed increased operational realism across all programs.

Ground-based Midcourse Defense flight tests included: operational sensors, next fielding block software and portions of the operational

communications architecture. Contractors were involved with some aspects of the flight tests that will in the future be operated by military personnel. For the first time, Warfighters controlled a live intercept test from the Battalion node at Fort Greely, Alaska.

Both the Aegis Ballistic Missile Defense and Terminal High Altitude Area Defense flight test programs also showed increased operational realism. For Aegis Ballistic Missile Defense, trained fleet sailors used fielded interceptors and other system hardware with some limitations. The Terminal High Altitude Area Defense flight test program incorporated for the first time final configurations for the interceptor and launcher, and improved the process of keeping knowledge of the launch time from the Warfighters. The testing included increased use of operational tactics, techniques, and procedures; and added more communication links to the test architecture. The final Terminal High Altitude Area operational fielding configuration will be included in future testing.

To fully assess the capability of an integrated Ballistic Missile Defense System, operational doctrine for simultaneous theater, regional, and homeland defense must mature. Wargames and improved test architectures are needed to support Warfighter doctrine and tactics, techniques, and procedures development.

Integration of Models and Simulations in the test program

We concur with the Missile Defense Agency plan to place increased emphasis on the development and implementation of validated system level hardware-in-the-loop and digital models that can be used to assess regional, theater, and strategic operational performance. The quality of element and component verification and validation products improved over the past two years. However, work is still needed in providing adequate verification and validation data/documentation to increase confidence in the Models and Simulations representations. This includes an increased emphasis on environmental simulations and codes and threat representations, to ensure these standards are applied properly in system performance simulations.

Target development/deployment

Target limitations related to both availability and performance continues to impact the value of flight test data. Both Aegis and Terminal High Altitude Area Defense require advanced targets to engage stressing threats and beyond short-range ballistic missiles. We will assist in the prioritization of the target needs.

Question 2: Assessment of on-going three-phase review of the Ballistic Missile Defense System test program

The three-phased review of the test program is a progressive technical effort to drive future test design and resource requirements. The Operational Test Agency team supports this review and is working closely with the Missile Defense Agency to achieve success in all phases. We believe that this comprehensive review will support a meaningful assessment of effectiveness, suitability and survivability.

Question 3: Thoughts about current status of Ballistic Missile Defense System capabilities and future actions needed to ensure Effectiveness, Suitability, and Survivability

Current Status

As discussed by Missile Defense Agency and Director, Operational Test and Evaluation, missile defense testing in 2008 supported increased understanding of the currently fielded and developing Ballistic Missile Defense System capability and limitations. Missile Defense Agency and the Operational Test Agency team are committed to sharing data from all Ballistic Missile Defense System integrated system, element, and component level flight tests, ground tests, wargames, exercises, models and simulations, and lethality test and analysis, as well as data supporting assessment of reliability, availability, maintainability, interoperability, survivability, and supportability. The Missile Defense Agency has continued its emphasis on planning and conducting combined developmental and operational testing to the maximum extent possible during both flight and

ground tests. Additionally, as a part of the focus to support model validation, the Missile Defense Agency has established a process to conduct timely element and system Post Flight Reconstruction.

The Ballistic Missile Defense System Operational Test Agency Operational Assessment Report, 15 Jan 2009, documents the capabilities and limitations of the Ballistic Missile Defense System based on test events conducted in 2008, and provides the current status of system Effectiveness, Suitability, and Survivability. The system has demonstrated a limited capability to defend against simple, long-range threats launched from Northeast Asia. The Aegis Ballistic Missile Defense demonstrated capabilities to detect, track, and engage simple short and medium range targets, while the Terminal High Altitude Area Defense demonstrated capability to detect, track, and engage both short-range non-separating and simple separating targets. These demonstrations of capabilities significantly enhance the current regional/theater defense provided by the Patriot system. The Command, Control, Battle Management Communications Element demonstrated capability to provide situational awareness to Warfighters worldwide and to control the AN/TPY-2 radar in a forward-based sensor mode. Current data shortfalls, which resulted in low confidence in the assessment conclusions, include limited number of flight tests, maturity of the system, unaccredited models and simulations, limitations in operational realism including participation by trained military crews, incomplete suitability and survivability data, and threat representation.

Future Needs

A synchronized set of flight and ground tests, linked with verified, validated, and accredited models and simulations are required to adequately assess the operational effectiveness, suitability and survivability of the Ballistic Missile Defense System and its elements. The thorough examination of the entire test program will address identified data limitations. When the three-phase test review is complete, we will be able to determine when we can assess all elements of effectiveness, suitability, and survivability with medium to high confidence. Accredited models will generate data to predict performance across the entire mission battlespace against multiple/varying threats, defended areas, scenarios, and manmade/natural environments. Increased focus on regional/theater ballistic missile defense testing will provide credible information about these developing mission capabilities. As operational realism is enhanced, test results will provide increased confidence that assessment results will reflect system operation in the hands of the Warfighter.

Summary

Currently, the Missile Defense Agency's test program is undergoing a comprehensive review, initiated by the Missile Defense Agency Director. When that process is completed and executed, the resulting verified, validated, and accredited models and simulations, when combined with other test and analysis

information, will provide quality data upon which to base a comprehensive independent assessment of the Ballistic Missile Defense System.

This concludes my remarks and I look forward to answering your questions.

Prepared Remarks before the:

House Committee on Armed Services,
Subcommittee on Strategic Forces

The Future of Missile Defense Testing
Wednesday, February 25, 2009
1:00 p.m.
2212 Rayburn House Office Building

Philip E. Coyle, III
Senior Advisor
World Security Institute

Chairwoman Tauscher, Ranking Member Turner, distinguished Members of the Committee, I very much appreciate the opportunity to appear before you today to support your examination of the Department of Defense programs in missile defense and the future of missile defense testing.

I am a Senior Advisor to the non-profit Center for Defense Information, a division of the World Security Institute, a Washington, D.C.-based national security study center. To help insure our independence, the World Security Institute and the Center for Defense information do not accept any funding from the Federal government, nor from any defense contractors.

In 2005 and 2006, I served on the nine-member Defense Base Realignment and Closure Commission, appointed by President George W. Bush and nominated by House Democratic Leader, Nancy Pelosi.

Beginning in late 2004, I served on Governor Arnold Schwarzenegger's Base Support and

Retention Council, from which I resigned to serve on the President's Commission.

From 1994 to 2001 I served in the Pentagon as Assistant Secretary of Defense and Director, Operational Test and Evaluation. In this capacity, I was principal advisor to the Secretary of Defense and the Undersecretary of Defense for Acquisition, Technology and Logistics on test and evaluation in the DOD. I had OSD OT&E responsibility for over 200 major defense acquisition systems including the present-day missile defense programs.

From 1959 to 1979, and again from 1981 to 1993, I worked at the Lawrence Livermore National Laboratory. Over those 33 years I worked on a variety of high technology programs, and retired from the Laboratory in 1993 as Laboratory Associate Director and deputy to the Director.

In my current capacity at the Center for Defense Information I am called upon to provide independent analysis on various defense matters. I have over 40 years of experience involving U.S. and worldwide military research, development and testing, on operational military matters, and on national security policy and defense spending.

Introduction

There is a troublesome lack of clarity in public discourse regarding both the rationale for and the technical progress toward an effective U.S. missile defense network. Quite simply, the public statements made by Pentagon officials and contractors have often been at variance with the facts at hand. It is difficult to separate programmatic spin from genuine progress. In particular, the missile defense program has made claims that have not been demonstrated through realistic testing.

In this prepared testimony I outline the steps that the Missile Defense Agency must take. These include:

1. Test to establish operational criteria, such as the levels of effectiveness the system can and cannot achieve. For example, is it acceptable if the system is only 10 percent effective and 90 percent of enemy missiles get through?

2. Test to demonstrate that the system can withstand attacks involving multiple missiles – not just one or two.

3. Test to demonstrate that the system is operationally effective in the presence of realistic decoys and countermeasures.

4. Test to eliminate the gaps left from past flight intercept tests, including years of kicking the can down the road on basic operational questions such as can the system work at night, in bad weather, or under likely battlefield conditions?

The most complex defense acquisition programs can face scientific and technical obstacles which if not conquered are so fundamental that the programs will fail. For missile defense, the most challenging technical obstacles are dealing with enemy attacks or more than one or two missiles and with decoys and countermeasures that can defeat missile defense. So far the testing programs have been kicking that can down the road.

I'd like to make an analogy. Suppose the Pentagon had a program in which I was going to prove that I could flap my arms and fly. Millions of dollars could be spent building a special runway for my project. I might also need some special ramps and launchers, some feathers for my arms, and a hangar for my supplies and to get out of the rain. Then I would need a special air traffic control system. Flying humans are not yet a risk to commercial aviation but they certainly could be if humans could fly.

I might also need a mid-air refueling system. Flapping one's arms and flying takes a lot of energy, so I might need a way to be fed in flight.

For years the Pentagon and I could provide progress reports to Congress without ever testing the fundamental physics behind my project to fly. We would report on the progress with the construction of the runway, the hangar, and the launchers and ramps. Because a human body has a smaller radar cross section than a 747 we might have setbacks with the new air traffic control system and ask Congress for more time and money. The mid-air refueling system might be especially challenging, but wanting to support this intriguing new project, Congress might let me string them along for years without engaging the fundamental question that human flight entails, namely, can I really flap my arms and fly? If I can't solve that problem, my human flight project is doomed, even though I might have made marvelous progress on the other steps leading up to my ultimate challenge: real physical, human-powered flight.

Missile defense faces an analogous problem. From dedicated testing we need to find out if under realistic operational conditions the program can "fly."

In my imaginary program for human flight, I may have convincing computer models that show that I can fly. Leonardo DaVinci thought it was possible. But without tests that discover and demonstrate the basic principles, all my computer models will just be unproven theories.

"The Enemy Has a Vote"

Our military often observes, "The enemy has a vote." In missile defense this means that if the enemy is bound and determined to attack us, they will do whatever they can to overwhelm and confound U.S. missile defenses. This means that the enemy may launch many missiles, not just one or two, may make their warheads stealthy and hard to detect and track, and may use decoys and other types of countermeasures to fool or confuse the defenses. The enemy may attack at night or in bad weather, may use electronic jamming, and may use stealth.

Recently the White House said this about National Missile Defense: "The Obama-Biden Administration will support missile defense, but ensure that it is developed in a way that

is pragmatic and cost-effective; and, most importantly, does not divert resources from other national security priorities until we are positive the technology will protect the American public."

How will the administration and Congress be positive that missile defense will protect the American public?

To do this is going to require testing far beyond what we have seen to date.

The easiest ways for an enemy to overwhelm missile defenses are to:

1. Build more offensive missiles,
2. Use decoys and countermeasures to fool the defenses, and
3. Attack in ways that ballistic missile defenses are not designed to handle, such as with cruise missiles, or through terrorism or insurgency.

The Missile Defense Agency does not have a charter to counter terrorism, but the MDA is responsible to address the ways that an adversary might try to overcome or fool our missile defenses. The testing program must put those issues front and center, but that has not been happening.

Just as it would make no sense to avoid testing my ability to flap my arms and fly in my hypothetical project human flight project, it also makes no sense to avoid testing the ability of our missile defenses to handle the real world conditions of battle, an attack of more than one or two missiles, and the confusion from decoys and countermeasures.

A Perspective on the Threat

The Pentagon is developing a variety of missile defense systems, - land, sea, air, and possibly space-based – but the Ground-based Midcourse Defense system (GMD) – formerly called National Missile Defense (NMD) – attracts the most attention from lawmakers and the media. It is the largest and most complex of the systems, and the most costly. It is also the centerpiece in the current Defense Department plan for

defending the United States from long-range intercontinental ballistic missiles (ICBMs) fired by a hostile enemy. Closely related to the GMD system is the controversial U.S. missile defense system proposed for Europe which would establish an interceptor missile field in Poland and an X-band radar in the Czech Republic.

In my prepared testimony today I concentrate on those two systems, and make three overarching points:

(1) In my view, Iran is not so suicidal as to attack Europe or the United States with missiles. To me it is not credible that Iran would be so reckless as to attack Europe, or the United States, with a single missile – and also with no decoys or countermeasures - and then sit back and wait for the consequences. As we know, ballistic missiles have return addresses.

The launch of a small satellite by Iran earlier this month does not change this situation.

Similarly, North Korea is not so suicidal as to attack Japan or the United States with missiles, and North Korea is negotiating an end to its nuclear programs. Both Iran and North Korea have done some reckless things, but they know that an attack on Europe, Japan, or the U.S. would justify massive retaliation.

(2) Those who believe that Iran is bound and determined to attack Europe or America no matter what, also have to assume that Iran would do whatever it takes to overwhelm our defenses, including using decoys to fool the defenses, launching stealthy warheads, and launching many missiles, not just one or two. The Missile Defense Agency admits it can't handle that situation today, and accordingly their testing program must begin to address these challenges soon.

(3) The Pentagon claims to be able to handle at best one or possibly two missiles from Iran. If Iran believed that U.S. missile defenses were effective, and if Iran were reckless enough to attack Europe or the United States, Iran would simply build more missiles to overwhelm our defenses. This would hurt U.S. security. Thus if Iran did attack Europe

with more than one or two missiles, the missile defense system as proposed couldn't defend Europe anyway. Developing an effective system will require much new testing.

In its January 30, 2009 report to Congress, "Assessment Testing and Targets Program," the Missile Defense Agency (MDA) writes, "MDA conducts flight tests to verify, not to discover." [1] I fundamentally disagree with this, not because testing isn't needed to verify models and simulations – it is – but because without testing to discover, MDA will not be able demonstrate to itself and to the Congress that its programs can be operationally effective.

Besides, the MDA statement is not true; MDA discovers something in every flight test.

But more to the point, in the future, testing to discover will need to be paramount if the MDA is to address the many technical obstacles that they face. Avoiding discovery leads nowhere.

Last week Lt. Gen. O'Reilly invited me to meet with him, and also to spend the next day with his staff in briefings. I very much appreciate Gen. O'Reilly's courtesy. He described to me the three-phase review of the entire Ballistic Missile Defense System (BMDS) that he has just begun, and his philosophy for realistic testing for discovery and to address critical factors such as I enumerated above. A decade ago, then Col. O'Reilly demonstrated the importance of testing to discover in the THAAD program, and I believe he is trying to apply now that same straightforward testing philosophy to all missile defense programs in the MDA portfolio. Given the size and complexity of the overall BMDS this change in culture will not come easily. Demanding and attentive oversight by this Subcommittee will be critical if MDA is ever to provide effective and suitable systems.

As I explain with illustrative examples in my prepared testimony below, missile defense faces many daunting technical issues. Unless those critical issues are confronted head on,

missile defense will have reached a dead end. Thus MDA has no real choice but to embrace the philosophy and approach, which Gen. O'Reilly has charted.

The Current Lack of Operational Criteria

In reviewing the status of U.S. missile defense testing programs, I want to stress that the current programs have no operational criteria for success. How good is the system supposed to be? Is 10% effectiveness good enough? What about 1%? Can the system handle realistic threats as documented in Intelligence Community threat assessments? How many interceptors should be required to defeat one target?

Without answers to such questions, it is very difficult to design an adequate testing program, and for the U.S. Congress to evaluate the results. And, as has often been noted by the GAO, it also makes it difficult for the GAO or for my former office in the Pentagon to evaluate these programs for the Congress.

This also explains why the warfighter, e.g. STRATCOM, has been reluctant to say that the United States has an operational capability or whether it would be effective.

Nearly a decade ago President Clinton established four criteria against which he would make a deployment decision. The Clinton criteria, announced by the White House in December 1999, a year before he would make a decision, were:

1. "Whether the threat is materializing;

2. The status of the technology based on an initial series of rigorous flight tests, and the proposed system's operational effectiveness;

3. Whether the system is affordable; and

4. The implications that going forward with National Missile Defense (NMD) deployment would hold for the overall strategic environment and our arms control objectives."

At that time the goal was to be able to shoot down a single missile from an accidental or unauthorized launch from Russia or China, not to be able to defend against a deliberate missile attack. But at that time there had only been only three NMD flight intercept tests, and because the last two of those three tests failed, the missile defense system clearly was shown not to be effective.

As a result, President Clinton did not have to devote much time considering the cost or the international relations aspects of his decision to not deploy the system. The system simply had not been shown to be effective, and that was that.

During the Reagan years, Paul Nitze, the highly regarded scholar and statesman, presented three criteria that any - in those days it was the Strategic Defense Initiative (SDI) - missile defense system must meet before being considered for deployment. Nitze's criteria were formally adopted as National Security Directive No. 172 on May 30, 1985. The Nitze criteria were:

1. The system should be effective;

2. Be able to survive against direct attack; and

3. Be cost effective at the margin - that is, be less costly to increase your defense than it is for your opponent to increase their offense against it.

The Ground-based Missile Defense system being deployed in Alaska and California, and the proposed U.S. missile defense system for Europe, meet none of the above criteria, not the Clinton criteria and not the Nitze criteria. And new or different criteria for the system were not established by the administration of George W. Bush.

In making his decision in December, 2002, to deploy the GMD system in Alaska and at Vandenberg AFB in California by the end of 2004, President George W. Bush appears to have had no criteria other than a commitment to deploy hardware as quickly as possible.

As a result, U.S. missile defenses are being deployed without well-established operational criteria, and the Congress has no baseline from which to evaluate these missile defense programs.

For this reason, the criteria described above, both the Clinton criteria and the Nitze criteria, are still helpful today in helping us to gauge where we stand with missile defense, what we have gotten for the effort, and where we should be going.

The Lack of an Overall BMDS Architecture

The Missile Defense Agency (MDA) is pursuing a path of "spiral development," sometimes called, "Capability-Based Acquisition," concepts which have been taken to an unworkable extreme by the MDA. The extreme example is the overall Ballistic Missile Defense System about which the Missile Defense Agency has insisted, "There are currently no final or fixed architectures and no set of operational requirements for the proposed BMDS."

Under this approach, spiral development or other "dynamic acquisition" concepts become like building a house while the floor plan is constantly changing. It makes for a very expensive house, and if your family ever gets to move in, they find they don't like how their topsy-turvy house turned out.

With dynamic acquisition processes, especially capability-based acquisition, there may be no established baseline for even the first increments. In missile defense, and a few other complex DOD programs, the problems with dynamic acquisition stem from a lack of definite requirements.

The Defense Science Board has advised the DOD that "Each spiral should be an enforced baseline," and adds, "There needs to be a careful assessment of technological readiness, with risk reduction activity outside and preceding major program activity where significant technical risks exist." [2]

In missile defense, this advice is too often not heeded.

Without an enforced baseline of requirements or other established criteria, Congress cannot rely on the Pentagon's cost estimates, or know whether an effective system will result. Without established criteria Congress is buying another Winchester Mystery House, that famous 160-room Victorian mansion in San Jose, California, that was under continuous construction for 38 years without any master building plan. The maze-like house has staircases that lead to nowhere, second floor outside doors that open to nothing except a 10 foot drop, and oddly arranged rooms where you would least expect them.

