Director, Operational Test and Evaluation

FY 2014 Annual Report

January 2015

This report satisfies the provisions of Title 10, United States Code, Section 139. The report summarizes the operational test and evaluation activities (including live fire testing activities) of the Department of Defense during the preceding fiscal year.

J. Michael Gilmore
Director

FY 2014
Annual Report

The purpose of operational testing is to assure the Military Services field weapons that work in combat. This purpose has been codified in both USC Title 10 and in the Department of Defense's (DOD) 5000-series regulations for many years without substantive alteration. Operational testing is intended to occur under "realistic combat conditions" that include operational scenarios typical of a system's employment in combat, realistic threat forces, and employment of the systems under test by typical users (Soldiers) rather than by hand-picked or contractor crews.

Thorough operational testing should be conducted prior to a system's Full-Rate Production decision or deployment to combat in order to inform acquisition decision makers and operators in an objective way about how the system will perform in its combat missions. Under current law, the Director of Operational Test and Evaluation (DOT&E) is required to present his opinion on whether the operational testing conducted prior to the Beyond Low-Rate Initial Production decision is adequate or not. The Director must consider all the operational facets of a system's employment in combat when he determines what constitutes adequate operational testing, including the performance envelope the system must be able to achieve, the various operating conditions anticipated in a time of war, and the range of realistic operational threats.

In 2014, I investigated many examples of recent programs across all Services to identify common themes in operational testing. These themes illustrate the value that operational testing provides to the Defense community. Additionally, they highlight the continuing improvements we have made in the credibility and efficiency of OT&E during my tenure. A briefing covering these six themes and dozens of examples across all Services is posted on the DOT&E website.[1] These themes reveal a common conclusion: OT&E provides value to the Department by identifying key problems and clearly informing warfighters and the acquisition community about the capabilities our combat systems do and do not have. Furthermore, we are getting this information now more efficiently and cost effectively than ever by employing rigorous scientific methods in test planning, execution, and evaluation.

Identifying Problems

One of the primary purposes of operational testing is to identify critical problems that can be seen only when systems are examined under the stresses of realistic operational conditions, prior to the Full-Rate Production decision. This early identification permits corrective action to be taken before large quantities of a system are procured and avoids expensive retrofit of system modifications. For a recent example, operational testing of the Navy's Cooperative Engagement Capability (CEC) on the E-2D Hawkeye aircraft revealed several deficiencies. The CEC created many more dual tracks compared to the baseline CEC system, exhibited interoperability problems with the E-2D mission computer, and there was a degradation in CEC's ability to maintain consistent air tracks compared to the baseline E-2C version. As a result of these discoveries in operational testing, the Navy's acquisition executive decided to delay the Full-Rate Production decision until the root causes for these deficiencies could be found and fixed. The Navy is now implementing fixes to address these problems, and operational testing will be conducted to verify these fixes have corrected the problems. The value of such testing is abundantly clear if one considers the alternative: discovering these problems for the first time in combat, when it is too late to correct them.

Fixing, Not Testing, Delays Programs

Operational testing frequently reveals deficiencies in a system that require time and perhaps also training to correct. The acquisition executives who are responsible for programmatic decisions then have to weigh whether the problems discovered are of sufficient magnitude to warrant delays to the program while they are fixed (and re-tested). The assertion that testing causes programmatic delays misses the essential point: fixing the deficiencies causes delays, not the testing. Furthermore, taking the time to correct serious problems is exactly what we desire in a properly-functioning acquisition system; testing is the vehicle by which decision makers can be informed and make decisions that will ultimately benefit the Services and the Nation.

This year, my office updated a previous study that we conducted with USD(AT&L) in 2011 on the causes of program delays. This year's analysis examined case studies for 115 acquisition programs, which were selected because they had experienced

1. http://www.dote.osd.mil/pub/presentations/Value_of_OT_Final_Version_8.pdf

a delay of 6 months or more and had a Full-Rate Production decision after 2000. Delays on these programs ranged from 6 months up to 15 years, and in some cases, programs were cancelled after the delays (Figure 1 shows the distribution of these delays for these 115 programs). The reasons behind the delays are varied. In most cases, the delay is not due to a single reason; rather multiple reasons led to a delay (see Figure 2 and Table 1).

The study revealed that the least common reason for a delay was a problem associated with test conduct. As shown in Table 1, problems in test conduct occur in only 23 percent of the case studies, 26 of 115 cases. Furthermore, all programs that had problems in test conduct also had at least one other reason that contributed to the delay; test conduct, therefore, was never the sole reason for delaying a program. On the other hand, the most common reason that contributes to a delay is a performance problem discovered during developmental or operational testing that must be addressed before a program moves forward. A total of 87 of 115 cases examined (76 percent) discovered system performance problems during testing; 38 cases discovered problems in developmental testing only; 17 cases discovered problems in operational testing only; and 32 cases discovered problems in both developmental and operational testing.

Furthermore, when examining the length of the delay, no statistical evidence exists to support the claim that test conduct problems drive longer delays. Rather, the statistics support the assertion that performance problems discovered in testing significantly affect the length of the delay, not problems in conducting the test. For programs that discovered problems in operational testing, the length of the delay was more significant than for programs that discovered problems in developmental testing. This is not a surprising result, since problems seen for the first time in operational tests are frequently discovered late in the program's development, when designs are set and it is more difficult and time consuming to change them to correct problems.[2] Moreover, the statistical analysis revealed the largest drivers of delays are whether the program experienced manufacturing, software development, or integration problems and programmatic issues. A briefing with more details on this analysis is available on the DOT&E website.[3]

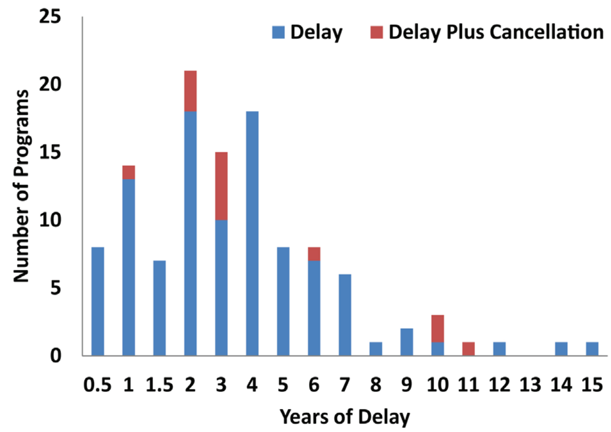


FIGURE 1. YEARS OF DELAY

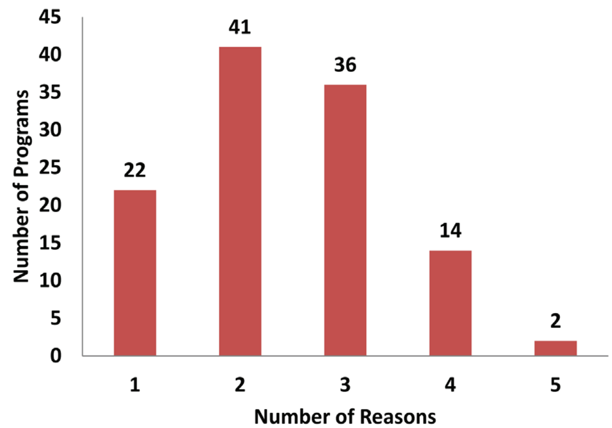


FIGURE 2. NUMBER OF REASONS FOR THE DELAY

TABLE 1. NUMBER OF PROGRAMS AFFECTED BY EACH REASON

Reason that Contributes to the Delay	Number of Programs Affected[1]
Problems conducting the test: problems with test resources, test instrumentation, or test execution that are typically beyond the control of the program manager	26
System problems identified during testing that must be addressed before the program can move forward: • During developmental testing only (38) • During operational testing only (17) • During developmental and operational testing (32)	87
Programmatic issues: funding, scheduling, or management problems	72
Manufacturing, software development, integration, or quality control problems	61
Critical Nunn-McCurdy breach[2]	34

1. The total number of programs affected is more than 115 because most programs had more than one reason for a delay.
2. A critical Nunn-McCurdy breach occurs when the program acquisition unit cost or the procurement unit cost increases by at least 25 percent over the current baseline estimate or by at least 50 percent over the original baseline estimate.

2. DOT&E employed a lognormal regression analysis that investigates the expected program delay duration as a function of each of the delay reasons listed in the table. The analysis revealed that delay duration is statistically significantly affected by the following factors: (small p-values, particularly those below 0.10, indicate that the factor significantly affects the delay duration). P-values were 0.08 for critical Nunn-McCurdy breaches; 0.08 for programmatic issues; 0.001 for manufacturing, software development, integration, or quality control problems; and 0.11 for problems discovered in operational testing. Problems discovered in developmental testing and problems in test conduct were not statistically significant factors, since their p-values were both greater than 0.30.
3. 2011 Study: http://www.dote.osd.mil/pub/presentations/20110830Program_delays_Nunn-McCurdy_final.pdf
2014 Update: http://www.dote.osd.mil/pub/presentations/ProgramDelaysBriefing2014_8Aug_Final-77u.pdf

So, to reiterate, fixing problems discovered during testing causes program delays, not the testing itself.

In the remainder of this introduction, I describe in more detail several recent areas of focus for my office. These include:

- My continued emphasis on the need for statistical rigor in both the planning of operational tests and the analysis of data from testing.
- My continued emphasis on the need to improve reliability of all weapon systems. I include an assessment of new policies on reliability growth and tracking, as well as how the Department is progressing in improving reliability of weapon systems.
- My new guidance on cybersecurity testing. Now and in the future, cybersecurity threats will arguably be some of the most dangerous threats our defense systems face. In 2014, I signed out guidance for testing the robustness of our combat systems' abilities to withstand cyber threats. In this introduction, I outline the highlights and the importance of this guidance, as well as recent cyber testing efforts.
- My emphasis on ensuring adequate test resources are available even when Department budgets are constrained.
- An assessment of problem discovery during testing. This section of the report was added in 2011 based on concerns from Congress that significant problems in acquisition programs are being discovered during operational testing that arguably should have been discovered in development testing (page 13 in the DOT&E Activity and Oversight section).

RIGOROUS, DEFENSIBLE, EFFICIENT TESTING

Since my appointment as Director, I have required thorough operational tests that provide adequate information to characterize system performance across a variety of operational conditions. This information is essential to my evaluation of system operational effectiveness, suitability, and survivability. I have advocated the use of scientific methodologies, including experimental design or design of experiments (DOE) to ensure that this characterization is done as efficiently as possible. The methodologies that I have advocated for not only provide a rigorous and defensible coverage of the operational space, they also allow us to quantify the trade-space between the amount of testing and the precision needed to answer the complex questions about system performance. They allow us to know, before conducting the test, which analyses we will be able to conduct with the data and therefore, what questions about system performance we will be able to answer. Finally, they equip decision makers with the analytical tools to decide how much testing is enough in the context of uncertainty.

There has been much progress in increasing the statistical rigor of test plans since 2009. Over the past several years, all of the Service Operational Test Agencies (OTAs) have implemented DOE practices to varying degrees and have offered training to their staffs on the statistical principles of DOE. Additionally, the Deputy Assistant Secretary of Defense Developmental Test and Evaluation (DASD(DT&E)) endorses these methods and advocates them through his Scientific Test and Analysis Techniques (STAT) T&E Implementation Plan. That office has also overseen the conduct of the STAT in T&E Center of Excellence (COE), which employs qualified statistics experts to aid acquisition program managers in applying advanced statistical techniques in developmental testing. However, these steps are not enough. In the DOD, we acquire some of the world's most complex systems, but our test and analysis capabilities lag behind the state of the practice, let alone the state of the art for statistical techniques. The DOD Test and Evaluation community should be setting the standard for test and evaluation, not struggling to apply methods that have been applied for decades in other test organizations.

Moreover, it is not sufficient to only employ statistical methods in the test design process; the corresponding analysis methods should be employed in the evaluation of system performance, else we risk missing important conclusions. One example of the benefits of statistical analysis methodologies was revealed during the operational test of a Navy helicopter program, the Multi-spectral Targeting System, which is intended to enable helicopters to target fast,small-boat threats and employ HELLFIRE missiles at safe-standoff distances. The testing conducted thoroughly examined performance under the variety of operational and tactical conditions that a crew might expect to encounter, including a variety of threat types and operating profiles, as well as engagements in different ocean and daylight conditions. A simple analysis of the results combining all of the data together into a single average (a particularly limiting but unfortunately common analysis technique) suggested the system was meeting requirements. However, only when the more complex and rigorous statistical analysis was employed did the testers discover that the system was significantly failing requirements in a subset of the operational conditions. The unique set of conditions in which performance was poor revealed a weakness in the system, which can now be addressed by system developers. It is important to note that if DOT&E had not pushed for this rigorous analysis, this result would have been missed completely.

While there has been a lot of progress, much work remains. The implementation of these techniques is still far from widespread across all DOD T&E communities. Overall, statistical analysis methods such as regression and analysis of variance, which supported the above discovery, are underused. Until they are routinely employed in the analysis of T&E data, many situations such as the Multi-spectral Targeting System example are likely to be missed. Furthermore, we are currently not leveraging these methods in a sequential fashion to improve knowledge as we move from developmental testing to operational testing. Sequential learning is at the heart of the experimental method, which all testing is based on, and we need to employ such approaches in DOD T&E. Doing so will aid in improving our defense systems by enabling early problem discovery, supporting integrated testing, and improving our ability to clearly define an adequate operational test that avoids the unnecessary expenditure of resources.

DOT&E Efforts to Institutionalize Test Science

Institutionalizing scientific approaches to testing in the DOD T&E community requires a change from business as usual. My office has worked to provide the motivation, resources, education and training, and overall support to the T&E community to make this change possible. DOT&E has worked to institutionalize test science principles by:

- Updating policy and guidance to reflect scientific best practices
- Developing educational and training resources to advance the current workforce
- Developing case studies and examples to illustrate the value of using such techniques in test and evaluation
- Forming advisory groups and a research consortium to provide the T&E workforce with advice, help solve challenging problems, and develop the future workforce

A 2013 report summarized the efforts to institutionalize scientific methods in the DOD T&E community and discussed each of these focus areas. This year, we have continued to advance each of those areas and provide support for the T&E community; our efforts are described below.

Policy and Guidance

Both the developmental and operational testing portions of the Interim DOD Instruction 5000.02, "Operation of the Defense Acquisition System," now call for a scientific approach to testing. The operational test section calls for documenting each of the elements of the test design, as well as basing all test resources on statistically-derived test design and quantification of risk. I have authored several guidance memos on the use of statistical methods in OT&E, and the new 5000.02 guidance codifies the driving principles of those guidance memos in DOD policy.

In 2014, I issued a new guidance memo on the design and use of surveys in OT&E. Surveys provide valuable quantitative and qualitative information about the thoughts and feelings of operators and maintainers as they employ weapon systems in an operationally realistic test environment. An objective measurement of these thoughts is an essential element of my evaluation of operational effectiveness and suitability. However, I have noted that many of the surveys used in operational T&E are of such poor quality they can actually hinder my ability to objectively evaluate the system. For this reason, I issued a policy memorandum, based on best practices from the academic community, that provided concrete guidance for the use of surveys in OT&E. The key elements included:

- Use surveys only when appropriate; do not ask operators about system performance attributes that are more appropriately measured by the testers (e.g., accuracy/timeliness of the system).
- Use the right survey and leverage established surveys when appropriate.
- Employ academically-established best practices for writing and administering surveys.

I strive to ensure that my guidance is widely available to the T&E community. The DOT&E website is a convenient source for all DOT&E guidance memos.[4] Additionally, the website has a copy of the current Test and Evaluation Master Plan (TEMP) Guidebook, which is an important resource for DOT&E guidance on TEMPs.[5] This guidebook provides references to all guidance and policy memoranda, describes in plain language what I am looking for in my review of TEMPs, and provides several examples taken from various TEMPs that meet my expectations. The TEMP format was revised with the new 5000.02. New content was added, including a requirements rationale and overview of the concept of operations. My staff is currently working on the development of the next version of the TEMP Guidebook, which I expect will be available in 2015.

Education and Training

The use of statistical methods in DOD T&E has been limited by inadequate access to education and training opportunities by our T&E practitioners. Many great training opportunities exist, and I encourage DOD leadership to make a commitment to improving the access of our T&E professionals to education and training. Select members of the workforce need to have graduate degrees in fields related to test science (statistics, applied mathematics, operations research, etc.). Additionally, all members of the T&E workforce, including the system engineers who develop and test these systems prior to formal

4. http://www.dote.osd.mil/guidance.html
5. http://www.dote.osd.mil/temp-guidebook/index.html

developmental and operational testing, should have a base level of training in experimental design and statistical analysis methods. A combination of both longer-term education and short-term training is necessary for our test organizations to truly improve the rigor of all testing. At DOT&E, we have developed custom training for our action officers on DOE, reliability, survey design, and statistical analyses. Additionally, we have developed advanced training materials for our analysts on power analysis and statistical analysis methods. I am always happy to share these resources with the rest of the T&E community and welcome the participation of OTAs and other organizations in our DOT&E training.

In addition to providing training, DOT&E is committed to developing an online knowledge center for the DOD T&E community. We have initiated development of a web-based interface to this knowledge center, which will include training material, resources for best practices, tutorials, and web-based tools related to DOE and statistical analysis. This website is being built in collaboration with many organizations across the DOD T&E community. An initial version of the knowledge center is scheduled for completion in 2015.

Case Studies

Case studies provide valuable insight on the application of statistical methods, including DOE in operational testing. Over the past several years, DOT&E has developed many case studies illustrating the application of DOE and statistical analysis in T&E. Many of these case studies are summarized in previous DOT&E publications (e.g., Test Science Roadmap published in 2013), but new case studies continue to be developed.[6] As these new case studies have become available, we have shared them with the OTA leadership.

Testing of the complex systems the DOD T&E community encounters often requires non-standard applications of the tools and methods currently available in the statistics and test literature. DOT&E has used case studies to illustrate how advanced methods can be used to improve test outcomes and sculpt existing methods to meet the needs of the T&E community. One example of this occurs in the translation between probability-based metrics and more informative continuous metrics, such as time, distance, etc. Binary or probability-based requirements such as probability-of-detection or probability-of-hit, provide operationally meaningful and easy-to-interpret test outcomes. However, they are information-poor metrics that are extremely expensive to test. Having a continuous metric can reduce test sizes by 50 percent or more and provide more information in the analysis, but it can be unclear how to convert between the probability metric and the corresponding continuous metric. DOT&E has developed several case studies illustrating this translation for different test outcomes. We are now using statistical cumulative density functions and censored data analyses, resulting in much more efficient tests that require smaller sample sizes than would be required to accurately measure the related binary metric.

Advisory Groups

Engagement with the academic community and leading experts in the field of T&E is essential to advancement of these rigorous statistical techniques in DOD T&E. In 2014, DOT&E renewed funding for the Test Science Research Consortium in partnership with the Department's Test Resource Management Center. This multi-year research consortium is tasked with addressing the unique needs of the T&E community. This consortium funds several graduate-level research projects on advanced statistical techniques, enabling these projects to focus on topics of benefit to the Department's T&E needs and preparing a pipeline of students with strong technical skills to learn about to the Department and the T&E community. This research consortium has already produced several new members of the T&E community with advanced degrees in statistics and related fields.

Finally, the STAT T&E COE has for three years provided direct T&E support to 24 program offices. The COE has provided these programs with direct access to experts in test science methods, which would otherwise have been unavailable. I have observed much benefit and value from the COE's engagement with programs. However, the COE's success has been hampered, in part, by unclear funding commitments in the out-years. Furthermore, the analysts are often constrained to only answering specific, and sometimes narrowly-defined questions, as opposed to providing independent thought on the full content of a program's development test strategy. In the case of the self-defense testing for the Air and Missile Defense Radar and DDG 51 Flight III Destroyer, the COE analysts were constrained to constructing a test for a limited set of conditions, particularly excluding the self-defense region near the ship where the complex interactions between multiple combat system components (missiles, radars, and control systems) are not known. Although the test design provided was robust for the limited question asked of the COE, it egregiously missed the most crucial region of the battlespace, and gave the false impression that results from such a test design were adequate to fully characterize performance of the combat system and that a self-defense test ship was unneeded to examine performance in the self-defense region. I will continue to advocate that programs have access to a STAT COE and make use of these excellent capabilities; however, the COE must

6. http://www.dote.osd.mil/pub/reports/20130711TestScienceRoadmapReport.pdf and http://www.dote.osd.mil/pub/reports/20130711Appdxes2theTestScienceRoadmapReport.pdf

have the ability to provide independent assessments to programs. Furthermore, the COE needs to be appropriately funded to be successful and needs to expand in size to aid program managers in smaller acquisition programs (Acquisition Category II and III). Smaller programs with limited budgets do not have access to strong statistical help in their test programs and cannot afford to hire a full-time PhD-level statistician to aid their developmental test program; having access to these capabilities in the STAT COE on an as-needed basis is one means to enable these programs to plan and execute more statistically robust developmental tests.

RELIABILITY ANALYSIS, PLANNING, TRACKING, AND REPORTING

I, and other Department leaders, have placed emphasis on improving the reliability of DOD systems via several reliability improvement initiatives, and I continue to emphasize the importance of reliability in my assessments of operational suitability. There is evidence that those systems that implement and enforce a comprehensive reliability growth program are more likely to meet their reliability goals; however, test results from the last few years indicate the DOD has not yet realized statistically-significant improvements in the reliability of many systems.

The Department has acknowledged this poor track record of meeting system reliability requirements. In 2011, the Under Secretary of Defense for Acquisition, Technology and Logistics (USD(AT&L)) issued a Directive Type Memorandum (DTM 11-003) on “Reliability, Analysis, Planning, Tracking, and Reporting.” The DTM requires program managers to formulate a comprehensive reliability and maintainability program that is part of the systems engineering process, assess the reliability growth required for the system to achieve its reliability threshold during Initial Operational Test and Evaluation (IOT&E), and report the results of that assessment to the Milestone Decision Authority at Milestone C. To instantiate reliability reporting in support of Defense Acquisition Executive Summary (DAES) reviews, DOT&E has worked with DOD’s Systems Engineering office in USD(AT&L) to implement a systematic process of tracking the reliability status of a Major Defense Acquisition Program (MDAP). Beginning with FY14, MDAPs in system-level developmental testing with a documented reliability growth curve in the Systems Engineering Plan or TEMP were required to report reliability data on a quarterly basis. At present, 18 programs are actively reporting reliability data via this process, making a system’s progress relative to its expectations (seen through its reliability growth curve) a visible factor for the DAES process to consider. While the number of systems reporting these data to DAES is increasing, the information is not yet being used to trigger programmatic reviews or decision-making.

Current Reliability Trends

To better understand ongoing trends in reliability, my office has conducted a survey of programs under DOT&E oversight in each of the past six years to determine the extent to which reliability-focused policy guidance is being implemented and to assess whether it is leading to improved reliability. The most recent survey focused on 90 programs that either submitted a TEMP to DOT&E and/or had an operational test in FY13.

The survey results indicate that programs are increasingly incorporating reliability-focused policy guidance. Since FY13:

- 89 percent of programs had a reliability growth strategy, with 92 percent documenting it in the TEMP.
- Likewise, 83 percent of programs incorporated reliability growth curves into the TEMP.
- 88 percent of programs had interim reliability metrics prior to the system requirement.
- While only 28 percent of programs with FY13 TEMPs included a discussion of producer and consumer risk for passing the reliability threshold in IOT&E, this represents significant progress because only one program had done this in the past.

Differences have been observed in the implementation of policy across the different services. The Army has been a leader at implementing reliability policy and the use of reliability growth planning curves, and while the Air Force has caught up considerably, many Navy programs have yet to adopt these methods. This includes the use of reliability growth curves, the use of intermediate goals based on demonstrating reliability thresholds at operational test events, and discussing producer and consumer risk (statistical power and confidence) in the TEMP.

Despite these improvements in policy implementation, we have not observed a similarly improving trend in reliability outcomes at operational test events. Reliability growth curves are excellent planning tools, but programs will not achieve their reliability goals if they treat reliability growth as a “paper policy.” Good reliability planning must be backed up by sound implementation and enforcement.

The survey results indicate that two essential elements of this implementation are 1) including the reliability program in contracting documents and 2) having reliability-based test entrance criteria. Programs that implemented at least one of these actions were statistically more likely to meet their reliability requirement in operational testing. This is to be expected, as inclusion of the reliability growth program in contracting documents provides the government with additional leverage to ensure that contractors deliver reliable systems. The survey results revealed that the Army and Air Force have been more likely than the Navy to include the reliability growth plan in contracting documents and meet entrance criteria based on reliability, availability, and maintainability for operational test events. Unfortunately, the survey also revealed that it is not common practice for any Service to implement these steps.

While following this guidance may lead to improvements in reliability in the future, at present, many programs still fail to reach reliability goals. The reasons programs fail to reach these goals are numerous, but include overly-ambitious requirements, unrealistic assumptions about a program's capability for reliability growth, lack of a design for reliability effort prior to Milestone B, and/or failure to employ a comprehensive reliability growth program. For example, the reliability thresholds for some programs were unachievably high or disconnected from what was really needed for the mission. In some cases, a program's reliability growth goal, though documented in a TEMP or SEP, was not supported by contractual obligations or funding. A larger fraction of surveyed programs met their reliability thresholds after fielding during Follow-On Operational Test and Evaluation (FOT&E) (57 percent) rather than before fielding during IOT&E (44 percent). I conclude from this study that although we are in a period of new policy that emphasizes good reliability growth principles, without a consistent implementation of those principles, the reliability trend will remain flat. Furthermore, until we as a Department demonstrate commitment to enforcing these principles by including them in contracting documents and enforcing test entrance criteria, programs will have little incentive to actively pursue and fund system changes that lead to improve reliability.

It is also essential that we collect enough information to adequately test system reliability. The survey results showed IOT&Es and FOT&Es often are not adequately sized to assess the system's reliability requirement with statistical confidence and power. For many programs, such testing is not achievable based on concerns such as cost and schedule. In other cases, the requirements were either not testable or not operationally meaningful. In these cases, as always, my assessment of system reliability was based on how the systems' demonstrated reliability would impact the warfighters' ability to complete their mission. Despite the fact the survey revealed many operational tests are not statistically adequate to assess requirements, in most of these cases, DOT&E had sufficient data to assess system reliability performance. When system reliability is substantially below the requirement, it is possible to determine with statistical confidence the system did not meet its requirement with substantially less testing than would otherwise be required. In other cases, other sources of data can be used. This overarching result demands that we must think about reliability testing differently. The next version of my TEMP Guidance will include discussion on how the TEMP should be used to specify which data sources will be used in assessing system reliability at IOT&E, as well as the fidelity these sources must achieve to be included in this assessment. This will assist programs in adequately scoping IOT&E and FOT&E test lengths, helping them to allocate their T&E resources more efficiently.

National Academy of Sciences (NAS) Reliability Study Results

Recently, the National Academy of Sciences (NAS) published a report on reliability and reliability growth for defense systems; this report was the result of a study commissioned by myself and Mr. Frank Kendall, the USD(AT&L).[7] In this report, NAS offered recommendations for improving the reliability of U.S. defense systems. The recommendations advocated for many of the same principles that I support, including:

- Implementing reliability growth programs that include failure definitions and scoring criteria as well as a structure for reporting reliability performance over the course of the acquisition process.
- Using modern design-for-reliability techniques supported by physics of failure-based methods.
- Planned test lengths that are statistically defensible.

NAS also suggested that these plans be updated periodically throughout the life of the program, including at major design reviews and program milestones.

The NAS study addresses the need for appropriate reliability requirements. NAS recognizes, as I have for years, the need for technically-justified, testable, mission-relevant requirements. These requirements must also balance acquisition costs and lifetime sustainment costs. Systems that push the limits of technical feasibility will be more expensive to acquire initially, but may reduce lifecycle costs. However, reliability requirements that greatly exceed current capabilities may be unachievable and drive acquisition costs unnecessarily. As systems evolve, the requirements may need to be updated as the system engineering becomes more fully understood, but all changes in these requirements should be considered in the context of the mission impact of the change.

The NAS report also points to the importance of reliability-focused contracting. Making reliability a Key Performance Parameter on all new systems and ensuring all proposals include explicit language designating funds and describing the

7. http://www.nap.edu/catalog/18987/reliability-growth-enhancing-defense-system-reliability

design for reliability activities (including early system reliability testing) will provide the DOD with leverage to ensure delivered systems are reliable. As mentioned above, my survey of acquisition programs has found that including the reliability growth plan in the contracting documents does indeed make systems more likely to meet their reliability threshold. NAS also recommends the use of rigorous reliability-based entrance criteria prior to operational testing, stating,

> *"Near the end of developmental testing, the USD(AT&L) should mandate the use of a full-system, operationally-relevant developmental test during which the reliability performance of the system will equal or exceed the required levels. If such performance is not achieved, justification should be required to support promotion of the system to operational testing."*

I have also found that making sure systems meet their entrance criteria prior to entering their IOT&E makes them much more likely to perform well in the operational test.

Recent Lessons on Reliability Requirements

The first step in ensuring reliable systems is to ensure that requirements are appropriate. Sound reliability requirements are grounded in the operational relevance of the missions the system will support. They also ensure technical feasibility based on existing systems and engineering limitations, balance acquisition costs and sustainment costs, and are testable. Two recent examples have illustrated the tendency to develop reliability thresholds for programs that are unachievably high and/or disconnected from what is needed for the mission.

Three-Dimensional Expeditionary Long-Range Radar (3DELRR)

Three-Dimensional Expeditionary Long-Range Radar (3DELRR) will be the principal Air Force long-range, ground-based sensor for tracking aircraft and other aerial targets. It replaces the aging TPS-75 radar, which is incapable of detecting some current and emerging threats and has become difficult and expensive to maintain.

While working with the Air Force to develop plans to test 3DELRR, DOT&E observed the 720-hour Mean Time Between Critical Failure (MTBCF) appeared to be unnecessarily high and disconnected from the related availability requirement, set at 0.947. When asked, the Air Force's rationale for this requirement was initially presented as "the system should be operational for 30 days, 24 hours per day, failure free." The initial Service position was that establishing an operational availability (A_O) of 0.947 with an associated 720-hour MTBCF would ensure the capability to sustain operations for 30 days in austere locations with minimum external support. However, the probability of completing the 30-day mission with zero critical failures is about 0.37, assuming a system MTBCF of 720 hours. Achieving mission reliability values higher than 0.37 would require very-high MTBCF values; requiring a 90-percent probability of completing a 30-day mission without failure would require an MTBCF of over 6,800 hours. A lower MTBCF of 300 hours would provide availability near 0.90, with each 100 hours of reliability adding just a fraction to the overall A_O. Based on these observations, DOT&E recommended the Service review the reliability requirement to determine if an MTBCF of 720 hours was truly needed to achieve reasonable reliability. Additionally, DOT&E recommended that once the reliability requirement was validated, the Service should implement a design for a reliability program and implement a reliability growth program.

After multiple discussions and review of the logistics supply concept, as well as the concept of operations for completing missions, the Air Force recognized that a 720-hour MTBCF was not, in fact, required. After further review, the Service set the requirement that the system will achieve an MTBCF of 495 hours by the end of government-conducted developmental T&E, along with an A_O of 0.947. Furthermore, the Air Force designed an acceptable reliability growth program that adheres to best practices, and DOT&E approved the program's TEMP for Milestone B.

Ground/Air Task Oriented Radar (G/ATOR)

The Marine Corps' Ground/Air Task Oriented Radar (G/ATOR) is a phased array, multi-role radar that is being designed to be used initially in the air surveillance and air defense roles, with follow-on capabilities that will be developed to support the ground weapon locating/counter-targeting and air traffic control mission areas. During a recent operational assessment period, G/ATOR met its A_O Key Performance Parameter; however, Key System Attributes reflecting system reliability were well below thresholds. DOT&E issued an operational assessment report, as well as a separate memorandum discussing the program's proposed reliability growth plans in the related draft TEMP, that again noted several problems with the system's reliability and growth-planning assumptions. As a result of G/ATOR not meeting planned reliability growth milestones, and with no clear means to grow the reliability to that required and maintain program timelines, the Navy stood up a "Blue Ribbon Panel" made of Department experts and stakeholders (including DOT&E) to assess the program's ability to achieve current reliability threshold requirements. The panel's findings included:

- The Mean Time Between Operational Mission Failure reliability threshold requirement is disconnected from the mission (not operationally relevant).

- There is no clearly defined G/ATOR system definition for government- and contractor-furnished equipment.
- The rationale for excluding certain government-furnished equipment from reliability calculations is ambiguous.
- There is no closed loop in the failure reporting, analysis, and corrective action system; specifically, the program's Failure Review Board determines which failures are valid but does not formally adjudicate the effectiveness of corrective actions.
- Reliability growth planning models used optimistic planning factors and growth curves, and were based on Mean Time Between Operational Mission Failure/Mean Time Between Failure initial values that were not previously realized during testing.
- Definitions for failures and operating time during previous developmental test are not consistent.

The findings were recently briefed to the Milestone Decision Authority for G/ATOR. Recommendations to the above findings are currently under review.

Both the 3DELLR and G/ATOR programs reveal the need to carefully consider the reliability requirements in relation to what is essential for completing a mission within the Services' own concepts of operations. Acting on the recommendations of the NAS study, as well as those others and I have stated, will ensure programs not only are successful in achieving their reliability goals, but also that the goals are realistic and achievable.

CYBERSECURITY OPERATIONAL TESTING AND ASSESSMENTS DURING EXERCISES

Cyber adversaries have become as serious a threat to U.S. military forces as the air, land, sea, and undersea threats represented in operational testing for decades. Any electronic data exchange, however brief, provides an opportunity for a determined and skilled cyber adversary to monitor, interrupt, or damage information and combat systems. The DOD acquisition process should deliver systems that provide secure and resilient cyber capabilities; therefore, operational testing must examine system performance in the presence of a realistic cyber threat. My assessment of operational effectiveness, suitability, and survivability is determined in part by the results of this crucial testing.

During 2014, cybersecurity testing of more than 40 systems showed improvements must occur to assure secure and resilient cyber capabilities. One important conclusion from my 2014 review of DOD programs was that operational testing still finds exploitable cyber vulnerabilities that earlier technical testing could have mitigated. These vulnerabilities commonly include unnecessary network services or system functions, as well as misconfigured, unpatched, or outdated software, and weak passwords. Developmental testing over the course of the program, including the process to grant a system the authority to operate on DOD networks, could have found most of these vulnerabilities; yet, such vulnerabilities are still found as late as during the IOT&E. My review of these systems also identified the need to increase the participation of network defenders and assessment of mission effects during threat-representative, adversarial assessments.

In August 2014, I published updated policy and procedures for cybersecurity assessments in operational T&E; the new guidance specifies that operational testing should include a cooperative vulnerability assessment phase to identify system vulnerabilities followed by an adversarial assessment phase to exploit vulnerabilities and assess mission effects.[8] The adversarial assessment phase includes system users and network defenders to detect the adversarial actions, react to those actions, and restore the system to full/degraded operations after a cyber-attack. My office continues to emphasize the need to assess the effects of a debilitating cyber-attack on the users of these systems so that we understand the impact to a unit's mission success. A demonstration of these mission effects are often not practicable during operational testing due to operational safety or security reasons. I have therefore advocated that tests use simulations, closed environments, cyber ranges, or other validated and operationally representative tools to demonstrate the mission effects resulting from realistic cyber-attacks.

Representative cyber environments hosted at cyber ranges and labs provide one means to accomplish the above goals. Such cyber ranges and labs provide realistic network environments representative of warfighter systems, network defenses, and operators, and they can emulate adversary targets and offensive/defensive capabilities without concern for harmful effects to actual in-service systems/networks. For several years, my office has proposed enhancements to existing facilities to create the DOD Enterprise Cyber Range Environment (DECRE), which is comprised of the National Cyber Range (NCR); the DOD Cybersecurity Range; the Joint Information Operations Range; and the Joint Staff J-6 Command, Control, Communications, and Computers Assessments Division. The need and use of these resources is beginning to outpace the existing DECRE capabilities. As an example, the NCR experienced a substantial increase in customers in FY14, and the Test Resource Management Center, which oversees the NCR, has initiated studies to examine new capabilities to further expedite the planning, execution, and sanitization of NCR events.

8. http://www.dote.osd.mil/pub/policies/2014/8-1-14_Procs_for_OTE_of_Cybersec_in_Acq_Progs(7994).pdf

Also in 2014, my office conducted 16 cybersecurity assessments in conjunction with Combatant Command and Service exercises. A notable improvement over previous years was the increased participation of higher-echelon computer network defense service providers and local defenders, resulting in a more comprehensive assessment of cyber defensive postures. Despite the improved defenses, my office found that at least one assessed mission during each exercise was at high risk to cyber-attack from beginner to intermediate cyber adversaries. I have placed emphasis on helping Combatant Commands and Services mitigate and reduce those persistent cybersecurity vulnerabilities observed from assessment to assessment. My continuing focus is on finding problems, providing information and assistance to understand and fix problems, and following up to verify cybersecurity status and ability to conduct operations in a contested cyberspace environment. At the request of several Combatant Commands, I have implemented more frequent operational site assessments during day-to-day operations on live networks to provide feedback on specific areas of interest such as status of patching or defense against specific attacks (e.g., phishing) and cybersecurity implications of physical security. Additional continuing efforts include working with the intelligence community to improve cyber threat realism, and to develop a persistent cyber opposition force with the capability to operate across several Combatant Commands.

TEST RESOURCES

Adequate funding of test resources remains a crucial aspect to fielding weapons that work. My office continues to monitor DOD and Service-level strategic plans, investment programs, and resource management decisions to ensure the Department maintains the capabilities necessary for adequate and realistic operational tests. I have continued to emphasize the need for these resources despite the constrained fiscal environment. There are some who argue that in a constrained fiscal environment, particularly in the face of sequestration, all testing should be cut commensurate with cuts in program budgets. That is, if the Department's budgets are reduced by 20 percent, then testing should also be reduced by 20 percent. Yet, we are fielding the weapons that are developed to satisfy 100 percent of their concepts of operation against 100 percent of the actual threat. In particular, what constitutes adequate operational testing under realistic combat conditions is determined not by fiscal constraints, but by our war plans and the threats we face—the enemy (always) gets a vote. It would therefore, be a false economy and a disservice to the men and women we send into combat to make arbitrary budget-driven reductions to either developmental or operational testing.

The T&E Resources section of this Annual Report details the projects and issues on which I am most concerned or focused. Of particular note this year is that I remain concerned about the substantial year-after-year staffing reductions taken by the Army T&E Executive and his office within the Office of the Deputy Under Secretary of the Army, as well as reduction in staff levels in both the Army Operational Test Command and the Army Evaluation Center. These reduced staff levels will cause delays to developmental and operational testing, the inability to conduct simultaneous operational test events, and longer timelines for the release of test reports. Furthermore, the Commander, Operational Test and Evaluation Force continues to try to enhance his workforce by growing in-house technical talent and hiring in personnel with advanced degrees.

As the Department moves forward in considering important test resource infrastructure and investments in the face of constrained budgets, I will continue to advocate for the need for the most crucial test assets. These include:

- The need for an Aegis-capable self-defense test ship to test Ship Self-Defense Systems' performance in the final seconds of the close-in battle and to acquire sufficient data to accredit ship self-defense modeling and simulation test beds. (While the Navy recognizes the capability as integral to the test programs for certain weapons systems (the Ship Self-Defense System, Rolling Airframe Missile Block 2, and Evolved SeaSparrow Missile Block 1) and ship classes (LPD-17, LHA-6, Littoral Combat Ship, LSD 41/49, DDG 1000, and CVN-78), the Navy has not made a similar investment in a self-defense test ship equipped with an Aegis Combat System, Air and Missile Defense Radar, and Evolved SeaSparrow Missile Block 2 for adequate operational testing of the DDG 51 Flight III Destroyer self-defense capabilities.)
- The DECRE, as discussed above.
- The electronic warfare infrastructure, which the Department is funding and for which some slow progress is being realized.
- The electronic warfare assets for anti-ship cruise missile seeker emulation and the jamming simulators for the assessment of Army communications networks.

Other resource needs that I consider crucial for the Department to pursue are detailed in the T&E Resources section of this report (page 339).

FY14 INTRODUCTION

SUMMARY

Since my first report to you in 2009, we have made progress increasing the scientific and statistical rigor of operational T&E; there is much work to be done, however, since the Department's test design and analysis capabilities lag behind the state of the practice. Additionally, we have focused attention on reliability design and growth testing, and in improving cybersecurity operational testing. Operational testing continues to be essential to characterize system effectiveness in combat so well-informed acquisition and development decisions can be made, and men and women in combat understand what their equipment and weapons systems can and cannot do. I submit this report, as required by law, summarizing the operational and live fire T&E activities of the DOD during Fiscal Year 2014.

J. Michael Gilmore
Director

FY14 TABLE OF CONTENTS

Air Force Programs

DOT&E Activity and Oversight

DOT&E Activity and Oversight

FY14 Activity Summary

DOT&E activity for FY14 involved oversight of 309 programs, including 26 Major Automated Information Systems. Oversight activity begins with the early acquisition milestones, continues through approval for full-rate production, and, in some instances, during full production until removed from the DOT&E oversight list.

Our review of test planning activities for FY14 included approval of 43 Test and Evaluation Master Plans (TEMPs); 3 Test and Evaluation Strategies; 90 Operational Test Plans; 5 Live Fire Test and Evaluation (LFT&E) Strategies and Management Plans; and disapproval of the following 5 TEMPs and 5 Test Plans:

- Remote Minehunting System (RMS) Test and Evaluation Master Plan (TEMP), TEIN 1520, Revision D, Change 1
- Littoral Combat Ship (LCS) Test and Evaluation Master Plan (TEMP)
- Surface Electronic Warfare Improvement Program (SEWIP) Block 3 Test and Evaluation Master Plan (TEMP)
- Distributed Common Ground System –Army (DCGS-A) Test and Evaluation Master Plan (TEMP)
- Mobile Landing Platform (MLP) Test and Evaluation Master Plan (TEMP)
- Global Command and Control System – Joint (GCCS-J) Version 4.3 Follow-on Operational Test and Evaluation (FOT&E) Plan
- TRICARE Online (TOL) Blue Button and Data Federation Operational Assessment (OA) Test Plan
- Remote Minehunting System OA Test Plan
- SEWIP Initial Operational Test and Evaluation (IOT&E) Test Plan
- Automated Identification Biometric System (ABIS) 1.2 Limited User Test (LUT) Plan

In FY14, DOT&E prepared for the Secretary of Defense and Congress: 6 IOT&E reports, 5 Early Fielding Reports, 5 FOT&E reports, 1 LFT&E report, 1 OT&E report, 1 OA report, 2 special reports, and the Ballistic Missile Defense program's FY13 Annual Report. DOT&E also prepared and submitted numerous reports to the Defense Acquisition Board (DAB) principals for consideration in DAB deliberations. Additional FY14 DOT&E reports that did not go to Congress included: 10 Cybersecurity reports, 1 Early Fielding report, 1 Early OA report, 3 FOT&E reports, 3 Force Development Evaluation reports, 1 IOT&E report, 1 LFT&E report, 11 Operational Assessment reports, 2 OT&E reports, and 5 special reports.

During FY14, DOT&E met with Service operational test agencies, program officials, private sector organizations, and academia; monitored test activities; and provided information to the DAB committees as well as DAB principals, the Secretary and Deputy Secretary of Defense, the Under Secretary of Defense for Acquisition, Technology and Logistics, the Service Secretaries, and Congress. Active on-site participation in, and observation of, tests and test-related activities are a primary source of information for DOT&E evaluations. In addition to on-site participation and local travel within the National Capital Region, approximately 930 trips supported the DOT&E mission.

Security considerations preclude identifying classified programs in this report. The objective, however, is to ensure operational effectiveness and suitability do not suffer due to extraordinary security constraints imposed on those programs.

TEST AND EVALUATION MASTER PLANS / STRATEGIES APPROVED

Aegis Cruiser and Destroyer Program TEMP CNO Project Number 1669 Revision 1

AH-64E TEMP Net Ready Annex.

Air Operations Center – Weapon System (AOC-WS) Increment 10.2 TEMP

AN/AAQ-24A (V) 25 Department of the Navy Large Aircraft Infrared Countermeasures (DoN LAIRCM) in a Pod Configuration (Guardian Pod) and AN/AAQ-24B (V) 25 DoN LAIRCM Advanced Threat Warning (ATW) TEMP

AN/SQQ-89A(V)15 Surface Ship Undersea Warfare (USW) Combat System Advanced Capability Build (ACB) TEMP

Armored Multi-Purpose Vehicle (AMPV) TEMP

Assault Amphibious Vehicle Survivability Upgrade TEMP

C-5 Core Mission Computer and Weather Radar (CMC/Wx Radar) Program TEMP

Cartridge 7.62 Millimeter: Ball, M80A1 TEMP Update

Combat Rescue Helicopter (CRH) TEMP for Milestone B

Common Aviation Command and Control System (CAC2S) TEMP

Consolidated Afloat Networks and Enterprise Services (CANES) TEMP Approval

Cougar Family of Vehicles Enduring Fleet Modifications TEMP Addendum

Defense Agencies Initiative (DAI) Increment 2 TEMP for Milestone B

Defense Enterprise Accounting and Management System (DEAMS) TEMP

Department of Defense Healthcare Management System Modernization (DHMSM) Program, Test Strategy

Distributed Common Ground/Surface System (DCGS-MC) – Marine Corps Geospatial Intelligence TEMP

E-2D Advanced Hawkeye (AHE) Revision D TEMP

Enhanced Polar System (EPS) TEMP

E-2D TEMP number 1654 Revision D

Family of Light Armored Vehicles (FOLAV) TEMP

Global Combat Support System – Joint (GCSS-J) Milestone B/C TEMP

Global Combat Support System – Marine Corps/Logistics Chain Management (GCSS-MC/LCM) Increment 1 TEMP

Indirect Fire Protective Capability Increment 2-I (IFPC Inc 2-I) Test and Evaluation Strategy)

Integrated Personnel and Pay System – Army (IPPS-A) Increment I Milestone C TEMP

Joint Battle Command – Platform (JBC-P) TEMP

Joint Battle Command – Platform (JBC-P) TEMP changes, Version 3.4

Key Management Infrastructure (KMI) Increment 2, Spiral 2 TEMP Addendum

M829E4 (120 mm: Armored Piercing, Fin Stabilized, Discarding Sabot – Tracer, Kinetic Energy Cartridge) System Live Fire Test and Evaluation Strategy

M829E4 Abrams Tank Main Gun Round TEMP

M982E1 Excalibur Increment Ib TEMP

Multifunctional Information Distribution System (MIDS), Joint Tactical Radio System (JTRS), Concurrent Multi-Netting Four (CMN-4) Full Deployment TEMP Annex J

Nett Warrior TEMP

Next Generation Chemical Detector (NGCD 1) Detector Alarm, ACAT II TEMP, Version 1.1 Supporting Milestone A

Next Generation Chemical Detector (NGCD 3) Sample Analysis, ACAT II TEMP, Version 1.1 Supporting Milestone A

Next Generation Chemical Detector (NGCD) Increment 2 Survey Detector TEMP

P-8A Poseidon Multi-mission Maritime Aircraft (MMA) Increment 2 and Full-Rate Production (INC 2/FRP) (ACAT 1D TEIN 1652) TEMP

P-8A Poseidon Multi-mission Maritime Aircraft (MMA) Increment 3 (Pre-MDAP-TEIN 1813) TEMP

Patriot TEMP

QF-16 Full Scale Aerial Target, Version 2.2k TEMP

RQ-7BV2 Tactical Unmanned Aircraft System (TUAS) Acquisition Category (ACAT) II (Shadow) TEMP

Small Tactical UAS (STUAS) (RQ-21A Blackjack) TEMP change

Three-Dimensional Expeditionary Long-Range Radar (3DELRR) TEMP

UH-60L Digital Black Hawk Helicopter TEMP

Warfighter Information Network – Tactical (WIN-T) Increment 2 (Inc 2) TEMP

Warfighter Information Network – Tactical (WIN-T) Increment 2 (Inc 2) TEMP Addendum

OPERATIONAL TEST PLANS APPROVED

AC-130J Precision Strike Package Operational Assessment (OA) Test Plan

Advanced Extremely High Frequency (AEHF) Satellite Communications (SATCOM) System Multi-Service Operational Test and Evaluation (MOT&E) Operational Test Agency (OTA) Test Plan

Aegis Baseline 9A Maintenance Demonstration (M-DEMO) OT-C2A1 Data Management and Analysis Plan (DMAP) Defense Enterprise Accounting and Management System (DEAMS) Financial Cyber Readiness Assessment Plan

Aegis Weapon System (AWS) Baseline 9A (BL 9A) Integrated Testing (ITT) on Air Defense Cruiser Data Management and Analysis Plan (DMAP)

Aegis Weapon System (AWS) Baseline 9A (BL9A) Air Defense Cruiser Integrated Test DMAP Change 3

Air Intercept Missile-9X (AIM-9X) Block ii (U) Test Plan Modifications

Amphibious Assault Ship Replacement LHA-R Flight 1 Early OA Test Plan for CNO Project No. 1697

AN/AAQ-24A (V) 25 Department of the Navy Large Aircraft Infrared Countermeasures (DoN LAIRCM) in a Pod Configuration (Guardian Pod) and AN/AAQ-24B (V) 25 DoN LAIRCM Advanced Threat Warning (ATW) Systems Integrated Evaluation Framework (IEF)

AN/PRC-117G Radio Operational Test Plan

AN/SQQ-89A(V)15 Surface Ship Undersea Warfare (USW) Combat System Program IOT&E Test Plan for CNO Project No. 0802-02

AN/TPQ-53 Target Acquisition Radar System Initial Operational Test Plan

Apache AH–64E FOT&E I OTA Test Plan

Automated Identification Biometric System (ABIS) 1.2 Limited User Test (LUT) Plan

B-2 IOT&E Plan Deviation

Ballistic Missile Defense System (BMDS) Integrated Master Test Plan (IMTP) v14.1 and v14.1 Annex

C-5 Reliability Enhancement & Re-Engining Program (RERP) Operational Flight Program (OFP) 3.5 Force Development Evaluation (FDE) Test Plan

CENTCOM AOR 14-1 (SOCCENT) Final Assessment Plan

Command Post of the Future (CPoF) LUT OTA Test Plan

Common Aviation Command and Control System (CAC2S) OA Test Plan

Consolidated Afloat Networks and Enterprise Services (CANES) IOT&E Test Plan

Consolidated Afloat Networks and Enterprise Services (CANES) IOT&E Test Plan Cyber Security Annex

Cooperative Engagement Capability (CEC) DMAP for the Maintainability Demonstration (M-Demo) Phase of OT-D1A

Countermeasure Anti-Torpedo (CAT) and Torpedo Warning System (TWS) Quick Reaction Assessment (QRA) DMAP