Missile defense is the most difficult developmental program the Pentagon has ever attempted, beyond any Army tank, Navy ship, high performance jet fighter or helicopter. And those developmental programs often take 20 years or more. Missile defense has been under development in the United States for 60 years. A conservative estimate is that the U.S. has spent more than $120 billion on missile defense. From looking at figures from the Congressional Budget Office, I would estimate that since President Reagan's famous 'Star Wars" speech in 1983, about $150 billion has been spent. [3] And over the next five years, the Pentagon has requested another $62.5 billion for missile defense, with no end in sight.

If the Congress supports this spending on missile defense, by the end of 2013 over $110 billion will have been spent just since 2003, not counting the missile defense spending in the previous 20, 40, or 60 years.

To continue this level of spending without first knowing from realistic test results whether the overall BMDS can fly would be a costly mistake.

Testing to Withstand Enemy Salvo Launches or Multiple Missile Attacks

To be effective against even a relatively unsophisticated enemy, U.S. missile defenses must be able to withstand attacks involving more than one or two missiles. This is because it is relatively inexpensive for an adversary to build more offensive missiles once

it has developed and produced the first. Also, knowing that the first interceptor might miss, and to reduce the probability that the defenses would be penetrated, U.S. military doctrine is to shoot as many as five interceptors at each incoming enemy missile, as was explained to the House Armed Services Committee by the Undersecretary of Defense for Acquisition, Technology and Logistics in testimony in 2003 [4]. The idea is that if the first interceptor misses, perhaps the second won't, and so on.

Thus if Iran were to attack Europe with two missiles, and the defense were to shoot five interceptors at each one, ten interceptors might be consumed. However, only ten interceptors are proposed for Poland and so in battle those ten interceptors could be quickly exhausted. If Iran were to launch more than two missiles at Europe, there might be no interceptors left to repel further attacks.

Accordingly testing is needed to explore ways in which the defense might be made less vulnerable to multiple simultaneous or salvo attacks.

Testing with Decoys and Countermeasures

Decoys and countermeasures are the Achilles Heel of missile defense, of the missile defense systems being deployed in Alaska and California, and also of the U.S. missile defense system proposed for Europe.

To use a popular analogy, shooting down an enemy missile going 17,000 mph out in space is like trying to hit a hole-in-one in golf when the hole is going 17,000 mph. If an enemy uses decoys and countermeasures, missile defense is shooting a hole-in-one when the hole is going 17,000 mph and the green is covered with black circles the same size as the hole. The defender doesn't know which target to aim for.

In 1999 and in 2000, the U.S. Intelligence community provided assessments that North Korea or Iran would soon know, if they didn't already, how to field decoys and countermeasures.

A September 16, 1999 report by Robert Walpole, National Intelligence Officer for Strategic and Nuclear Programs, stated:

> "Penetration Aids and Countermeasures
>
> "We assess that countries developing ballistic missiles would also develop various responses to US theater and national defenses. Russia and China each have developed numerous countermeasures and probably are willing to sell the requisite technologies.
>
> "Many countries, such as North Korea, Iran, and Iraq probably would rely initially on available technology - including separating RVs, spin-stabilized RVs, RV reorientation, radar absorbing material (RAM), booster fragmentation, low-power jammers, chaff, and simple (balloon) decoys - to develop penetration aids and countermeasures.
>
> "These countries could develop countermeasures based on these technologies by the time they flight test their missiles." [5]

Mr. Walpole's assessment is not surprising since decoy and countermeasure techniques are described in the public literature and on the internet.

As Mr. Walpole noted, decoys can include objects that provide a close representation of the attacking enemy missile or its warhead encased in a re-entry vehicle. For example, a simple balloon in the shape of a cone – the shape of a re-entry vehicle – would travel out in space as fast as the RV itself and be confusing to the defender. An enemy missile could carry many of these balloons that are inflated at the time of stage separation and travel along with the re-entry vehicle and other objects, such as the "bus" that first housed all these objects, and debris from stage separations.

The debris from stage separation itself could act as a kind of decoy as that debris might reflect, turn, or tumble in a manner resembling the target re-entry vehicle.

Countermeasures could include chaff or debris deliberately scattered by the attacker with the target missile or warhead to reflect the search radar of a missile defense system. This might be short metal wires – like paper clips - of the proper length, or bits of metal foil to reflect the radar, or to cloud the view the radar might otherwise have of the target.

For missile defense systems that operate in the infrared, flares or infrared burning pellets can be released by the attacker to confuse the defender. Even the angle of the sun can be important, heating various objects in the target cluster by different amounts. The five early, successful, GMD flight intercept tests that included simple round balloon decoys were all conducted so that the sun was shining away from the interceptor and "over its shoulder" and not shining into the "eyes" of the infrared seeker on the interceptor. As a result, the sun was heating up those balloons and making them hotter and easier to spot than they would have been at other times of the day or at night.

Different missile defense systems prompt the use of different sorts of decoys or countermeasures by the offense. For example, the Airborne Laser, is a high power laser carried in a jumbo 747 aircraft. But if the enemy paints their missiles with an ordinary white paint, a white paint that is 90% reflective to the laser, then 90% of the laser energy bounces off. [6] To compensate for this, the Airborne Laser would need to be ten times more powerful.

Missiles with polished aluminum surfaces can reflect about 95% of the energy. Special coatings can raise reflectivity further, to 98% and more.
If the enemy missile rotates, as sometimes missile do, the focus of the ABL laser would no longer being in the same place. Just as burning a leaf with a magnifying glass requires keeping the sun focused on one spot, the ABL will have a better chance of working if the enemy missile is not rotating. Since missiles tend to rotate anyway, this would take almost no effort on the part of an enemy.

Yet another countermeasure against the ABL would be an ablative coating that burned

off the outside of the enemy missile. The ABL laser might burn the ablative blanket but not the missile inside.

For radars, jamming or electronic interference with the radar is another common countermeasure. An enemy also can apply radar absorbing materials to the attacking missiles or re-entry vehicles to reduce their radar cross-sections and make them "stealthy" and less easily detected by radar.

In all-out battle, missile defense radar and interceptor sites would be prime targets for an enemy. The Director, Operational Test and Evaluation notes this also in his January 2009 Report to Congress, saying, "Specific assets are lightly protected from physical attack." [7]

Testing GMD System Target Discrimination

Last year, the MDA noted that there were five early flight intercept tests that used simple round balloons as decoys. The MDA has told the press that five successful intercept tests from 1999 to 2002 used the type of decoys we would expect "from countries such as North Korea and Iran." [8]

But the decoys in those tests did not resemble the target re-entry vehicle (RV).

With respect to those five early tests, the decoys used were round balloons, not ice-cream cone shaped like the mock target, and with much different infrared signatures than the target warhead.

MDA has asserted that North Korea or Iran will do exactly what MDA has done, namely, use round balloons as decoys that have infrared signatures that are different from the RV, not balloons that resemble the RV in shape and/or signature.

If North Korea or Iran were to attack the United States, why wouldn't North Korea or Iran try to confuse our missile defenses? Are we to depend on North Korea or Iran being

smart enough to make balloons that are both larger and smaller than would be required to fool us, but not the proper size to fool us?.

MDA has never done a GMD flight intercept test where the decoy or decoys resembled the RV in shape and/or infrared signature.

In a report issued on February 28, 2002, the GAO reviewed the technical challenges of conducting flight intercept tests with decoys that closely match the target, and explained why the MDA had decided then to use decoys that did not resemble the target RV. [9]

Basically, the MDA and its advisors felt that such tests would be too stressing, that is, why take the chance with tests that might fail?

Thus it is misleading for the MDA to suggest now that those early flight intercept tests demonstrated the capability to discriminate real targets from well-matched decoys, or decoys that would be representative of what the Intelligence Community has assessed North Korea or Iran could field today.

The Limitations of Past GMD Flight Intercept Tests

Flight intercept tests with parts of the GMD system have been ongoing for nearly a decade.

So far there have been 14 GMD flight intercept tests. Seven of these 14 tests have been successful, but seven have failed for one reason or another. By failed I mean the primary purpose of the test was not achieved. This is not to suggest that nothing was learned or that the test was not valuable.

Two failed because the Exoatmospheric Kill Vehicle (EKV) located atop the interceptor failed to separate from its booster, and two other tests failed because the interceptor never got off the ground. One test failed because the infrared sensor on the EKV did not cool properly, and two other tests failed because of problems with the mock targets.

By that measure the success rate is 50%. But in the last five years there have only been 6 flight intercept tests, and four of those have failed, a success rate of only 33%. The MDA counts the most recent of those six tests as a partial failure, but considering that the main reason for the test was not achieved, it was a serious setback.

Thus, in the past five years there have been just two successful GMD flight intercept tests. The MDA still must carry out successfully about 20 or more, perhaps 25, flight intercept tests of different types before the system could fully demonstrate effectiveness in a series of realistic operational tests. If MDA does not improve their rate of success, it could take them 50 years to achieve 20 successful flight intercept tests. By then we may face drastically different threats to U.S. national security that may render these missile defense systems useless and outdated.

Obviously the MDA must increase both its rate of success and its rate of testing overall in the GMD program. However, the issue is not just additional tests, although many more tests will be needed, but also the design of new types of tests, the type and extent of instrumentation, the sensors characterized, and the metrics probed.

FTG-05: A Lost Opportunity

From a target discrimination point of view, during the past five years the flight intercept tests have been simpler and less realistic than the tests in the first five years. None of the GMD flight intercept tests have included decoys or countermeasures during the past seven years.

The most recent GMD flight intercept test, FTG-05, conducted December 5, 2008, was intended to be the first test in seven years to include decoys, but in this test the decoys failed to deploy.

However, even if the decoys had deployed, those decoys would have been less sophisticated than the countermeasures flown in 2002, seven years ago. To put it

differently, the early GMD flight intercept tests circa 1997-1998 used more sophisticated countermeasures than the countermeasures planned for this most recent test, FTG-05.

This means that even if FTG-05 had been "successful," MDA would not have been able to claim that they had moved the ball forward from a target discrimination point of view. If the decoys had deployed in FTG-05 last December, the EKV would have been LESS challenged than in flight intercept tests with decoys a decade ago. In those earlier tests, the decoys also were not decoys in the true sense of the word, that is, they were not objects designed to fool the EKV by matching the target RV in infrared signature.

MDA might say that this decision was "to reduce risk," which is short-hand for not wanting to take the chance that they would miss, that is, so that FTG-05 would not be a failure, which it turned out to be anyway when the decoys did not deploy.

However, before the FTG-05 test, MDA claimed that the countermeasures would be threat representative, as follows:
"The threat target will include representative countermeasures and a threat representative warhead re-entry vehicle that will be discriminated and intercepted by the ground based interceptor (GBI). These countermeasures are the first in a series to be use in testing the operational GBI and are fully representative of countermeasures that might exist on an adversary's intercontinental ballistic missile. These countermeasures have been designed to be threat representative and will accurately test the Ballistic missile defense system." [10]

By going to a special set of decoys custom built for FTG-05, MDA had planned to use decoys in FTG-05 that were not as fully threat representative as claimed.

Testing the System under Realistic Operational Conditions

In addition, tests also are needed to demonstrate that the system can work at night or in bad weather, when the sun is shining in a disadvantageous direction, when the enemy re-entry vehicle is spin-stabilized to minimize its radar cross section, and alternatively when

tumbling and not spinning, when multiple attempts are needed to bring down a single target, and when more than one missile is launched by an enemy.

The MDA has fallen far behind in demonstrating these capabilities. Consider nine examples:

1. In the Clinton administration, the first test with a tumbling enemy RV [11] was planned to have been in early 2001, but it hasn't happened yet. So that's a slip of at least 8 years, and it is unlikely that the MDA will try to test with a tumbling RV anytime soon.

2. The first nighttime test [12] was to have been on December 11, 2002. It still hasn't happened either. So that's at least 7 years behind schedule if they tried a nighttime test later this year. Also unlikely.

3. The first test with decoy balloons that closely resembled the target RV was to have been in the Summer of 2002. Again, no chance this will happen any time soon.

4. In March 2002, MDA told Congress the first GMD test with multiple targets, that is, with several mock enemy missiles launched at once could take place as early as 2005. Now it is unknown when that might happen.

5. The Sea-based X-band radar (SBX) has never fulfilled its intended role in a flight intercept test, and may not be suitable for bad weather. The Director of Operational Test and Evaluation notes, "The MDA has yet to station SBX at its home port of Adak, Alaska, leaving the suitability of the SBX to be operated and maintained in that environment unknown." [13]

6. The MDA has never had a successful flight intercept test in the high-speed engagement conditions that can result from a long-range ICBM trajectory.

7. In past flight intercept tests, with the interceptor based at Kwajalein, MDA has waited until the mock enemy target launched from Vandenberg nearly reached Kwajalein before attempting an intercept.

This maximized the time to track the target and be sure of its trajectory, but left too little time for a second try if the first try missed. The Missile Defense Agency has said that their intended mode of operation will be to try more than once to hit an enemy target to increase the probability of success. But to do this requires taking the first shot much earlier so that there could be time for a second, third, or fourth attempt, something they've never tried.

8. The MDA also has never demonstrated in a flight intercept test that they can redirect or steer the Exo-atmospheric Kill Vehicle (EKV) with successive In-flight Target Updates to the correct target despite other confusing objects or decoys in the target cluster. To discriminate between similar looking or confusing objects, the system will have to be able to redirect the EKV in real time to focus on a new object different from another object the EKV may have picked out incorrectly. This has never been demonstrated in a GMD flight intercept test.

9. Some of the elements of the planned BMDS system-of-systems do not yet exist. For example, the Space-Based Infrared System (SBIRS)-High and the Space Tracking and Surveillance System (STSS) – satellite systems that are important for missile defense and warning - are billions of dollars over budget and years behind schedule. The GAO has reported repeatedly on the difficulties with these systems.

If, as the MDA has asserted in the past, the GMD system can already defend the United States when two major satellite systems for missile defense – SBIRS-High and STSS – do not exist, why should the Congress appropriate funds for these satellite systems? And if these satellite systems are required, how can the MDA claim that the system defends us today?

Of course, new testing will be required to demonstrate that these satellite systems, once they are available, can perform within the overall BMDS system-of-systems, and can perform as part of the GMD system.

Testing Proposed U.S. Missile Defenses for Europe

If, as proposed, the U.S. missile defense system for Europe is to defend both Europe and the United States, this requires the system in Europe to handle BOTH intermediate-range ballistic missiles aimed at Europe and intercontinental missiles aimed at the United States.

As such, the proposed system in Europe must operate as both a mid-course system and a post-boost, ascent phase system.

This is something that the Ground-based Interceptors (GBIs) in Alaska and California cannot do, and which has never been demonstrated with GMD interceptors in any location.

To be effective with this dual mission, the proposed system must be able to demonstrate a capability that the prototype system in Alaska and California has never demonstrated and cannot do from those locations.

The interceptors proposed to be located in Poland would be much closer to Iran than GBI interceptors in Alaska and California are to North Korea. This means the time available for response and engagement would be much shorter than the time available to intercept missiles from North Korea.

Such short timelines have never been attempted with the GMD system in a flight intercept test, and this presents new challenges that must be resolved through testing.

These shorter timelines would be stressing enough if the radar proposed to be located in the Czech Republic had adequate range to detect an Iranian missile launch as soon as it

cleared the horizon. However, recent technical analysis suggests that the proposed radar's range is too short to provide prompt track data or discrimination for long-range missiles launched from the Middle East toward the United States. [14]

Obviously these issues also will need to be resolved through rigorous testing.

In addition, Iran could perhaps field intermediate range missiles more easily than ICBMs, and so to be effective the proposed European system might have to deal with several intermediate-range missiles fired at Europe, requiring multiple, simultaneous engagements by the proposed interceptors in Poland.

This capability has never been demonstrated through flight intercept tests with the GMD system.

Before deciding to fund the proposed system in Europe, the U.S. Congress should examine in considerable detail the results from future flight intercept tests that will attempt to demonstrate the capabilities described above, and review whether then the system has "demonstrated through successful, operationally realistic flight testing, a high probability of working in an operationally effective manner," as required by the FY-2008 Defense Authorization Act and as signed by President Bush. [15]

To match the near-term plans that the MDA has for beginning construction in Europe and for deploying U.S. missile defenses in Europe, these tests will need to be planned, scheduled, and conducted soon.

Testing the Multiple Kill Vehicle Program

To try to deal with enemy countermeasures, the MDA is pursuing the Multiple Kill Vehicle program, and this is an example of another program that will require a new approach to testing at the MDA. Conceptually, the MKV is a set of smaller interceptors, that is, small kill vehicles, carried onboard a GMD Carrier Vehicle. [Potentially MKVs might be carried on the Kinetic Energy Interceptor or on Aegis interceptors, also.] If

hitting a single target with a single interceptor is like hitting a bullet with a bullet, the MKV is like hitting a shotgun with a shotgun.

The MKV concept is "many on many," the idea being that the MKV will be able to carry as many small kill vehicles as the enemy would put up targets and decoys.

A difficulty is that each small interceptor must carry sensors, guidance, and propulsion systems, and these features add weight. For this reason the MKV interceptor may only carry a few small interceptors. Artist's renderings of the MKV show a dozen small kill vehicles, but in actual practice only a few small kill vehicles may be all that will fit.

The MKV is like hitting a shotgun with a shotgun when the defender's shotgun shell only has a dozen or fewer pellets. If the enemy launches more warheads, or launches more countermeasures and RV targets than the number of small kill vehicles the MKV can carry, the MKV will be overwhelmed.

In prepared testimony before the Senate Armed Services Committee on April 1, 2008, the MDA Director explained the MKV as follows:

"In the years ahead we expect our adversaries to have midcourse countermeasures. The Multiple Kill Vehicle (MKV) program is developing a payload for integration on midcourse interceptors to address complex countermeasures by identifying and destroying all lethal objects in a cluster using a single interceptor." [16]

The single interceptor referred to in the MDA Director's statement would be a two-stage version of the three-stage Ground-based Interceptor (GBI), or something similar to the interceptors now deployed in Alaska and California. Each GBI would carry a Carrier Vehicle that in turn would carry a number of small kill vehicles as described above.

Demonstrating that the MKV can do what the MDA Director said, namely, identify and destroy "all lethal objects in a cluster using a single interceptor" will require a new

approach to missile defense testing.

The MDA hopes to demonstrate MKV capability by 2017. [17]

The Nuclear Environment

The Pentagon does not explain it, but the Congress will remember that if we ever need to rely on missile defenses against enemy ICBMs it would be in an environment where nuclear weapons are exploding, even in an all-out nuclear war.

In all-out nuclear war, some of those enemy missiles could reach their targets, including the ones that U.S. missile defenses miss.

Some enemy ICBMs might be equipped with warhead fuses to go off before an approaching interceptor would reach them.

Some enemy ICBMs might be deliberately triggered to explode at high altitude, to cause Electromagnetic Pulse (EMP) interference that can disrupt U.S. military command and control including U.S. missile defense command and control systems. EMP effects also can disable satellite systems and computer systems that enable the U.S. to detect the source of an attack.

So when we talk about "realistic operational conditions," that includes the effects of the nuclear environment – mushroom clouds, blast, neutrons, x-rays - on U.S. missile defense silos, radars, satellites, and command and control installations.