Defense Enterprise Accounting and Management System (DEAMS) IOT&E Test Plan

Distributed Common Ground System – Marine Corps (DCGS-MC) IOT&E Plan

DOD Teleport Generation-3, Phase 1 (G3P1) OT&E Plan

DOD Teleport Generation-3, Phase-2 (G3P2) OT&E Plan

E-2D FOT&E Test Plan

Enhanced Combat Helmet (ECH) Lot Acceptance Testing (LAT) Marine Corps Operational Test and Evaluation Activity Observation Plan

EPIC GUARDIAN 14 Information Assurance and Interoperability Assessment Plan

Excalibur Increment Ib IOT&E OTA Test Plan

F/A-18E/F Infrared Search and Track System (IRST) Block I OA Test Plan

F/A-18E/F Infrared Search and Track System (IRST) Block I OA Phase II Test Plan

Family of Advanced Beyond Line-of-Sight Terminals (FAB-T) (Raytheon Variant) OA-1 Plan

Global Combat Support System – Marine Corps (GCSS-MC) Increment 1 FOT&E Test Plan

Global Command and Control System – Maritime (GCCS-M) Group Level v4.1.0.1 IOT&E Plan

Global Command and Control System – Maritime (GCCS-M) Group Level v4.1.0.1 IOT&E Revised Plan

Global Command and Control System – Joint (GCCS-J) Version 4.3 Update 1 OT&E Plan

GLOBAL THUNDER 14 Information Assurance and Interoperability Assessment Plan

Guided Multiple Launch Rocket System (GMLRS) – Alternate Warhead (AW) Integrated Developmental Test/Operational Test (DT/OT) OTA Test Plan

Guided Multiple Launch Rocket System – Alternative Warhead (GMLRS- AW) (IOT&E) OTA Test Plan

H-1 Upgrades Program AH-1Z/UH-1Y System Configuration Set (SCS) 6.0 Verification of Correction of Deficiency (VCD) Execution DMAP

Handheld, Manpack, Small Form Fit – Manpack Radio (HMS-MP) FOT&E OTA Test Plan

III Marine Expeditionary Force Exercise Ulchi Freedom Guardian (UFG) 14 System Assessment Test Plan

Integrated Defensive Electronic Counter (IDECM) Suite Block IV FOT&E Test Plan

Integrated Electronic Health Record (iEHR) Increment 1 Single Sign-on (SSO)/Context Management (CM) OA Plan

Integrated Electronic Health Record (iEHR) Increment 1 Single Sign-On (SSO)/Context Management (CM) Operational Test Plan

Joint Battle Command – Platform (JBC-P) MOT&E OTA Test Plan

Joint High Speed Vessel (JHSV) FOT&E Test Plan approval

Joint High Speed Vessel (JHSV) FOT&E Test Plan Change

Joint Inter Agency Task Force – South (JIATF-S) Final Assessment Plan

Joint Light Tactical Vehicle (JLTV) Development Test/Operational Test (DT/OT) OTA Test Plan

Joint Light Tactical Vehicle (JLTV) LUT Operational Test Agency Test Plan

Joint Warning and Reporting Network (JWARN) FOT&E 4 OTA Test Plan

Joint Warning and Reporting Network (JWARN) Increment 1 Modernization FOT&E 2 Test Plan

Littoral Combat Ship (LCS 3) *FREEDOM*-Variant with Surface (SUW) Mission Package (MP) Increment 2 Information Assurance (IA) Revised IOT&E Test Plan

Littoral Combat Ship (LCS 3) *FREEDOM*-Variant with Surface Warfare (SUW) Mission Package (MP) Increment 2 Information Assurance (IA) IOT&E Test Plan

Littoral Combat Ship (LCS) with Surface Warfare (SUW) Mission Package Increment 2 IOT&E Plan

Littoral Combat Ship (LCS) with Surface Warfare (SUW) Mission Package Increment 2 IT DMAP

MH-60S with the Airborne Laser Mine Detection Systems (ALMDS) and the Airborne Mine Neutralization System (AMNS) Phase B OA Test Plan

MH-60R Multi-mission Helicopter Digital Rocket Launcher (DRL) Advanced Precision Kill Weapon System II (APKWS II) QRA DMAP

MH-60S Digital Rocket Launcher (DRL) QRA DMAP

MH-60S w/ Airborne Mine Neutralization System (AMNS) OA Test Plan

Miniature Air Launched Decoy (MALD) Operational Flight Software (OFS) 8.0 FDE Test Plan

Mk 48 Mod 6 Advanced Common Torpedo (ACOT) and Mk 48 Mod 7 Common Broadband Advanced Sonar System (CBASS) Torpedo Test Plan Addendum for Execution of Fleet ICEX per Test Plan OT-Cl Change 2

Mobile Landing Platform (MLP) Core Capability Set (CCS) IOT&E Phase I Test Plan

Nett Warrior IOT&E Test Plan

P-8A Poseidon Multi-Mission Maritime Aircraft (MMA) FOT&E Test Plan

P-8A Poseidon Multi-mission Maritime Aircraft (MMA) OT-C2 FOT&E Test Plan, Change 1

Patriot Advanced Capability -3 (PAC-3) Missile Segment Enhancement (MSE) Live Fire Test (LFT) OTA Test Plan

Precision Guidance Kit (PGK) OTAOperational Test Plan

QF-16 Full Scale Aerial Target (FSAT) IOT&E Plan

Remote Minehunting System (RMS) IT DMAP

Ship to Shore Connector (SSC) OA Test Plan

Small Tactical Unmanned Aircraft System (STUAS) Joint COMOPTEVFOR/ MCOTEA IOT&E Test Plan

Standard Missile-6 (SM-6) OT-D1 FOT&E Test Plan

Surface Electronic Warfare Improvement Program (SEWIP) Block 2 IOT&E Test Plan

Surveillance Towed Array Sensor System/Low Frequency Active (SURTASS CLFA) Test Plan

Tactical Unmanned Aircraft System Tactical Common Data Link (Shadow) FOT&E OTA Test Plan

Tempest Wind 2014 (TW14) Final Assessment Plan (FAP)

Turbo Challenge 2014 Information Assurance and Interoperability Assessment Plan

United States Strategic Command Global Lightening 14 Assessment Plan

Valiant Shield 2014 Cybersecurity and Interoperability Assessment Plan

Warfighter Exercise 14-4 Final Assessment Plan and Addendum

LIVE FIRE TEST AND EVALUATION STRATEGIES/MANAGEMENT PLANS

CVN 78 *Gerald R. Ford* class LFT&E Management Plan

Mobile Landing Platform (MLP) LFT&E Management Plan

PATRIOT Advanced Capability-3 (PAC-3) Missile Segment Enhancement (MS) Program, Detailed LFT&E Test Plan for the Penetration Characterization for 6A1-4V Titanium Fragments

USS *Fort Worth* (LCS 3) Total Ship Survivability Trial (TSST) Plan

VXX Alternate LFT&E Strategy

FY14 REPORTS TO CONGRESS	
PROGRAM	**DATE**
Initial Operational Test and Evaluation Reports	
P-8 Poseidon Multi-Mission Maritime Aircraft (MMA)	October 2013
Joint Battle Command – Platform (JBC-P) with classified annex	November 2013
MH-60R AN/APS-153 Automatic Radar Periscope Detection and Discrimination (ARPDD) Program	April 2014
M982E1 Excalibur Increment 1b with classified appendices	June 2014
Joint High Speed Vessel (JHSV)	July 2014
Multi-static Active Coherent (MAC)	July 2014
Early Fielding Reports	
Massive Ordnance Penetrator (MOP)	October 2013
Joint Tactical Radio System (JTRS) Handheld, Manpack, Small Form Fit (HMS) Manpack Radio	December 2013
Littoral Combat Ship (LCS)	December 2013
Surveillance Towed-Array Sensor System (SURTASS) with the Compact Low-Frequency Active (CLFA) System	February 2014
Surface Ship Torpedo Defense (SSTD)	April 2014
Follow-on Operational Test and Evaluation Reports	
Virginia class Submarine Dry Deck Shelter (DDS)	October 2012
MH-60R/S Helicopters Employing AGM-114 HELLFIRE Missiles with the AN/AAS-44C(V) Multi-Spectral Targeting System (MTS)	April 2014
USS *San Antonio* LPD-17	June 2014
P-8A Poseidon Increment 1 Multi-Mission Maritime Aircraft	June 2014
Mk 54 Mod 0 Lightweight Hybrid Torpedo with Block Upgrade (BUG) Tactical Software	September 2014
Live Fire Test and Evaluation Reports	
Modernized Expanded Capacity Vehicle – Survivability (MECV-S)	January 2014
Operational Test and Evaluation Reports	
Cobra King (formerly Cobra Judy Replacement (CJR))	July 2014
Operational Assessment Reports	
Nett Warrior at Network Integration Evaluation (NIE) 13.2 with classified annex	November 2013
Special Reports	
Response to the House Armed Services Committee National Defense Authorization Act (HASC NDAA) Tasking on Distributed Common Ground System – Army (DCGS-A)	October 2013
Chief of Naval Operations Report to Congress on the Current Concept of Operations and Expected Survivability Attributes of the Littoral Combat Ship	April 2014
Ballistic Missile Defense Reports	
FY13 Assessment of the Ballistic Missile Defense Systems (includes Classified Appendices A, B, C, D, and E)	February 2014

OTHER FY14 REPORTS (NOT SENT TO CONGRESS)	
PROGRAM	DATE
Cybersecurity Reports	
Defense Connect Online (DCO) Access and Authentication Vulnerability Assessment	November 2013
U.S. Special Operations Command Exercise EMERALD WARRIOR 2013	February 2014
U.S. Army's Warfighter Exercise 13-4	February 2014
Electronic Security of Special Handling Documents Assessment	April 2014
Host Based Security System (HBSS) Access and Authentication Vulnerability Assessment	April 2014
U.S. Strategic Command Exercise Global Thunder 2014	May 2014
Aegis Shipboard Tactical Data Links Finding Memorandum	June 2014
FY13 Assessment of DOD Information Assurance during Major Combatant Command and Service Exercises	September 2014
U.S. Northern Command Exercise Vigilant Shield 2014	September 2014
U.S. Transportation Command Exercise Turbo Challenge 2014	September 2014
Early Fielding Reports	
Joint Land Attack Cruise Missile Defense (LACMD) Elevated Netted Sensor System (JLENS)	February 2014
Early Operational Assessment Reports	
Ohio Replacement	July 2014
Follow-on Operational Test and Evaluation Reports	
Navy Enterprise Resource Planning (ERP)	October 2013
C-17 Increased Gross Weight (IGW) and Formation Spacing Reduction (FSR)	April 2014
MV-22 OT-IIIJ	June 2014
Force Development Evaluation Reports	
Global Broadcast Service (GBS)	November 2013
Air Force Distributed Common Ground System (AF DCGS)	August 2014
MQ-9 Increment One Unmanned Aircraft System (UAS) Operational Flight Program (OFP) 904.2 Software Upgrade	September 2014
Initial Operational Test and Evaluation Reports	
Integrated Personnel and Pay System – Army (IPPS-A) Increment 1	September 2013
Live Fire Test and Evaluation Reports	
HELLFIRE Romeo Missile Final Lethality Assessment	May 2014
Operational Assessment Reports	
Defense Readiness Reporting System – Strategic (DRRS-S)	October 2013
Defense Enterprise Accounting and Management System (DEAMS)	October 2013
USS *Gerald R. Ford* (CVN 78) class Aircraft Carrier	December 2013
Remote Minehunting System (RMS)	January 2014
Ground/Air Task Oriented Radar (G/ATOR)	January 2014
Advanced Medium Range Air-to-Air Missile (AMRAAM) Basic Electronic Protection Improvement Program (EPIP)	May 2014
Integrated Electronic Healthcare Record Increment 1 (iEHR) Report	May 2014
Defense Enterprise Accounting and Management System (DEAMS) Release 2 with Classified Appendix B: Cyber Economic Vulnerability Assessment Report	June 2014
Mark XXIIA Mode 5 Joint Operational Test Approach (JOTA) 2	July 2014
AN/PRC-117G with classified annex	September 2014
NA28 Precision Guidance Kit (PGK) Urgent Materiel Release (UMR) Variant Limited User Test (LUT)	September 2014
Operational Test and Evaluation Reports	
Theater Medical Information Program – Joint (TMIP-J)	December 2013
Global Command and Control System – Joint (GCCS-J) Global Release 4.3	March 2014

OTHER FY14 REPORTS (NOT SENT TO CONGRESS) (CONTINUED)	
PROGRAM	**DATE**
Special Reports	
Joint Land Attack Netted Sensor (JLENS) Quick Look Assessment	October 2013
Special Operations Forces Mine Resistant Ambush Protected (MRAP) – All Terrain Vehicle Underbody Improvement Kit – Special Operations Command (SOF M-ATV UIK-S) Correction of Deficiencies	November 2013
E-2D Advanced Hawkeye (AHE) Lot 2 Verification of Correction of Deficiencies (VCD)	March 2014
Requirement for Use of a Self-Defense Test Ship (SDTS) for Operational Testing of the DDG 51 Flight III Equipped with the Air and Missile Defense Radar (AMDR)	September 2014
Oversight of Submarine Tactical Systems (Interim Operational Testing Assessment for the Advanced Process Build 2011 (APB-11) Version of the AN/BYG-1(V) Combat Control System (CCS) and the AN/BQQ-10 Acoustic Rapid Commercial Off-the-Shelf (COTS) Insertion (A-RCI) Sonar System)	September 2014

Program Oversight

DOT&E is responsible for approving the adequacy of plans for operational test and evaluation and for reporting the operational test results for all Major Defense Acquisition Programs to the Secretary of Defense, Under Secretary of Defense for Acquisition, Technology and Logistics, Service Secretaries, and Congress. For DOT&E oversight purposes, Major Defense Acquisition Programs were defined in the law to mean those programs meeting the criteria for reporting under Section 2430, Title 10, United States Code (USC) (Selected Acquisition Reports (SARs)). The law (sec.139(a)(2)(B)) also stipulates that DOT&E may designate any other programs for the purpose of oversight, review, and reporting. With the addition of such "non-major" programs, DOT&E was responsible for oversight of a total of 309 acquisition programs during FY14.

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

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

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

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

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

DOT&E was responsible for the oversight of 121 LFT&E acquisition programs during FY14.

Programs Under DOT&E Oversight
Fiscal Year 2014
(As taken from the September 2014 DOT&E Oversight List)

DOD PROGRAMS

AC-130J

BMDS – Ballistic Missile Defense System Program

BMTC – Ballistic Missile Technical Collection

CHEM DEMIL-ACWA – Chemical Demilitarization Program – Assembled Chemical Weapons Alternatives

CHEM DEMIL-CMA – Chemical Demilitarization (Chem Demil) – Chemical Materals Agency (Army Executing Agent)

Common Analytical Laboratory System

Defense Agency Initiative (DAI)

Defense Enterprise Accounting and Management System – Increment 1 (DEAMS-Inc. 1)

Defense Healthcare Management System (DHMS)

Defense Medical Information Exchange (DMIX)

Defense Readiness Reporting System – Strategic

Defense Security Assistance Management System (DSAMS) – Block 3

DOD PROGRAMS (continued)

EDS – Explosive Destruction System

Enterprise Business Accountability System – Defense

EProcurement

Global Combat Support System – Joint (GCSS-J)

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

Joint Aerial Layer Network

Joint Biological Tactical Detection System

Joint Chemical Agent Detector (JCAD)

Joint Command and Control Capabilities (JC2C) [Encompasses GCCS-FoS (GCCS-J, GCCS-A, GCCS-M, TBMCS-FL, DCAPES, GCCS-AF, USMC JTCW, USMC TCO]

Joint Information Environment

Joint Light Tactical Vehicle (JLTV)

Joint Warning and Reporting Network (JWARN)

Key Management Infrastructure (KMI) Increment 2

MC-130J

Mid-Tier Networking Vehicle Radio

milCloud

Modernized Intelligence Database (MIDB)

Multi-Functional Information Distribution System (includes integration into USAF and USN aircraft)

Next Generation Chemical Detector

Next Generation Diagnostic System

Public Key Infrastructure (PKI) Incr 2

SOCOM Dry Combat Submersible Medium (DCSM)

Teleport, Generation III

Theater Medical Information Program – Joint (TMIP-J) Block 2

ARMY PROGRAMS

ABRAMS TANK MODERNIZATION – Abrams Tank Modernization (M1E3)

Abrams Tank Upgrade (M1A1 SA / M1A2 SEP)

Advanced Field Artillery Tactical Data System (AFATDS) Increment 2

AH-64E Apache

Airborne and Maritime/Fixed Site Joint Tactical Radio System (AMF JTRS) Small Airborne Link 16 Terminal (SALT)

Airborne and Maritime/Fixed Site Joint Tactical Radio System (AMF JTRS) Small Airborne Networking Radio (SANR)

AMF Airborne & Maritime/Fixed Station

AN/PRC-117G Radio

AN/TPQ-53 Radar System (Q-53)

Armed Aerial Scout (previously named ARH Armed Recon Helicopter)

Armored Multipurpose Vehicle (AMPV)

Armored Truck – Heavy Dump Truck (HDT)

Armored Truck – Heavy Equipment Transporter (HET)

Armored Truck – Heavy Expanded Mobility Tactical Truck (HEMTT)

Armored Truck – M915A5 Line Hauler

Armored Truck – M939 General Purpose Truck

Armored Truck – Palletized Loading System (PLS)

Army Vertical Unmanned Aircraft System

Biometrics Enabling Capability (BEC) Increment 1

Biometrics Enabling Capability Increment 0

Black HAWK (UH-60L) – Utility Helicopter Program

Black HAWK (UH-60M) – Utility Helicopter Program

Bradley Engineering Change Proposal (ECP) and Modernization

C-17 Increase Gross Weight (IGW) and reduced Formation Spacing Requirements (FSR) with T-11 parachute

Cartridge, 7.62mm, M80A1

CH-47F – Cargo Helicopter

Common Infrared Countermeasures (CIRCM)

Common Operating Environment

Common Remotely Operated Weapons System III

Department of Defense Automated Biometric Information System

Distributed Common Ground System – Army (DCGS-A)

EXCALIBUR – Family of Precision, 155 mm Projectiles

FBCB2 – Force XXI Battle Command Brigade and Below Program

FBCB2 – Joint Capability Release (FBCB2 – JCR)

Field Deployable Hydrolysis System (FDHS)

Fixed-Wing Utility Aircraft

FMTV – Family of Medium Tactical Vehicles

General Fund Enterprise Business System (GFEBS)

Global Combat Support System – Army (GCSS-A)

Guided Multiple Launch Rocket System – Unitary (GMLRS Unitary)

Guided Multiple Launch Rocket System – Alternate Warhead (GMLRS AW)

HELLFIRE Romeo

High Mobility Multipurpose Wheeled Vehicle (HMMWV)

HIMARS – High Mobility Artillery Rocket System

Identification Friend or Foe Mark XIIA Mode 5 (all development and integration programs)

Improved Turbine Engine Program

Indirect Fire Protection Capability Increment 2 – Intercept

Integrated Air and Missile Defense (IAMD)

Integrated Personnel and Pay System – Army (Army IPPS) Increment 1

Integrated Personnel and Pay System – Army (IPPS-A) Increment 2

Interceptor Body Armor

Javelin Antitank Missile System – Medium

Joint Air-to-Ground Missile

ARMY PROGRAMS (continued)

Joint Assault Bridge
Joint Battle Command – Platform (JBC-P)
Joint Future Theater Lift Concept (JFTLC)
Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System
Joint Personnel Identification (JPIv2)
Joint Tactical Network (JTN)
Kiowa Warrior, OH-58F Cockpit and Sensor Upgrade Program (CASUP)
Logistics Modernization Program (LMP)
Long Range Precision Fires (LRPF)
M1200 Knight Targeting Under Armor (TUA)
M270A1 Multiple Launch Rocket System (MLRS)
M829E4
Modernized Expanded Capacity Vehicle (MECV) – Survivability Project
MQ-1C Unmanned Aircraft System Gray Eagle
Nett Warrior
One System Remote Video Terminal
Paladin/FASSV Integrated Management (PIM)
PATRIOT PAC-3 – Patriot Advanced Capability 3 (Missile only)
PATRIOT/MEADS – Patriot/Medium Extended Air Defense System
RQ-11B Raven – Small Unmanned Aircraft System
RQ-7B SHADOW – Tactical Unmanned Aircraft System
Soldier Protection System
Spider XM7 Network Command Munition
Stryker ECP – Stryker Engineering Change Proposal
Stryker M1126 Infantry Carrier Vehicle including Double V-Hull variant
Stryker M1127 Reconnaissance Vehicle
Stryker M1128 Mobile Gun System
Stryker M1129 Mortar Carrier including the Double V-Hull variant
Stryker M1130 Commander's Vehicle including the Double V-Hull Variant
Stryker M1131 Fire Support Vehicle Including the Double V-Hull Variant
Stryker M1132 Engineer Squad Vehicle Including the Double V-Hull Variant
Stryker M1133 Medical Evacuation Vehicle Including the Double V-Hull Variant
Stryker M1134 ATGM Vehicle Including the Double V-Hull Variant
Stryker M1135 NBC Reconnaissance Vehicle (NBCRV)
Tactical Mission Command
Tactical Radio System Manpack
Tactical Radio System Rifleman Radio
UH-72A Lakota Light Utility Helicopter
WIN-T INCREMENT 1 – Warfighter Information Network – Tactical Increment 1
WIN-T INCREMENT 2 – Warfighter Information Network – Tactical Increment 2
WIN-T INCREMENT 3 – Warfighter Information Network – Tactical Increment 3
WIN-T INCREMENT 4 – Warfighter Information Network – Tactical Increment 4
XM1156 Precision Guidance Kit (PGK)
XM25, Counter Defilade Target Engagement (CDTE) System
XM395 Accelerated Precision Mortar Initiative (APMI)

NAVY PROGRAMS

Advanced Airborne Sensor
Advanced Extremely High Frequency Navy Multiband Terminal Satellite Program (NMT)
AEGIS Modernization (Baseline Upgrades)
AGM-88E Advanced Anti-Radiation Guided Missile
AH-1Z
AIM-9X – Air-to-Air Missile Upgrade Block II
Air and Missile Defense Radar (AMDR)
Air Warfare Ship Self Defense Enterprise
Airborne Laser Mine Detection System (AN/AES-1) (ALMDS)
Airborne Mine Neutralization System (AN/ASW-235) (AMNS)
Airborne Resupply/Logistics for Seabasing
Amphibious Assault Vehicle Upgrade
Amphibious Combat Vehicle (ACV)
AN/APR-39 Radar Warning Receiver
AN/AQS-20A Minehunting Sonar
AN/SQQ-89A(V) Integrated USW Combat Systems Suite
Assault Breaching System Coastal Battlefield Reconnaissance and Analysis System Block I
Assault Breaching System Coastal Battlefield Reconnaissance and Analysis System Block II
CH-53K – Heavy Lift Replacement Program
Close-In Weapon System (CIWS) including SEARAM
Cobra Judy Replacement – Ship-based radar system
Common Aviation Command and Control System (CAC2S)
Consolidated Afloat Networks and Enterprise Services (CANES)
Cooperative Engagement Capability (CEC)
Countermeasure Anti-Torpedo
CVN-78 – *Gerald R. Ford* class Nuclear Aircraft Carrier
DDG 1000 – *Zumwalt* class Destroyer – includes all supporting PARMs and the lethality of the LRLAP and 30mm ammunition
DDG 51 – *Arleigh Burke* class Guided Missile Destroyer – includes all supporting PARMs
DDG 51 Flight III – *Arleigh Burke* class Guided Missile Destroyer – includes all supporting PARMs

NAVY PROGRAMS (continued)

Dept of Navy Large Aircraft Infrared Countermeasures Program

Distributed Common Ground System – Navy (DCGS-N)

Distributed Common Ground System – Marine Corps (DCGS-MC)

E-2D Advanced Hawkeye

EA-18G – Airborne Electronic Attack

Electro-Magnetic Aircraft Launching System

Enhanced Combat Helmet

Evolved Sea Sparrow Missile (ESSM)

Evolved Sea Sparrow Missile Block 2

F/A-18E/F – SUPER HORNET Naval Strike Fighter

Future Pay and Personnel Management Solution (FPPS)

Global Combat Support System – Marine Corps (GCSS-MC)

Global Command and Control System – Maritime (GCCS-M)

Ground/Air Task Oriented Radar (G/ATOR)

Identification Friend or Foe Mark XIIA Mode 5 (all development and integration programs)

Infrared Search and Track System

Integrated Defensive Electronic Countermeasures Block 4

Joint and Allied Threat Awareness System

Joint High Speed Vessel (JHSV)

JOINT MRAP – Joint Mine Resistant Ambush Protected Vehicles FOV – including SOCOM vehicles

Joint Precision Approach and Landing System Increment 1 (Ship system)

Joint Precision Approach and Landing System Increment 2 (Land system)

Joint Stand-Off Weapon C-1 variant (JSOW C-1)

KC-130J with Harvest Hawk

Landing Ship Dock Replacement (LX(R))

Large Displacement Unmanned Undersea Vehicle

LCS Interim Surface to Surface Missile

LHA 6 – *AMERICA* class – Amphibious Assault Ship – includes all supporting PARMs

LHA 8 Amphibious Assault Ship (*America* class with well deck)

Light Armored Vehicle

Light Weight Tow Torpedo Countermeasure (part of LCS ASW Mission Module)

Littoral Combat Ship (LCS) – includes all supporting PARMs, and 57mm lethality

Littoral Combat Ship Mission Modules including 30mm

Littoral Combat Ship Surface-to-Surface Missile (follow on to the interim SSM)

Littoral Combat Ship Variable Depth Sonar (LCS VDS)

Logistics Vehicle System Replacement

LPD 17 – *SAN ANTONIO* class – Amphibious Transport Dock Ship – includes all supporting PARMs and 30 mm lethality

Marine Personnel Carrier

Medium Tactical Vehicle Replacement Program (USMC) (MTVR)

MH-60R Multi-Mission Helicopter Upgrade

MH-60S Multi-Mission Combat Support Helicopter

Mk 54 torpedo/MK 54 VLA/MK 54 Upgrades Including High Altitude ASW Weapon Capability (HAAWC)

MK-48 CBASS Torpedo including all upgrades

Mobile Landing Platform (MLP) Core Capability Set (CCS) Variant and MLP Afloat Forward Staging Base (AFSB) Variant

Mobile User Objective System (MUOS)

MQ-4C Triton

MQ-8 – Vertical Takeoff and Land Tactical Unmanned Air Vehicle (VTUAV) (Fire Scout)

Multi-static Active Coherent (MAC) System CNO project 1758

Naval Integrated Fire Control – Counter Air (NIFC-CA) From the Air

Naval Integrated Fire Control – Counter Air (NIFC-CA) From the Sea

Navy Enterprise Resource Planning (ERP)

Next Generation Jammer

Offensive Anti-Surface Warfare Increment 1

Offensive Anti-Surface Warfare, Increment 2

Ohio Replacement Program (Sea-based Strategic Deterrence) – including all supporting PARMs

OSPREY MV-22 – Joint Advanced Vertical Lift Aircraft

P-8A Poseidon Program

Remote Minehunting System (RMS)

Replacement Oiler

Rolling Airframe Missile (RAM) including RAM Block 1A Helicopter Aircraft Surface (HAS) and RAM Block 2 Programs

Ship Self Defense System (SSDS)

Ship to Shore Connector

Small Tactical Unmanned Aerial System (STUAS) – UAS Tier II

SSN 774 *VIRGINIA* class Submarine

SSN 784 *VIRGINIA* class Block III Submarine

Standard Missile-2 (SM-2) including all mods

Standard Missile-6 (SM-6)

Submarine Torpedo Defense System (Sub TDS) including countermeasures and Next Generation Countermeasure System (NGCM)

Surface Electronic Warfare Improvement Program (SEWIP) Block 2

Surface Electronic Warfare Improvement Program (SEWIP) Block 3

Surface Mine Countermeasures Unmanned Undersea Vehicle (also called Knifefish UUV) (SMCM UUV)

Surveillance Towed Array Sonar System/Low Frequency Active (SURTASS/LFA) including Compact LFA (CLFA)

Torpedo Warning System (Previously included with Surface Ship Torpedo Defense System) including all sensors and decision tools

TRIDENT II MISSILE – Sea Launched Ballistic Missile

UH-1Y

Unmanned Carrier Launched Airborne Surveillance and Strike System

Unmanned Influence Sweep System (UISS) include Unmanned Surface Vessel (USV) and Unmanned Surface Sweep System (US3)

USMC MRAP – Cougar

VXX – Presidential Helicopter Fleet Replacement Program

AIR FORCE PROGRAMS

20mm PGU-28/B Replacement Combat Round

Advanced Pilot Trainer

AEHF – Advanced Extremely High Frequency (AEHF) Satellite Program

AFNet Modernization capabilities (Bitlocker, Data at Rest (DaR), Situational Awareness Modernization (SAMP))

AFNET Vulnerability Management (AFVM) – Assured Compliance Assessment Solution (ACAS)

AIM-120 Advanced Medium-Range Air-to-Air Missile

Air Force Distributed Common Ground System (AF-DCGS)

Air Force Integrated Personnel and Pay System (AF-IPPS)

Air Operations Center – Weapon System (AOC-WS) initiatives including 10.0 and 10.1

Air Operations Center – Weapon System (AOC-WS) initiative 10.2

Airborne Signals Intelligence Payload (ASIP) Family of Sensors

Airborne Warning and Control System Block 40/45 Computer and Display Upgrade

ALR-69A Radar Warning Receiver

B-2 Defensive Management System Modernization (DMS)

B-2 Extremely High Frequency SATCOM and Computer Increment 1

B-2 Extremely High Frequency SATCOM and Computer Increment 2

B61 Mod 12 Life Extension Program

Base Information Transport Infrastructure (BITI) - Wireless

Battle Control System – Fixed (BCS-F) 3.2

C-130J – HERCULES Cargo Aircraft Program

C-5 Aircraft Reliability Enhancement and Re-engining Program

C-5 Core Mission Computer and Weather Radar Replacement

Cobra Judy Replacement Mission Planning Tool

Combat Rescue Helicopter (CRH)

Command and Control Air Operations Suite (C2AOS)/Command and Control Information Services (C2IS) (Follow-on to Theater Battle Management Core Systems)

Defense Enterprise Accounting and Management System – Air Force (DEAMS – AF)

ECSS – Expeditionary Combat Support system

Enclave Control Node (ECN)

EPS – Enhanced Polar System

F-15 Eagle Passive Active Warning Survivability System

F-15E Radar Modernization Program

F-22 – RAPTOR Advanced Tactical Fighter

F-35 – Lightning II Joint Strike Fighter (JSF) Program

FAB-T – Family of beyond Line-of-Sight Terminals

Full Scale Aerial Target

GBS – Global Broadcast Service

Geosynchronous Space Situational Awareness Program

GPS OCX – Global Positioning Satellite Next Generation Control Segment

GPS-IIIA – Global Positioning Satellite III

Hard Target Munition

HC/MC-130 Recapitalization

Identification Friend or Foe Mark XIIA Mode 5 (all development and integration programs)

Integrated Strategic Planning and Analysis Network (ISPAN) Increment 2

Integrated Strategic Planning and Analysis Network (ISPAN) Increment 4

Joint Air-to-Surface Standoff Missile Extended Range

Joint Space Operations Center Mission System (JMS)

JSTARS Recapitalization

KC-46 – Tanker Replacement Program

Long Range Stand Off (LRSO) Weapon

Long Range Strike Bomber

Massive Ordnance Penetrator (MOP)

Military GPS User Equipment (GPS MGUE)

Miniature Air Launched Decoy – Jammer (MALD-J)

MQ-9 REAPER – Unmanned Aircraft System

Multi-Platform Radar Technology Insertion Program

NAVSTAR Global Positioning System (GPS) (includes Satellites, Control and User Equipment)

OSPREY CV-22 – Joint Advanced Vertical Lift Aircraft

Presidential Aircraft Recapitalization

RQ-4B Block 30 – High Altitude Endurance Unmanned Aircraft System

RQ-4B Block 40 Global Hawk – High Altitude Long Endurance Unmanned Aircraft System

SBIRS HIGH – Space-Based Infrared System Program, High Component

SBSS B10 Follow-on - Space-Based Space Surveillance Block 10 Follow-on

SF – Space Fence

SIPRNET Modernization

Small Diameter Bomb, Increment II

Three-Dimensional Expeditionary Long-Range Radar

Weather Satellite Follow-on (WSF)

Problem Discovery Affecting OT&E

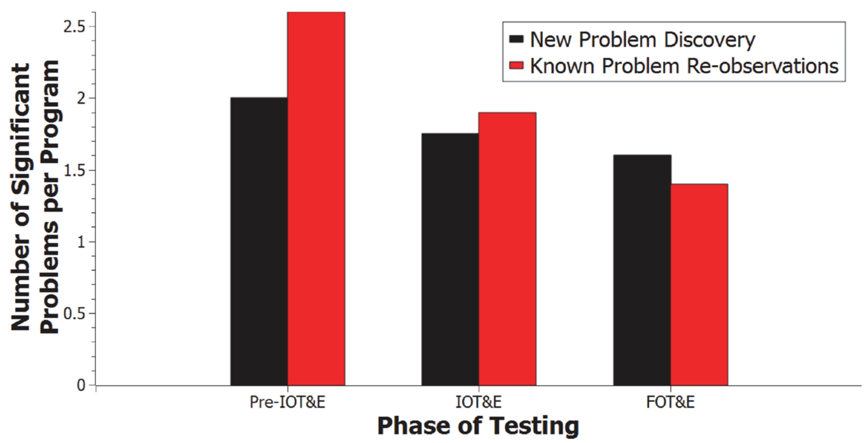
Background

In 2011, Congress expressed concern that acquisition programs are discovering problems during operational testing (OT) that: (1) should have been discovered in developmental testing (DT), and (2) should have been corrected prior to OT. In response to this congressional concern, I added this section to my Annual Report, as a means to survey across all DOT&E oversight programs covered in this report, the extent of late problem discovery and to identify known problems that jeopardize a system's successful performance in upcoming OT.

This is the fourth time this section has been included in my Annual Report, and this iteration presents a more in-depth review of the programs included in this report. Last year, this section consisted of short case studies that discussed problems that were identified during OT or DT. This year's section includes data that break down into several relevant categories the effectiveness, suitability, and cybersecurity problems that were either observed during OT or that jeopardize a system's successful performance in an upcoming OT event (i.e., if known problems are not fixed, a finding of not effective, not suitable, and/or not survivable could occur).[1] The results presented in this section continue to show that OT is necessary, and that we continue to find significant and substantial problems during OT that were either not previously observed or could not be observed in DT. Also, as documented in this section, OT continues to identify problems that were previously discovered but not fixed.

Overview of Problem Discovery in OT

Figure 1 below shows a breakdown of the number of significant problems (per program and by the phase of testing) and where the problems were newly discovered or already known. As expected, the rate of new problem discovery in early OT that occurs prior to Initial Operational Test and Evaluation (IOT&E) (pre-OT conducted to inform acquisition and/or early fielding decisions) is higher than the rate of problem discovery in both IOT&E and Follow-on Operational Test and Evaluation (FOT&E). This is a desirable trend because the earlier a problem is discovered, the easier it is to fix it, and it is consistent with DOT&E's initiative for early involvement in test programs. The ratio for new problem discovery (black bars) is the highest (two "significant problems" per program) for early OT. Significant problems are those that would have a negative impact on DOT&E's assessment of effectiveness, suitability, or cybersecurity.



		Pre-IOT&E	IOT&E	FOT&E
New Problem Discovery	Total Problems	10	14	8
	Total Programs	5	8	5
	Ratio	**2**	**1.75**	**1.6**
Known Problem Re-observations	Total Problems	13	19	14
	Total Programs	5	10	10
	Ratio	**2.6**	**1.9**	**1.4**

FIGURE 1. PROBLEM DISCOVERY RATIOS IN PRE-IOT&E, IOT&E, AND FOT&E

For re-observations of known problems, the rate is also higher in early OT, and is higher overall than for new problem discovery (red bars). This result indicates that while early OT is effective in demonstrating the operational impact of known problems prior to IOT&E, OT is observing more known problems in all phases of testing compared to new problem discovery.[2] In cases where known issues prior to OT are significant (indicating a lack of system maturity), DOT&E has suggested not doing the OT because the resources expended conducting the test would not be worth the little or irrelevant information gained from an OT at that time. This year, DOT&E suggested foregoing planned OT events for the F-35 Joint Strike Fighter (JSF), Air and Missile Defense Radar (AMDR), and Remote Minehunting System (RMS) because of several known performance issues.

1. Cybersecurity problems are evaluated through OT and are considered in DOT&E's survivability assessments. Survivability problems discovered through Live Fire Test and Evaluation are not included in this discussion of OT.
2. For pre-IOT&E testing, observing known problems is not a major issue because the program still has time to correct them prior to IOT&E; this fact underscores the importance of conducting an operational assessment prior to the Milestone C or Low-Rate Initial Production decision.

Other trends are:

- About one-third of the programs that underwent OT during FY14 did so successfully; that is, they did not uncover problems significant enough to negatively affect my assessment of operational effectiveness, suitability, or cybersecurity.
- For new problem discovery, about half of the effectiveness problems found in OT were not discoverable in DT because the operationally realistic conditions required in OT were needed to discover the problem (i.e., testing under realistic combat conditions by typical military users).
- More than two-thirds of the programs that commenced IOT&E or FOT&E in FY14 with known suitability problems implemented (and in many cases tested) fixes to these problems prior to the OT. This is an area where DOT&E's initiatives on reliability growth are having a positive effect.
- Looking to the future and consistent with the first bullet above, about one-third of the programs with upcoming OT events in the next three years have not yet exhibited any effectiveness, suitability, or cybersecurity problems significant enough to jeopardize successful performance in OT. (However, we know that about half of the new problems observed during OT cannot be observed in early testing because of the need for operationally realistic environments.)
- Thirty percent of the programs undergoing OT in FY14 only re-observed previous known problems during OT; no additional significant problems were found.
- Pre-IOT&E test events are more likely to be delayed to allow time to correct problems compared to delaying either IOT&Es or FOT&Es.
- A majority of programs (10/13) that observed problems during IOT&E re-observed at least one problem that was known prior to the IOT&E.
- Five of the nine programs that re-observed known effectiveness issues during an IOT&E or FOT&E in FY14 did not identify fixes to address these problems prior to operational test.

EVALUATION OF PROBLEM DISCOVERY

Programs with an FY14 OT

I surveyed 81 programs that either underwent OT in FY14 or will undergo OT within the next three years (some programs fall into both categories), and are reported on in this Annual Report.[3] The results presented in this section, including those in Figure 1 above, focus on these programs. I classified the programs that underwent OT into one of three main categories: (1) successful performance in OT; (2) new performance problems discovered; and (3) known performance problems re-observed. The more detailed review conducted this year also allowed me to categorize individual problems and Program Office responses to these problems, whereas last year's report only categorized problems at the program level. Otherwise, the categories used in this year's report are similar to those used in previous years. These categories are described in Table 1. For problems that were discovered during OT, I assess whether these problems affected effectiveness, suitability, or cybersecurity and whether they reasonably could have been discovered prior to the OT event.

TABLE 1. PROBLEM DISCOVERY CATEGORIES FOR PROGRAMS WITH AN OT EVENT OR A DOT&E REPORT IN THE LAST YEAR

Category		Description
Successful OT	Successful OT without delays	No significant problems were discovered during OT that would negatively affect DOT&E's assessment of operational effectiveness, suitability, and/or cybersecurity.
	Successful, but delayed, OT	Problem(s) were discovered that delayed entry into OT so they could be addressed, thus contributing to a successful OT outcome.
New problem discovery		Problem(s) significant enough to negatively affect DOT&E's assessment of operational effectiveness, suitability, and/or cybersecurity were discovered for the first time in OT.
Known problem re-observations		Problem(s) were observed in OT that were known prior to entering OT and significant enough to negatively affect DOT&E's assessment of operational effectiveness, suitability, and/or cybersecurity.

Programs with an upcoming OT

For programs that are scheduled to undergo an OT event within the next three years, I identified those that have not uncovered any problems that jeopardize a system's successful performance in upcoming OT events, and those with problems significant enough that, if uncorrected, would negatively affect my assessment of operational effectiveness, suitability, and/or cybersecurity. I classify these programs into one of three categories: (1) no problems for upcoming OT; (2) problems delayed upcoming OT; and (3) problems have not delayed upcoming OT. They are described in more detail in Table 2.

3. The original congressional request specified programs scheduled to commence operational testing within the next two years. I expanded that window to three years to include programs that delayed their entry into OT so they could fix known problems before commencing OT.

TABLE 2. PROBLEM DISCOVERY IN CATEGORIES FOR PROGRAMS IN THIS ANNUAL REPORT SCHEDULED TO UNDERGO OT WITHIN THE NEXT 3 YEARS

Category	Description
No problems for upcoming OT	The program has not exhibited any problems that would negatively affect DOT&E's assessment of operational effectiveness, suitability, and/or cybersecurity for the upcoming OT.[1]
Problems delayed upcoming OT	Problems exist that, if not corrected, would negatively affect DOT&E's assessment of operational effectiveness, suitability, and/or cybersecurity for the upcoming OT. OT has been delayed so these problems can be addressed prior to commencing OT.
Problems have not delayed upcoming OT	Problems exist that, if not corrected, would negatively affect DOT&E's assessment of operational effectiveness, suitability, and/or cybersecurity for the upcoming OT, but OT has not (yet) been delayed to address these problems.

1. Such programs could be examples where the program development process, including DT and OT, appears to be moving along well. Alternatively, the testing to date might not have been sufficiently stressing to surface any problems.

SUMMARY OF RESULTS

For problem discovery in FY14, I found a mixture of positive trends and areas that may need improvement. The results are shown in Figure 2. Blocks that are colored green signify positive trends, while the block in red signifies areas that need improvement. The yellow block represents an outcome that is in-between or neutral. The two blocks with a yellow/green color gradient are a combination of mixed results. The outcomes shown in Figure 2 are discussed in more detail in the sections that follow.

About one-third of the programs (15 of 48) that underwent OT during FY14 did so successfully; that is, they did not uncover problems significant enough to negatively affect DOT&E's assessment of operational effectiveness, suitability, and cybersecurity.[4] About two-thirds of the programs (33 of 48) that underwent OT during FY14 encountered problems that negatively affected DOT&E's assessment of their operational effectiveness, suitability, and/or cybersecurity. These problems were either new problems discovered in the OT event, or were re-observations of known problems. Of these 33 programs, 8 programs discovered only new problems, 15 only re-observed known problems, and 10 both discovered new problems and re-observed known problems.

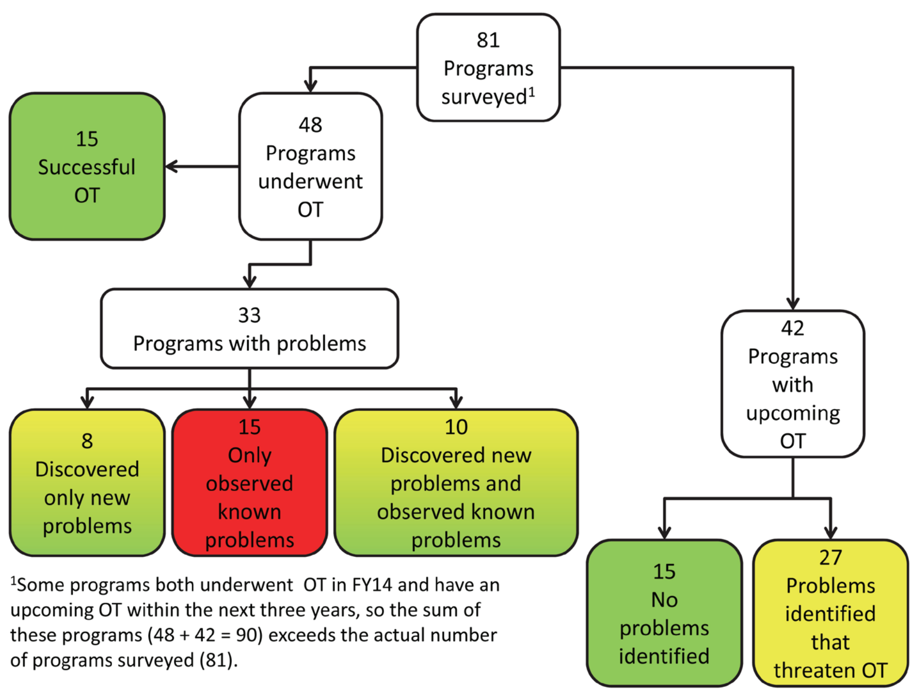


FIGURE 2. PROBLEM DISCOVERY IN OT RESULTS MEASURED BY PROGRAM COUNTS

For programs with upcoming OT events in the next three years, I determined that slightly more than one-third (15 of 42) of the programs currently exhibit no effectiveness, suitability, or cybersecurity problems significant enough to jeopardize their successful performance in upcoming OT, which is to say that no problems have yet been found that, if not corrected, would negatively affect my assessment of operational effectiveness, suitability, or cybersecurity. Of the remaining two-thirds of programs (27), I identified 23 that have effectiveness, suitability, and/or cybersecurity problems that, if not corrected, could negatively affect my operational assessments. The remaining four programs have items that potentially jeopardize successful performance in OT, but these relate more to schedule or process as opposed to effectiveness, suitability, or cybersecurity. Examples include test schedules in Test and Evaluation Master Plans that are not executable; reliance on other programs that are facing development challenges; and failed, cancelled, or delayed DTs that jeopardize successful performance in OT.

4. Note that even in these cases, OT provides recommendations or potential improvements to improve system performance for the warfighter.

PROGRAMS THAT CONDUCTED OT IN FY14

For programs that conducted an OT event in FY14, my analysis consists of the following:

- Program-Level – Analysis of the number of programs that fall into each of the categories listed in Table 1, broken down by the types of problems found by each program (effectiveness, suitability, or cybersecurity), and across the three phases of OT (pre-IOT&E, IOT&E, or FOT&E)
- Problem-Level – For programs that experienced significant problems during their OT, analysis of the number of problems found by all the programs, broken down by the types of problems and across the three phases of OT
- Responses to Known Problems – For programs that re-observed known problems, analysis of the number of programs that identified, implemented, and in many cases tested fixes to these problems prior to the OT

Program-Level

Analysis of the number of programs in which problems have been observed is necessary to assess the scale of problem discovery in OT. Note that some programs, as shown in Figure 2, observed both new and known problems, so these can contribute to program counts for both types of problems. The types of problems observed can be related to effectiveness, suitability, or cybersecurity; programs can observe multiple types of problems during their OT.

TABLE 3. FY14 OT RESULTS BASED ON NUMBER OF PROGRAMS

Category		Number of Programs[1]	Number of Programs by Type of Problem[2]		Number of Programs by Phase of Testing		
					Pre-IOT&E	IOT&E	FOT&E
Successful OT	Successful OT without delays	11			1	6	4
	Successful, but delayed, OT	4			1	2	1
New problem discovery		18	Effectiveness	11	4	4	4
			Suitability	9	2	4	2
			Cybersecurity	5	0	4	1
				Total	**5**	**8**	**5**
Known problem re-observations		25	Effectiveness	13	4	4	5
			Suitability	14	3	7	4
			Cybersecurity	4	1	1	2
				Total	**5**	**10**	**10**

1. Forty-eight programs underwent an OT in FY14. Fifteen had successful OTs (11 + 4), and 33 uncovered problems. The number of programs that experienced new problem discovery or re-observed known problems adds up to more than 33 in the table because some programs experienced both new problem discovery and known problem re-observations, thus contributing to both counts.
2. The count of programs that discovered/observed problems during testing exceeds the totals in the "Numbers of programs" column because some programs discovered multiple types of problems.

Of the 15 programs that successfully completed OT in FY14, 4 programs delayed their OT in order to fix performance problems prior to the OT. Table 3 shows these broken down by program discovery category, type of problem observed, and phase of testing. A list of the programs that fall under these categories in Table 3 is included at the end of this section.

More than one-third of the programs (18 of 48) undergoing OT in FY14 discovered new problems. When aggregated, these programs were divided nearly evenly between observing effectiveness (11) and suitability (9) problems, along with a few cybersecurity (5) problems. When broken down by the phase of testing, the ratio of programs discovering new suitability problems to the discovery of new effectiveness problems is lowest in pre-IOT&E testing. This suggests that suitability issues manifest themselves later in the testing lifecycle, but the sample size is too small to definitively state whether this is a trend, or simply random chance.

The proportion of programs re-observing known problems in OT remains high.[5] Table 3 shows that 25 of the 48 programs that underwent OT in FY14 encountered known, significant problems. Fifteen of the 25 programs (see Figure 2) encountered only known problems during their OT, while the other 10 also discovered new problems.

Problem-Level

Analysis based on the number of problems observed during OT can help characterize the completeness of testing prior to OT. Such results are shown in Table 4. Table 4 is similar to Table 3, except it indicates the number of problems encountered during OT instead of the number of programs encountering problems.[6] Some of the new problems observed were not discoverable prior to commencing OT while others were. For new problem discovery, about half of the effectiveness problems found (8 of 17) were not discoverable prior to the OT. Such problems generally require the operationally realistic (or "test-as-you-fight") environment that is the hallmark of OT in order to be discovered. For new suitability problems discovered, this drops to one-third (3 of 9).

5. This result is shown in Figure 2, but is not directly observable in Table 3 because some programs observed both new problems and known problems.
6. The problems referred to here are the number of "significant" problems, not all problems. Recall that significant problems are those that would negatively affect my assessment of operational effectiveness, suitability, or cybersecurity.

The proportion of the number of known problems encountered in OT to new problem discovery may be an area where improvement is possible. Table 4 shows that 42 known problems were re-observed in OT, compared to 27 new problems being discovered (of which 11 were not discoverable in pre-OT testing).

TABLE 4. FY14 OT RESULTS BASED ON NUMBER OF PROBLEMS					
Category	Number of Problems by Type[1]		Number of Problems by Phase of Testing[1]		
			Pre-IOT&E	IOT&E	FOT&E
New problem discovery	Effectiveness	18 (8)	8 (4)	5 (2)	5 (2)
	Suitability	9 (3)	2 (1)	5 (1)	2(1)
	Total	**27 (11)**	**10 (5)**	**10 (3)**	**7 (3)**
Known problem re-observations	Effectiveness	19	7	7	5
	Suitability	23	5	11	7
	Total	**42**	**12**	**18**	**12**

1. Numbers in parentheses are the number of problems that were not discoverable prior to OT. For example, in IOT&E, five new effectiveness problems were identified in FY14 across all programs undergoing IOT&E. Of these, two were not discoverable prior to IOT&E.