There is no evidence that missile defense could be depended upon under those conditions. As the Director Operational Test and Evaluation puts it in the Survivability section of his January 2009, report to Congress, "Specific assets are unhardened to nuclear, biological, or chemical attack." [18]

Conclusion

Without results from dramatically increased testing the Congress will not be adequately informed about the capabilities, limitations, or liabilities of U.S. missile defense systems.

Currently U.S. missile defenses have not demonstrated effectiveness to defend Europe or the U.S. under realistic operational conditions. U.S. missile defenses lack the ability to deal with decoys and countermeasures, lack demonstrated effectiveness under realistic operational conditions, and lack the ability to handle attacks involving multiple missiles.

With respect to the latter, and referring to the most basic capability called "Block 1", the Director, Operational Testing and Evaluation puts it this way in his January 2009, Report to Congress, "Block 1 has not demonstrated interceptor performance in a salvo defense (multiple interceptors against multiple targets) or in a multiple simultaneous engagement (multiple interceptors against multiple targets) in a flight test." [19]

From the examples given in the pages above it is clear that the GMD system and the U.S. missile defense system proposed for Europe require challenging and realistic testing before Congress and the administration can determine if those systems can be operationally effective and operationally suitable, and whether those systems can defend the American people and our friends and allies in Europe. To do this will require increasing both the pace of testing overall and the success rate while also adding operational realism.

End Notes

[1] MDA Report to Congress, Assessment of Testing and Targets Program, page 5, January 30, 2009.

[2] Reference: Enabling Joint Force Capabilities, DSB, 2003.

[3] See Congressional Budget Office, "The Long-Term Implications of Current Defense Plans and Alternatives," various years.

[4] Hearing, House Committee on Armed Services, March 20, 2003.

[5] Statement for the Record to the Senate Foreign Relations Committee on Foreign Missile Developments and the Ballistic Missile Threat to the United States Through 2015, by Robert D. Walpole, National Intelligence Officer for Strategic and Nuclear Programs, September 16, 1999.

[6] For example, see work on reflective white paint by NASA et al.

[7] Director Operational Test and Evaluation 2008 Assessment of the Ballistic Missile Defense System, January 2009, page 46.

[8] Letter to the Editor, *Boston Globe*, Rick Lehner, U.S. Missile Defense Agency, Washington, DC., April 11, 2008.

[9] GAO-02-124, Review of Results and Limitations of an Early National Missile Defense Flight Test, issued in February 2002.

[10] Press release, Missile Defense Agency, December 5, 2008.

[11] A test with a tumbling RV is important because an enemy might not "spin up" its

warheads for greater accuracy. If aiming at Los Angeles an enemy doesn't need accuracy. Sometimes in tests the United States will have trouble spinning up an RV and it will tumble. An enemy could have that trouble also. A tumbling RV presents a "blinking" signal to the GMD sensors. But other objects in the target suite - traveling along in space with the warhead RV - are tumbling also, for example the bus, and other pieces of metal or debris from stage separations. If the GMD system cannot tell one object that is tumbling from another, it won't know which one to aim for.

[12] Nighttime tests are important because the GMD system uses infrared heat sensors to "see" the target. At night the enemy reentry vehicle may not have been exposed to the heat of the sun, and so it could be colder and harder to see.

[13] Director Operational Test and Evaluation 2008 Assessment of the Ballistic Missile Defense System, January 2009, page 46.

[14] See for example, Bulletin of the Atomic Scientists, "The European missile defense folly," George N. Lewis and Theodore A. Postol, May/June 2008, Vol. 64, No. 2.

Also see, "Technical Effectiveness of European Ballistic Missile Defense Options, Dean Wilkening, Stanford University Center for International Security and Cooperation, Wilton Park, October 31, 2008.

[15] H.R.4986, National Defense Authorization Act for Fiscal Year 2008 (Enrolled as Agreed to or Passed by Both House and Senate)

[16] Testimony, Lieutenant General Henry A. Obering III, USAF
Director, Missile Defense Agency,
Missile Defense Program and Fiscal Year 2009 Budget
Before the Senate Armed Services Committee
Subcommittee on Strategic Forces
April 1, 2008

[17] *Defense Acquisitions. Progress Made in Fielding Missile Defense, but Program Is Short of Meeting Goals*. GAO-08-448, March, 2008.

[18] Director Operational Test and Evaluation 2008 Assessment of the Ballistic Missile Defense System, January 2009, page 46.

[19] Director Operational Test and Evaluation 2008 Assessment of the Ballistic Missile Defense System, January 2009, page 45.

DISCLOSURE FORM FOR WITNESSES
CONCERNING FEDERAL CONTRACT AND GRANT INFORMATION

INSTRUCTION TO WITNESSES: Rule 11, clause 2(g)(4), of the Rules of the U.S. House of Representatives for the 111th Congress requires nongovernmental witnesses appearing before House committees to include in their written statements a curriculum vitae and a disclosure of the amount and source of any federal contracts or grants (including subcontracts and subgrants) received during the current and two previous fiscal years either by the witness or by an entity represented by the witness. This form is intended to assist witnesses appearing before the House Armed Services Committee in complying with the House rule.

Witness name: PHILIP E. COYLE

Capacity in which appearing: (check one)

X Individual

___Representative

If appearing in a representative capacity, name of the company, association or other entity being represented:_____

FISCAL YEAR 2009

federal grant(s) / contracts	federal agency	dollar value	subject(s) of contract or grant
NONE			

FISCAL YEAR 2008

federal grant(s) / contracts	federal agency	dollar value	subject(s) of contract or grant
NONE			

FISCAL YEAR 2007

Federal grant(s) / contracts	federal agency	dollar value	subject(s) of contract or grant
NONE			

Federal Contract Information: If you or the entity you represent before the Committee on Armed Services has contracts (including subcontracts) with the federal government, please provide the following information:

Number of contracts (including subcontracts) with the federal government:

Current fiscal year (2009): NONE;
Fiscal year 2008: NONE;
Fiscal year 2007: NONE.

Federal agencies with which federal contracts are held:

Current fiscal year (2009): NONE;
Fiscal year 2008: NONE;
Fiscal year 2007: NONE.

List of subjects of federal contract(s) (for example, ship construction, aircraft parts manufacturing, software design, force structure consultant, architecture & engineering services, etc.):

Current fiscal year (2009): NONE;
Fiscal year 2008: NONE;
Fiscal year 2007: NONE.

Aggregate dollar value of federal contracts held:

Current fiscal year (2009): NONE;
Fiscal year 2008: NONE;
Fiscal year 2007: NONE.

Federal Grant Information: If you or the entity you represent before the Committee on Armed Services has grants (including subgrants) with the federal government, please provide the following information:

Number of grants (including subgrants) with the federal government:

Current fiscal year (2009): NONE;
Fiscal year 2008: NONE;
Fiscal year 2007: NONE.

Federal agencies with which federal grants are held:

Current fiscal year (2009): NONE;
Fiscal year 2008: NONE;
Fiscal year 2007: NONE.

List of subjects of federal grants(s) (for example, materials research, sociological study, software design, etc.):

Current fiscal year (2009): NONE;
Fiscal year 2008: NONE;
Fiscal year 2007: NONE.

Aggregate dollar value of federal grants held:

Current fiscal year (2009): NONE;
Fiscal year 2008: NONE;
Fiscal year 2007: NONE.

United States Government Accountability Office

GAO

Testimony

Before the Subcommittee on Strategic Forces, Committee on Armed Services, House of Representatives

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DEFENSE ACQUISITIONS

Charting a Course for Improved Missile Defense Testing

Statement of Paul Francis, Director, Acquisition and Sourcing Management

GAO
Accountability * Integrity * Reliability

GAO-09-403T

February 25, 2009

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Highlights

Highlights of GAO-09-403T, a testimony before the Subcommittee on Strategic Forces, Committee on Armed Services, House of Representatives

DEFENSE ACQUISITIONS

Charting a Course for Improved Missile Defense Testing

Why GAO Did This Study

The Missile Defense Agency (MDA) has spent about $56 billion and will spend about $50 billion more through 2013 to develop a Ballistic Missile Defense System (BMDS). This testimony is based on two reviews GAO was directed to conduct in 2008. In addition to our annual review assessing the annual cost, testing, schedule, and performance progress MDA made in developing BMDS, we have also reported on MDA's targets program. In this testimony we discuss (1) the productivity of MDA's recent test program, (2) the consequences of the testing shortfalls, and (3) key factors that should be considered as MDA revises its approach to testing.

GAO assessed contractor cost, schedule, and performance; tests completed; and the assets fielded during 2008. GAO also reviewed pertinent sections of the U.S. Code, acquisition policy, and the activities of a new missile defense board.

What GAO Recommends

We have previously made recommendations to improve the MDA's testing and targets programs that include establishing a revised business case for providing targets for a robust flight test program as well as adding sufficient scope to tests to enable an assessment of the BMDS' suitability and effectiveness, but MDA only partially agreed. We also have a draft report that is currently with DOD for comment that includes additional recommendations regarding testing.

View GAO-09-403T or key components. For more information, contact Paul Francis, 202-512-4841, Francisp@gao.gov.

What GAO Found

The scale, complexity, cost and safety associated with testing the missile defense system constitute a unique challenge for MDA, test agencies and other oversight organizations. This challenge is heightened by the fact that missile defense assets are developed, produced, and fielded concurrently. Overall, during fiscal year 2008, testing has been less productive than planned. While MDA completed several key tests that demonstrated enhanced performance of BMDS, all elements of the system had test delays and shortfalls, in part due to problems with the availability and performance of target missiles. GMD in particular was unable to conduct either of its two planned intercept attempts in fiscal year 2008. While it did subsequently conduct one in December 2008, it was not able to achieve all primary objectives because the target failed to release its countermeasures. As a result, aspects of the fielded ground-launched kill vehicles may not be demonstrated since no more flight tests have been approved. Target missiles continue as a persistent problem in fiscal year 2008 as poor target performance caused several tests to either fail in part or in whole.

Testing shortfalls have had several consequences. First, they have delayed the validation of models and simulations, which are needed to assess the system's overall performance. As a result, the performance of the fielded BMDS as a whole cannot yet be determined. Second, the production and fielding of assets has continued and in some cases has gotten ahead of testing. For example, enhanced Exoatmospheric Kill Vehicles will now be produced and delivered before they are flight tested. Third, MDA has relied on a reduced basis—fewer test, model, and simulation results—to declare capabilities as operational in the field.

MDA has undertaken a three-phase review of the entire BMDS test program that involves identifying critical variables that have not been proven to date, determining what test scenarios are needed to collect the data, and developing an affordable, prioritized schedule of flight and ground tests. This review, as long as it continues to involve test and evaluation organizations, appears to offer a sound approach for closing the gaps that exist between testing, modeling, and simulation. Critical to being able to implement the approach will be addressing the factors that have limited the productivity of the current test approach, such as the availability and performance of targets. An additional consideration in a new testing approach must be to ensure that assets are sufficiently tested before they are produced and fielded. An important consideration in this regard is for modeling, simulation, and testing events to be re-synchronized so that they properly inform decisions on producing, fielding, and declaring assets operational. Contingency plans could then be formed for adjusting the pace of these decisions should shortfalls occur in modeling, simulation, or testing. Because MDA has indicated implementation will take time, managing the transition may need to include reassessing the ambitious fiscal year 2009 test plan. In the mean time, MDA will have to be prudent in making decisions to produce and field assets.

Madame Chairman and Members of the Subcommittee:

I am pleased to be here today to discuss the future of the Missile Defense Agency's (MDA's) testing program.

MDA has been charged with developing and fielding the Ballistic Missile Defense System (BMDS), a system expected to be capable of defending the United States, deployed troops, friends, and allies against ballistic missiles of all ranges in all phases of flight. In fulfilling this charge, MDA placed an initial set of missile defense components in the field in December 2005.

The National Defense Authorization Acts for fiscal years 2002, 2007 and 2008 mandated that we prepare annual assessments of MDA's ongoing cost, schedule, testing, and performance progress. In March 2009, we plan to issue our report covering MDA's progress toward achieving its goals during fiscal year 2008 as well as its efforts to improve transparency, accountability, and oversight. Additionally, in September 2008, we issued a report on MDA's Target Program. My statement today will focus on the testing-related issues covered in both reports. We conducted these performance audits from February 2008 to February 2009 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

The Missile Defense Agency's mission is to develop an integrated and layered BMDS to defend the United States, its deployed forces, allies, and friends. In order to meet this mission, MDA is developing a highly complex system of systems—land, sea and space based sensors, interceptors and battle management. Since its initiation in 2002, MDA has been given a significant amount of flexibility in executing the development and fielding of the BMDS. To enable MDA to field and enhance a missile defense system quickly, the Secretary of Defense in 2002 delayed the entry of the BMDS program into the Department of Defense's traditional acquisition process until a mature capability was ready to be handed over to a military service for production and operation. Therefore, the program concurrently develops, tests and fields assets. This approach helped MDA rapidly deploy an initial capability. On the other hand, because MDA can field

assets before all testing is completed, it has fielded some assets whose capability is uncertain.

Because MDA develops and fields assets continuously, it combines developmental testing with operational testing. In general, developmental testing is aimed at determining whether the system design will satisfy the desired capabilities; operational testing determines whether the system is effective, survivable, and suitable in the hands of the user. MDA conducts testing both on the ground and in flight. The most complex of these is an end-to-end flight test that involves a test of all phases of an engagement including detecting, tracking and destroying a target with an interceptor missile. An end-to-end intercept involves more than one MDA element. For example, a recent intercept test involved a target flown out of Kodiak, Alaska, tracked by the AN/TPY-2 radar located in Alaska, and the Beale upgraded early warning radar located in California, the Sea-based X-band radar and an Aegis radar located at different points in the Pacific. All of the radars communicated with fire control centers in Alaska to guide an interceptor launched from California to hit the target over the Pacific Ocean.

Due to the complexity, scale, safety constraints, and cost involved, MDA is unable to conduct a sufficient number of flight tests to fully understand the performance of the system. Therefore, MDA utilizes models and simulations, anchored by flight tests, to understand both the developmental and operational performance of the system. To ensure confidence in the accuracy of modeling and simulation the program goes through a process called accreditation. The models are validated individually using flight and other test data and accredited for their intended use. Models and simulations are used prior to a flight test to predict performance, the flight test is then run to gather data and verify the models, and then data is analyzed after the flight and reconstructed using the models and simulations to confirm their accuracy.

MDA intends to group these models into system-level representations according to user needs. One such grouping is the annual performance assessment, a system-level end-to-end simulation that assesses the performance of the BMDS configuration as it exists in the field. The performance assessment integrates element-specific models into a coherent representation of the BMDS. Fundamentally, performance assessments anchored by flight tests are a comprehensive means to fully understand the performance capabilities and limitations of the BMDS.

In addition to testing, modeling and simulation, and performance assessments, MDA also has a formal process for determining when a newly fielded asset or group of assets can be declared operational—that is, cleared for use by the warfighter in operational situations. MDA uses a variety of information as a basis to assess a new capability for declaration. For example, MDA will define in advance tests, models, and simulations it will use to base a specific decision on whether an asset or capability can be declared ready for fielding. Each capability designation so designated represents upgraded capacity to support the overall function of BMDS in its mission as well as the level of MDA confidence in the system's performance.

To assess testing related progress in fiscal year 2008, we examined the accomplishments of ten BMDS elements that MDA is developing and fielding. Our work included examining documents such as Program Execution Reviews, test plans and reports, and production plans. We also interviewed officials within each element program office and within MDA functional directorates. In addition, we discussed each element's test program and its results with DOD's Office of the Director, Operational Test and Evaluation. We also interviewed officials from the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics.

Test, Targets and Performance Challenges Continue During Fiscal Year 2008

MDA continues to experience difficulties achieving its goals for testing. During fiscal year 2008, while several tests showed progress in individual elements and some system level capabilities, all BMDS elements experienced test delays or shortfalls. Most were unable to accomplish all objectives and performance challenges continued for many. Table 1 summarizes test results and target performance for the BMDS elements during the year.

Table 1: Fiscal Year 2008 Test and Targets Issues

Element	Tests/Activities Conducted as Scheduled	All Objectives Achieved	Target Issues
Airborne Laser	No	Yes	N/A
Aegis Ballistic Missile Defense (BMD)	No	No	Target availability delayed key test from 2008 until at least third quarter fiscal year 2009.
Command, Control, Battle Management and Communications	No	No	N/A
Ground-based Midcourse Defense (GMD)	No	No	Target failed to release countermeasures during December 2008 flight test—FTG-05.[a]
Kinetic Energy Interceptor	No	No	N/A
Multiple Kill Vehicle (MKV)	No	No[b]	N/A
Sensors	No	No	Target failed to release countermeasures during July 2008 testing (FTX-03).
Space Tracking and Surveillance System	No	No	N/A
Targets and Countermeasures	No	No	Flexible Target Family delivery delayed and experienced cost growth.
Terminal High Altitude Area Defense (THAAD)	No	No	Target experienced anomaly during a September flight test resulting in a no-test.

Source: GAO (presentation); MDA (data).

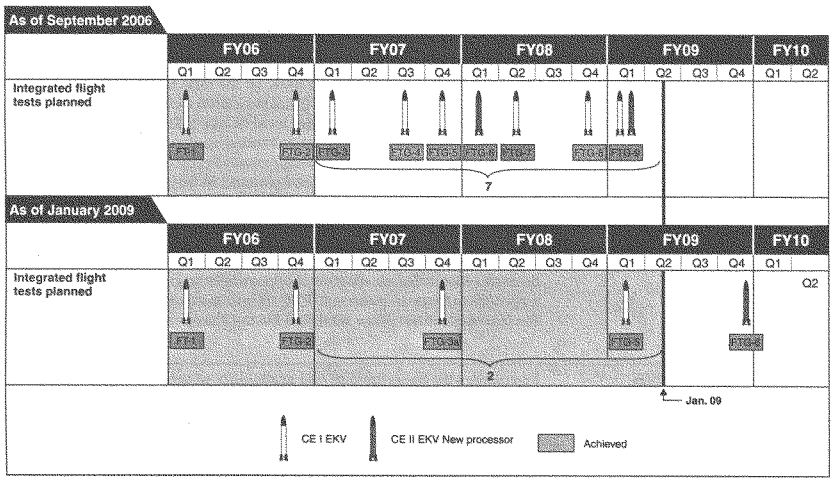
[a]This flight test was originally scheduled for fiscal year 2008, but was later executed in fiscal year 2009.

[b]The MKV program was able to achieve this test objective in the first quarter of fiscal year 2009.

Because of delays in flight test and a key ground test, MDA was unable to achieve any of the six knowledge points the MDA Director had scheduled for fiscal year 2008. In May 2007, the MDA Director established key system-level and element-level knowledge points, each based on an event that was to provide critical information—or knowledge—for a decision requiring his approval. For example, two knowledge points that MDA had to defer because of testing problems were confirmation of a new target's performance and assessment of the SM-3 Block 1A missile's ability to engage and intercept a long range target.

GMD in particular continues to experience testing problems and delays. Based on its September 2006 plan, MDA had expected to conduct 7 GMD interceptor flight tests from the start of fiscal year 2007 through the first quarter of fiscal year 2009. MDA however was only able to conduct two, as shown in figure 1.