Responses to Known Problems

As shown in Table 5, about half of the programs that commenced IOT&E or FOT&E in FY14 with one or more known effectiveness problems did not identify fixes to address these problems prior to OT (both 3 of 5 in IOT&E and 2 of 5 in FOT&E).[7] The situation is better, however, when the program commenced OT with known suitability problems. In this case, 5 of 7 programs in IOT&E, and 3 of 4 in FOT&E implemented (and in many cases tested) fixes to these problems prior to OT. Note, however, that by breaking down the results thus far, the number of programs in each category (fix not identified or fix implemented (and in many cases tested)) is small. The sample size is too small to definitively state whether this is a trend or simply random.

TABLE 5. ACTIONS TAKEN TO MITIGATE KNOWN PROBLEMS PRIOR TO ENTERING OT							
Category	Number of Programs	Number of Programs by Type of Problem		How was the problem addressed prior to OT?			
				IOT&E		FOT&E	
				Fix Not Identified[1]	Fix Implemented (tested)[2]	Fix Not Identified[1]	Fix Implemented (tested)[2]
Known problem re-observations (IOT&E or FOT&E)	20	Effectiveness	9	3	2 (1)	1	3(1)
		Suitability	11	2	5 (3)	1	3 (3)
		Cybersecurity	3	1	1 (1)	1	1 (0)

1. Number of programs that had at least one problem for which no fix was identified.
2. Number of programs that had at least one problem for which a fix was implemented (tested).

Specific Programs that had OT in FY14

Successful OT

Fifteen of the 48 programs that underwent OT in FY14 experienced successful performance in OT. The majority of these (11 of 15) that successfully completed an OT event did so without having to delay OT. These programs are listed below in Table 6 and are examples of a successful development process, including DT and OT. Additional details on any of these programs can be found in the program-specific entries in the main body of this report.

TABLE 6. PROGRAMS THAT HAD SUCCESSFUL OT IN FY14	
Successful OT (No Delays)	Successful OT (with Delays)
AH-64E	Cobra King (formerly Cobra Judy Replacement)
AIM-120 Advanced Medium-Range Air-to-Air Missile (AMRAAM)[1]	Excalibur Increment 1B M982E1
F/A-18E/F Super Hornet and EA-18G Growler	Global Command and Control System – Joint (GCCS-J)[2]
Global Command and Control System – Maritime (GCCS-M)	MQ-9 Reaper Armed Unmanned Aircraft System (UAS)
Integrated Personnel and Pay System – Army (IPPS-A)	
Joint Tactical Network (JTN)	
MH-60R Multi-Mission Helicopter	
MH-60S Multi-Mission Combat Support Helicopter	
Nett Warrior	
RQ-7BV2 Shadow Tactical Unmanned Aircraft System (TUAS)	
Department of Defense (DOD) Teleport	

1. This was the Electronic Protection Improvement Program (EPIP), a software upgrade to a previously-fielded missile.
2. Emerging results from the OT have not been completely analyzed.

7. Programs that had known problems prior to commencing pre-IOT&E testing are not counted here because in most cases there may be sufficient time prior to starting IOT&E to address these problems. Furthermore, not all required system capabilities might be present for pre-IOT&E events.

New problem discovery

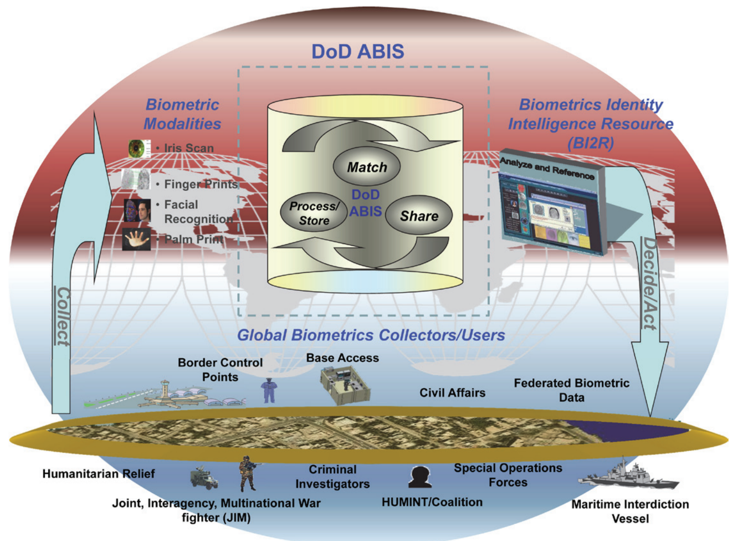
Of the 48 programs that underwent OT in FY14, 18 discovered problems that had not been seen before. There are a variety of reasons why some problems are not observed prior to OT. In some cases, problems can be uncovered only by testing under the operationally realistic conditions that characterize formal OT. The sooner these problems are discovered, the better. Hence, finding these problems in the pre-IOT&E phase of OT, such as an operational assessment prior to the Milestone C or Low-Rate Initial Production decision, is highly desirable. Other problems are discovered for the first time that could have been found and addressed during testing prior to OT, such as dedicated Developmental Test and Evaluation (DT&E). Table 7 gives a list of the programs that had new problem discovery and indicates whether these problems were discoverable earlier. Note that many programs experience both new problem discovery in OT and re-observation of known problems. These programs are highlighted in grey in Table 7. Additional details on any of these programs can be found in the program-specific entries in the main body of this report.

TABLE 7. PROGRAMS THAT HAD NEW PROBLEM DISCOVERY IN OT IN FY14

Program	OT Event Type	Service	Discoverable Prior to OT			Not Discoverable Prior to OT		
			Effectiveness	Suitability	Cybersecurity	Effectiveness	Suitability	Cybersecurity
AN/PRC-117G	Pre-IOT&E	Army	×					
DOD Automated Biometric Identification System (ABIS)	Pre-IOT&E	Army	×			×		
Defense Medical Information Exchange (DMIX)	Pre-IOT&E	Joint	×	×				
Joint Light Tactical Vehicle (JLTV) Family of Vehicles (FoV)	Pre-IOT&E	Joint					×	
Surface Ship Torpedo Defense (SSTD) System: Torpedo Warning System (TWS) and Countermeasure Anti-Torpedo (CAT)	Pre-IOT&E	Navy	×					
Ballistic Missile Defense System (BMDS)	IOT&E	MDA	×					
Distributed Common Ground System – Marine Corps (DCGS-MC)	IOT&E	Marine Corps		×				×
F-15E Radar Modernization Program (RMP)	IOT&E	Air Force		×				
Joint Battle Command – Platform (JBC-P)	IOT&E	Joint			×			
Joint High Speed Vessel (JHSV)	IOT&E	Navy			×	×	×	
Miniature Air-Launched Decoy (MALD) and MALD – Jammer (MALD-J)	IOT&E	Air Force	×					
Q-53 Counterfire Target Acquisition Radar System	IOT&E	Army	×		×			
RQ-21A Blackjack (formerly Small Tactical Unmanned Aerial System (STUAS))	IOT&E	Navy		×				
AIM-120D Advanced Medium-Range Air-to-Air Missile (AMRAAM)	FOT&E	Air Force				×	×	
Air Operations Center – Weapon System (AOC-WS)	FOT&E	Air Force				×	×	
Mark XIIA Mode 5 Identification Friend or Foe (IFF)	FOT&E	Navy	×					
MK 54 Lightweight Torpedo	FOT&E	Navy		×				
Manpack Radio	FOT&E	Army		×	×			

The following discussion involves the discovery of new problems in two of the programs listed in Table 7. The programs are: (1) the DOD Automated Biometric Identification System (ABIS) and (2) the Ballistic Missile Defense System (BMDS). These two programs illustrate the value of OT regarding new problem discovery. Specifically, the DOD ABIS provides a powerful example of the benefits of testing in an operationally realistic environment. The BMDS is an example of an exceedingly complex weapon system that discovers problems during operational flight testing (costing hundreds of millions of dollars), that should have been found in a more cost-effective fashion through comprehensive ground testing.

DOD Automated Biometric Identification System (ABIS)



DOD ABIS is the result of a Joint Urgent Operational Need request and consists of information technology components and biometric examiner experts that receive, process, and store biometrics from collection assets across the globe, match new biometrics against previously stored assets, and update stored records with new biometrics and contextual data to positively identify and verify actual or potential adversaries.

ABIS has been fielded and supported as an Army Quick Reaction Capability since 2009. Since it was not a formal program of record, ABIS has not had an approved Test and Evaluation Master Plan to guide the developmental or OT&E of this system. After an initial deployment attempt in August 2013, which was unsuccessful, the biometrics program undertook a set of user tests that, while not fully conducted to the rigor of a formal DT, were more rigorous than previous regression testing.

In August 2014, the Army Test and Evaluation Command performed a two-phased OT on ABIS version 1.2. This was the first OT conducted on the system. The first phase was conducted August 7 – 28, 2014. The second phase, which was supposed to begin directly following the first phase, was delayed to address the five effectiveness problems discussed below. The second phase of OT was conducted October 17 – 22, 2014.

The first phase of OT was structured to allow comparison between the then current Authoritative Database (ABIS 1.0) and the system under test (ABIS 1.2) by streaming all live data into both systems. To mitigate operational risk, only ABIS 1.0 sent responses back to the field. Since the ABIS 1.2 system was not the authoritative system, Phase 1 of the OT could have been conducted as an operationally realistic DT event.

During the first phase of OT, the following problems were noted in a DOT&E memo to Army acquisition leadership. If a rigorous DT using an operationally realistic environment had been conducted prior to the OT, the problems detailed in the DOT&E memo after Phase 1 of the OT would have likely been identified. The issues are detailed as follows:

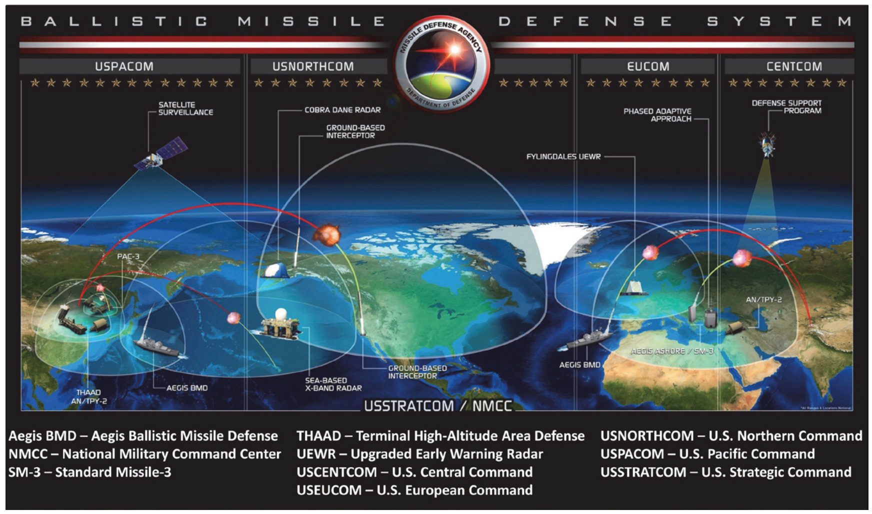
- The National Ground Intelligence Center (NGIC) puts all ABIS biometric match results into its Biometric Identity Intelligence Repository (BI2R). NGIC also fuses the data from worldwide biometric collection systems into and out of ABIS. BI2R is used by DOD Intelligence agencies to identify persons that should be added to the watchlist. During Phase 1 OT, NGIC observed thousands of discrepancies between match results returned from ABIS 1.0 and 1.2. Other problems included incorrect email addresses for sending alerts. Without alerts, no actions can be taken when a person on a watchlist is identified by the system. The mission impact is the potential loss of actionable intelligence when encountering persons of interest throughout the world. OT was necessary to uncover this problem because the number and complexity of live interfaces with real-world biometric submitters could not be adequately simulated in a DT.
- A latent fingerprint is one taken from an object in the field, such as an improvised explosive device. Latent (fingerprint) examiners at the Biometrics Identity Management Activity noted a key identifier (Grand ID) was missing from Latent Examination tools in ABIS 1.2. This capability was available in ABIS 1.0. The Grand ID enables latent examiners to link different latent images with a single forensic case. The problem was not discoverable prior to entering OT because the user cases that were exercised required external interfaces with biometric and latent submitters that could not be simulated in the DT environment.
- ABIS 1.2 responses to biometric submissions failed to meet the specifications required by the Federal Bureau of Investigation Integrated Automated Fingerprint Identification System (IAFIS) preventing acceptance by the IAFIS

interface. An operational environment with the actual production equipment receiving submissions in parallel with the legacy operational system was essential to allow discovery of such issues.

- One of four custom watchlists had over 1,800 discrepancies between the responses from ABIS 1.0 and 1.2. Custom watchlists are used by military personnel in the field to determine courses of action when a person is detained in a particular geographic area. Custom Biometrically Enabled Watchlists could have been assessed before the Phase 1 OT began while the live submissions were streaming into both systems.

Ballistic Missile Defense System (BMDS)

The BMDS is designed to protect the United States, deployed forces, allies, and friends against ballistic missiles of all ranges and in all phases of flight. The BMDS is a distributed system currently comprised of five elements (four shooters and one command and control element) and five sensor systems (four radar systems and one space-based system).



The first OT of the BMDS, referred to as Flight Test Operational – 01 (FTO-01) occurred in September 2013 and demonstrated a layered upper-tier regional/theater BMDS defense against a raid of two simultaneously-launched and threat-representative medium-range ballistic missiles threatening a shared defended area. Although a layered defense was demonstrated in this test, true system integration was not demonstrated due to system network configuration errors, interoperability limitations, and component failures.

FTO-01 was an extremely complex flight test event—it was the second most complex flight test ever attempted by the Missile Defense Agency (MDA) to date. A major difficulty in finding problems such as those uncovered during FTO-01 is that the BMDS can be instantiated in many ways using different combinations of shooters, sensors, and operational laydowns. Despite this variability, some of these findings could have been discovered prior to executing the flight test. In particular, some of the network configuration errors could have been discovered through comprehensive ground testing and analyses. The MDA has taken action to correct the problems uncovered during FTO-01. Details of the problems and specific actions are classified.

Known problem re-observations
Some problems are observed in OT that are already known from prior testing; known problems were observed in 25 of the 48 programs that underwent OT in FY14. As noted earlier, many programs that re-observed known problems also experienced new problem discovery in OT; these are highlighted in grey in Table 8.

TABLE 8. PROGRAMS WITH KNOWN PROBLEM RE-OBSERVATIONS

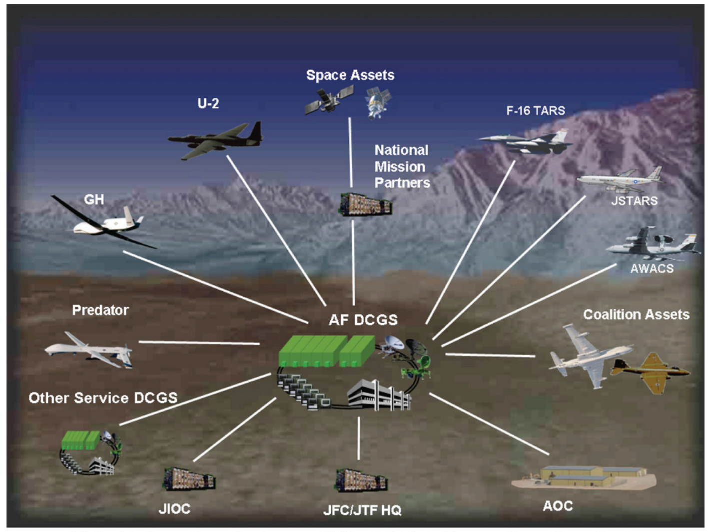
Program	OT Event Type	Service	Known Problem		
			Effectiveness	Suitability	Cybersecurity
AN/PRC-117G	Pre-IOT&E	Army	×		
AN/SQQ-89A(V)15 Integrated Undersea Warfare (USW) Combat System Suite	Pre-IOT&E	Navy		×	
CVN-78 *Gerald R. Ford* class Nuclear Aircraft Carrier	Pre-IOT&E	Navy	×	×	
Defense Enterprise Accounting and Management System (DEAMS)	Pre-IOT&E	Air Force	×	×	×
Infrared Search and Track (IRST)	Pre-IOT&E	Navy	×		
Aegis Ballistic Missile Defense (BMD)	IOT&E	Navy, MDA		×	
F-15E Radar Modernization Program (RMP)	IOT&E	Air Force		×	
Joint Battle Command – Platform (JBC-P)	IOT&E	Joint		×	
Littoral Combat Ship (LCS)[1]	IOT&E	Navy	×	×	×
Miniature Air Launched Decoy (MALD) and MALD – Jammer (MALD-J)	IOT&E	Air Force		×	
Multi-Static Active Coherent (MAC) System	IOT&E	Navy	×		
Q-53 Counterfire Target Acquisition Radar System	IOT&E	Army	×		
QF-16 Full-Scale Aerial Target (FSAT)	IOT&E	Air Force	×		
RQ-21A Blackjack (formerly Small Tactical Unmanned Aerial System (STUAS))	IOT&E	Navy		×	
Surveillance Towed Array Sensor System (SURTASS) and Compact Low Frequency Active (CLFA) Sonar	IOT&E	Navy	×		
Air Force Distributed Common Ground System (AF DCGS)	FOT&E	Air Force	×		
Air Operations Center – Weapon System (AOC-WS)	FOT&E	Air Force			×
Battle Control System – Fixed (BCS-F)	FOT&E	Air Force			×
F/A-18E/F Super Hornet and EA-18G Growler	FOT&E	Navy	×	×	
Joint Warning and Reporting Network (JWARN)	FOT&E	Joint		×	
Mark XIIA Identification Friend or Foe (IFF) Mode 5	FOT&E	Navy	×		
MK 54 Lightweight Torpedo	FOT&E	Navy	×		
MV-22 Osprey	FOT&E	Joint		×	
P-8A Poseidon Multi-Mission Maritime Aircraft (MMA)	FOT&E	Navy	×		
Manpack Radio	FOT&E	Army	×	×	

1 . Two survey entries for separate oversight programs with separate problems, both discussed in the LCS section of the annual report.

The following discussion involves the re-observation of known problems in three of the programs listed in Table 8. The programs are: (1) Air Force Distributed Common Ground System (AF DCGS); (2) Multi-static Active Coherent (MAC) System; and (3) Small Tactical Unmanned Aerial System (STUAS) Tier II. These three programs illustrate the value of OT in highlighting the operational implications of known problems. In these three cases, program management either decided to accept the risk that their known problems would not affect the OT assessment, or let schedule drive the program into OT in spite of known shortcomings.

Air Force Distributed Common Ground System (AF DCGS)

The AF DCGS provides software tools for operators to task, process, exploit, and disseminate Intelligence, Surveillance, and Reconnaissance information. AF DCGS consists of multiple ground systems at dispersed operational sites. AF DCGS participates in the DOD intelligence enterprise via the DCGS Integration Backbone, which uses a metadata catalog and discovery service to enable sharing of information among participants.



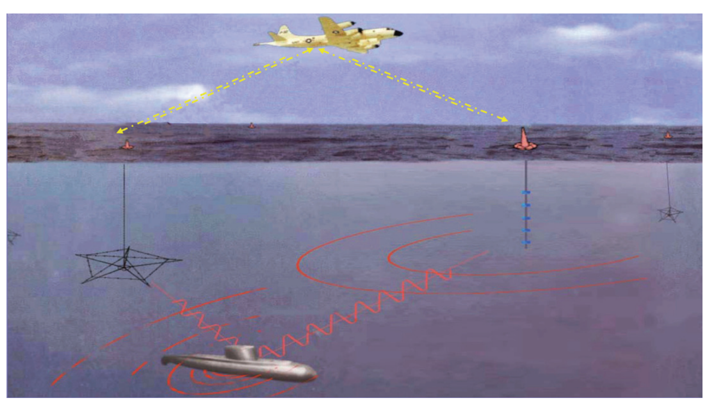
AOC - Air Operations Center
AWACS - Airborne Warning and Control System
GH - Global Hawk
HQ - Headquarters
JFC - Joint Forces Command
JIOC - Joint Intelligence Operations Center
JSTARS - Joint Surveillance Target Attack Radar System
JTF - Joint Task Force
TARS - Tactical/Theater Airborne Reconnaissance System

AF DCGS Bulk Release 10B failed both developmental and regression testing and did not meet the entrance criteria for the OT phase known as the Force Development Evaluation. Despite not meeting the OT entrance criteria (the system had two known Category I and four Category II software deficiencies that were open and unresolved), the Air Force Intelligence, Surveillance, and Reconnaissance Agency approved entrance into OT. In January and June 2014, the 605th Test and Evaluation Squadron conducted Phases 1 and 2 of a two-phase Force Development Evaluation to assess the operational effectiveness and suitability of AF DCGS Bulk Release 10B. Two new software applications that were part of the Geospatial Intelligence upgrade known as Bulk Release 10B had major performance problems. They caused such significant slowdowns in workflow that the Air Force made the decision to stop using the new applications, and operators reverted to using the legacy manual processes during the test. The system did not meet any of its reliability requirements because of critical failures and downtime. While users can execute their missions with AF DCGS under normal load conditions, performance under heavy loads could not be determined. Heavier loads are expected in the future when new sensors are deployed and the number of simultaneous external users is increased.

In part because the Air Force placed AF DCGS in the sustainment vice development phase, the program lacks a strategy for testing and evaluation, documented performance requirements for planned enhancements, accurate software maturity trend information, and an approved system-engineering plan. By developing and following these key programmatic guidance documents, the Air Force would likely improve AF DCGS performance.

Multi-static Active Coherent (MAC) System

The MAC system is an active sonar system composed of two types of sonobuoys (source and receiver) and an acoustic processing-software suite. It is employed by the Navy's maritime patrol aircraft (P-3Cs and eventually P-8As) to search for and locate threat submarines in a variety of ocean conditions.



The Navy completed OT of the MAC Phase 1 system on P-3C Multi-mission Aircraft (MMA) in October 2013. OT consisted of 3 DT events conducted off the coast of Jacksonville, Florida; 7 dedicated OT events conducted in the Southern California Fleet Operating Areas; and 14 events in the Narragansett Bay Operating Areas. After the series of OT in January 2013 near San Diego, the Navy knew the system did not work in some environments. However, the program requirement criterion for MAC was a roll-up of test detection results, and testing was not stopped until a series of test events in May 2013 in the Narragansett Bay test area, where performance appeared below threshold, even after counting DT results prior to 2013.

During the May 2013 series of tests, it became clear operators were not recognizing valid target returns as targets because the target-signature criteria they had been trained to use did not cover the new environment. There was also a need to fix some materiel information technology problems with the aircraft used for the test. OT was halted for a period of four to five months because of a combination of materiel problems with the aircraft used to employ the system and training of operators to use the system. More thorough DT might have minimized or eliminated this delay. The operators were retrained to recognize new target signature features that enabled them to distinguish between valid target returns and clutter returns more effectively. In the October 2013 test series following the re-training, the operators were able to recognize valid targets more accurately, but not by a margin that could be clearly distinguished from previous rates under the confidence limits of the data collected.

RQ-21A Blackjack (formerly Small Tactical Unmanned Aerial System (STUAS) Tier II)

Marine Corps commanders will use the RQ-21A Blackjack (formerly Small Tactical Unmanned Aerial System (STUAS)) to provide units ashore with a dedicated persistent battlefield Intelligence, Surveillance, and Reconnaissance (ISR) capability that will reduce their dependence on higher headquarters for ISR support. The persistence of the system allows commanders greater coverage of their areas of interest, while providing the capability to concentrate for longer periods of time on a specified target of interest. The Marine Corps is developing RQ-21A as an organic asset in an effort to wean itself off the contractor-owned, contractor-operated systems currently under contract. In order to transition from ISR services contracts to an organic ISR asset, the Program Office decided to enter IOT&E in spite of the low reliability demonstrated during an earlier operational assessment.

The Navy started the RQ-21A IOT&E in January 2014. Testing consisted of a land-based IOT&E phase (with concurrent ship-based DT) intended to be followed by a ship-based IOT&E phase aboard an LPD-17 class ship. During the land-based phase of IOT&E at Marine Corps Air Ground Combat Center, Twentynine Palms, California, operators flew 188 flight hours during 31 flights. The first flight ended in a mishap and loss of the air vehicle. Post-mishap investigation suspended OT flights for 10 days. The RQ-21A demonstrated a Mean Flight Hours Between Abort (MFHBA) of 15.8 hours, well below the MFHBA threshold criterion of 50 hours. Low reliability adversely affected the ability of operators to support ground units in a timely manner. Many of the reliability problems identified during the land-based IOT&E appear to result from poor quality control during the production process. The Program Office is working with the manufacturer to increase quality control processes with sub-vendors, improve acceptance testing of spare parts, and review their acceptance procedures.

Concurrent with the land-based phase of IOT&E, the Navy conducted RQ-21A ship-based DT aboard an LPD-17 class ship. This ship testing identified interference between the ship's degaussing system and the air vehicle's magnetometer. Without realistic shipboard testing, this deficiency would not have been identified. This deficiency necessitated software upgrades and regression testing, which delayed the scheduled ship-based phase of IOT&E until December 2014. Based on poor system performance during the land-based phase of IOT&E and software update to correct a GPS deficiency associated with shipboard operations, the Navy conducted a second land-based phase of IOT&E in June at Marine Corps Base Camp Lejeune, North Carolina. Operators flew 20.9 hours during eight flights. Analysis of results is ongoing.

For programs with upcoming OT events in the next three years, I found that slightly more than one-third (15 of 42) of the programs currently do not exhibit performance problems significant enough to jeopardize successful performance in OT. Table 9 shows these results by type of problem and phase of testing.

PROGRAMS WITH UPCOMING OT EVENTS

For programs with upcoming OT events in the next three years, I found that slightly more than one-third (15 of 42) of the programs currently do not exhibit performance problems significant enough to jeopardize successful performance in OT. Table 9 shows these results by type of problem and phase of testing.

TABLE 9. PROGRAMS COMMENCING OT WITHIN THE NEXT THREE YEARS						
Category	Number of Programs[1]	Number and Type of Problems (program count)[2]		Phase of Testing (program count)		
				Pre-IOT&E	IOT&E	FOT&E
No problems for upcoming OT	15			4	5	6
Problems have delayed upcoming OT	7	Effectiveness	11	3	0	0
		Suitability	9	4	2	0
		Cybersecurity[3]	5	0	0	0
			Total	**5**	**2**	**0**
Problems have not delayed upcoming OT	19	Effectiveness		2	7	4
		Suitability		1	5	4
		Cybersecurity[3]		1	1	1
			Total	**4**	**8**	**6**
Other problems threaten upcoming OT	4			2	2	0

1. Forty-two programs will undergo an OT in the next three years. The number of programs adds up to more than 42 because some programs have problems that delayed their upcoming OT as well as problems that did not delay OT.
2. The number of programs summed across type of problems adds up to more than the number of programs because some programs have multiple problems or more than one type of problem..

Upcoming pre-IOT&E test events are far more likely to be delayed to correct problems compared to both upcoming IOT&E and FOT&E. In fact, Table 9 shows that for the programs covered in this Annual Report, there were no upcoming FOT&E events that were delayed to correct problems. Of the programs for which potential problems exist for upcoming OT events, 5 of 7 of the pre-IOT&E events were delayed to address at least one issue, 2 of 10 of the IOT&E events were delayed, and 0 of 6 of the FOT&E (or post-IOT&E) events were delayed.

For programs that have not delayed their upcoming OT and have known problems, the distribution between effectiveness and suitability problems is about the same (13 compared to 10), with three cybersecurity problems. Table 10 expands further upon programs that have not delayed their upcoming OT and shows that FOT&E events are considerably more likely to have a fix implemented (and in many cases tested) going into the OT, regardless of type of problem, compared to both pre-IOT&E and IOT&E. The data are currently insufficient to determine whether the differences between the rate of implementing and testing fixes prior to FOT&E compared to IOT&E is a trend or simply random.

TABLE 10. ACTIONS TAKEN TO ADDRESS PROBLEMS FOR UPCOMING OT EVENTS FOR WHICH OT HAS NOT (YET) BEEN DELAYED										
Category	Type of Problem	How has the problem been addressed to date (program count)?								
		pre-IOT&E			IOT&E			FOT&E		
		Fix Not Identified	Fix Documented	Fix implemented (tested)	Fix Not Identified	Fix Documented	Fix implemented (tested)	Fix Not Identified	Fix Documented	Fix implemented (tested)
Problems have not delayed upcoming OT[1]	Effectiveness	2	0	1 (0)	4	4	2 (1)	2	0	2 (2)
	Suitability	0	1	0	4	1	1 (0)	0	1	3 (2)
	Cybersecurity	1	0	0	0	0	1 (0)	0	0	1 (1)

1. Numbers in parentheses are the number of problems that have already tested fixes prior to the upcoming OT.

Specific Programs that have upcoming OT in the next three years

No problems for upcoming OT

Fifteen of the 42 programs with upcoming OT events have not yet exhibited problems considered to significantly jeopardize performance in upcoming OT events. Such programs could be examples where the program development process, including DT and OT, appears to be moving along well. Alternatively, the testing to date might not have been sufficiently stressing to surface any problems. These programs are listed below in Table 11.

Problems delayed upcoming OT
For some programs, early testing has uncovered problems and entry into the upcoming OT has already been delayed to provide the program an opportunity to correct them. Seven programs fall into this category and are given in Table 12. Note that some programs that have problems that delayed their upcoming OT also have problems that did not delay the OT; the programs with both types of problems are highlighted in grey.

Problems have not delayed upcoming OT
Some programs have uncovered problems in early testing that, if not satisfactorily corrected, could result in my assessing the system as not being operationally effective or suitable. Unlike the above, the OT has not (yet) been delayed to correct these problems. These programs are also shown in Table 12. Note that some programs that have identified problems that did not delay their upcoming OT have also identified other problems that did delay the OT; the programs with both types of problems are highlighted in grey.

TABLE 11. PROGRAMS WITH NO PROBLEMS FOR UPCOMING OT
AIM-9X – Air-to-Air Missile Upgrade
Air and Missile Defense Radar (AMDR)
C-17 Increase Gross Weight (IGW) and Formation Spacing Reduction (FSR)
Common Aviation Command and Control System (CAC2S)
E-2D Advanced Hawkeye
F-22A Advanced Tactical Fighter
Family of Advanced Beyond Line-of-Sight Terminals (FAB-T)
Guided Multiple Launch Rocket System – Alternative Warhead (GMLRS-AW) XM30E1[1]
Integrated Defensive Electronic Countermeasures (IDECM)
Joint Information Environment (JIE)[2]
Joint Standoff Weapon (JSOW)
Massive Ordnance Penetrator (MOP)
Rifleman Radio
Small Diameter Bomb (SDB)
Standard Missile-6 (SM-6)

1. Emerging Results from the recent GMLRS-AW IOT&E indicate its lethality is insufficient.
2. The JIE has not had any OT to date pending development of governance processes for the Joint Regional Security Stack transport infrastructure.

TABLE 12. PROGRAMS WITH PROBLEMS THREATENING UPCOMING OT

Program	OT Event Type	Service	OT Delayed			OT Not Delayed		
			Effectiveness	Suitability	Cybersecurity	Effectiveness	Suitability	Cybersecurity
AC-130J Ghostrider	Pre-IOT&E	USSOCOM	×					
Distributed Common Ground System – Army (DCGS-A)	Pre-IOT&E	Army		×				×
F-35 Joint Strike Fighter (JSF)	Pre-IOT&E	Joint	×	×				
Key Management Infrastructure (KMI)	Pre-IOT&E	NSA		×				
MQ-4C Triton Unmanned Aircraft System	Pre-IOT&E	Navy				×		
Public Key Infrastructure (PKI)	Pre-IOT&E	Joint					×	
Remote Minehunting System (RMS)	Pre-IOT&E	Navy	×	×		×		
AN/SQQ-89A(V)15 Integrated Undersea Warfare (USW) Combat System Suite	IOT&E	Navy					×	
Ballistic Missile Defense System (BMDS)	IOT&E	MDA				×		
Defense Enterprise Accounting and Management System (DEAMS)	IOT&E	Air Force				×		×
Infrared Search and Track (IRST)	IOT&E	Navy				×		
LHA-6 New Amphibious Assault Ship	IOT&E	Navy				×		
Littoral Combat Ship (LCS)	IOT&E	Navy		×		×	×	
Mobile Landing Platform (MLP) Core Capability Set (CCS) and Afloat Forward Staging Base (AFSB)	IOT&E	Navy					×	
Patriot Advanced Capability-3 (PAC-3)	IOT&E	Army				×	×	
Precision Guidance Kit (PGK)	IOT&E	Army		×				
RQ-4B Global Hawk High-Altitude Long-Endurance Unmanned Aerial System (UAS)	IOT&E	Air Force				×	×	
AGM-88E Advanced Anti-Radiation Guided Missile (AARGM)	FOT&E	Navy				×		
Air Force Distributed Common Ground System (AF DCGS)	FOT&E	Air Force				×		
Defense Medical Information Exchange (DMIX)	FOT&E	Joint				×	×	
M829E4 Armor Piercing, Fin Stabilized, Discarding Sabot-Tracer (APFSDS-T)	FOT&E	Army					×	
MQ-9 Reaper Armed Unmanned Aircraft System (UAS)	FOT&E	Air Force					×	
Warfighter Information Network – Tactical (WIN-T)	FOT&E	Army				×	×	×

The following discusses the problems that potentially jeopardize successful performance in upcoming OT in three of the programs listed in Table 12. The programs are: (1) AC-130J Ghostrider; (2) Remote Minehunting System (RMS); and (3) Warfighter Information Network – Tactical (WIN-T). These programs illustrate the types of problems that jeopardize successful performance in upcoming OT and should be addressed to the maximum extent possible prior to OT.

AC-130J Ghostrider

The AC-130J is a medium-sized, multi-engine, tactical aircraft with a variety of sensors and weapons for close air support. U.S. Special Operations Command is developing AC-130J through the integration of a modular Precision Strike Package (PSP) onto existing MC-130J aircraft. The PSP provides a 30 mm side-firing gun; wing-mounted, GPS-guided Small Diameter Bombs; Griffin laser-guided missiles; two electro-optical/infrared sensor/laser designator pods; a synthetic aperture radar pod; and multiple video, data, and communication links.

There have been problems with integration of the PSP weapon kit onto the aircraft that continue to delay portions of DT by prohibiting weapons employment and hindering system effectiveness. First, the visual acuity of the electro-optical/infrared sensors installed on the AC-130J is not sufficient for accurate target identification and designation because of excessive vibration on the new aircraft as compared to the legacy AC-130W aircraft on which the PSP was previously installed. Second, electrical/radio-frequency interference between aircraft systems and the hand controllers used by crewmembers to direct the sensors and weapons has caused erratic sensor movements. This inhibits target tracking and is a safety hazard (risk of fratricide) during weapon employment. The program is working on correcting the sensor vibration issue by collecting flight test data that can be used by the subsystem contractor to develop mechanical and software updates to reduce the effect of vibration. Similar efforts are underway to characterize and correct electrical interference with the controllers. The program has reported some progress in the laboratory environment on both fixes, but definitive solutions have not yet been demonstrated on the aircraft.

The program has accomplished 36 test flights out of approximately 130 flights planned for a total of 97 flight hours. Initial DT is now expected to be completed in May 2015. Delays in DT have delayed the planned operational assessment by the 18th Flight Test Squadron by approximately four months, and IOT&E has been delayed until October 2015. This schedule does not allow much time to developing and implementing fixes to problems already observed in the DT.

Remote Minehunting System (RMS)

The RMS is a system-of-systems designed to detect and classify mine-like objects throughout the water column and to identify bottom objects in shallow waters. The Navy expects to employ the system with both variants of the Littoral Combat Ship (LCS) as a key component of the Mine Countermeasures (MCM) mission package.

DOT&E disapproved the Navy's plan to conduct an operational assessment of the RMS in 2QFY14 because the assessment would have been a wasted effort for the following reasons:

- The proposed test article was not representative of the system the Navy plans to employ in the first increment of the LCS MCM mission package (it was an earlier version without planned upgrades) and therefore, would not provide data necessary to augment the IOT&E of an LCS equipped with that mission package;
- Test limitations would have precluded an operational evaluation of some phases of the end-to-end mission; and
- Conduct of the test would have delayed vehicle upgrades necessary to support testing of the system the Navy expects to field.

The RMS program has not yet demonstrated that the system can meet its detection and classification requirements against moored and bottom mines spanning the portion of the shallow water regime not covered by the Airborne Laser Mine Detection System (ALMDS). The program anticipates that the AN/AQS-20B sensor will permit the system to cover the portion of the water column below that covered by the ALMDS. The new sensor will be tested in FY15.

RMS radios have had difficulty establishing reliable communications with the LCS during DT, and once communications are established, the current communications systems do not support Remote Multi-Mission Vehicle (RMMV) mine identification operations beyond the horizon. RMMV will need to operate beyond the horizon to support efficient MCM operations in long shipping channels while LCS remains in an area clear of mines. This problem arose when the Navy decertified the MH-60S helicopter for towing MCM devices, including the AN/AQS-20A/B sensor. The range limitation did not exist when the sensor was towed by the helicopter. The Navy has not subsequently developed a solution to this problem.

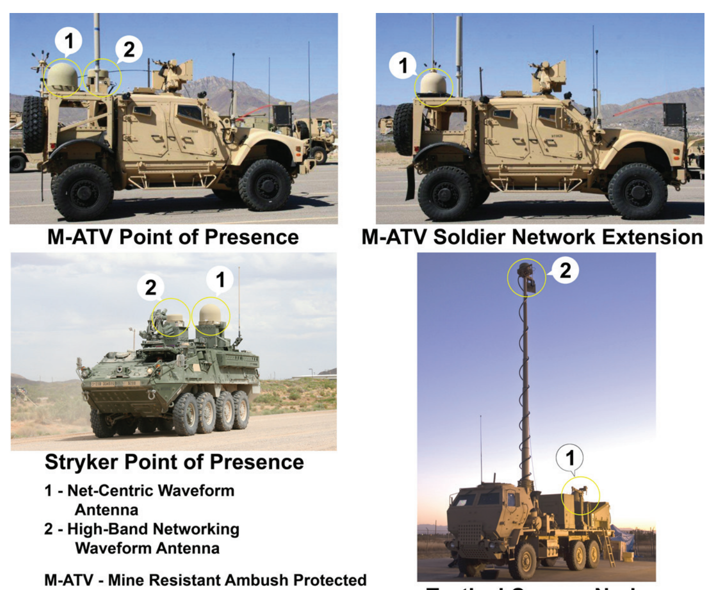
The combined results of shore-based and LCS-based testing conducted since the program was recertified following a Nunn-McCurdy breach in 2010 have not demonstrated that an LCS equipped with an MCM mission package that includes two RMMVs and three AN/AQS-20A sonars will be able to support the sustained area coverage rate the Navy has established for the Increment 1 MCM mission package. The program believes that RMMV reliability improvements and an upgraded version of the minehunting sensor, designated AN/AQS-20B, will resolve many of the program's identified problems.

The reliability of the version 4.2 (v4.2) RMMV during combined developmental and integrated testing completed in FY14 was 31.3 hours Mean Time Between Operational Mission Failure (MTBOMF), which is well below the required reliability. DT completed in 1QFY15 provides a point estimate for v6.0 vehicle reliability of 34.6 hours MTBOMF. Statistical analysis of all test data indicates the result is not sufficient to conclude that reliability has actually improved since a Nunn-McCurdy review of the program in 2010. Therefore, test data currently available (including early testing of the v6.0 vehicle) do not support the Navy's assertion that vehicle reliability has improved. Moreover, the current estimate of RMS reliability, once all of the other components of the system are considered, is no more than 20 hours MTBOMF, which is well-short of what is needed to complete MCM missions in a timely fashion and meet the Navy's desired mission timelines.

The results of combined DT/integrated testing completed in FY14 continued to show that the RMS's AN/AQS-20A sensor does not meet Navy requirements for contact depth localization accuracy (the difference in depth between reported contact position and ground truth target position) or false classification density (number of contacts erroneously classified as mine-like objects per unit area searched). The sensor also continues to have problems meeting the Navy's detection and classification requirements in shallow waters, and RMS has difficulty guiding the sensor over bottom objects for identification in deep water. Because the first phase of the LCS IOT&E with an embarked MCM mission package was delayed, the Navy was afforded more time to develop an upgraded sensor and implement other system changes that it expects will correct these problems. The program believes that the new sensor, AN/AQS-20B, will correct or greatly mitigate the depth localization and false classification problems; however, the AN/AQS-20B prototypes received from the vendor performed poorly during acceptance and early characterization testing and thus required rework. Testing will continue in FY15.

Warfighter Information Network – Tactical (WIN-T)

WIN-T Increment 2 is a two-tiered communications architecture (celestial and terrestrial) that serves as the Army's high-speed and high-capacity tactical communications network. It is designed to provide reliable, secure, and seamless communications for units operating at theater level and below. It supports both mission command and situational awareness through native WIN-T applications and existing and future battle command applications.



M-ATV Point of Presence

M-ATV Soldier Network Extension

Stryker Point of Presence

1 - Net-Centric Waveform Antenna

2 - High-Band Networking Waveform Antenna

M-ATV - Mine Resistant Ambush Protected (MRAP) All-Terrain Vehicle (M-ATV)

Tactical Comms Node

WIN-T has executed its last three OTs as part of the Army's Network Integration Evaluations (NIEs). This includes a May 2012 IOT&E and May 2013 FOT&E for which DOT&E prepared an IOT&E report and operational assessment report, respectively. A second FOT&E was executed in November 2014 and analysis is ongoing. The NIEs provide access to a full brigade equipped with a complete set of battle command applications to drive traffic on the WIN-T network. The complete brigade is necessary for OT to ensure the WIN-T transport layer can realistically support the data needs of a brigade with a complete set of battle command applications. While laboratory testing of these is possible, it is difficult to execute, and DOT&E has not yet seen a DT for WIN-T that included the full breadth of these applications. The only way to ensure thorough OT is to use a fully equipped and trained brigade combat team.

A concern with the NIEs, from an OT perspective, is their inherent schedule-driven nature; NIEs are very complex events, which are held twice each year. Planning for the NIEs begins 12 to 18 months prior to execution and systems are inserted into the event after planning has begun. Relevant Army programs plan their test schedule around fitting into the NIE, rather than ensuring their system is truly ready for test. The NIE is but one example of external events driving the OT schedule vice scheduling tests to verify fixes implemented to correct problems observed in earlier testing.

WIN-T has executed four OT to date (including a Limited User Test executed in May 2009, prior to the existence of NIEs). Some performance problems identified in the IOT&E have remained constant throughout WIN-T testing. Many of these problems could not have been observed during the WIN-T DTs. Sometimes this was due to the limited scope of the DTs, sometimes because the observation requires a representative unit facing a representative threat in an operational environment. The problems include:

- Poor performance of the line-of-sight Highband Networking Waveform (HNW) – HNW is required to offer 27 megabits per second (Mbps) at-the-halt at a 12-kilometer distance and 18 Mbps on-the-move at a distance of 2 kilometers. OT has shown the HNW is not capable of providing this capability to a dispersed brigade. This could have been identified in DT, but was not because of the limited scope and benign conditions of DT.
- Poor performance of the Soldier Network Extension (SNE) – The SNE is a company-level vehicle kit that includes a satellite transponder and computer for connection to the WIN-T network. At the IOT&E and FOT&E, it had major usability and reliability problems that were only discoverable in OT. Identification of these problems required the evaluation of the ability of representative trained operators in an operational setting to execute their mission.
- Lack of Network Operations capability – Outside of the central Network Operations and Security Center, there is very limited capability for the unit to monitor and manage the WIN-T network. This was only observable in OT. This would have been difficult to identify in DT because it requires an assessment of a representative unit's ability to monitor and manage a dispersed network reacting to a realistic operational scenario.
- Poor reliability – The WIN-T Increment 2 configuration items were not reliable. They did not meet the Army's requirements or serve the needs of operators and commanders. The consequences of reliability problems on the unit's ability to complete its mission are discoverable in OT but not DT. The context of OT provides programs and users the magnitude of the mission consequences.
- Cybersecurity vulnerabilities – The Army's brigade-level network has a significant number of cyber vulnerabilities. These vulnerabilities can only be put into context and evaluated properly when tested using a representative computer network defense and threat employed during OTs, such as the NIEs. Additionally, cybersecurity assessments require the presence of the complete set of battle command applications (hardware and software) and the support of external computer network defense organizations to create a representative environment, which is only available through OT. The WIN-T Program Office has combined their efforts with the cooperative and adversarial cybersecurity assessment teams to identify vulnerabilities and initiate fixes.

RELIABILITY

Of the 81 total programs surveyed, 21 had reliability problems serious enough to either negatively affect the suitability assessment in an FY14 OT report or jeopardize successful performance in OT. Programs are taking corrective actions throughout the acquisition cycle to address reliability problems, but for some systems, reliability remains a concern even after IOT&E or FOT&E. Table 13 summarizes this information. (One system had reliability problems during a pre-IOT&E test that will be tested in an upcoming FOT&E.)

TABLE 13. FY14 OT RELIABILITY RESULTS BASED ON NUMBER OF PROGRAMS

Category	Number of programs with reliability problems[1]	Pre-IOT&E	IOT&E	FOT&E
Known problem re-observations	9	1	6	2
New problem discovery	4	1	2	1
Problems delayed upcoming OT	4	2	2	0
Problems have not delayed upcoming OT	5	1	2	2

1. Twenty-one programs had reliability problems serious enough to either affect a suitability assessment or jeopardize the successful performance in an upcoming OT event. I identified one program that had a reliability problem in a pre-IOT&E event, and this item will be tested in an upcoming FOT&E. This program contributes both to the number of programs that have conducted an OT and to the number programs with upcoming OT events. Thus, the sum of the number of programs is 22.

For the most part, programs are either delaying OT to address reliability and/or are implementing fixes to address reliability prior to entering an OT event; Table 14 summarizes program responses to reliability problems. Of the eight programs that re-observed reliability problems during an IOT&E or FOT&E, six implemented fixes to address reliability prior to the OT event. Similarly, of the nine programs with known reliability problems that jeopardize successful performance in an upcoming OT event, four have delayed OT to address reliability (Table 14). Early OTs are the most likely to be delayed. All five of the programs with reliability problems that have not delayed an upcoming OT have, at a minimum, identified a fix, and four have implemented fixes.

TABLE 14. PROGRAM RESPONSES TO RELIABILITY PROBLEMS

Category	pre-IOT&E			IOT&E			FOT&E		
	Fix Not Identified	Fix Documented	Fix implemented (tested)	Fix Not Identified	Fix Documented	Fix implemented (tested)	Fix Not Identified	Fix Documented	Fix implemented (tested)
Known problem re-observations (IOT&E or FOT&E)	--	--	--	2	--	4 (1)	0	--	2 (2)
Problems have not delayed upcoming OT	0	1	0	0	1	1 (0)	0	0	2 (1)

Despite program attempts to address reliability, some programs continue to observe reliability shortfalls during IOT&E and FOT&E. In part, this reflects the iterative nature of reliability improvement; programs go through multiple cycles of testing and implementing fixes. Nevertheless, a decrease in reliability problems observed during IOT&E and FOT&E, as opposed to earlier phases of testing, might be possible with further improvement in reliability growth plans. See the discussion on reliability in my introduction to this Annual Report for further details.

PROGRESS UPDATES ON DISCOVERIES REPORTED IN THE FY13 DOT&E ANNUAL REPORT

In FY13, I identified 12 systems that had significant problems in IOT&E that should have been discovered and resolved prior to commencement of OT. They are listed in Table 15 below.

I also identified 10 programs that re-observed known problems in IOT&E, shown in Table 16.

One of the programs in Table 16, the Mission Planning System (MPS) is no longer under oversight. The status of the remaining systems is shown below.

TABLE 15. FY13 SYSTEMS THAT HAD SIGNIFICANT NEW PROBLEM DISCOVERY IN OT	
IOT&E with New Problem Discovery	**OT other than IOT&E with New Problem Discovery**
AIM-9X Air-to-Air Missile Upgrade	Acoustic Rapid Commercial Off-the-Shelf Insertion (A-RCI) AN / BQQ-10 (V) Submarine Sonar System
AIM-120 Advanced Medium-Range Air-to-Air Missile (AMRAAM)	Defense Enterprise Accounting and Management System (DEAMS)
Joint Battle Command – Platform (JBC-P)	DOD Automated Biometric Identification System (ABIS)
Miniature Air Launched Decoy (MALD) and MALD – Jammer (MALD-J)	Mk 54 Lightweight Torpedo
Multi-Static Active Coherent (MAC) System	Public Key Infrastructure (PKI)
Surveillance Towed Array Sensor System (SURTASS) and Compact Low Frequency Active (CLFA)	Warfighter Information Network – Tactical (WIN-T)

All fixes implemented and demonstrated in OT
- AIM-9X Air-to-Air Missile Upgrade
- Global Command and Control System – Joint (GCCS -J)

Some (or all) fixes implemented but new problems discovered or known problems re-observed in OT
- F-15E Radar Modernization Program (RMP)
- Manpack Radio
- Joint Battle Command – Platform (JBC-P)
- Miniature Air-Launched Decoy (MALD) and MALD-Jammer (MALD-J)
- P-8A Poseidon Multi-Mission Maritime Aircraft (MMA)

TABLE 16. FY13 SYSTEMS THAT HAD KNOWN PROBLEMS RE-OBSERVED IN IOT&E
Known Problem Re-Observations in IOT&E
AIM-120 Advanced Medium-Range Air-to-Air Missile (AMRAAM)
Cooperative Engagement Capability (CEC)
E-2D Advanced Hawkeye
F-15E Radar Modernization Program (RMP)
Global Broadcast System (GBS)
Global Command and Control System – Joint (GCCS-J)
H-1 Upgrades – U.S. Marine Corps Upgrade to AH-1Z Attack Helicopter and UH-1Y Utility Helicopter
Manpack Radio
Mission Planning System (MPS)/Joint Mission Planning Systems – Air Force (JMPS-AF)
P-8A Poseidon Multi-Mission Maritime Aircraft (MMA)

Some fixes (potentially) implemented; Currently in OT or planning additional OT
- AIM-120 Advanced Medium-Range Air-to-Air Missile (AMRAAM)
- Defense Enterprise Accounting and Management System (DEAMS)
- DOD Automated Biometric Identification System (ABIS)
- E-2D Advanced Hawkeye
- H-1 Upgrades – U.S. Marine Corps Upgrade to AH-1Z Attack Helicopter and UH-1Y Utility Helicopter
- Multi-Static Active Coherent (MAC) System
- Public Key Infrastructure (PKI) Increment 2
- Surveillance Towed Array Sensor System (SURTASS) and Compact Low Frequency Active (CLFA)
- Warfighter Information Network – Tactical (WIN-T)

No Fixes Planned
- Mk 54 Lightweight Torpedo

Not reported on in this year's Annual Report because no OT took place this year
- Acoustic Rapid Commercial Off-the-Shelf (COTS) Insertion for Sonar AN/BQQ-10 (V) (A-RCI) and the AN/BYG-1 Combat Control System
- Cooperative Engagement Capability (CEC)
- Global Broadcast System (GBS)

In FY13, I also identified 16 systems that had significant issues in early testing that should be corrected before IOT&E. They are listed in Table 17.