Figure 1: GMD Reduction in Flight Test from January 2006 to March 2010



Source: GAO analysis of GMD's flight test and interceptor fielding schedule as of 2/25/07 and updated as of 1/31/09.

GMD was unable to conduct either of its planned intercept attempts during fiscal year 2008 – FTG-04 and FTG-05. MDA first delayed and then later cancelled the FTG-04 test in May 2008 due to a problem with a telemetry component in the interceptor's Exoatmospheric Kill Vehicle. The cancellation of FTG-04 removed an important opportunity to obtain end-game performance data needed to develop GMD models and to verify the capability of the fielded Capability Enhancement I (CE-I) EKV. Moreover, MDA planned to test the CE-I EKV against a dynamic target scene with countermeasures in both the FTG-04 and FTG-05 flight tests. However, since FTG-04 was cancelled and the target failed to release the countermeasure in FTG-05, the fielded CE-I's ability against countermeasures still has not been verified. According to MDA no more CE-I EKV flight tests have been approved.

The test delays led MDA to restructure its flight test plan for fiscal year 2009, increasing the number of tests, compressing the amount of time to analyze and prepare for subsequent tests, and increasing the scope of individual tests. For example, MDA plans to conduct 14 of 18 flight tests in the third and fourth quarter of fiscal year 2009. Past testing performance raises questions about whether this is realistic. In fiscal year 2008, MDA had planned to conduct 18 flight tests, but it only accomplished 10, and delayed several flight tests into 2009. In the next GMD end-to-end flight test—FTG-06 in fourth quarter fiscal year 2009 to first quarter fiscal year 2010 —MDA is accepting a higher level of risk than it previously expected in conducting this first test of an enhanced configuration of the Kill Vehicle called the Capability Enhancement II (CE-II)[1] because it will include several objectives that had planned to be previously tested, but have not been. For example, the FTG-06 flight test will be the first GMD test assessing both a CE-II EKV and a complex target scene. Adding to the risk, it will be only the second test using a newly developed FTF LV-2 target. Moreover, MDA in January 2008 had merged FTG-06 and FTG-07, thereby eliminating an additional opportunity to gather important information from an intercept. FTG-07 will instead be an intercept test of the two-stage interceptor intended for the European site.

Poor Target Missile Performance Continues to Hamper BMDS Testing

Problems with the reliability and availability of targets (which are themselves ballistic missiles) have increasingly affected BMDS development and testing since 2006. As MDA recently acknowledged, target availability became, in some cases, a pacing item for the overall test program. As was noted in Table 1, problems with targets have reduced testing of GMD, Sensors, and THAAD during 2008.

Repeated target problems and test cancellations have particularly reduced opportunities to demonstrate the ability of sensors to discriminate the real target from countermeasures. In the mid-course of flight, a more sophisticated threat missile could use countermeasures in an attempt to deceive BMDS radars and interceptor sensors as to which is the actual reentry vehicle. In order to improve the effectiveness of the BMDS against evolving threats, MDA elements are developing advanced discrimination software in their component's sensors to distinguish the threat reentry vehicle from countermeasures and debris. The cancellation of FTG-04 and

[1] The CE-II was intended to replace obsolescent parts, but it has demonstrated improved performance.

subsequent target problems during FTX-03 and FTG-05 prevented opportunities to gather data to test how well discrimination software performs in an operational environment. The current fielded configuration of the GMD kill vehicle has not been tested against countermeasures.

To address the growing need for more sophisticated and reliable targets for the future BMDS test program, MDA has been developing a new set of targets called the Flexible Target Family (FTF), which was intended to provide new short, medium, and long-range targets with ground, air, and sea launch capabilities. It was viewed as a family in the sense that the different target sizes and the variants within those sizes would use common components. MDA embarked on this major development without estimating the cost to develop the family of target missiles. MDA proceeded to develop and even to produce some FTF targets without a sound business case and, consequently, their acquisition has not gone as planned. The funds required for the FTF were spent sooner than expected and were insufficient for the development.

Development of all FTF sizes and variants has been discontinued except for the 72-inch diameter ground-launched target, referred to as the LV-2. With guidance from the Missile Defense Executive Board, MDA is currently conducting a comprehensive review of the targets program to determine the best acquisition strategy for future BMDS targets. It is expected to be completed in mid-2009. Whether or not MDA decides to restart the acquisition of the 52-inch diameter targets, or other FTF variants, depends on the results of this review.

The process of qualifying FTF target components for the LV-2 was more difficult than expected. While many of the LV-2's components are found on existing systems, their form, fit, function, and the environment they must fly in are different. Consequently, many critical components initially failed shock and vibration testing and other qualification tests and had to be redesigned. MDA has acknowledged that the component qualification effort ran in parallel with design completion and initial manufacturing. So far, the resultant delays in the LV-2 target have had two consequences. First, a planned test flight of the LV-2 itself for the Space Tracking and Space Surveillance program was delayed and instead its first flight will be as an actual target for an Aegis BMD intercept. Second, because the LV-2 was not ready, that Aegis intercept test was deferred from fiscal year 2008 to third quarter fiscal year 2009.

Other Consequences of Less Productive Testing

In addition to delaying progress on individual elements, testing problems have had other consequences for BMDS. Specifically, the reduced productivity of testing has delayed understanding the overall performance of BMDS, production and fielding have in some cases gotten ahead of testing, and declarations of capabilities ready for fielding have been made based on fewer tests and less modeling and simulation than planned.

Overall Performance of BMDS Can Not Yet Be Assessed

The overall performance of the BMDS cannot yet be assessed because MDA lacks a fully accredited end-to-end model and simulation capability and, according to the BMDS Operational Test Agency, it will not have that capability until 2011 at the earliest. The lack of sufficient flight test data has inhibited the validation of the models and simulations needed for the ground tests and the simulation. MDA's modeling and simulation program enables it to assess the capabilities and limitations of how BMDS performs under a wider variety of conditions than can be accomplished through the limited number of flight tests conducted. Flight tests alone are insufficient because they only demonstrate a single collection data point of element and system performance. Flight tests are, however, an essential tool used to both validate performance of the BMDS and to anchor the models and simulations to ensure they accurately reflect real performance. Computer models of individual elements replicate how those elements function. These models are then aggregated into various combinations that simulate the BMDS engagement of enemy ballistic missiles.

Developing an end-to-end system-level model and simulation has been difficult. MDA's first effort to bring together different element models and simulations to produce a fully accredited, end-to-end model and simulation was for the first annual performance assessment of the fielded BMDS configuration in 2007. Performance Assessment 2007 was unsuccessful primarily because of inadequate data, particularly flight test data, for verification and validation to support accreditation. Instead, Performance Assessment 2007 used several models and simulations that represented different aspects of the BMD system and were not fully integrated. Consequently, acting on a joint recommendation between MDA and the Operational Test Agency, MDA officials cancelled the 2008 performance assessment in April 2008 because of developmental risks associated with modeling and simulations, focusing instead on testing and models for Performance Assessment 2009.

According to the BMDS Operational Test Agency's January 2009 Modeling and Simulation accreditation report, confidence in MDA's Modeling and Simulation efforts remains low although progress was made during the year. Out of 40 models, the BMDS Operational Test Agency recommended

in January 2009 full accreditation for only 6 models, partial accreditation for 9 models, and no accreditation for 25 models. MDA is now exercising stronger central leadership to provide guidance and resources as they coordinate the development of verified and validated models and simulations.

MDA intends to verify and validate models and simulations by December 2009 for Performance Assessment 2009. However, BMDS Operational Test Agency officials stated that there is a high risk that the performance assessment 2009 analysis will be delayed because of remaining challenges and MDA's delayed progress in accreditation. MDA does not expect to have a single end-to-end simulation for use in performance assessments until 2010.

Production and Fielding Proceed Despite Delays in Testing and Assessments

Testing problems have contributed to a concurrent development, manufacturing and fielding strategy in which assets are produced and fielded before they are fully demonstrated through testing and modeling. For example, although a test of the ability of the SM-3 Block 1A missile to engage and intercept a long range ballistic target was delayed until the third quarter of fiscal year 2009, MDA purchased 20 of the missiles in fiscal year 2008 ahead of schedule.

While the GMD program has only been able to conduct two intercepts since 2006 for assessing the fielded configuration, the production of interceptors has continued. From the beginning of fiscal year 2007 through the first quarter of fiscal year 2009, MDA planned to conduct 7 flight tests and field 16 new ground-based interceptors. The plan included a test that would utilize two ground-based interceptors against a single target, known as a salvo test. By January 2009, GMD had conducted only 2 flight tests and dropped the salvo test; yet it fielded 13 ground-based interceptors.

Moreover, the GMD program had planned to conduct an intercept test to assess the enhanced version of the EKV called the Capability Enhancement II (CE-II) in the first quarter of fiscal year 2008, months before emplacing any interceptors with this configuration. However, developmental problems with the new configuration's inertial measurement unit and the target delayed the first flight test with the CE-II configuration—FTG-06—until at least fourth quarter fiscal year 2009. Despite these delays, emplacements will proceed; MDA expects to have emplaced five CE-II interceptors before this flight test. More importantly, GMD projects that the contractor will have manufactured and delivered 10 CE-II EKVs before that first flight test demonstrates the CE-II capability.

This amounts to over half of the CE-II EKV deliveries that are currently under contract.

Declaration of Capabilities Proceed with Reduced Levels of Information

When MDA determines that a capability can be considered for operational use it does so through a formal declaration. MDA bases its declarations on, among other things, a combination of models and simulations—such as end-to-end performance assessments (from missile launch to attempted intercept)—and ground tests all anchored to flight test data.

In fiscal year 2008, MDA declared it had fielded 7 of 17 BMDS capabilities planned for 2008 (postponing 10). In doing so MDA largely reduced the basis for the declarations due in part to test problems and delays. Specifically, MDA had intended to use a GMD flight test that was cancelled, a key ground test that was delayed and a performance assessment that was cancelled. MDA had to shift the basis of the 7 declarations to previous flight and ground tests.

Review of BMDS Modeling and Testing Holds Promise, but Must Anticipate Contingences

MDA has undertaken a three-phase review of the entire BMDS modeling, simulation, and test program. According to MDA, the three phases involve identifying critical variables that have not been proven to date, determining what test scenarios are needed to collect the data, and developing an affordable and prioritized schedule of flight and ground tests. MDA intends to complete all three phases of the review by May 2009. At this point, our knowledge of the review is limited, as we have only had an introductory briefing on it. Nonetheless, the review appears to offer a sound approach for closing the gaps that exist between testing, modeling, and simulation. Further, the involvement of test and evaluation organizations is encouraging.

While sound, the success of this approach hinges on providing sufficient resources, ensuring robustness, and anticipating contingencies. In addition to linking the critical modeling and simulation variables with test events, the review will have to address the factors that have limited the productivity of the current test approach, such as the availability and performance of targets. MDA's current approach to testing could be characterized as a just-in-time approach to having the test assets, such as targets, ready. This left little margin to solve issues that arise leading up to the tests. Accordingly, the third phase of MDA's new approach—properly resourcing the tests with sufficient time, funding and reliable targets—will be key. MDA has indicated that its revision will result in a more robust test plan, providing more margin to conduct the tests through, for example, having spare interceptors and targets available.

Other contingencies that a new approach to modeling, simulation, and testing should anticipate include unexpected or incomplete test results, and problems in accrediting the models that are needed for aggregated simulations, such as performance assessments. An important consideration in this regard is for modeling, simulation, and testing events to be re-synchronized so that they properly inform decisions on producing, fielding, and declaring assets operational. Contingency plans could then be formed for adjusting the pace of these decisions should shortfalls occur in modeling, simulation, or testing.

MDA has indicated that this new approach to testing will take time to implement, with partial implementation in fiscal year 2010 and full implementation not occurring until fiscal year 2011. Therefore, MDA must manage the transition to the new testing approach. In particular, the ambitious fiscal year 2009 flight test plan may need to be reassessed with the goal of establishing a robust series of tests that can withstand some delays without causing wholesale changes to the test plan during the transition. In the mean time, MDA will have to be prudent in making decisions to produce and field additional assets.

Our annual report on missile defense is in draft and with DOD for comment. It will be issued in final by March 13, 2009. In that report, we are recommending additional steps to further improve the transparency, accountability, and oversight of the missile defense program. Our recommendations include actions to improve cost reporting as well as testing and evaluation. DOD is in the process of preparing a formal response to the report and its recommendations.

Madame Chairman, this concludes my statement. I would be pleased to respond to any questions you or members of the subcommittee may have.

Contacts and Staff Acknowledgments

For questions about this statement, please contact me at (202) 512-4841 or Francisp@gao.gov. Individuals making key contributions to this statement include David B. Best, Assistant Director; Steven B. Stern; LaTonya D. Miller; Thomas Mahalek; Ivy Hübler; Meredith Allen Kimmett; Kenneth E. Patton; and Alyssa Weir.

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TESTIMONY OF DONALD C. MITCHELL

CHIEF ENGINEER FOR BALLISTIC MISSILE DEFENSE

THE JOHNS HOPKINS UNIVERSITY, APPLIED PHYSICS LABORATORY

BEFORE THE

HOUSE ARMED SERVICES COMMITTEE

SUBCOMMITTEE ON STRATEGIC FORCES

ON

STATUS OF BALLISTIC MISSILE DEFENSE TESTING

FEBRUARY 25, 2009

Chairwoman Tauscher, Ranking Member Turner, and other members of the subcommittee, thank you for the privilege of appearing before you today on the topic of Ballistic Missile Defense. My testimony today is drawn from reflections on my service to MDA during the last four years as either a member of the Mission Readiness Task Force or the Director for Readiness Assessment. In those capacities, I worked with the test and evaluation communities of GMD, Aegis BMD and THAAD as they prepared for firing exercises in order to provide an independent assessment to MDA/D of their readiness to conduct the missions. Although my testimony is based on these experiences while serving the Missile Defense Agency as a member of The Johns Hopkins University Applied Physics Laboratory, it should be taken solely as my personal view. Neither the Laboratory nor the Agency has approved these remarks, nor have they suggested points to be made in response to the topics for discussion included in the invitation to testify.

After reflecting on the three topics included in the Chair's invitation to testify, I concluded that the nation not only has a military capability that cannot be discounted by a potential adversary, but also is poised to claim even more robust performance that will counter improvements (e.g. countermeasures) in an adversary's basic offensive capability. The next three sections in my testimony will cite factual evidence that should give pause to military planners in countries with a basic ballistic missile capability, endorse MDA's use of Critical Engagement Conditions as a cost effective way to understand the operational effectiveness of the BMDS and outline an opportunity to anticipate design issues affecting the operational suitability of the BMDS. I believe that the observations that I will share indicate that our nation's ballistic missile defense capability cannot be disregarded today and will provide an even more effective defense in the future.

Assessment of Missile Defense Testing Programs to Date

Demonstration of a credible military capability requires successful engagement of threat representative targets flying operationally realistic trajectories by members of the armed forces using production representative systems. Sailors, soldiers and airmen have manned their stations on an Aegis combatant, assumed their posts in a THAAD battery, stood duty in GMD and fulfilled their duties at COCOMs in numerous successful, operationally realistic missile firing exercises. DOT&E has reported these accomplishments in the annual report for FY2008, particularly noting that their firing histories indicate that "Aegis BMD made progress towards demonstrating a robust theater-level missile defense capability against its assigned threats," that "THAAD

testing indicates that it will provide a significant increase in capability against short to intermediate range threats…" and that " While GMD has demonstrated a capability against a simple foreign threat, GMD flight testing to date will not support a high level of confidence in its limited capability." Although GMD did not engage a target in FY2008, the firing exercise (FTG05) in December 2008 reaffirmed its ability as demonstrated in its last two intercept missions to deal with a simple separating target. I agree with DOT&E's assessments but note that the reference to "limited capability" by GMD should be applied to demonstrated capability vice inherent capability.

One should note that in these successes (except for FTG05), Aegis, THAAD and GMD essentially operated autonomously to detect, track, engage and intercept the warhead of the target. Aegis succeeded in one exercise against a dual ballistic missile threat raid, succeeded in another while simultaneously engaging a ballistic missile threat and an Anti-Air Warfare threat, shot down an errant satellite and killed a short range ballistic missile threat with an SM2 Block IV missile. Similarly, THAAD has shown a repeatable ability successfully to intercept targets throughout its engagement envelope and GMD's EKV has hit the incoming warhead three times in three attempts. These facts demonstrate that the autonomous functionality and performance in these weapon systems enable their kill vehicles to strike the warheads of unitary or simply separating ballistic threats.

This conclusion does not extend to the oft discussed question of lethality of hit-to-kill; computer simulations must inform our thinking on this matter. Experts on lethality use these simulations during post-mission analysis to determine if the strike line of the kill vehicle on the warhead that was achieved in an intercept would have effected a lethal

hit. Consistent results from this post-mission analysis indicate that the kill vehicles, the supporting functionality and weapon system performance for Aegis, THAAD and GMD hold incoming warheads in jeopardy.

I conclude from this evidence that a fundamental, useful defensive capability based on autonomous operation of the Aegis BMD, THAAD and GMD elements is available to our armed forces, but I cannot state that the BMDS has reached maturity. Stable track picture presentation with multiple sensors on line viewing many objects has yet to be demonstrated, bringing weapons to bear based on remote tracks is just being attempted, discrimination of the warhead in a complex target scene and delivering a lethal blow to it will be initially demonstrated in flight later this year, and a finding from DOT&E that the BMDS is operationally effective and suitable is not yet available. I understand that these live firing exercises will add to our demonstrated system capability, but I do not believe that an accurate assessment of system performance can be drawn solely from intercept tests.

Basing BMDS Test Planning and Design on Critical Factors

As mentioned above, demonstration of a credible military capability requires successful engagement of threat representative targets flying operationally realistic trajectories by members of the armed forces using production representative systems. Though necessary, these successful demonstrations will not be sufficient to develop a statistically significant statement of probability of success throughout the regime of scenarios that the system will encounter in the real world. Statistical significance is necessary to narrow the uncertainty in estimates of performance so program managers

can budget for procurements that produce the necessary force structure and military planners can develop realistic operational plans.

Let me explain the issue with the following illustration about a coin and whether it is biased towards a particular outcome when flipped:

- Ten flips of the coin produces six heads. Is the coin biased towards heads?
- One hundred flips produces sixty-one heads. One can suspect a bias.
- One thousand flips produces 603 heads. One can be more certain about the probability of a head.

Statistics describes this increasing confidence as a result of more flips of the coin in terms of the number of trials (e.g. flips of the coin), estimate for the variable (ratio of heads to flips), confidence level for the estimate and the width of the confidence interval. For the 100 trials, 61 heads means that the 95% confidence level for the true probability for heads in the coin is between 0.5 and 0.7. For 1000 trials, the 603 heads mean that the 95% confidence interval is between 0.57 and 0.63. The betting line from Las Vegas on the outcome of the next flip of the coin would change as successive flips narrow the interval for the probability that the outcome will be a head.