The following provides an update on the progress these systems made in implementing fixes to those problems. Two of these programs are not reported on in this year's Annual Report because no significant OT activity occurred and the Integrated Electronic Health Record (iEHR) program is no longer on the oversight list.

TABLE 17. FY13 SYSTEMS THAT HAD SIGNIFICANT ISSUES IN EARLY TESTING	
CVN-78 *Gerald R. Ford* class Nuclear Aircraft Carrier	LHA-6 New Amphibious Assault Ship
Defense Enterprise Accounting and Management System (DEAMS)	Littoral Combat Ship (LCS)
DOD Automated Biometric Identification System (ABIS)	M109 Family of Vehicles (FoV) Paladin Integrated Management (PIM)
Manpack Radio	Next Generation Diagnostic System (NGDS)
Rifleman Radio and Nett Warrior	Public Key Infrastructure (PKI)
Integrated Defensive Electronic Countermeasures (IDECM)	Q-53 Counterfire Target Acquisition Radar System
Integrated Electronic Health Record (iEHR)	RQ-4B Global Hawk High-Altitude Long-Endurance Unmanned Aerial System (UAS)
Joint Warning and Reporting Network (JWARN)	Surface Ship Torpedo Defense (SSTD) System: Torpedo Warning System (TWS) and Countermeasure Anti-torpedo Torpedo (CAT)

Fixes tested in OT – New problems discovered
- DOD Automated Biometric Identification System (ABIS)
- Surface Ship Torpedo Defense (SSTD) System: Torpedo Warning System (TWS) and Countermeasure Anti-torpedo (CAT)

Fixes tested in OT – Known problems re-observed
- CVN-78 *Gerald R. Ford* class Nuclear Aircraft Carrier
- Defense Enterprise Accounting and Management System (DEAMS)
- Joint Warning and Reporting Network (JWARN)

Fixes tested in OT – Both new problems discovered and known problems re-observed
- Manpack Radio
- Q-53 Counterfire Target Acquisition Radar System

Upcoming testing with no problems identified
- Rifleman Radio and Nett Warrior
- Integrated Defensive Electronic Countermeasures (IDECM)

Upcoming testing with problems identified
- LHA-6 New Amphibious Assault Ship
- Littoral Combat Ship (LCS)
- Public Key Infrastructure (PKI)
- RQ-4B Global Hawk High-Altitude Long-Endurance Unmanned Aerial System (UAS)
- M109 Family of Vehicles (FoV) Paladin Integrated Management (PIM)

Not reported on in this year's Annual Report because no OT took place this year
- Next Generation Diagnostic System (NGDS)

DOD Programs

DOD Programs

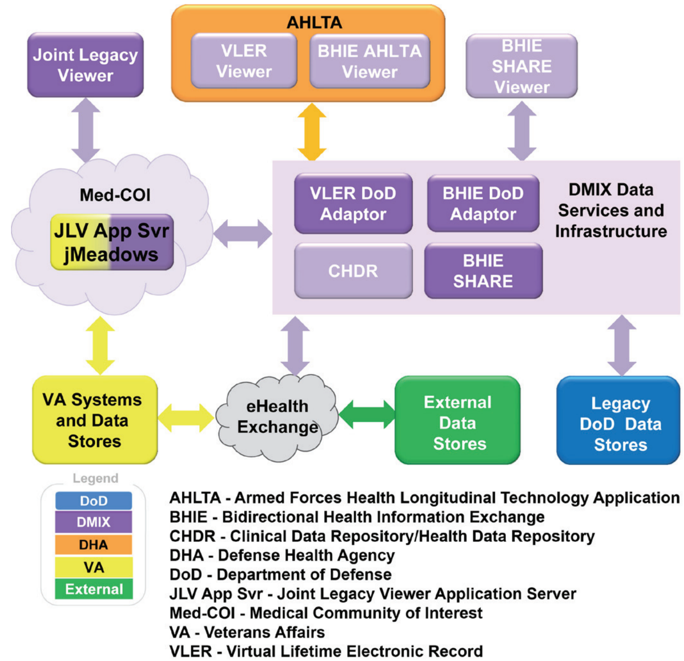
Defense Medical Information Exchange (DMIX)

Executive Summary

- In January 2014, the USD(AT&L) directed the Program Executive Officer (PEO) for DOD Healthcare Management Systems (DHMS) to align all health data and interoperability programs, projects, and initiatives between DOD and external organizations under a single program and develop a Health Data Sharing and Interoperability Roadmap that includes an acquisition and technical strategy based on functional requirements.
- PEO DHMS created an Automated Information System called Defense Medical Information Exchange (DMIX). The DMIX program provides the infrastructure and services to support the integrated sharing of standardized health data among the DOD Healthcare Management System Modernization (DHMSM) system, DOD legacy systems, the Department of Veterans Affairs (VA), other Federal agencies, and private sector healthcare providers.
- The DOD is acquiring DHMSM to replace DOD legacy healthcare systems including the Armed Forces Health Longitudinal Technology Application (AHLTA), the Composite Health Care System, and the Electronic Health Record (EHR) component of the Theater Medical Information Program – Joint program. Together, DHMSM and DMIX are intended to modernize the Military Health System to enhance sustainability, flexibility, and interoperability, for improved continuity of care.
- The DOD is developing DMIX incrementally, delivering upgrades to capabilities that have already been fielded. During FY14, three major capabilities were upgraded:
  - Data Federation
  - Virtual Lifetime Electronic Record (VLER)
  - Integrated Electronic Health Record (iEHR).

Data Federation

- The 2014 National Defense Authorization Act required that all healthcare data contained in the DOD's AHLTA and the VA's Veterans Health Information Systems and Technology Architecture (VistA) systems be computable in real time and in compliance with national standards by October 1, 2014. The DOD and VA created clinical terminology maps to associate health data from AHLTA and VistA to a common set of terms based upon the Health Data Dictionary. The DOD and VA delivered terminology maps for seven clinical domains in November 2013 to support Data Federation Release 0 (DF R0). The DMIX Program Management Office (PMO) loaded the clinical terminology maps into a multiple mapping table in DF R0 to associate over 64,000 terms across the 7 clinical domains. The DMIX PMO intended for subsequent DMIX DF releases to add terminology maps for 21 additional clinical data domains.



- The DOD and VA were unable to deliver additional terminology maps to support the testing and fielding of DF R1 in September 2014. Although no maps were delivered, the DMIX PMO developed DF R1 to allow users to view unmapped patient data for an additional eight clinical domains. DF R1 included updates to both the Joint Legacy Viewer (JLV) and the Bi-directional Health Information Exchange (BHIE) DOD Adapter. The DMIX PMO conducted DF R1 system integration testing, validating the ability to view both mapped and unmapped patient data within 15 clinical domains.
- A DF R0 operational assessment was scheduled for January 2014, but the PEO DHMS did not support operational testing of this release; therefore, none was conducted.
- Using data from live operations, DOT&E determined that DF R0's operational availability was 53.19 percent, which was unacceptably low. The types of failures and frequency of occurrence suggested systemic problems in the DMIX architecture and supporting network infrastructure.
- Operational testing of DF R1 is planned for 2QFY15.

Virtual Lifetime Electronic Record (VLER)

- The DMIX PMO conducted system integration testing of VLER v2.0.2.0 in September and October 2014. The Army Test and Evaluation Command (ATEC) and United States Army Medical Department Board (USAMEDDBD) will test VLER v2.0.2.0 as part of DMIX R2 operational testing in 3QFY15.

Integrated Electronic Health Record (iEHR)

- In January 2014, USD(AT&L) directed PEO DHMS to: (1) transition all relevant iEHR Increment 2 clinical application requirements to the DHMSM program; (2) complete iEHR Increment 1 Milestone B requirements including Context Management, Single Sign-On (SSO), and Roaming capabilities; and (3) conduct an operational assessment of iEHR Increment 1 in coordination with DOT&E.
- Prior to being realigned under the DHMSM and DMIX programs, iEHR Increment 1 was intended to provide 59,000 users at 16 sites access to DOD and VA patient data. However, the DOD recently decided to limit iEHR Increment 1 fielding to only the Captain James A. Lovell Federal Health Care Center (JALFHCC), where the system is currently deployed.
- An operational assessment of iEHR, conducted by USAMEDDBD at JALFHCC in April 2014, demonstrated that users considered iEHR Increment 1 Context Management, SSO, and Roaming capabilities helpful when they were available. However, iEHR Increment 1 did not provide these capabilities reliably. Four of the 66 users surveyed reported that Context Management sometimes displayed data corresponding to the wrong patient, creating a potential risk to patient safety. JALFHCC and PEO DHMS took immediate action to protect patient safety.
- In July 2014, USD(AT&L) approved a limited fielding for iEHR Increment 1 to JALFHCC and directed that: (1) Context Management, SSO, and Roaming capabilities be part of the DHMSM requirements; (2) full deployment of iEHR Increment 1 to additional sites was no longer required; and (3) a follow-on operational assessment of iEHR Increment 1 would be conducted at JALFHCC to evaluate system effectiveness following DMIX PMO corrective actions.
- ATEC and USAMEDDBD conducted a follow-on operational test in September 2014 after the DMIX PMO made system and network improvements that showed improved system availability.
  - A small subset of users experienced the Context Management toolbar disappearing or turning black preventing use of the capability.
  - No patient safety deficiencies were observed.
  - Cybersecurity testing could not be scheduled during the operational test but is planned for 1-2QFY15.
- In November 2014, PEO DHMS approved iEHR Increment 1 Full Deployment to JALFHCC in coordination with the Assistant Secretary of Defense, Health Affairs.

System

- The DMIX program provides the infrastructure and services to support the integrated sharing of standardized health data among the DOD's DHMSM, DOD legacy systems, VA, other Federal agencies, and private sector healthcare providers. DHMSM will replace DOD legacy healthcare systems including AHLTA, the Composite Health Care System, and the EHR component of the Theater Medical Information Program – Joint program. Together, DHMSM and DMIX are intended to modernize the Military Health System to enhance sustainability, flexibility, and interoperability, for improved continuity of care.
- DOD is developing DMIX incrementally, delivering upgrades to capabilities that have already been fielded.
  - Data Federation is designed to advance DOD and VA interoperability by providing standardized VA and DOD health data through mapping to standard medical terminology using the JLV browser, which presents aggregated patient data from DOD and VA healthcare systems. The JLV provides an integrated read-only, chronological view of health data from DOD and VA EHR systems, eliminating the need for VA or DOD clinicians to access separate viewers to obtain real-time patient information.
  - The VLER provides views of a patient's medical history and clinical visits in the outpatient environment within DOD medical facilities. The VLER also provides the ability to both retrieve and share medical documentation with external partners, such as the VA and other Federal and commercial institutions.
  - The BHIE enables the VA to access clinical data from multiple DOD and VA systems using the BHIE DOD Adapter, BHIE Share, and Clinical Data Repository/Health Data Repository. The Clinical Data Repository/Health Data Repository enables bi-directional exchange of outpatient pharmacy and medication allergy data for checking drug-to-drug and drug-to-allergy interaction.
  - The Medical Community of Interest system facilitates seamless connectivity between DOD and VA healthcare providers, applications, and data via a shared, secure network capability.
  - The iEHR SSO and Context Management system capabilities are intended to automate user log-on to all published applications via a Common Access Card. Context Management allows users to enter a patient once in a Context Management Toolbar or Context Management-enabled application and the same patient will automatically populate in other Context Management-enabled applications. iEHR provides a Roaming capability to allow users to access their information from multiple devices. It maintains persistent virtual desktops for each user, allowing providers to continue viewing and updating patient records across multiple end-user devices.

Mission

The DOD, VA, other Federal agencies, and private sector providers will use the DMIX infrastructure and services to:

- Support an integrated sharing of standardized health data
- Securely and reliably exchange standardized electronic health data with all partners

Major Contractors

- Data Federation/JLV: Hawaii Resource Group – Honolulu, Hawaii
- Data Federation (Enterprise Service Bus/Service Oriented Architecture): Harris – Leesburg, Virginia
- Test Support: Deloitte – Falls Church, Virginia
- JALFHCC SSO and Context Management: General Dynamics Information Technology – Fairfax, Virginia
- Program Manager/VLER support: Technatomy – Fairfax, Virginia

Activity

- PEO DHMS consolidated all health data sharing and interoperability programs, projects, and initiatives under a automated information system called DMIX. DOT&E placed DMIX on test and evaluation oversight on February 18, 2014. The following sections discuss testing of the DMIX capabilities.

Data Federation

- The 2014 National Defense Authorization Act required all DOD and VA healthcare data to be computable in real time and in compliance with national standards by October 1, 2014. The DOD and VA delivered terminology maps for seven clinical domains in November 2013 to support DF R0.
- The DMIX PMO conducted DF R0 system integration testing from November through December 2013.
- On December 18, 2013, the PEO DHMS approved fielding of DF R0, including JLV upgrades, to nine VA and DOD sites where JLV had been deployed previously.
- DOT&E worked with ATEC and USAMEDDBD during 2013 to plan a DF R0 operational assessment. The operational assessment was scheduled for January 2014, but the PEO DHMS did not support operational testing of this release; therefore, none was conducted.
- DOT&E received log files from the systems on which DF R0 was operating in January and February 2014 to assess the availability of the network and software infrastructure of DF R0 following its deployment.
- From July through August 2014, the DMIX PMO conducted system integration testing of the next release, DF R1.
- From August through September 2014, the DMIX PMO conducted capacity testing of JLV v2.2.0.2 and BHIE DOD Adapter v1.0.1.7.2 at the Richmond Development and Test Center (DTC).
- On September 12, 2014, PEO DHMS approved fielding of DF R1, supporting an expanded DOD user base of no more than 1,000 users at 68 sites.

VLER

- In September and October 2014, the DMIX PMO conducted system integration testing of VLER v2.0.2.0 at the Richmond DTC. VLER v2.0.2.0 provides software and hardware upgrades to VLER v2.0.1.3, the currently fielded version.
- ATEC and USAMEDDBD will test VLER v2.0.2.0 as part of DMIX R2 operational testing in 3QFY15

iEHR

- USAMEDDBD conducted an operational assessment of iEHR Increment 1 at JALFHCC in April 2014.
- USAMEDDBD conducted a follow-on operational test of iEHR Increment 1 at JALFHCC in September 2014.

Assessment

Data Federation

- The DMIX PMO originally scheduled the DF R0 system integration test from November 11 – 22, 2013, but extended the schedule to correct defects, overcome environment outages, and test additional requirements. The DMIX PMO created 20 patient records along with medical history to exercise terminology mappings within the 7 clinical domains. A more robust set of patient data was created for testing at the Richmond DTC, but could not be used because the site was not yet fully operational. During testing, four software patches were applied to the JLV and two software patches were applied to the BHIE DOD Adapter. After discovered defects were corrected, all tested clinical data were queried, retrieved, and displayed correctly across all domains, except for the immunization domain, where 4 of 32 trials had duplicate entries due to an open BHIE DOD Adapter software defect.
- DOT&E determined that DF R0's operational availability was 53.19 percent, which was unacceptably low. The types of failures and frequency of occurrences suggest systemic problems in the DMIX architecture and supporting network infrastructure. User confidence in DF R0 is expected to be negatively affected by low system availability and inadequate outage notification procedures. The DMIX PMO intends to replace or improve these systems under the DMIX program as time and resources permit.
- The DF R1 system integration test was expected to include 8 additional terminology maps, for a total of 15 of the required 28 maps. However, the DOD and VA were unable to deliver any additional maps in time to support testing. The DMIX PMO had completed enhancements to JLV and the BHIE DOD Adapter to allow users to view unmapped patient data for these additional eight clinical domains. The DMIX PMO validated the integration and display of patient data (both mapped and unmapped) within the 15 clinical domains. Test metrics included JLV's ability to display a complete and accurate record, by validating that

displayed clinical data matched those in the database. The DMIX PMO used a larger data set of 284 patient records, as compared to 20 patient records used in DF R0 testing, resulting in greater coverage of mapped clinical data. During the test event, two software patches were applied to both the JLV and BHIE DOD Adapter to fix high-severity defects. After the defects were corrected, all tested clinical data were queried, retrieved, and displayed correctly.
- During capacity testing of the JLV and BHIE DOD Adapter, the DMIX PMO encountered schedule delays due to system and DTC environment problems. The majority of tests executed during capacity testing were unsuccessful, so the DMIX PMO performed hardware and software upgrades to JLV and BHIE DOD Adapter to improve system performance. Following system upgrades, JLV v2.2.0.2 and BHIE DOD Adapter v1.0.1.7.2 could support 300 concurrent users, exceeding the 250-user requirement. DOT&E analysis of JLV user activity through July 2014 showed limited use of JLV, resulting in a concurrent user load well below the required capacity.
- Subsequent DMIX DF releases were planned to add terminology maps for 21 additional clinical data domains, but the DOD and VA were unable to deliver any additional maps to support the testing and fielding of DF R1 in September 2014. It is unclear when either the DOD or VA will provide additional maps in support of the DMIX program.
- Operational testing of DF R1 is planned for 2QFY15. ATEC and USAMEDDBD will assess the accuracy and completeness of mapped terminology, as well as the procedures and tools to maintain terminology maps, as part of DMIX R2 operational testing.

VLER
- No operational test data are available to assess VLER.

iEHR
- The operational assessment, conducted in April 2014, showed that most JALFHCC users considered iEHR Increment 1 Context Management, SSO, and Roaming capabilities helpful when they were available. However, iEHR Increment 1did not provide these capabilities reliably. Four of the 66 users surveyed reported that Context Management sometimes displayed data corresponding to the wrong patient, creating a potential risk to patient safety. JALFHCC alerted all personal of the potential patient safety problem and provided mitigation instructions. PEO DHMS deployed developer and test teams to support JALFHCC, but the teams were unable to duplicate the problem. Because the problem could not be re-created in a laboratory test environment, it requires operational testing to resolve.
- User inability to connect to the Application Virtualization Hosting Environment was a pervasive problem, resulting in a loss of Context Management, SSO, and Roaming capabilities. As a workaround, users kept trying to connect until the system worked. This cumbersome and time-consuming process discouraged users from using the system.
- The follow-on operational test, which ATEC and USAMEDDBD conducted after system and network improvements, showed improved system availability. However, a small subset of users experienced the Context Management toolbar disappearing or turning black preventing use of the capability. No patient safety issues were observed. Cybersecurity testing could not be scheduled during the test and is planned for 1-2QFY15.

Recommendations

- Status of Previous Recommendations. This is the first annual report for this program.
- FY14 Recommendations.
  1. The DOD and VA should accelerate clinical terminology mapping efforts; or if not feasible, pursue an alternate approach to exchange healthcare data in real time between the departments.
  2. The DMIX PMO should correct the iEHR Increment 1 toolbar defect to ensure the system is available to all users.
  3. The DMIX PMO should conduct cybersecurity testing of iEHR Increment 1.
  4. ATEC and USAMEDDBD should conduct operational testing of DF R1 and DMIX R2 as planned.

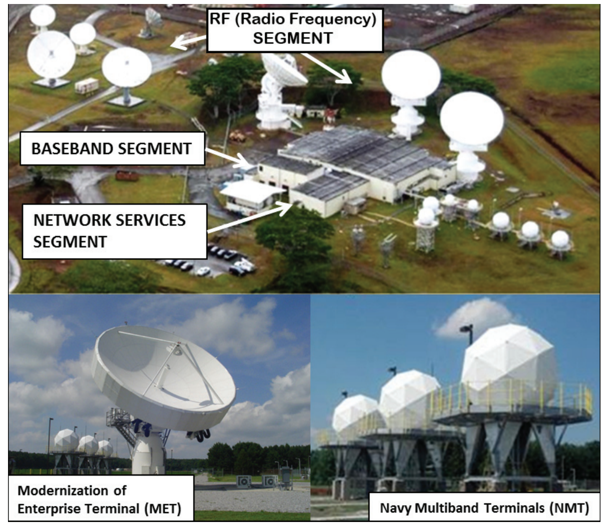
Department of Defense (DOD) Teleport

Executive Summary

- The Defense Information Systems Agency (DISA) is developing DOD Teleport Generation 3. Generation 3 is comprised of three satellite gateway improvements separated into phases:
  - Phase 1 is intended to upgrade the Extremely High Frequency (EHF) gateway capabilities used to communicate with Advanced Extremely High Frequency (AEHF) and Milstar satellites.
  - Phase 2 is designed to upgrade X- and Ka-band capabilities used to communicate with the Defense Satellite Communications System (DSCS) and Wideband Global Satellite Communications (SATCOM) (WGS) system.
  - Phase 3 is intended to provide Mobile User Objective System (MUOS) users interoperability with legacy Ultra-High Frequency (UHF) users.
- The Joint Interoperability Test Command (JITC) conducted the operational test of the Generation 3 Phase 1 (G3P1) capability at the Northwest Teleport in Chesapeake, Virginia, from July 21 through September 19, 2014. Deployed operational users from the Army, Marine Corps, Navy, and National Guard communicated over Milstar and AEHF satellites at data rates up to 8.192 Megabits per second (Mbps) using Defense Information Systems Network (DISN) services. G3P1 developmental test results and preliminary analysis of the operational test data suggest the DOD Teleport system is capable of interoperating with deployed EHF users to provide end-to-end information exchanges for data and voice communications.
- JITC conducted the operational test of the Generation 3 Phase 2 (G3P2) capability at the Northwest Teleport from July 21 through October 10, 2014. Deployed operational users from the Army, Air Force, and Navy communicated over WGS and DSCS satellites using DISN services, including secure and non-secure video teleconferencing. Preliminary analysis of the G3P2 operational test data suggests that the DOD Teleport is capable of interoperating with deployed X- and Ka-band users to provide end-to-end information exchanges for data, voice, and video communications.
- The Generation 3 Phase 3 (G3P3) capability has been delayed due to MUOS waveform reliability problems currently being addressed by the MUOS program. JITC projects the G3P3 operational test will take place 2QFY16 after DISA completes developmental testing.

System

DOD Teleport sites are globally-distributed SATCOM facilities. The system has six core Teleport facilities located in Virginia, Germany, Italy, Japan, Hawaii, and California, and three secondary facilities located in Bahrain, Australia (future), and Guam. Teleport sites consist of four segments:



- The radio frequency segment consists of SATCOM earth terminals that operate in UHF, X, C, Ku, Ka, and EHF frequency bands. The terminals provide radio frequency links between the Teleport site and the deployed user SATCOM terminal via military or commercial satellites.
- The base-band segment includes encryption, switching, multiplexing, and routing functions for connecting data streams or packetized data to the terrestrial DISN.
- The network services segment provides connectivity to the DISN long-haul networks and other internet-working functions necessary to meet the user's requirements.
- The management control segment provides centralized monitoring and control of Teleport base-band hardware, earth terminal hardware, transmission security, and test equipment.
- Teleport provides deployed forces access to standard fixed gateways from anywhere in the world for all six DISN services:
  - Secret Internet Protocol Router Network (SIPRNET)
  - Non-secure Internet Protocol Router Network (NIPRNET)
  - Defense Red Switch Network (DRSN)
  - Defense Switched Network (DSN)
  - Video Teleconference (VTC)
  - Joint Worldwide Intelligence Communications System (JWICS)

Mission

Combatant Commanders, Services, and deployed operational forces use DOD Teleport systems in all phases of conflict to gain access to worldwide military and commercial SATCOM services.

Major Contractor

Government Integrator: DISA

Activity

- Teleport Generation 3 is comprised of three satellite gateway improvements separated into phases:
  - G3P1 is intended to upgrade the existing EHF gateway capability with Navy Multiband Terminals that provide data rates up to 8.192 Mbps.
  - G3P2 is designed to upgrade the existing X- and Ka-band gateway capabilities with Modernization of Enterprise Terminals, which can simultaneously access both X- and Ka-band communications on the WGS satellites.
  - G3P3 is intended to provide interoperability between MUOS users and legacy UHF users.
- DISA installed and integrated three Navy Multiband Terminals at the Northwest Teleport site in Chesapeake, Virginia, and conducted G3P1 developmental testing in January 2014.
- DISA and JITC conducted the G3P1 integrated test from April 21 through May 16, 2014, at the Northwest Teleport with deployed Army and Navy users communicating over the AEHF satellite system accessing DISN services, including secure and non-secure data and voice communications.
- JITC conducted the operational test of the G3P1 capability at the Northwest Teleport from July 21 through September 19, 2014. Deployed operational users from the Army, Marine Corps, Navy, and National Guard communicated over Milstar and AEHF satellites at data rates up to 8.192 Mbps accessing DISN services.
- DISA installed and integrated a Modernization of Enterprise Terminal at the Northwest Teleport site and conducted G3P2 developmental testing from April 28 through May 16, 2014, communicating with deployed Marine Corps and Air Force users over WGS satellites accessing DISN services.
- JITC conducted the operational test of the G3P2 capability at the Northwest Teleport from July 21 through October 10, 2014. Deployed operational users from the Army, Air Force, and Navy communicated over WGS and DSCS satellites accessing DISN services, including secure and non-secure video teleconferencing.
- DISA has installed a test suite of the MUOS to Legacy UHF capability at the DOD Teleport Test Lab within the Army's Joint Satellite Engineering Center, at Aberdeen Proving Ground, Maryland. Site acceptance testing at the Northwest Teleport is planned for April 2015 with an operational test event projected for 2016.
- JITC conducted G3P1 and G3P2 testing in accordance with a DOT&E-approved Test and Evaluation Master Plan and test plan.
- DOT&E submitted an OT&E Report on the DOD Teleport in November 2014.