Firing exercises are obviously more complex than the flip of a coin, but the same statistical concepts apply in order to develop a level of confidence in the performance of a weapon system. Suppose that the **same exact scenario** is repeated ten times and that a successful engagement of the target occurs nine times. The 95% confidence interval for the true probability of success in that one mission based on ten firings (i.e. trials) is between .54 and 1.0. What should program managers and military planners assume as the probability of success? If they assume 0.54, more force structure than might be

necessary will be purchased to counter the threat. If they assume 1.0, insufficient force structure might be fielded. Clearly the cost to conduct a firing mission makes it prohibitively expensive to develop a high degree of confidence for the performance of the system for any one scenario, much less the full battle space, using only live fire events.

High fidelity models and simulations offer a much less expensive method to develop statistically significant statements of performance throughout the battle space. For this technique to produce a **believable**, statistically significant statement of performance, the models and simulations must be proven to represent accurately the functional behavior, performance attributes and error sources in the weapon system. That proof (Verification, Validation and Accreditation (VV&A)) comes from a number of experiments and tests, one of which is demonstrating that the results of live firing exercises can be replicated in the model and/or simulation.

MDA is embarked on a task that will determine the critical engagement conditions that will be exercised in live firing events to contribute to VV&A of models and simulations with which to explore system performance. This makes sense to me, especially if DOT&E is aware of the methodology, contributes an operational perspective to the Critical Engagement Conditions and agrees that it will produce an effective tool with which to develop a finding concerning the operational effectiveness of the BMDS. This Critical Engagement Condition methodology makes even more sense to me if it offers an opportunity to define an associated ground test campaign that DOT&E is willing to accept as a tool with which to develop a finding concerning the operational suitability of the BMDS. Including a ground test demonstration of operational suitability

as an integral part of the output of the effort is important if it enables MDA to plan the simplest possible set of live firing missions.

"Simplest" does not mean simple; it means "use the minimum number of elements" that are necessary to serve the critical engagement condition(s) being addressed in that flight test. The cost to launch a ballistic missile target demands careful planning and execution to produce the desired technical results with the minimum amount of risk to maximize the return on the investment. Predicting the probability of success for the mission, an important facet in planning with which to understand risk, becomes more time consuming as the architecture for the system under test becomes more complex. Experience gained to date in preparation for the last two GMD missions indicates that predicting the probability of success can be a very long pole in the pre-mission schedule for a multi-element test. DOT&E's FY2008 Annual Report notes that "the ground test program has advanced faster than flight test program can provide validation data for the models and simulations upon which ground testing relies…" Prudent preparation for flight tests will continue to slow the pace of intercept missions if a maximum number of elements of the BMDS is included in each firing exercise.

A minimalist approach to flight testing can increase the frequency of flight tests, but will limit the opportunities to bring the entire BMDS into play and thus reduce the opportunities for DOT&E to observe the full BMDS in operation. Without such opportunities, I would find it difficult to decide if the full system's behavior was clumsy or graceful, if displays for the operators were intuitive or arcane, or if human interaction with the system was facile or difficult. A minimalist flight test approach can increase test tempo, but can be correctly criticized as not demonstrating full BMDS operation. This

potential criticism from DOT&E was the motivation for the recommendation above in which a ground test campaign would be used to determine the operational suitability of the BMDS.

Future Actions

A ground test campaign to demonstrate operational suitability must exercise the complex interactions, or interoperability, between elements of the BMDS. Interoperability involves maintaining a consistent track picture in all command and control portions of the BMDS, ensuring that tracking uncertainties are properly reflected in fire control solutions that depend upon them, knowing that shifts in reporting responsibilities for tracks by sensors is recognized throughout the BMDS, employing consistent interpretations of the protocols that govern the exchange of information over data links, etc. etc. Interoperability is a tricky business when one tries to make function as one BMDS, a family of elements each with their own autonomous capability. Since the natural focus for forming the BMDS from the elements is the C2BMC suite being developed by MDA, care must be taken to ensure that its functionality meshes cleanly with that of GMD, THAAD, Aegis BMD, et al. One must take care to ensure that C2BMC's implementations do not confuse the operation of the BMDS when it fields a function such as system track development that is similar to a pre-existing function in the elements. Competing responses from these similar functions can propagate over data links to produce different track pictures within the BMDS with attendant confusion over what object to engage. Care must be taken to ensure that the BMDS is interoperable if one expects DOT&E to find that it is operationally suitable.

The missions in which I have participated to date have employed limited functionality by C2BMC. Preliminary results from the last GMD intercept and initial predictions for the upcoming Aegis mission uncovered some issues with this limited implementation that prompted me to recommend to the system engineering team an effort to anticipate other issues that might be in the offing. That activity would:

- Poll all the elements' understandings of the requirements of the standards governing the data links and resolve any differences within the BMDS.
- Convene a table top exercise with a red team mentality whose objective is to anticipate potential interoperability issues when the full suite of C2BMC functionality is in place. Define implementations which resolve any issues and explain the sequence in which those implementations should occur. Pay special attention to resolutions requiring cooperation among elements.

As noted above, the possibility of a ground test campaign to complement the "minimalist" set of firing exercises expanded my thinking on this interoperability effort to include:

- Confer with DOT&E to develop a series of ground tests with which the operational suitability of the BMDS can be demonstrated.
- Develop a systematic sequence of test events using ground based HWIL assets that demonstrates first that parts of, and eventually that all of, the BMDS are interoperable. (The intent of this plan is to prepare the system for the DOT&E endorsed series of tests from which an assessment of operational suitability will be drawn. Reserve time in the plan to resolve issues as you move from event to event.)

- Identify the necessary modifications, if any, to the current ground test program.
- Obtain the endorsement of the plan from the Director of the Missile Defense Agency, then execute.

To succeed, this effort must have the support of the Director, the cooperation of the elements and expertise with which to meets its obligations. All are available within MDA.

In this scheme, ground tests focus on interoperability while flight tests anchor the models and simulations with which to ascertain effectiveness. Although these two regimes, ground tests and flight tests, are designed to produce a finding of "operationally effective and operationally suitable," there is potentially a subtle difference in their execution. A minimalist flight test plan could be mostly element centric with only a few firing exercises involving multi-element operations and even fewer involving the total BMDS. Such a plan would definitely be paced by the availability of system improvements from the firing elements (e.g. Baseline 4.0 for Aegis BMD , CEII EKV for GMD, et al) and only loosely tied to developments within C2BMC. Conversely, the DOT&E endorsed ground test definitely cannot occur until the interoperability plan has completed. The interoperability plan, and consequently the ground test to demonstrate operational suitability, will definitely be paced by the development cycle of C2BMC.

This subtle difference can be used to advantage by first coupling the two test regimes at the point where the interoperability plan would be nearing completion. Initially the two test regimes do not depend upon one another to progress to the next events, but at an appropriate point one can imagine that an event in the DOT&E endorsed

ground test would also serve as a rehearsal for an intercept test. Exploitation of such an advantage requires thoughtful planning of the activities for the two test regimes that recognizes the necessary alignment of the programs of record. As one approaches the "operationally suitable" series of events, the ground tests must be utilizing element configurations that represent a defined block of capability to be delivered to the armed forces and the flight tests must have addressed all the Critical Engagement Conditions for that block.

This approach does not guarantee success, but does allow room for different fielding decisions if one of the test efforts significantly outpaces the other in attaining its goal. If flight testing proceeds well ahead of ground testing, one has the option of deploying improved performance within a paradigm of essentially autonomous operations by the firing elements with C2BMC continuing to provide situational awareness for the COCOMs. If ground testing finishes well ahead, one can field the matured C2BMC if the requisite functionality is available within the other elements or wait until they catch up. In all events there are options, but this complementary ground test and flight test strategy is viable only if a "minimalist" approach to flight testing arises from the Critical Engagement Conditions effort.

GMD

Chairwoman Tauscher, you asked me for specific comments about how to ensure that GMD will work in an effective, suitable and survivable manner. Two important points made by RADM Paige in her after action report on the activities of the Mission Readiness Task Force (MRTF) bear directly on the answer. The admiral noted in her first

point that GMD had adopted the disciplined flight test preparations demonstrated to them by the members of the MRTF. I can assure you that GMD inculcated the discipline embodied in the phrases "fire to verify, not to discover" and "test as you fight." In its last four missions, GMD has prepared for flight tests with a sense of urgency but has not cut corners in the name of schedule. GMD conducted those missions when preparations were complete and utilized the equipment that is available to the armed forces to detect the target, process the engagement and intercept the warhead. GMD is doing the same for its upcoming firing test. RADM Paige noted in her second point that the inherent performance of GMD can only be as ready for service as the reliability of the system allows it. GMD heard that message and incorporated quality improvement provisions in its contracts to industry. Time will tell us what benefits are reaped from that contractual action. Until then, I respectfully urge the committee to support the testing discipline and the quality initiatives that are a part of GMD's culture.

Closing Thoughts

In summary, I have made the following points:

1. Our armed forces possess a credible ballistic missile defense capability.
2. MDA is poised to demonstrate an even more robust capability.
3. MDA is redefining flight tests using thoughtful Critical Engagement Conditions as a means to anchor high fidelity models and simulations that can be used to assess the operational effectiveness of the BMDS.
4. The redefined flight tests might offer an opportunity for a complementary series of ground tests with which to assess the operational suitability of the BMDS.

In closing, let me again thank you for the opportunity the testify and to thank each one of you for your service to the nation.

Donald C. Mitchell
Principal Professional Staff, The Johns Hopkins University Applied Physics Laboratory

SUMMARY
Mr. Mitchell has an extensive background in combat system engineering, test
and evaluation, and program management. His engineering experience includes at sea testing of the Anti-Ship and Anti-Radiation Missile modifications to the TALOS Guided Missile Fire Control System, the development of the TARTAR variant of the New Threat Upgrade (NTU) Combat System, test and evaluation at sea of both the TERRIER and TARTAR NTU variants, the development of the combat system modifications in support of the TERRIER Lightweight Ex-Atmospheric Projectile (LEAP) program, and the specification of options for employment of Standard Missile 2 by foreign navies. His program management experience includes responsibility for the NTU Program, FFG 7 AAW Weapons System Program, SM-2 Block IVA Risk Reduction Flight Program and an IPA assignment to PEO TSC/IWS.

EDUCATION
M.S. Electrical Engineering, University of Southern California (1973)
B.S. Electrical Engineering, Washington University (1969)

WORK EXPERIENCE
2003-Present: Served as a trusted advisor to flag and general officers in various capacities. Lead a multi-organizational team that produced the AEGIS Ballistic Missile Defense Balanced Investment Strategy. That strategy, produced in early 2004, continues to serve as the developmental principle from which the ABMD program is planned and executed. Served as the technical director for the Mission Readiness Task Force (commissioned by the Missile Defense Agency Director after flight failures by GMD) that produced and implemented a plan that returned Ground Based Midcourse Defense to successful flight testing. Currently serving as the Director for Readiness Assessment for the Director of the Missile Defense Agency. In that role, Mr. Mitchell reports directly to the Director of the Missile Defense Agency with assessments of planned missile firing exercises' readiness to conduct the missions. In that role, he enjoys full freedom within MDA to execute his role, subject only to direction from MDA/D.

1999-2003: Air Defense Systems Department Office
Served as the Technical Director for PEO Theater Surface Combatants and PEO Integrated Warfare Systems in an Intergovernmental Personnel Assignment. Exercised complete technical authority over all programs within the PEOs. Revived system engineering discipline within the PEOs' technical community. Worked on point with other Navy and DoD offices in the successful completion of high visibility projects such as CEC DT/OT, AEGIS LEAP Intercept, ESSM DT/OT and the NIMITZ Battle Group Accelerated Deployment.

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Witness name: Donald C. Mitchell

Capacity in which appearing: (check one)

_X_ Individual Although offering testimony as an individual, complete disclosure insists that I inform the committee that my primary assignment at JHU/APL involves providing an independent assessment to the Director of the Missile Defense Agency of the readiness of Aegis BMD, THAAD and GMD to conduct their firing missions. Funding sent to JHU/APL for that effort For FYs 2007, 2008 and 2009 are provided below.

___ Representative

If appearing in a representative capacity, name of the company, association or other entity being represented: _____

FISCAL YEAR 2009

federal grant(s) / contracts	federal agency	dollar value	subject(s) of contract or grant
HQ0006-07-D-0001	Missile Defense Agency	$530,000	Mission Readiness

FISCAL YEAR 2008

federal grant(s) / contracts	federal agency	dollar value	subject(s) of contract or grant
HQ0006-07-D-0001	Missile Defense Agency	$302,000	Mission Readiness

FISCAL YEAR 2007

Federal grant(s) / contracts	federal agency	dollar value	subject(s) of contract or grant
HQ0006-07-D-0001	Missile Defense Agency	$952,000	Mission Readiness

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Current fiscal year (2009):_____;
Fiscal year 2008:_____;
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Federal agencies with which federal contracts are held: **NONE**

Current fiscal year (2009):_____;
Fiscal year 2008:_____;
Fiscal year 2007:_____.

List of subjects of federal contract(s) (for example, ship construction, aircraft parts manufacturing, software design, force structure consultant, architecture & engineering services, etc.): **NONE**

Current fiscal year (2009):_____;
Fiscal year 2008:_____;
Fiscal year 2007: _____.

Aggregate dollar value of federal contracts held: **NONE**

Current fiscal year (2009):_____;
Fiscal year 2008:_____;
Fiscal year 2007:_____.

Federal Grant Information: If you or the entity you represent before the Committee on Armed Services has grants (including subgrants) with the federal government, please provide the following information:

Number of grants (including subgrants) with the federal government: **NONE**

Current fiscal year (2009): _____;
Fiscal year 2008: _____ ;
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Federal agencies with which federal grants are held: **NONE**

Current fiscal year (2009):_____;
Fiscal year 2008:_____;
Fiscal year 2007:_____.

List of subjects of federal grants(s) (for example, materials research, sociological study, software design, etc.): **NONE**

Current fiscal year (2009): _____;
Fiscal year 2008: _____ ;
Fiscal year 2007: _____ .

Aggregate dollar value of federal grants held: **NONE**

Current fiscal year (2009): _____;
Fiscal year 2008:_____;
Fiscal year 2007:_____.

QUESTIONS SUBMITTED BY MEMBERS POST HEARING

FEBRUARY 25, 2009

QUESTIONS SUBMITTED BY MS. TAUSCHER

Ms. TAUSCHER. What is your current assessment of the capability of the GMD system to successfully engage and destroy a long-range missile threat from North Korea—high, medium, or low?

Dr. MCQUEARY. Ground-based Midcourse Defense (GMD) has demonstrated a limited capability to defend against simple, long-range ballistic missile threats launched from North Korea toward the United States.

As I have previously testified, my statistical confidence in the performance of the GMD system across the entire battle space and against the full range of possible threat types remains low for two reasons. First, the Missile Defense Agency (MDA) has conducted only three intercept flight tests using the operational equipment and software and all of these occurred within a relatively small portion of the threat battlespace. Second, the models and simulations used by the MDA to assess GMD capability over the full battlespace and threat scenarios have not yet been verified, validated, or accredited for use in these assessments.

Notwithstanding these limitations, I believe the warfighters have developed tactics, techniques, and procedures that improve the capability of the GMD to successfully engage and destroy a long-range missile threat from North Korea. I defer to the operational commander for his assessment of his ability to defend against any specific threat that may be posed against the United States today.

Ms. TAUSCHER. To what extent was the GMD system designed to be suitable and survivable?

- What specific steps do you believe are necessary to increase our confidence in the suitability and survivability of the GMD system?

Dr. MCQUEARY. The Missile Defense Agency (MDA) has imposed design specifications on the prime contractor that in its opinion balanced need for the Ground-based Midcourse Defense (GMD) system's rapid deployment with operational suitability and survivability. The Agency is best suited to provide design specifics and the underlying rationale.

While the GMD system did not have Reliability, Availability and Maintainability (RAM) requirements designed into the system, the Agency implemented a limited RAM program in 2006. For the last year, the Operational Test Agency (OTA) Team has been working with the Agency to collect data on the suitability of the fielded GMD components. The current three-phased review of testing is examining the suitability and survivability data that have already been gathered. As improved components are fielded, such as the Capability Enhancement II Exoatmospheric Kill Vehicle, the Agency and the OTA Team will collect and assess the reliability, availability, and maintainability data.

The MDA has committed to enhance the current RAM program and to implement a reliability growth program for new components. Building on the Critical Operational Issues and measures previously developed by the multiservice OTA Team, the Director, Operational Test & Evaluation staff, and U.S. Strategic Command, the Agency and the multiservice OTA Team will identify and prioritize tests, venues and resources needed. The updated Integrated Master Test Plan (IMTP) will incorporate the results of this three-phase review. Execution of this updated IMTP will provide the necessary confidence in the operational suitability and survivability of the GMD system.

Ms. TAUSCHER. As MDA develops its revised testing program, what testing work remains to be done and how would you prioritize the work?

Dr. MCQUEARY. The Missile Defense Agency's (MDA) three-phased test review began with an agency wide effort to identify the critical factors necessary to examine system capability for each element and the overall Ballistic Missile Defense System (BMDS). The goal is to build a foundation of models and simulations that will allow us to understand performance at the system, element, or sub-element level. In addition, both the developmental and operational test communities are identifying the other data, such as reliability and maintainability data, necessary to support their respective evaluations. This review has already highlighted common gaps across the elements such as modeling of threats, debris, and general environmental conditions. The focus is to identify the testing that the MDA needs to accomplish

to validate and accredit the models and simulations necessary to evaluate the capability of the elements, such as Ground-based Midcourse Defense, as well as to evaluate the BMDS as an integrated system. The second phase is developing test strategies to capture the required data. The third phase will prioritize these requirements and allocate them to the test resources available, considering all test capabilities and limitations. The MDA plans to complete this effort by June 2009 and to publish a new Integrated Master Test Plan that will establish the priorities. The MDA Director and I will review and approve this plan. In general terms, I expect the top priority to be collecting the data to validate the basic system performance models within the likely operational domain of current threat systems. Once the basic performance models are validated, the Agency can expand testing to examine emerging threat capabilities.

Ms. TAUSCHER. In the Fiscal Year 2008 Annual Report to Congress, DOT&E continued to raise concerns about the effectiveness, suitability, and survivability of the GMD system, noting that there was insufficient information available to make a determination.

- What specific actions do you need to see before you are prepared to declare GMD effective, suitable, and survivable?

Dr. MCQUEARY. To declare the Ground-based Midcourse Defense (GMD) effective, suitable, and survivable, the Missile Defense Agency (MDA) will need to accomplish sufficient ground and flight testing to successfully validate and accredit the models and simulations that we will use to assess GMD capability. There may also be certain events which are best empirically measured, such as flight tests with low radar cross section re-entry vehicles, high closing and separation velocities, and tumbling re-entry vehicles. Finally, technical analyses and maintenance data from fielded components will be integrated into analytical models to provide predictions of sustainability and survivability. I am confident that the MDA's three-phase test review will result in a test program that, if fully funded and implemented, will allow me to assess GMD effectiveness, suitability, and survivability.

Ms. TAUSCHER. What multi-mission events, such as cyber attack or other asymmetric attacks of key assets, have been introduced during GMD flight testing?

- What multi-mission events are planned to be introduced in the future and when?
- How is MDA adjusting its overall information assurance plan to address these issues?
- If we have no such plans, why is this lack of threat realism acceptable?

Dr. MCQUEARY. Given the overarching safety considerations, flight tests are generally not an appropriate venue for the introduction of cyber attacks. The Missile Defense Agency (MDA) has conducted this type of testing on ground equipment and communication links using integrated and distributed ground tests. To date, cyber-attacks scenarios have been simulated for Ground-based Midcourse Defense during the Assured Response warfighter exercise, and are also planned in future Terminal Fury (1 scenario) and Global Thunder (10 scenarios) exercises. This is an appropriate method to evaluate the vulnerability and hardness of the Ballistic Missile Defense System (BMDS) elements and their communication links to cyber and asymmetric attacks. The MDA is coordinating the execution of its information assurance plan with the overall ground test plan. The on-going three-phased review will identify the additional testing required to validate and accredit the models and simulations, as well as any other testing needed to complete a comprehensive survivability evaluation. The MDA is developing an updated Integrated Master Test Plan that will identify the future testing needed to address any voids in the BMDS system assessment. The warfighter's ability to employ the BMDS under asymmetric or cyber attack is best assessed during ground tests or major warfighter exercises employing multiple attack vectors simultaneously.

Ms. TAUSCHER. The Fiscal Year 2009 National Defense Authorization Act prevents DOD from deploying long-range missile defense interceptors in Europe until the Secretary of Defense, taking into account the views of DOT&E, certifies that the proposed interceptor will work in an operationally effective manner and accomplish the mission.

- From your perspective, what are the key operational differences associated with deploying the GMD system in Europe as compared to Alaska and California?
- What impact would those differences have on how you would structure the testing program for the European GMD deployment?
- What specific steps do you believe MDA needs to complete before you would recommend that the Secretary of Defense certify that the proposed interceptor has

a high probability of working in an operational effective manner and is capable of accomplishing the mission?

Dr. MCQUEARY. I see four key operational differences associated with employing the Ground-based Midcourse Defense (GMD) in Europe as compared to the current deployment in Alaska and California: the two-stage missile; the sensors; the command, control, battle management & communications (C2BMC); and the mission timelines. These key operational differences must be considered in the testing program for the European GMD deployment.

It is important to note that while the two-stage missile is an essential component of the European Capability, the interceptor itself is not necessarily unique to the European mission. There are certain scenarios where the employment of a two-stage interceptor from Alaska might offer specific operational advantages. There are numerous similarities between the two-stage booster, its associated launch hardware and software, and the existing three-stage booster. The Missile Defense Agency (MDA) has successful experience making this kind of modification. These changes can be adequately tested in the two flight tests currently proposed by the MDA. On the other hand, there are two distinct issues with the proposed two-stage interceptor: the interceptor itself and its performance in the European scenario. Testing the European mission cannot be accomplished with only one intercept flight test. I anticipate that the MDA will need to accomplish multiple intercept tests as well as numerous hardware-in-the-loop and ground tests, replicating as closely as possible intercept geometries and the timelines associated with them, to validate and accredit the necessary models and simulations.

Testing the sensors, C2BMC, and mission timelines—basically the heart of the European mission—is even more challenging. The very short timelines associated with threat and target locations, the sensor locations, and their associated intercept geometries, makes understanding the coordination challenges and communications latencies of the C2BMC critical to mission success. The only way to confidently understand and adjust to these challenges and latencies is to ground test in Europe after the hardware and software have been deployed there. If this is not possible, all testing, not just the live intercept testing, must be accomplished using the current Pacific test bed.

The intercept geometries, the timelines associated with them for both decision making and intercept, and the complex command & control issues must be developed, refined, and tested during both intercept flight tests and extensive hardware-in-the-loop ground testing while simulating the European architecture. To do this, there are a number of issues that must be resolved. How does the MDA emulate the European Midcourse Radar if it cannot be used for actual intercept testing in the Pacific test bed? How does the MDA accurately calculate and then replicate communications latencies in the Pacific test bed? How does the MDA overcome the limitations with the Pacific test bed that prevent realistic testing of the European Mission? Ultimately, models and simulations must be developed and verified, validated, and accredited before we can be confident in our ability to perform the European missile defense mission. This process must be accomplished using the Pacific test bed which is not an optimum solution.

The results of the MDA's current three-phase testing review should provide me with better estimate of when I will be able to recommend that the Secretary of Defense certify that the proposed interceptor has a high probability of working in an operational effective manner and is capable of accomplishing the mission.

Ms. TAUSCHER. Would you recommend that the GMD program establish a master test program similar to Aegis BMD and THAAD?

- What impact has the lack of a master test plan had on GMD's ability to adequately plan for the system's long-term testing?

Dr. MCQUEARY. Both Aegis Ballistic Missile Defense (BMD) and the Terminal High Altitude Area Defense (THAAD) have benefited from having legacy master test programs. This approach has also allowed these programs to efficiently and effectively verify and validate the models and simulations necessary to fully examine their capabilities. The Missile Defense Agency (MDA) Director has recognized the value of having a master test program. He has initiated the Agency wide three-phase review of the test program and directed development of a test plan that spans the Future Years Defense Plan (FYDP). This new approach will benefit all of the MDA's programs and will clearly define the requirements and resources necessary to accomplish this testing.

Ms. TAUSCHER. Last year, the operational test authorities accredited the models for Aegis BMD version 3.6.

- Does the Aegis BMD do modeling and simulations differently from other BMDS elements?

- If so, what are the key differences?
- Are there lessons from the Aegis BMD modeling and simulation program that could be applied across the BMDS, particularly to the GMD system?

Dr. MCQUEARY. Aegis Ballistic Missile Defense (BMD) modeling and simulation differs from other Ballistic Missile Defense System (BMDS) elements principally due to differences in model maturity. The recently transitioned Aegis BMD build (Version 3.6) leveraged existing Aegis hardware and software, including associated models and simulations. In comparison to other BMDS element models and simulations (for example Ground-based Midcourse Defense and Terminal High Altitude Area Defense), the Aegis BMD models are older and have acquired significant anchoring data to support verification, validation, and accreditation.

Aegis BMD employs a number of complementary, element-focused, and predominantly digital models and simulations. Their results are rigorously compared and analyzed during pre-test readiness reviews to gain confidence in the model estimates and to predict system performance. The results are then compared with the post-flight reconstructions.

The MDA's actions to conduct a comprehensive three-phase test review and to develop verification and validation plans for their models and simulations (supported by anchoring data) are evidence that the MDA is already applying lessons-learned from the Aegis BMD modeling and simulation program to other BMDS elements.

Ms. TAUSCHER. In its Fiscal Year 2008 Annual Report to Congress, DOT&E noted that theater missile defense systems (e.g., Aegis BMD, THAAD, and PAC-3) continued to make progress, while strategic systems (e.g., GMD) continue to face challenges in regards to testing.

- What are the key reasons for these differences?
- To what extent have Aegis BMD and THAAD's success been a result of using their original operational requirements document to guide their testing and development?
- Are their lessons from the Aegis BMD and THAAD programs that we could apply to the GMD program?

Dr. MCQUEARY. There are several reasons for these differences:

1. The Ground-based Midcourse Defense (GMD) mission (defense against intercontinental ballistic missiles) is a more complex task than the defense against short and medium range ballistic missiles. While there was extensive prototype testing, the current GMD system is still in a predominantly developmental test regime with the first flight of the new production Capability Enhancement II Exoatmospheric Kill Vehicle scheduled later this year.
2. The Navy and Army have long traditions of conducting operationally realistic testing. The active involvement of the respective Service Operational Test Agencies has contributed to this success, particularly in determining operational suitability.
3. Unlike the Aegis Ballistic Missile Defense (BMD) and Terminal High Altitude Area Defense (THAAD) programs, GMD did not originate from a Service program with clearly stated operational requirements. While it is difficult to ascribe specific benefits to the Aegis BMD and THAAD programs, operational requirements documents frame the evaluation requirements that ultimately drive rigorous testing.

In general, Aegis BMD, THAAD, and Patriot have been executing rigorous, evaluation-based, traditional test programs that use Service best practices to demonstrate required capabilities through testing. Completion of the three-phase test review will give the Missile Defense Agency (MDA) a significantly improved and evaluation-based test program. Execution of this evaluation-based strategy should result in verified and validated models and simulations over the expected engagement envelope with unique capabilities demonstrated through empirical measurement events. The comprehensive test review is evidence that the MDA is applying lessons from the Aegis BMD and THAAD programs to other Ballistic Missile Defense System elements, including the GMD program.

Ms. TAUSCHER. How have the missile defense elements, including interceptors and sensors, proven in their suitability for rain, high winds, snow or sleet, and other severe weather conditions?

Dr. MCQUEARY. To date, most Ballistic Missile Defense System flight testing has occurred under benign conditions. This is primarily due to the fact that, while the Missile Defense Agency follows a combined operational and developmental (DT/OT) testing program, flight testing to date has been more developmental in nature requiring controlled test conditions to meet both test objectives and safety require-

ments. On the other hand, all the sensors have tracked objects during a variety of environmental conditions; they have just not supported intercept flight tests in these conditions.

Future operational testing will occur in natural environments and conditions, as they are present on the day of testing, subject to range safety limitations. As long as safety requirements are met, the test will execute. However, it would be cost prohibitive to delay a test—and all the expensive test support—waiting for specific weather conditions. Therefore, high fidelity ground testing, incorporating validated and accredited environmental models, will be the primary means to assess system performance under severe weather conditions. This includes, when and where possible, testing in climatic chambers such as will be done with all elements of the Terminal High Altitude Area Defense system connected and powered simultaneously.

Ms. TAUSCHER. How was the Sea-based X-Band radar designed to be survivable?

- Have we tested and run exercises to understand this issue?
- What about other BMDS sensors?

Dr. MCQUEARY. The Sea-Based X-band (SBX) radar and the host platform were designed to support operations in the Northern Pacific Ocean. The 2007 Winter Shakedown period demonstrated SBX survivability in extreme environmental conditions. Survivability design considerations also included electromagnetic interference and compatibility; information operations; and physical security. The Department of Defense has developed and implemented tactics, techniques and procedures to address the physical security of the SBX. In addition, the SBX was designed to provide for future survivability (Nuclear, Biological, and Chemical) upgrades. The Missile Defense Agency (MDA) continues to conduct tests, exercises, and analyses to provide data to characterize SBX survivability.

For fixed-site sensors such as the Upgraded Early Warning Radars and Cobra Dane, which are located on military installations, the MDA and the multiservice Operational Test Agency Team will leverage previous Service assessments (for example, physical security) wherever possible. Performance of these long time operational sensors in various environmental conditions is well understood.

For the AN/TPY-2, the MDA is conducting tests, exercises, and analyses of data from actual deployments to characterize the survivability of both the forward-based version and the tactical version of the radar system. In addition, the tactical version will undergo environmental testing in the climatic chamber at Eglin Air Force Base, Florida.

The assessment of sensor survivability is an on-going process. Where data voids exist, the MDA will address them as part of the current three-phase test review.

Ms. TAUSCHER. Due to cost pressures, MDA has removed three flight tests from the THAAD flight test program. In the past, DOT&E has raised concerns that this action has increased risk to the THAAD program.

- Does it remain your view that MDA's decision to remove the three flight tests from the THAAD test program has increased risk to the program?
- What specific steps would you recommend for reducing risk for the THAAD test program?

Dr. MCQUEARY. It is still my view that the re-baseline of the Terminal High Altitude Area Defense (THAAD) test program increased development risk to the program. The reduced number of flight tests, combined with the loss of data from FTT-04 as the result of the target failure, means fewer opportunities to demonstrate repeatability of performance, which raises development risk and lowers confidence in any assessments we will make in the future. As it stands today, any loss of flight test data will likely require additional flight tests to achieve the prescribed knowledge points for THAAD. To the Missile Defense Agency's (MDA) credit, when the target failed during FTT-10, the agency elected to repeat the flight test (FTT-10a). This decision reflects MDA's renewed commitment to an evaluation driven approach.

The completion of the current three phased review will provide another bottom up review of test requirements. The key to reduced development risk and a successful program remains a commitment to an evaluation based strategy that focuses on the information needed to form an evaluation rather than a specific number of flight tests.

Ms. TAUSCHER. Do you think that the lethality demonstration scheduled for 2009 will constitute proof that ABL is operationally effective, suitable, or survivable?

- Will additional tests and analysis are required before the operational effectiveness or suitability can be determined?

Dr. MCQUEARY. The Missile Defense Agency (MDA) is building the Airborne Laser (ABL) to demonstrate technology, not to demonstrate effectiveness, suitability, and survivability. The MDA did not structure the technology demonstration program to

provide the data necessary to make such an operational assessment. Testing leading up to the demonstration will concentrate on preparations for achieving a successful shoot down.

Additional tests and analyses will need to be conducted during the systems development phase. Questions of effectiveness, suitability and survivability are normally addressed during testing of the production representative equipment, in this case airframe #2. I cannot draw meaningful conclusions about the potential operational suitability, or survivability of the ABL based on the program to date and the success, or failure, of the demonstration shoot down. Even attempting to relate lessons learned from the design, development, and construction of the current ABL airframe to future operational effectiveness, suitability, and survivability would be conjecture at best. The demonstration airframe is strictly a prototype built to demonstrate a technology. A single shoot down during a very controlled, non-operational scenario will only give a single example of capability at one point in the projected operational envelope of the ABL. At the time of the demonstration, there will be no data to draw any conclusions about the suitability of the ABL. Any survivability conclusions would be hypothetical, as the current technology demonstrator program is not structured to address ABL survivability issues. One would anticipate that the MDA would make many changes in the first developmental ABL, airframe #2, in an effort to make it operationally effective, suitable, and survivable. I will be better able to answer these questions during the development and testing of the first developmental airframe, not the current ABL technology demonstrator.

That said, a successful high-power laser flight demonstration would be a major program milestone and could, with additional relevant testing, validate the feasibility of employing the current platform in support of high energy laser adjunct missions.

Ms. TAUSCHER. The Director of Operational Test and Evaluation has indicated in its fiscal year 2008 annual report, that testing for the MDA is not yielding enough data to support certification of the elements at an individual level and at the integrated system level.

- How does MDA plan to ensure that the BMDS is fully tested—including operationally effective and suitable—prior to continuing production?
- How is MDA working with DOT&E to improve the data that DOT&E needs to certify the BMDS and its elements?
- Will MDA continue the approach of concurrent testing and fielding under the new block structure?
- Is that approach still necessary given that the Presidential directive to field an early capability has been met?

Dr. MCQUEARY. A combination of flight and ground testing together with validated and accredited models and simulations is needed to ensure that the Ballistic Missile Defense System (BMDS) is fully tested and demonstrated to be operationally effective and suitable. An integrated approach that leverages combined developmental and operational testing to the maximum extent feasible is essential.

Based upon the on-going three-phase review, the Missile Defense Agency (MDA) is developing a revised Integrated Master Test Plan (IMTP) to document test requirements and ensure that they fully accomplish all required BMDS testing through the Future Years Defense Plan. The plan, once executed, should also provide all the necessary validation data to anchor the models and simulations. My staff is working closely with the MDA and the multiservice Operational Test Agency Team to ensure that the IMTP addresses our data requirements for certifying the BMDS and its elements.

The MDA has sought to balance developmental maturity and production stability, technical risks, and costs, to provide a capability to the warfighter where none existed. I will recommend certification after the system has demonstrated a high probability of accomplishing its mission in an operationally effective manner. The decision as to whether or not to continue with concurrent testing and fielding of part or all of the BMDS is a matter of policy best considered after advice from the Chairman of the Joint Chiefs of Staff and the Combatant Commanders. My commitment is to provide the Congress and the Secretary of Defense (and ultimately through the latter, the warfighter) with the best available information upon which to make their decisions.

Ms. TAUSCHER. If a missile defense system has the "technical capability" to shoot down an incoming ballistic missile target, does that mean the system is operationally effective, suitable, or survivable and has the ability to accomplish the mission?

- What are the differences between technical capability and effectiveness, suitability, and survivability?

Dr. MCQUEARY. Even though a missile defense system may have the "technical capability" to shoot down an incoming ballistic missile, it does not necessarily mean that the system is operationally effective, suitable, or survivable.

"Operational Effectiveness" is the overall degree of mission accomplishment of a system when used by representative personnel in the environment planned or expected for operational employment of the system considering organization, doctrine, survivability, vulnerability, and threat.

"Operational Suitability" is the degree to which a system can be satisfactorily placed in field use, with consideration given to availability, compatibility, transportability, interoperability, reliability, wartime usage rates, maintainability, safety, human factors, manpower supportability, logistics supportability, documentation, and training requirements.

"Survivability" is the susceptibility and vulnerability of a system to a threat and the ability to repair the system following threat-induced damage.

Technical capability is a system's ability to perform a specific function or accomplish a specific mission, for example the ability to intercept a particular threat in a given flight regime. While not all technically capable systems are effective, all effective systems are technically capable. Operational effectiveness implies that the system will perform as desired across the full battle space against the full spectrum of intended threat systems. Similarly, an operationally suitable system will perform satisfactorily under the full range of conditions, not just under a certain demonstrated subset.

Ms. TAUSCHER. To what extent was the GMD system designed to be suitable and survivable?

- What specific steps do you believe are necessary to in increase our confidence in the suitability and survivability of the GMD system?

General O'REILLY. The GMD system continues to mature its suitability and survivability capabilities. The DOT&E has specified several critical operational issues to characterize suitability and survivability, and these are listed in their 2008 Assessment of the BMDS, dated January 2009. Suitability is defined in the context of BMDS strategic and theater missile defense operations as being (1) interoperable, (2) reliable, (3) available, and (4) maintainable.

Interoperability has been ground and flight tested and the Agency continues to demonstrate good interoperability among BMDS sensors (AN/TPY-2, Sea-Based X-band radar, Upgraded Early Warning Radar—UEWR, and the Aegis SPY-1 surveillance and tracking radar). Interoperability with C2BMC upgrades includes effective communications between the command authorities who authorize engagements to the weapon system operators at the fire direction centers. GMD flight test FTG-05, in December 2008, successfully demonstrated end-to-end testing of the BMDS system with excellent interoperability among all four sensors and led to the generation of a weapons task plan, a successful engagement, and an intercept.

GMD is implementing a comprehensive, but very limited Reliability, Availability and Maintainability (RAM) program to both quantify capabilities as well as increase the reliability of the System. The current RAM Program, initiated in 2006, includes data collection and assessments of deployed assets, reliability growth testing of critical components, root cause and corrective action for failures, and a stock pile reliability program to assess the shelf-life of selected components. GMD formed a Joint Reliability & Maintainability Evaluation Team (JRMET) with the Operational Test Agencies (OTAs) to assess the RAM data generated from field assets and test events.

Specific steps to enhance confidence in reliability include: comprehensive testing of all components as well as implementing a true growth program to both increase reliability as well as enhance service life of the components. The GMD System has much the same reliability of the initial Minute Man System, which has a comparable missile to the GMD Ground-Based Interceptor.

The DOT&E reported that GMD Blocks 1 and 3 are partially suitable for their missions based on a very limited database, and that more data are required to perform a comprehensive characterization of suitability. GMD materiel readiness has been maintained over the past 36 months to the point that GMD components are readily available to meet heightened Readiness Conditions (REDCON) requirements. In addition, readiness rates have consistently exceeded GMD program material readiness goals and are consistent with legacy missile systems.

Survivability is an attribute of the degree to which the system is survivable against a conventional attack and is survivable in its intended operating environment. Therefore, the survivability of the GMD system reflects the security of its primary operating locations at Schriever AFB, Vandenberg AFB, and Ft. Greely. Addi-

tionally, these sites have been augmented to meet the security requirements established by USSTRATCOM.

In the area of improvements to Physical Security, GMD is in the process of upgrading the Integrated Electronic Security System and overall security capabilities. GMD is working with Space & Missile Defense Command (SMDC) to definitize requirements that achieve necessary system effectiveness to secure the Fort Greely, Alaska site. In 2008/2009 GMD installed Ground Surveillance Radars to improve detection and plan to increase access delay and denial capabilities in 2010–2012. As part of this overall upgrade we are also exploring the options to harden existing facilities to make them better able to withstand direct and indirect attack.

Survivability of network communications is currently achieved via multiple diverse and redundant communications paths provided by both satellite and fiber optic links. Ground Systems [GMD Fire Control (GFC), GMD Communications Network (GCN), Command Launch Equipment (CLE), and In-Flight Interceptor Communications System (IFICS) Data Terminal (IDT)] support survivability currently through multiple computer processors, communications diversity, and geographic redundancy.

GMD is improving the survivability of its interceptors through implementation of the Fleet Avionics Upgrade/Obsolescence Program for interceptors to enhance our current capability to operate in the operational natural environment.

Ms. TAUSCHER. What is your current level of confidence in the ability of the GMD system to successfully intercept a potential long-range missile launched from North Korea—high, medium, or low?

General O'REILLY. Our confidence in the GMD system's ability to successfully intercept a long-range missile launched from North Korea at the United States is high. Our confidence is based on several factors, 1) Testing of the GMD system, 2) Sufficient weapons (ground-based interceptors) to counter the expected threat, and 3) Sufficient warfighter interaction with the system to develop effective tactics, techniques and procedures.

Although limited to North Korean scenarios, GMD flight testing has been successful, as evidenced from three GMD Flight Tests (FTG-02 in September 2006, FTG-03a in September 2007, and FTG-05 in December 2008) where we intercepted threat representative targets on each occasion. However, GMD has not tested the battlespace beyond North Korean scenarios representing simplistic threats. Our analysis strongly suggests countermeasure tests can be managed during an engagement, and a series of countermeasure tests will begin with the next flight test, FTG-06 in the 4QFY09.

The warfighting community has and continues to participate in ground and flight tests. Warfighters also use wargames and exercises as opportunities to develop and hone their tactics, techniques, and procedure to maximize its ability to prosecute the missile defense mission. They are trained and certified with the most recent BMDS configuration available, and have demonstrated the ability on several occasions to activate the system when needed and posture for credible and effective operational missile defense of the homeland.

Ms. TAUSCHER. What percentage of the currently deployed GMD interceptors in Alaska and California would you rate as fully mission capable for combat operations at any given time?

General O'REILLY. [The information referred to is classified and retained in the committee files.]

Ms. TAUSCHER. Recent GAO reports state the GMD element has experienced the same anomaly during each of its flight tests since 2001. According to the GAO, while the anomaly has not yet prevented the program from achieving any of its primary test objectives, GMD has been unable to determine its source or determine the anomaly's root cause.

- Please provide an update on the assessment of the anomaly, including its potential for causing the interceptor to miss its target.
- Please detail how the GMD element has mitigated the anomaly and whether all the mitigations have been flight tested and the data analysis completed.
- Does this anomaly reduce the confidence in the reliability of the emplaced interceptors?
- And has the shot doctrine been changed to provide a better chance of probability of kill?

General O'REILLY. [The information referred to is classified and retained in the committee files.]

Ms. TAUSCHER. Given its strategic mission to intercept potential nuclear armed long-range ballistic missiles, why weren't GMD interceptors designed to operate in nuclear environments?

- Do you have plans to retrofit GMD interceptors to operate in nuclear environments?
- What are the costs associated with such an upgrade?
- Has MDA planned and programmed for this?

General O'REILLY. [The information referred to is classified and retained in the committee files.]

Ms. TAUSCHER. To what extent has the GMD been tested in harsh weather environments (e.g., rain, snow, fog, etc)?

- What information can be learned from such testing?
- If not, what are your plans to do so?

General O'REILLY. The GMD system operates in benign environments since it operates at fixed sites on U.S. military bases. The interceptors are comprehensively verified after emplacement in silos whose environments are carefully monitored and controlled. However, the GMD system-level components have been tested under harsh environments per MIL-STD-1540. These environments include analysis and testing for vibration, shock, thermal balance and climatic conditions. This testing has provided high confidence in the components' abilities to perform in the widest range of harsh environments expected. Using models and simulations, the Agency has conducted system-level ground testing against threats in conditions of rain, high winds, snow, sleet, and other weather conditions. Results indicate that the GMD system will meet its requirements.

The amount of useful information from ground testing and analysis is sufficient to characterize system performance across the spectrum of conditions expected.

Ms. TAUSCHER. What multi-mission events, such as cyber attack or other asymmetric attacks of key assets, have been introduced during GMD flight testing?

- What multi-mission events are planned to be introduced in the future and when?
- How is MDA adjusting its overall information assurance plan to address these issues?
- If we have no such plans, why is this lack of threat realism acceptable?

General O'REILLY. All aspects and operating conditions of the GMD system undergo intense scrutiny of multiple Department of Defense review and test teams to ensure it is protected from cyber and other symmetric attacks in all operating phases, including analysis of performance during flight tests. MDA in coordination with COCOMs, JTF-GNO, and NSA continuously conducts network monitoring and defense in order to protect the BMDS.

Cyber attack simulations or other asymmetric attacks of key BMDS assets are not expressly included during development flight testing. Introducing an anomaly like a cyber attack rendering inoperable a portion of the BMDS during the course of a developmental flight test would introduce an unacceptable level of risk of corrupting the test objectives. However, for an operational test of military utility, or as part of a warfighter's rehearsal or operational readiness drill, simulating an attack on the infrastructure would be entirely necessary and appropriate.

To date, cyber-attack scenarios have been simulated for GMD during Assured Response warfighter exercise, and are also planned in future Terminal Fury (1 scenario) and Global Thunder (10 scenarios) exercises. These scenarios exercise the responsiveness to simulated cyber-attacks. Penetration tests are regularly performed immediately following ground-test runs for record. Current Penetration Tests are in planning stages to incorporate defensive operations and procedures in response to realistic cyber-attacks.

As part of developing and fielding BMDS capabilities, MDA performs Information Assurance (IA) compliance validation tests to make sure BMDS capabilities are IA compliant with DoD standards and can operate in a cyber threat environment.

As part of the ground test program, while the system is still in the test configuration, MDA performs penetration testing to determine if there are any IA weaknesses that could be exploited by potential adversaries.

During normal day-to-day operations, Blue teams are scheduled to perform cyber attacks on selected key assets to determine likely threat vectors that could be used against BMDS capabilities.

The Agency continues to plan for and expand testing to address emerging threats consistent with the intent of OSD procedures for OT&E of Information Assurance in Acquisition Programs, and we are moving towards compliance as our penetration testing capabilities increase. Our overall information assurance plan provides for a risk-based implementation of procedures and countermeasures. The cyber-threat is monitored and analyzed, and those results are made available to GMD and other

elements through a variety of mechanisms including daily summaries and, for GMD, presentations at the quarterly GMD System Protection Working Group.

In addition to the simulated threat, it is worthwhile noting that, from a threat mitigation perspective, the Agency works closely with our Intelligence Community partners, and service counterparts to identify the foreign threat to all of our tests—this includes cyber. The exact details of this are classified, but we generally ensure that safeguards are in-place to identify, and where possible counter every level of threat including technical.

Ms. TAUSCHER. Do you plan to fly the CE1 version of the GMD EKV against a target with countermeasures in an intercept?

- If not, why?
- If we don't conduct such a test, how will we have confidence that the system will work in a real-time combat situation?

General O'REILLY. MDA is currently reexamining its flight testing program and expects to include additional flight testing of the Capability Enhancement CE-I exoatmospheric kill vehicle (EKV). A BMDS test review is now underway to determine the complete body of data necessary to validate the BMDS models and simulations and the data needed to validate operational effectiveness, suitability and survivability. The integrated master test plan will be revised following the BMDS test review and it is expected that testing of the CE-I EKV will be accomplished and include the specific objective to discriminate and intercept a dynamic lethal object from an operationally realistic target scene with countermeasures.

Ms. TAUSCHER. In fiscal year 2008, due to technical challenges, the GMD program was unable to conduct any intercept tests, despite the fact that Congress had authorized and appropriated more than $200 million to conduct such tests.

- Did the Missile Defense Agency provide the prime contractor (Boeing) an award fee for its fiscal year 2008 performance?
- If so, how much and what was the justification for such an award?

General O'REILLY. Boeing was awarded $182.48M (66%) out of a potential fee pool of $276.45M for their performance during fiscal year 2008.

Boeing's less than satisfactory performance during fiscal year 2008 resulted in the removal of $95.08M from the award fee pool. More specifically, the lost fee opportunities were attributed to:

- Failure to achieve any flight test intercepts during fiscal year 2008;
- Missed commitments to deploy up to six new interceptors;
- Delayed deployment of new capability to the warfighter;
- Programmatic and budgetary impact within GMD and the Agency due to restructures of the integrated ground and flight test program; and
- Failure to provide a joint product for establishing a common architecture for the Common Avionics Module.

$33.57M of the $95.08M lost fee opportunity in fiscal year 2008 was authorized to be carried over to the fiscal year 2009 award fee period. $25M is authorized to be applied to GMD Flight Test-05 (FTG-05), $5M to Distributed Ground Test-03 (GTD-03), $3.57M to Sea-based X-Band shipyard performance parameters, Simultaneous Test and Operations long haul communications and safety certification, and Upgraded Early Warning Radar documentation for Transition and Transfer.

The Boeing Company significantly contributed to the BMDS mission in the following areas:

- Excellent job planning and conducting ground test events GTD-02 and GTI-03;
- Exceptional planning and execution of the BMDS system-level Sensor Characterization Flight Test (FTX-03) and associated data analysis even though the target flew an off-nominal trajectory; and
- Noteworthy support of real-world events such as Operation Fast Shield.

Ms. TAUSCHER. The Director of Operational Test and Evaluation has indicated in its fiscal year 2008 annual report, that testing for the MDA is not yielding enough data to support certification of the elements at an individual level and at the integrated system level.

- How does MDA plan to ensure that the BMDS is fully tested—including operationally effective and suitable—prior to continuing production?
- How is MDA working with DOT&E to improve the data that DOT&E needs to certify the BMDS and its elements?
- Will MDA continue the approach of concurrent testing and fielding under the new block structure?

- Is that approach still necessary given that the Presidential directive to field an early capability has been met?

General O'REILLY. A. How does MDA plan to ensure that the BMDS is fully tested-including operationally effective and suitable-prior to continuing production?

In the on-going three-phase test review, MDA, the DOT&E and the BMDS Operational Test Agency Team are defining how operational testing attributes can be incorporated within the BMDS test program. As part of the review, critical operational issues are driving future test events, to include multiple simultaneous engagements, salvo launches, and more complex target presentations. MDA is developing detailed test planning requirements for meeting a more robust system assessment, with inputs from the BMDS OTA Team and the DOT&E. The review participants are planning tests with verifiable, quantifiable results, which will take place over the next three to four years. The BMDS Integrated Master Test Plan will be approved by MDA, the DOT&E and the BMDS Operational Test Agency Team and delivered at the end of May.

MDA works with USSTRATCOM, DOT&E and the Military Departments to ensure adequate integrated development and operational testing. MDA has sought an appropriate balance between developmental maturity and production stability, technical risks and costs, to provide a capability to the warfighter where none existed. The goal is to add capabilities with demonstrated military utility, as they mature.

B. How is MDA working with DOT&E to improve the data that DOT&E needs to certify the BMDS and its elements?

One of MDA's highest priorities is to refocus the BMDS test and evaluation program to determine what data are needed to validate our models and simulations, so that our warfighter commanders, the DOT&E, the BMDS OTA Team, and other decision-makers on the Missile Defense Executive Board have confidence in the predicted performance of the BMDS. The results of the on-going three phase test review will be a top-down-driven, event-oriented plan that extends until the collection of all identified data is complete.

The BMDS test review to date confirms our need to significantly improve the rigor of the BMDS digital models and simulations of threat missiles, the phenomenology, and operational environments. The BMDS Integrated Master Test Plan (IMTP) will define the test program that will produce the data needed by DOT&E and the BMDS OTA Team to assess the BMDS capabilities, and will be signed by the DOT&E and the BMDS OTA Team.

In order to assure close working relationships, the great majority of the BMDS OTA Team members are collocated with the MDA testing staff in Huntsville, and the MDA Director for Test meets on a bi-weekly basis with his counterpart in the Office of the Director, Operational Test and Evaluation.

C. Will MDA continue the approach of concurrent testing and fielding under the new block structure?

No. MDA intends to complete DT/OT prior to development programs being considered for fielding and operational acceptance decisions by the Services. However, when a contingency need arises (such as protection of the U.S. from long-range North Korean missiles) the appropriate COCOM Commanders and Joint Chiefs of Staff consider the capability and limitations of our developmental systems. If ordered, MDA will employ components of the BMDS on a contingency basis.

D. Is that approach still necessary given that the Presidential directive to field an early capability has been met?

MDA uses a capability-based acquisition process that allows MDA to address emerging, real-world threats as expeditiously as possible. Our process is based on collaboration with the warfighter community throughout development, testing and fielding. The priorities of the warfighter are based on the need to respond to real world threat. The results of the Joint Capability Mix Phase II study are evidence that DoD supports the importance of responding to the threat quickly.

In some cases, such as GMD, we fielded limited capabilities to protect the Nation where portions of the system performance had been demonstrated in early tests. MDA fielded parts of GMD to provide a limited capability, and we continue to test in parallel for a full capability. In other cases, such as Aegis BMD 3.6.1, we have fielded an operational capability that has been tested and evaluated by the Navy's COMOPTEVFOR, and continue to field additional capabilities for optimum BMDS integration and multi-area-of-responsibility use. With THAAD, we developed an initial capability that we have demonstrated against most short range threats, but have just begun our test campaigns to address medium range threats. MDA plans to continue this approach, to provide critical capability in increments to the warfighter based on their priorities.

Ms. TAUSCHER. To what extent has the BMD sensors been tested in harsh weather environments (e.g., rain, snow, fog, etc)?

- What information can be learned from such testing?
- If you have not conducted such testing, when to you plan to initiate such testing?

General O'REILLY. Sea-Based X-Band (SBX) radar and AN/TPY-2 radars:

A. SBX equipment and procedures were thoroughly tested in a detailed Winter Shakedown test from 3 Jan through 20 Feb 07 in the harsh northern Pacific Ocean, to include wave heights up to 50 feet and sustained winds of 60 knots, gusting to 102 knots. The assessment demonstrated payload performance in Alaska environments; safety at sea; vessel navigation; sustainment operations; and COCOM and external agency inter-operability.

B. The AN/TPY-2 radar has been performing very well in austere environments in both Japan (since 2006) and Israel (since 2008).

C. Cobra Dane and Upgraded Early Warning Radars were designed, built, and tested by the Air Force. The operating frequencies of UEWR (UHF) and CDU (L-Band) are minimally affected by weather environments (e.g., rain, snow, fog). The UEWR and CDU use the same external facilities (e.g.., array face, structure) that housed the Early Warning radars and COBRA DANE. The facilities have been in place for more than 20 years and have successfully operated and survived in all environments during that period. Therefore, specific weather related testing is unnecessary for UEWR and CDU.

Ms. TAUSCHER. To what extent was the Sea-based X-Band radar designed to be survivable?

- Have you tested and run exercises to understand this issue?
- What about other BMDS sensors?

General O'REILLY. [The information referred to is classified and retained in the committee files.]

Ms. TAUSCHER. DOT&E's latest report indicated that target reliability was a continuing problem in 2008. For example, in two recent flight tests, FTX-03 and FTG-05, target missiles did not successfully deploy the planned countermeasures, which prevented the elements from developing algorithms needed for advance discrimination. DOT&E reported that until these target problems are solved, this poses a risk to future flight tests using countermeasures.

- Please provide a status on developing advanced algorithms for discrimination.
- What capability does MDA currently possess for discrimination? How was this capability verified?
- Will additional flight tests need to be scheduled to understand the discrimination capabilities of the currently fielded interceptors?

General O'REILLY. [The information referred to is classified and retained in the committee files.]

Ms. TAUSCHER. Last year, the operational test authorities accredited the models for Aegis BMD version 3.6.

- Does the Aegis BMD do modeling and simulations differently from other BMDS elements?
- If so, what are the key differences?
- Are there lessons from the Aegis BMD modeling and simulation program that could be applied across the BMDS, particularly to the GMD system?

General O'REILLY. The primary difference in accreditation status resulted when the Navy's Commander Operational Test and Evaluation Force (COMOPTEVFOR), accredited Aegis Element models, primarily MEDUSA, for Navy operational effectiveness. While in a MDA system-level performance simulation venue, Performance Assessment 2007 (PA07), EADSIM was used as the Aegis 3.6 representation which the MDA Operational Test Agency (OTA) did not accredit for BMDS system performance, primarily due to model limitations.

In Performance Assessment 2009 (PA09), the Navy is using MEDUSA as the Aegis representation and will be the first opportunity for the OTA to evaluate the performance of the Aegis MEDUSA model during a MDA system-level performance event.

Aegis BMD has a successful test program that provides numerous opportunities to collect test data to validate their M&S representations. This is their main advantage that can be shared with GMD. The lesson learned is that a lack of test data, especially from flight tests, does not allow OTA to accredit their representations. I have placed personal emphasis and scrutiny on tightly linking test events for elements and the BMD system to validating MDA models and simulations.

Ms. TAUSCHER. System-level performance assessments are a comprehensive means to fully understand the performance capabilities and limitations of the

BMDS. In order to have high confidence in system-level models and simulations, MDA relies on an independent entity, the BMDS Operational Test Agency, to provide an accreditation. This organization depends on the verification and validation work performed by MDA's elements. Accreditation is an official decision of how much confidence there is in a model or simulation used in the performance assessment. Currently, the BMDS Operational Test Agency has fully accredited 6 out of 40 models and simulations, which are used for annual performance assessments. MDA intends to complete Performance Assessment 2009 by the end of the calendar year, but it is highly unlikely that this performance assessment will be fully accredited.

- What is MDA doing to make progress in validating models and simulations?
- When do you anticipate that MDA will have a fully-accredited, system-level performance assessment?

General O'REILLY. The Missile Defense Agency (MDA) has implemented a Modeling and Simulation (M&S) System Post Flight Reconstruction (SPFR) program to better leverage the performance data that is gained through Flight Testing for model validation. During SPFR assessments, BMDS M&S representations are exercised under day-of-flight conditions to compare model performance to actual system performance. For calendar year 2009, MDA will implement SPFR validation assessments for system level flight tests in both Hardware-in-the-Loop (HWIL) and end-to-end digital performance assessment representations.

The BMDS is a capability based continuously evolving architecture—a spiral development process. Each delivery of a new missile defense capability requires the delivery of new models and simulations. The delivery of new models and simulations requires additional accreditation. Thus, as new versions of components emerge, their modeling and simulation representations must be anchored back to real-world events and data. Utilizing the SPFR program, and through analysis of the models and simulations database, the level of accreditation and confidence in the representation of BMDS performance will continue to increase. As we complete the Performance Assessment 2009 (PA09) effort in late Calendar Year 2009, we will complete accreditation review, based on OTA criteria, of the models that represent the December 2009 BMDS configuration. Any model structure or real world validation data shortcomings indentified in this process will be addressed through anchoring back to real world events and data when available. Validation data requirements will be provided to the test planning process. The completion of accreditation for models of the December 2009 BMDS configuration will not be precisely known until this accreditation review is complete. The PA09 model ensemble which represents the BMDS December 2009 configuration will be maintained and improved to meet any shortcomings indentified in the accreditation process. The Agency is restructuring the test program to provide data for Modeling & Simulation (M&S) Validation. The M&S Verification and Test Design Process will allow for collection of data parameters through flight and ground tests. As part of this on-going effort, the system level simulations, Digital Simulation Architecture (DSA) and the Single Stimulation Framework (SSF), will provide a fully capable representation of the fielded 2010 BMDS configuration in October of 2010. The data to support Verification, Validation & Accreditation (VV&A) of the DSA and SSF is being addressed as part of the scheduling activity during Phase III of the M&S Test Verification and Design Process. The product of the Phase III activity is a revised BMDS Integrated Master Test Plan (IMTP) which identifies the test events providing M&S validation data. The schedule for completion of BMDS Block Validation and Accreditation will be completed in conjunction with the revised IMTP.

Ms. TAUSCHER. In its Fiscal Year 2008 Annual Report to Congress, DOT&E noted that theater missile defense systems (e.g., Aegis BMD, THAAD, and PAC-3) continued to make progress, while strategic systems (e.g., GMD) continue to face challenges in regards to testing.

- What are the key reasons for these differences?
- To what extent have Aegis BMD and THAAD's success been a result of using their original operational requirements document to guide their testing and development?
- Are there lessons from the Aegis BMD and THAAD programs that we could apply to the GMD program?

General O'REILLY. What are the key reasons for these differences?

The relative level of maturity between the programs is the key reason for differences noted in the DOT&E Annual Report. GMD was an advanced concept program in 2002, when National Security Presidential Directive-23 directed MDA to deploy a set of initial missile defense capabilities beginning in 2004. GMD early devel-

opment assets were placed into operational service to provide this initial capability. Continuing the spiral development process, while at the same time responding to real world demands, has slowed some of GMD's planned progress. For example as a first priority, the initial GMD test program focused on establishing confidence that the system would in fact meet the challenges of the early threat.

In contrast, the first Aegis ship was commissioned in 1983. Starting in 2002, MDA developed the necessary modifications to add Aegis Ballistic Missile Defense capability into an already existing Aegis fleet. Sound systems engineering in support of performance cornerstones was and remains essential to how the Aegis project, and now Aegis BMD, organizes and executes the ballistic missile defense mission. A combination of development, system engineering, integration, testing, training, logistics, technical support, operations and sustainment has been operating successfully for close to forty years. Leadership, to include communication, responsibility, authority and accountability, is a hallmark of the Aegis BMD program.

THAAD was defined as a program in 1992 and went through an eight year concept definition phase before entering full scale development in 2000, and is expected to deliver its first operational assets later this year.

Both Aegis and THAAD were significantly more mature programs at the time MDA was created and given the mission to provide Limited Defensive Capability through accelerated development, testing and deployment of the GMD system.

To what extent have Aegis BMD and THAAD's success been a result of using their original operational requirements document to guide their testing and development?

Greater system maturity, not the existence of operational requirements documents, accounts for the greater success of the Aegis and THAAD test programs. The Secretary of Defense cancelled all missile defense Operational Requirements Documents in 2002. Since then, MDA specification documents and test plans have guided development and testing for GMD, Aegis BMD and THAAD. For each element, testing under operationally realistic conditions is an important part of maturing the BMDS. The MDA has been fielding test assets in operational configurations in order to conduct increasingly complex, end-to-end tests of the system. Comprehensive ground tests of the elements and components precede each flight test. MDA increasingly introduces operational realism into BMDS flight tests, bound only by consideration of and compliance with environmental and safety regulations.

Aegis BMD uses a number of different BMDS and Aegis BMD documents for testing and development. However, system maturity and the Aegis BMD test program philosophy drive their success rate. Throughout its development, Aegis BMD has employed a deliberate, rigorous and disciplined technical approach to testing. There is tight coupling of modeling and simulation, ground testing and flight tests. Modeling and simulation are anchored with ground and flight test data. Aegis BMD philosophy to "test as we fight" institutes operational realism in all flight tests. Aegis BMD involves the operational test agent and warfighter in the early planning and conduct of each mission. Following each mission, critical Fleet feedback is provided to engineering development.

The THAAD Project Office had a JROC approved Operational Requirements Document (ORD) on 1 May 2000. The ORD was the principal tool to guide the THAAD Project Office through the design phase. The ORD was used to conduct requirement trades for the System Preliminary Design Review in 2002 and was used as a guide for System Critical Design Review (CDR) in 2003. The ORD was not used to write critical operational issues and criteria for use in current test designs and operational assessments.

Are there lessons from the Aegis BMD and THAAD programs that we could apply to the GMD program?

GMD has drawn some lessons learned from Aegis BMD. In 2005 there were two early GMD flight test failures attributable to flaws, first in the software, and then with a fixture in a test silo. A mission readiness task force was established to set standards for rigor in test reviews. Drawing on lessons learned from the Aegis test program, these standards were applied not just to GMD, but implemented throughout MDA, and have resulted in successful flight tests from that point. MDA encourages the staff at all levels to collaborate and apply lessons learned both within their elements, as well as across the board, to improve mission success.

Ms. TAUSCHER. In 2009, MDA plans to demonstrate the ABL during a lethality demonstration in which the system will attempt to shoot down a short-range ballistic missile. The KEI element also has a key decision point—a booster flight test—scheduled for 2009. In preparation for this test, the program conducted static fire tests and wind tunnel tests in fiscal year 2007 to better assess booster performance. Upon completion of KEI's 2009 booster flight test and ABL's 2009 lethality dem-

onstration, MDA will compare the progress of the two programs and decide their futures.

- Do you believe that the lethality demonstration scheduled for 2009 will constitute proof that an operational ABL is feasible and should be acquired for the boost phase system?

General O'REILLY. No. The lethality demonstration is necessary but not sufficient to determine if the ABL should be acquired. A successful lethal demonstration by the ABL will answer two vital questions. First, is the technology ready? A successful demonstration will prove the technology is available to engage and destroy a ballistic missile during a missile's most vulnerable phase before a payload can be employed or countermeasures can be deployed. Second, is the lethality concept feasible? A successful demonstration will increase the value of a layered missile defense while reducing the viability and effectiveness of enemy ballistic missiles. DoD's intent is to continue to test and comprehensively assess the current prototype ABL as a research test bed while refining the design prior to a Tail 2 production decision in the future.

Ms. TAUSCHER. The 2009 lethality demonstration is a key knowledge point for the ABL. Upon completion of the demonstration, MDA will decide the future of the program. Even with a successful demonstration, MDA will need to determine whether an operationally effective and suitable ABL can be developed.

- Given that the 2009 lethality demonstration is successful and the ABL continues through development and into fielding, how does MDA plan to proceed with the development of the system's unique operations and support requirements?
- Starting with the lethality demonstration, please lay out the key questions that must be answered on ABL in order for it to be considered technically practical (that is, it can do its job reliably), operationally practical (that is, it can actually be where it needs to be and when), and practically supportable (that is, its maintenance can be performed by military personnel, its maintenance and support is affordable, and the basing/support operation is feasible in terms of human safety)?
- How does MDA plan to minimize the difficulty of relocation and unique handling difficulties associated with the ABL?
- What safety concerns currently exist with the ABL?

General O'REILLY. Q1) How does MDA plan to proceed with the development of the system's unique operations and support requirements?

A1) MDA will work closely with Air Combat Command (ACC) to refine the Concept of Operations (CONOPS). ACC developed the current ABL CONOPs (January 2007) and has been instrumental in providing user requirements into the ABL element of BMDS.

The ABL aircraft is a Boeing 747-400F that requires minimal ABL airframe-unique maintenance and support. These aircraft are in service throughout the world with a robust support structure. The weapon system utilizes commercially available chemicals (hydrogen peroxide, salt, chlorine, ammonia, iodine and helium) that are available globally. ABL has developed a prototype deployable/transportable chemical mix facility that will allow the manufacturing of laser fuel at any Forward Operating Location. A demonstration of ABLs ability to deploy will occur after lethal demonstration. ABL will continue to mature the life-cycle operation and support plans through continued tests, studies and user inputs. ABL will meet warfighter operational and support requirements and provide a globally deployable capability.

Q2) What are the key questions that must be answered in order for ABL to be considered technically practical (that is, it can do its job reliably)?

Key Questions include: Is the ABL lethal against all classes of ballistic missiles? Can ABL detect and track ballistic missiles threats? Can ABL compensate for the effects of atmospheric effects between ABL and the target? Does the ABL provide a capability that meets warfighter needs?

ABL will address the most critical question of lethality during ABL's lethality test/demonstration against a threat-representative ballistic missile in Fall of 2009. Data from this demonstration can then be used to anchor models to predict lethality against different types/classes of missiles. Successful completion of this test will also demonstrate ABL's ability to detect and track ballistic missiles.

The most technically challenging requirement for ABL has been compensating for the atmospheric effects between ABL and the target. ABL repeatedly demonstrated its ability to perform this critical function in 2006 during dozens of flight tests against special aircraft designed to assess ABL's atmospheric compensation capability.

After lethal demonstration, MDA will continue to generate knowledge concerning ABL by addressing military utility issues. These follow-on ABL efforts will develop and demonstrate more robust capability within the ABL design and address key warfighter requirements such as: BMDS interoperability, weapon system maneuverability, ABL deployability, survivability, Reliability, Maintainability and Sustainability (RM&S). Key technology areas that will be addressed are improving performance of the optics, optimum chemical utilization, increased laser power, modularization of the onboard chemical supply system, and increased beam quality. In combination with the existing RM&S program, these efforts will ensure that future ABLs provide a revolutionary warfighting capability.

Q3) What are the key questions that must be answered in order for ABL to be considered operationally practical (that is, it can actually be where it needs to be and when)?

Key questions include: Is ABL deployable? Is ABL maintainable at a Forward Operating Location? Are the laser chemicals available at Forward Operating Locations?

Actions to address questions: According to the ABL Concept of Operations, operational ABLs will be primarily based in the continental United States. Operational ABLs will be able to deploy to Forward Operating Locations world-wide. The deployment of ABL is dependent on threat. ACC and STRATCOM will utilize current intelligence to ensure ABL, as a critical component of the BMDS, is in the appropriate theater of operations to engage targets to defend U.S. interests, and to provide critical tactical information to other BMDS components. ABL plans to demonstrate its deployment capability after lethal demonstration. Deployment requirements have been documented, a prototype chemical mix facility has been built and some unique support equipment is available to support deployment. ABL will utilize common support equipment available at bases that already support heavy aircraft. This will reduce the size of the deployment package. During deployments, required maintenance will be accomplished on the flight line or in maintenance facilities located just off the flight line. Deployed ABLs will have technical support and supply reach-back to the home bases to ensure operational availability. Continued collection and analysis of ABL sustainment data will ensure refinement of operational support needs. ABL will have the ability to deploy its entire support requirements on short notice to anywhere in the world in 72 hours.

Q4) What are the key questions that must be answered in order for ABL to be considered practically supportable (that is, its maintenance can be performed by military personnel)? Are its maintenance and support affordable? Is the basing/support operation feasible in terms of human safety?

Key question to determine ABL being practically supportable . . . utilizing military personnel . . . include: Are ABL maintenance requirements significantly different than other complex weapon systems? Are maintenance tasks that are required for normal ABL operations within the capability of Air Force maintenance personnel?

ABL maintenance by Military personnel: ABL, like other complex weapon systems will have multiple levels of maintenance. Future ABL logistics support will be a mix of contractor support (depot and complex repairs) and organic Air Force support. As the program continues to gain knowledge via the existing ABL, we will be better able to determine the appropriate level of support required by both Air Force and contractor support. For deployed ABLs, Air Force maintenance personnel will perform aircraft maintenance and basic weapon system maintenance. ABL, with the support of ACC, has performed initial studies on the various skills required to operate and maintain the weapon system. ACC will continue to be actively involved in development of ABL maintenance. ABL will further refine maintenance requirements during the Characterization and Capabilities Demonstration period following lethal demonstration.

Key questions to determine ABLs maintenance and support is affordable: Does the ABL program have a Reliability, Maintainability and Sustainability program in place? Does the RM&S program address life-cycle cost of maintenance and associated support? Are efforts in place or planned to reduce cost drivers?

ABL maintenance and support affordable: During the Characterization and Capabilities Demonstration period, ABL will perform affordability studies to include maintenance and support of ABL within the BMDS layered defense environment. The key components that will be addressed during this period are the life-cycle cost drivers. The studies undertaken by the ABL System Program Office and industry partners will utilize the existing Reliability, Maintainability and Sustainability (RM&S) program to evaluate factors that contribute to life-cycle costs. Management of these life-cycle cost drivers will provide the efficient and effective support of future ABLs.

Key question to determine that ABL basing/support operation is feasible in terms of human safety: Does the ABL safety program adequately mitigate potential personnel hazards associated with operation and maintenance of ABL?

Safe ABL operation and maintenance: At Edwards AFB, ABL has successfully demonstrated the ability to safely support all ABL operations since testing of the high power laser in 2004. This excellent safety record is a result of ABL safety program. We will utilize this safety program wherever ABL is located. ABL has performed initial deployment studies addressing issues related to safe operation and maintenance at forward operating locations. ABL has planned a deployment demonstration that will demonstrate ABL's ability to conduct safe operations at various U.S. and foreign bases.

Q5) How does MDA plan to minimize the difficulty of relocation and unique handling difficulties associated with the ABL?

A5) Operational ABL will be able to deploy to Forward Operating Locations worldwide. These locations can be at any operational location where heavy cargo aircraft operate. Runways, taxiways, and instrument approach requirements are similar to those for other heavy aircraft. ABL support equipment is comprised of typical military and commercial aircraft ground support equipment (air conditioning, auxiliary power, etc.) and equipment that is particular to ABL. ABL will utilize common support equipment available at bases in-theater wherever possible to reduce the size of the deployment package. ABL will require a limited number of specialized support equipment to service the laser weapon and mix laser chemicals. ABL has developed and demonstrated a prototype deployable chemical mixing facility. The chemicals required to operate the High Energy Laser are globally available in commercial markets (chlorine, hydrogen, ammonia, iodine and helium). To ensure the quality and availability of chemicals, pre-positioning of ABL laser fuels at pre-designated FOLs will ensure immediate availability upon arrival of ABL aircraft. The laser fuel chemicals have an unlimited shelf-life prior to mixing. Air mobility or sea transportation can then be used to replenish those laser fuels not locally available. Transport of specialized equipment will require military airlift. The amount of deployed equipment will depend on the operational scenario, but will be smaller than the footprint of the actual 747 aircraft.

Q6) What safety concerns currently exist with the ABL?

A6) Current ABL safety concerns are categorized into ten hazard areas—these include chemical containment on and off the aircraft, fire suppression on and off the aircraft, degradation of critical structures and critical systems, degradation of flying qualities, solar avoidance, incorrect pointing, and beam containment. The program utilizes a rigorous 4-prong safety approach to identify, assess, and mitigate all safety concerns. First, the Program Office identifies the level of risk associated with each hazard area, prior to each test series. These risks are then accepted at the proper level within the MDA. Second, the Air Force Flight Test Center at Edwards AFB identifies, documents, and accepts any risks associated with testing the system safely. Third, the Boeing Commercial Aircraft Group assesses the system to determine the safety implications from modifications made to the 'green aircraft' and subsequently issues a 'safe-to-fly' letter prior to each flight test series. Lastly, an Executive Independent Review Team assesses ABL's compliance with airworthiness standards and assesses the safety of flight test risks and hazard mitigations; they also provide a 'safe-to-fly' recommendation prior to each flight test series.

QUESTIONS SUBMITTED BY MR. HEINRICH

Mr. HEINRICH. BMDS test schedules are driven by the costs and availability of targets. MDA has also experienced a number of failures with targets over the past several years. The lack of affordable threat representative targets is seriously impacting the adequacy of operationally realistic flight testing.

- What is MDA doing to ensure affordable targets are available to support adequate developmental and operational test objectives?

General O'REILLY. MDA is taking a number of steps beginning this year to ensure targets are more affordable and available including:

- Identifying cost drivers in requirements and challenging their need or identifying other/cheaper ways to obtain data (e.g., range sensors already participating in test)
- Reviewing and refining the acquisition strategy, identifying industry capabilities and considering alternative approaches for supporting the test program. In the industry request for information released in January, we emphasized that we will focus on target reliability, affordability, flexibility, and threat represen-

tation. Based on the results of industry input and the performance of current target development programs, MDA will determine this summer if recompeting current target contracts is warranted.

- Evaluating test campaigns, grouping by threat and by range, and improving efficiencies in mission planning and execution.
- Increased quantity buys for economy of scale.
- Increasing the availability of targets by providing a rolling spare for each mission.
- Improving the long-term requirements development process to allow better target planning across the Future Year's Defense Program to reduce perturbations in target requirements (a major target cost/schedule driver).

Mr. HEINRICH. A recent study indicated that the Army and Sandia National Laboratory provided MDA with targets on time and at a reasonable cost before the targets management and procurements efforts were moved to MDA.

- Has MDA considered giving the targets development and acquisition program back to the Army Targets Office and Sandia National Laboratory?
- What are the pros and cons of giving responsibility for development and acquisition of missile targets program back to the Army Targets Office?

General O'REILLY. Target production is an integral part of the MDA test mission and there are no ongoing discussions with the Army regarding assuming this function. The targets procured from the Army were primarily through a Missile Defense Targets office whose personnel were direct funded by MDA and used Space and Missile Defense Center contract vehicles. The Target Vehicles were shorter range, lower fidelity, targets and did not represent threat capabilities as accurately as current target configurations under development by MDA. The lower fidelity targets are, by their very nature, less costly to develop or manufacture. With the establishment of an MDA targets office, Army personnel have either become MDA employees or found other employment and the Army contract vehicles have lapsed or were transferred to MDA. In addition, targets from Sandia National Laboratories (SNL) have come under increased scrutiny with the failure of the last two SNL targets (FTG-05 and FTX-03) to deliver associated objects. As a result, not all critical test objectives were achieved despite achieving most test objectives for FTX-03 and a successful intercept test with FTG-05.

MDA is assessing recent inputs from industry and other sources in response to an MDA Request for Information to determine the need to recompete target delivery contracts. All respondents, including SNL, are being considered.

Mr. HEINRICH. Given the greater complexity, difficulty, and risk of intercepting missiles during the midcourse phase, how important do you think it is to invest in technologies focused on boost phase?

General O'REILLY. [The information referred to is classified and retained in the committee files.]

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