Assessment

- The DISA-conducted G3P1 integrated test was operationally representative and demonstrated the Teleport capability to perform as a satellite gateway for deployed EHF users to connect to and use DISN services.
- Although analysis of the G3P1 operational test data is ongoing, developmental test results and preliminary analysis of operational test data suggest that the DOD Teleport is capable of interoperating with deployed EHF users to provide end-to-end information exchanges for data and voice communications.
- The DISA-conducted G3P2 developmental test was operationally representative, but provided only a limited set of data. The DISA program manager concluded the developmental test reduced enough risk to forego the integrated test and proceed directly to the operational test.
- Preliminary analysis of the G3P2 operational test data suggests that the DOD Teleport is capable of interoperating with deployed X- and Ka-band users to provide end-to-end information exchanges for data, voice, and video communications.
- A DOT&E recommendation from the November 2009 G2P2 MOT&E for DISA to develop a network management system in coordination with the Theater Network Operations Center (TNC) to support Continuity of Operations remains unresolved. If communication is lost between the TNC and the Teleport system, the Teleport operators cannot manage and control internet protocol-based deployed users' networks; therefore, the deployed users' communications are at risk.
- The G3P3 capability has been delayed due to MUOS waveform reliability problems currently being addressed by the MUOS program. JITC projects the G3P3 operational test will take place 2QFY16 after DISA completes developmental testing. There is no DOT&E-approved Test and Evaluation Master Plan for G3P3.

Recommendations

- Status of Previous Recommendations. DISA has satisfactorily addressed all three previous recommendations.
- FY14 Recommendations. DISA should:
  1. Resolve the lien from the November 2009 G2P2 MOT&E to develop a network management system in coordination with the TNC to support Continuity of Operations.
  2. Update the Test and Evaluation Master Plan to support G3P3 testing.

F-35 Joint Strike Fighter (JSF)

Executive Summary

Test Planning, Activity, and Assessment

- The program focused on completing F-35 Joint Strike Fighter (JSF) Block 2B development and flight testing in an effort to provide limited combat capability to the fielded early production aircraft and to support the Marine Corps plans for declaring Initial Operational Capability (IOC) in 2015.
  - The test centers sustained flight operations at nearly the planned pace through the end of November, despite stoppages and restrictions placed on the test fleet of aircraft.
  - Flights sciences testing for the F-35A lagged behind its test flight and test point goals for CY14 as the test centers prioritized resources to focus on Block 2B mission systems testing. Flight sciences testing for the F-35B and F-35C maintained overall test point productivity by accomplishing additional test points for Block 3F, while lagging behind planned progress for completing Block 2B.
  - Test flights using the mission systems aircraft were ahead of the plan for the year, but test point productivity for Block 2B and Block 3i lagged behind the annual plan.
- In spite of the focused effort, the program was not able to accomplish its goal of completing Block 2B flight testing by the end of October.
  - Slower than planned progress in mission systems, weapons integration, and F-35B flight sciences testing delayed the completion of the testing required for Block 2B fleet release. The program now projects this to occur by the end of January 2015, instead of the end of October 2014 as was previously planned.
  - Restrictions imposed on the test fleet as a result of the engine failure in June reduced test point availability and slowed progress in mission systems and flight sciences testing from July through November. For example, the effect on mission systems testing was approximately 17 percent loss of productivity in accomplishing test points, from 210 points accomplished per month prior to the engine restrictions to approximately 175 points per month.
  - Discoveries of deficiencies continued to occur in later versions of Block 2B software, further slowing progress. For example, completion of weapons delivery accuracy events lagged the plans for CY14 and was put on hold in August when the program discovered a deficiency in the F-35 navigation system.
  - Through the end of November, 10 of 15 weapon delivery events had been completed; all events were planned to be completed by the end of October. However, the program must transition development and flight test resources to Block 3 in order to preserve an opportunity to complete the System Design and Development phase as planned in 2018. Block 2B will finish later than planned, with deficiencies remaining that will affect operational units; fixes for these deficiencies will be deferred to Blocks 3i and 3F.
- In the FY13 Annual Report, DOT&E estimated that the program would complete Block 2B testing between May and November 2015 (7 to 13 months late), depending on the level of growth experienced, while assuming the program would continue test point productivity equal to that of the preceding 12 months. Since the end of October 2013, the program has made several adjustments to reduce the delay estimated in the FY13 report:
  - In February 2014, while finalizing the 2014 annual plan, the program consolidated test points from plans of earlier blocks of mission systems (Blocks 1A, 1B, and 2A) with those from the Block 2B test plan and decided to account for only those test points needed for Block 2B fleet release, eliminating approximately 840 points. All of these points were planned to be accomplished as of the DOT&E report. This reduction amounts to approximately four months of testing.

- Further adjustments to the baseline number of test points needed for Block 2B fleet release were made in June 2014, resulting in additional reduction of points planned for the year. Although the program added points for new testing requirements (i.e., Manual Ground Collision Avoidance System), they also eliminated points that were assessed as no longer required. These adjustments resulted in the net reduction of 135 points.
- The program continued to experience an average test point growth rate throughout CY14 higher than planned (91 percent growth experienced through the end of November, 45 percent planned), but lower than experienced in CY13 (124 percent).
- The program realized a higher test point productivity rate per aircraft in CY14 than in CY13 (averaging 40 points per aircraft per month through the end of November, compared to 35).
- The program delayed plans to transition aircraft out of the Block 2B configuration to the Block 3i configuration, allowing more mission systems test aircraft to be available to contribute to Block 2B testing. At the time of this report, only AF-3 had been modified to the Block 3i configuration, among the six mission systems test aircraft assigned to the Edwards AFB test center, California, where the majority of the mission systems testing is accomplished. BF-5, a mission systems test aircraft assigned to the Patuxent River test center, Maryland, was modified into the Block 3i configuration in September and completed limited Block 3i testing prior to entering climatic testing later in the month.

- Based on test point accomplishment rates experienced since October 2013, the program will complete Block 2B development in February 2015.
  - This estimate assumes no further growth in Block 2B testing (this is possible only if the current version entering test is the final Block 2B version) and productivity at the current rate. It further assumes all current Block 2B mission systems aircraft staying in the Block 2B configuration through the end of January 2015 (the program's estimated completion date for Block 2B development), then one F-35B and one F-35C mission systems test aircraft converting to Block 3i while the other three stay in the Block 2B configuration until developmental testing is complete. Also, the operating restrictions stemming from the engine failure must be relieved for the test aircraft such that all blocked test points are made available.
  - Completion of Block 2B development by the end of January will, therefore, require a significant increase in test point productivity and/or elimination of additional test points.
- In April, the program accepted a DOT&E recommendation that the Block 2B Operational Utility Evaluation (OUE), which was being planned for CY15, should not be conducted and that instead, resources should be focused on conducting limited assessments of Block 2B capability and re-allocated to assist in the completion of development and testing of Block 3i and Block 3F capabilities.
  - This recommendation was based on DOT&E's review of Block 2B progress and assessment of the program's ability to start the Block 2B OUE as planned without creating a significant impact to Block 3F development.
  - The Program Office, JSF Operational Test Team, and Service representatives then began working to "re-scope" use of operational test aircraft and operational test activities in lieu of the OUE—detailed planning is still under development. The scope of the operational test activities will be limited until the flight restrictions induced by the engine failure are removed from the operational test aircraft. Availability of the operational test aircraft will continue to be affected in CY15 and CY16 by the depot time required for modifications.

F-35A Engine Failure

- As a result of the engine failure that occurred in an F-35A in late June, the program imposed aircraft operating limitations (AOL) on all variants of F-35 aircraft at the flight test centers and operational/training bases. These AOLs were:
  - Maximum speed of 1.6 Mach (0.9 Mach for production aircraft at operational/training bases),
  - Maximum g-load of 3.2 g for test aircraft and 3.0 for production aircraft,
  - Maneuvers limited to half-stick roll rate and 18 degrees angle of attack
  - No rudder input, unless required for safe flight (production aircraft restriction only)
  - Note: In some circumstances during flight test (but not in operational/training aircraft), exceedances were permitted and testing continued, controlled by the flight test team monitoring the aircraft, on an aircraft-by-aircraft basis (i.e., individual aircraft are cleared for specific test points).
- Due to the AOL, numerous test points needed for the Block 2B fleet release and Marine Corps IOC were blocked and cannot be attempted until the restrictions are lifted.
  - These test points include:
    - Loads and buffet, Short Take-off and Vertical Landing (STOVL) envelope expansion, and propulsion testing for F-35B flight sciences
    - Loads and buffet for F-35A flight sciences testing
    - Manual ground collision avoidance system testing (for both aircraft). The manual ground collision avoidance system is a warning system that alerts the pilot that the state of aircraft attitude and altitude may be entering an unsafe condition (Service IOC requirement).
  - There was also a requirement to inspect the engine with borescope equipment after no more than three flight hours; this creates additional down time and places stringent scheduling requirements, which negatively affects aircraft availability.
    - Restrictions for test aircraft were gradually reduced between June and November, allowing access to more test points. The program developed a procedure to

"rub-in" the seal in the stators of the engines in the test aircraft. Once this procedure was accomplished, restrictions were eased to allow greater g and angle of attack, but not to the full limits of the planned Block 2B envelope.
  - The program began installing "pre-trenched" stators (where clearance between the stator and rotor has already been cut into the seal and no rub-in procedure is necessary) in the engines of the test aircraft in October, as they became available, to remove the restrictions associated with the engine failure. By the end of November, 6 of the 18 test aircraft had the pre-trenched stators installed. The program plans to have the engines in all developmental test aircraft modified by the end of February 2015. Also, the borescope inspection requirements were removed in November, with the latest revision of the list of restrictions. However, fielded production aircraft remained restricted at the time of this report.

Mission Data Load Development and Testing

- The F-35 relies on mission data loads – which are a compilation of the mission data files needed for operation of the sensors and other mission systems components – working in conjunction with the system software data load to drive sensor search parameters and to identify and correlate sensor detections of threat radar signals. The loads will be produced by a U.S. government lab, the U.S. Reprogramming Lab.
  - The first two mission data loads support the Marine Corps IOC, planned for July 2015. Because the lab received its equipment late from the major contractor who produces the equipment, and with limited capability, the first two mission data loads will not be available until November 2015.
  - Mission data loads undergo a three-phased lab development and test regimen, followed by flight test. The current plans are to certify the first two mission data loads in November 2015 after flight testing occurs between March and October 2015. Although this is later than desired by the program and the Marine Corps, truncating the mission data load development and conducting flight testing early on a limited open-air range for the purpose of releasing a mission data load in mid-2015 would create significant operational risk to fielded units, since the load will not have completed the planned lab test regimen and because the test infrastructure on the open-air range is capable of verifying only a small portion of the mission data.

Weapons Integration

- Progress in weapons integration, in particular the completion of planned Block 2B weapon delivery accuracy (WDA) events, has been less in 2014 compared to that planned by the program. The program planned to complete all 15 Block 2B WDA events by the end of October, but completed only 7. Through the end of November, the program completed 10 Block 2B WDA events and deferred 2 to Block 3F testing due to deficiencies and limitations in Block 2B capabilities. The remaining 3 Block 2B WDA events are scheduled to be completed by the end of January 2015.
  - Multiple deficiencies in mission systems, aircraft grounding, and subsequent flight restrictions caused by the June engine failure all contributed to the limited progress.
  - In addition, all WDA events were put on hold in August, when a deficiency in the aircraft's navigation solution was discovered. Corrections to the deficiency were tested and confirmed in October, permitting Block 2B WDA events to restart in November.

Suitability

- Overall suitability continues to be less than desired by the Services, and relies heavily on contractor support and unacceptable workarounds, but has shown some improvement in CY14.
  - Aircraft availability was flat over most of the past year, maintaining an average for the fleet of 37 percent for the 12-month rolling period ending in September – consistent with the availability reported in the FY13 DOT&E report of 37 percent for the 12-month period ending in October 2013. However, the program reported an improved availability in October 2014, reaching an average rate of 51 percent for the fleet of 90 aircraft and breaking 50 percent for the first time, but still short of the program objective of 60 percent set for the end of CY14. The bump in availability in October brought the fleet 12-month average to 39 percent.
  - Measures of reliability and maintainability that have Operational Requirements Document (ORD) requirements have improved since last year, but all nine reliability measures (three for each variant) are still below program target values for the current stage of development.
  - The reliability metric that has seen the most improvement since May 2013 is not an ORD requirement but a contract specification metric, mean flight hour between failures scored as "design controllable" (which are equipment failures due to design flaws). For this metric, the F-35B and F-35C are currently above (better than) program target values, and F-35A is slightly below (worse than) the target value but has been above the target value for several months over the last year.

Live Fire Test and Evaluation (LFT&E)

- The F-35 LFT&E program completed two major live fire test series using an F-35B variant full-scale structural test article. Preliminary evaluations are that the tests:
  - Demonstrated the capabilities of multiple structural wing load paths and aft boom structure to mitigate threat-induced large scale structural failure.
  - Confirmed the expected vulnerabilities of the fuel tank structure.

- Demonstrated the expected cascading damage vulnerability to fuel ingestion, fuel and hydraulic fire, and hydrodynamic ram events.
- Engine live fire tests in FY13 and prior live fire test data and analyses demonstrated vulnerability to engine fire, either caused by cascading effects or direct damage to engine fuel lines and fueldraulic components. Additional details and analyses of the uncontained F135 fan blade release and subsequent fuel fire in an F-35A at Eglin AFB in June are needed to support and update the existing engine vulnerability assessment.
- The program demonstrated performance improvements of the redesigned fuel tank ullage inerting system in the F-35B ground-based fuel system simulator. However, aircraft ground and flight tests, designed to validate the fuel system simulator tests and aircraft system integration, revealed redesign deficiencies that require further hardware and software modifications.
- Lockheed Martin provided test and analysis results to resolve the concern expressed in FY13 for the potential aircraft loss due to ballistically-induced shorting of the 270 Volt and 28 Volt flight control electrical systems. Protection on the 28 Volt electrical system (designed for lightning protection) provides tolerance to such a single ballistic shorting event and is unlikely to result in a loss of aircraft.
- The F-35 program continues to make progress in assessing the survivability of the F-35 to unconventional threats. Development of the chemical and biological agent protection and decontamination systems will be evaluated in the full-up system-level decontamination test planned for FY16. The Navy has been testing the vulnerability of the F-35B electrical and mission systems to electromagnetic pulse (EMP), and plans to complete this testing by 2QFY15.
- The program is making advances in assessing the lethality of the 25 mm x 137 mm PGU-48 Frangible Armor Piercing (FAP) round, a designated round for the F-35A variant, and the PGU-32/U Semi-Armor Piercing High Explosive Incendiary-Tracer (SAPHEI-T) ammunition currently designated for the F-35B and F-35C variants.

Actual versus Planned Test Metrics through November 2014

TEST FLIGHTS					
	All Testing	Flight Sciences			Mission Systems
	All Variants	F-35B Only	F-35A Only	F-35C Only	
2014 Actual	1,268	313	197	286	472
2014 Planned	1,209	296	262	261	390
Difference from Planned	4.9%	5.7%	-24.8%	9.6%	21.0%
Cumulative Actual	5,046	1,648	1,194	944	1,260
Cumulative Planned	4,674	1,471	1,205	894	1,104
Difference from Planned	8.0%	12.0%	-0.9%	5.6%	14.1%

TEST POINTS											
	All Testing	Flight Sciences[1]						Mission Systems			
	All Variants	F-35B Only		F-35A Only		F-35C Only		Block 2B[2]	Block 3i	Block 3F	Other
		2B	3F	2B	3F	2B	3F				
2014 Baseline Accomplished	7,055	1,070	846	546	708	768	1,453	1,126	177	0	361
2014 Baseline Planned	7,471	1,127	619	583	1,356	922	648	1,490	276	74	376
Difference from Planned	-5.6%	-5.1%	36.7%	-6.3%	-47.8%	-16.7%	124.2%	-24.4%	-35.9%	-100.0%	-4.0%
Added Points	1,756	119		236		329		1,021	51	0	0
Test Point Growth Rate	24.9%	6.2%		18.8%		14.8%		90.7%	28.8%	0%	0%
Total Points Accomplished in 2014[3]	8,811	2,035		1,490		2,550		2,147	228	0	361
Cumulative SDD Actual[4]	34,888	11,689		9,269		8,322		3,872	177	0	1,559
Cumulative SDD Planned	35,683	11,252		10,056		7,399		4,359	276	74	2,267
Difference from Planned	-2.2%	3.9%		-7.8%		12.5%		-11.2%	-35.9%	N/A	-31.2%
Estimated Test Points Remaining	22,956	77	7,013	54	4,049	150	4,880	529	523	3,811	1,870

1. Flight Sciences Test Points are shown separately for Block 2B and Block 3F. Flight envelopes differ in airspeed, maximum allowable g, and weapons carriage, depending on variant.
2. Includes Block 0.5, Block 1, and Block 2A quantities for Cumulative Actual and Cumulative Planned
3. Total Points Accomplished = 2014 Baseline Accomplished + Added Points
4. SDD – System Design and Development

System

- The F-35 Joint Strike Fighter (JSF) program is a tri-Service, multi-national, single seat, single-engine family of strike aircraft consisting of three variants:
  - F-35A Conventional Take-Off and Landing (CTOL)
  - F-35B Short Take-Off/Vertical-Landing (STOVL)
  - F-35C Aircraft Carrier Variant (CV)
- It is designed to survive in an advanced threat (year 2015 and beyond) environment using numerous advanced capabilities. It is also designed to have improved lethality in this environment compared to legacy multi-role aircraft.
- Using an Active Electronically Scanned Array radar and other sensors, the F-35 is intended to employ precision-guided bombs such as the Joint Direct Attack Munition (JDAM) and Joint Standoff Weapon, AIM-120C radar-guided Advanced Medium-Range Air-to-Air Missile, and AIM-9 infrared-guided short-range air-to-air missile.
- The program provides mission capability in three increments:
  - Block 1 (initial training, two increments were fielded: Blocks 1A and 1B)
  - Block 2 (advanced training in Block 2A and limited combat in Block 2B)
  - Block 3 (limited combat in Block 3i and full combat in Block 3F)
- The F-35 is under development by a partnership of countries: the United States, Great Britain, Italy, the Netherlands, Turkey, Canada, Australia, Denmark, and Norway.

Mission

- A force equipped with F-35 units should permit the Combatant Commander to attack targets day or night, in all weather, and in highly-defended areas of joint operations.
- F-35 will be used to attack fixed and mobile land targets, enemy surface units at-sea, and air threats, including advanced cruise missiles.

Major Contractor

Lockheed Martin, Aeronautics Division – Fort Worth, Texas

Test Strategy, Planning, and Resourcing

- In March, DOT&E recommended to the USD(AT&L) that the Block 2B Operational Utility Evaluation (OUE), which was being planned to occur in mid-2015 in accordance with the approved Test and Evaluation Master Plan (TEMP), should not be conducted. Instead, resources should be focused on conducting limited assessments of Block 2B capability and re-allocated to assure the completion of development and testing of Block 3i and Block 3F capabilities. This recommendation was based on DOT&E's review of Block 2B progress and assessment of the program's ability to start the Block 2B OUE as planned without creating a significant impact to Block 3F development.
  - The factors that led to the DOT&E recommendation include: poor operational suitability, an inability to prepare pilots with adequate training and approved tactics on the planned schedule, and the deferral to Block 3 of operationally-relevant deficiencies that would affect performance. It was clear in March that aircraft availability for operational testing would be driven by the long timelines required to modify and retrofit the early production operational test aircraft to the Block 2B configuration, which would not be complete until mid-2016. DOT&E assessed that delaying the Block 2B OUE until late 2016, as opposed to cancelling it, would have a negative impact on the program's ability to complete development of the full Block 3F combat capability in a timely manner.
  - In April, in coordination with the Service Acquisition Executives and the JSF Program Executive Officer, the USD(AT&L) agreed with the DOT&E recommendation and approved revising the operational test period that was allocated for the Block 2B OUE in the TEMP into a re-scoped effort of assessing the limited Block 2B set of capabilities. The JSF Operational Test Team, JSF Program Office, and the Services' operational test agencies began re-planning the Block 2B operational test period and activities.
  - By the middle of October, five of the six F-35A operational test aircraft assigned to the Edwards AFB, California, operational test squadron had been converted to the Block 2B configuration and loaded with a version of Block 2B software equivalent to the one being flown on the developmental test aircraft. The sixth F-35A operational test aircraft began an extended modification period at the depot in September and is scheduled to be returned to Edwards AFB in February 2015 in the Block 2B configuration. These operational test aircraft, although not in a full Block 2B operationally-representative configuration as would have been necessary to start the OUE, will be used to accomplish both developmental and operational testing events. They will be loaded with the latest version of Block 2B software as it becomes available and is determined airworthy for operational test purposes.
  - Program schedule pressures that caused DOT&E to recommend not completing the Block 2B OUE as planned increased throughout CY14. For example, Block 2B flight testing, which was scheduled to be complete in October 2014, is now projected by the Program Office to complete in January 2015. Aircraft depot modification plans are another example. The program developed plans to upgrade fielded production aircraft from Lots 3 through 5, which includes operational test aircraft planned

for use in the OUE, to the full Block 2B configuration. These plans show that all of the operational test aircraft which were planned for the Block 2B OUE will not be in the full Block 2B configuration until September 2016, 21 months later than would have been needed to conduct the OUE.

- DOT&E conditionally approved Revision 4 of the TEMP in March 2013, under the provision that the program revise the master schedule so that there was no overlap of spin-up training for IOT&E and the certification period needed for the Services' airworthiness authorities to approve a flight clearance with the software to be used for IOT&E. Specifically, this would require the program to adjust the start of the spin-up training from February to July 2017, coinciding with an Operational Test Readiness Review. This adjustment also moved the start of IOT&E to January 2018, vice August 2017, and hence pushed the completion of IOT&E into FY19. In spite of the conditional approval, the program continues to show schedules that plan for the start of spin-up training in February 2017 and the start of IOT&E in August 2017. In addition to the justifications for adjusting the schedule that DOT&E outlined in the March 2013 TEMP conditional approval memo, the program has encountered more challenges to meeting the planned schedule to start IOT&E in August 2017 and completing System Design and Development (SDD) in 2018. These challenges include:
  - Block 3i flight testing began in late May 2014, five months later than the program's baseline plan.
  - Block 3F flight testing was scheduled to start in November 2014 according to the program's baseline plan; current program estimates show the testing starting no earlier than late February 2015, three months late.
  - Modification plans for the IOT&E aircraft will likely not have aircraft ready to begin the start of spin-up training in February 2017 as planned by the errant schedule submitted in the TEMP. To become Block 3F capable, the operational test aircraft require extensive modifications, including new processors, in addition to those needed for Block 2B capability. Block 3F modification plans are taking into consideration some modifications that already have engineering solutions and approved designs. Other modifications – although known to be required – are still in the formal change approval process leading to parts and modification kits being developed and procured from suppliers. Some of these latter modifications are currently not scheduled to be available until May 2017 for the F-35A and February 2018 for the F-35C, which is later than needed to support spin-up training for IOT&E.
  - There is carryover of incomplete work from Block 2B development into Block 3. In coordination with the Services, the program completed a review in June of 1,151 open deficiency reports identified during Block 2B development and earlier. Of these, 572 were rated as relevant to and affecting Block 2B capability; 579 were carried over for consideration for corrections in Block 3.
  - The program removed test points that were originally planned to be flown to support Block 2B fleet release (approximately 1,000 mission systems test points); some of these points may carry over and need to be flown during Block 3F development.
  - In order to account for these realities and reduce the overlap of spin-up training for IOT&E with final development activities (such as the activities that provide the certifications for use of the final configuration), the program master schedule should be adjusted to reflect these realities and depict the start of spin-up training for IOT&E no earlier than the Operational Test Readiness Review in November 2017, and the start of IOT&E for Block 3F to occur six months later, in May 2018 and completing in May 2019. If it becomes apparent that spin-up training entry criteria (e.g., providing properly configured production-representative aircraft in sufficient numbers) cannot be met on this timeline, then the schedule will have to be adjusted again.
- This report reviews the program by analyzing the progress of testing and the capability delivered as a function of test results. The program plans a specific set of test points (discrete measurements of performance under specific test conditions) for accomplishment in a given calendar year. In this report, test points planned for a given calendar year are referred to as baseline test points. In addition to baseline test points, the program accomplishes test points added for discovery, regression of new software, and verification of fixes to deficiencies identified in flight test; these additional points are referred to as "growth" points in this report. Cumulative SDD test point data refer to the total progress towards completing development at the end of SDD.

F-35A Engine Failure

- An F-35A aircraft assigned to the training center at Eglin AFB, Florida experienced an engine failure on take-off on June 23, 2014. The aircraft was a Lot 4 production aircraft, delivered to Eglin AFB in June 2013, and had flown approximately 160 hours prior to the incident.
- As a result of the engine failure, the Program Office and the Services initiated a series of actions that affected flight operations for both the fielded production aircraft and the test aircraft.
  - The Program Office instituted an operational pause to flight testing at the test centers on June 25, and the contractor suspended acceptance flight operations at the production plant.
  - A fleet-wide stop order was issued by the Program Office on July 4, which officially suspended flight operations and ground engine runs. This order also initiated requirements to visually inspect the affected engine components using special equipment called a borescope.
  - On July 8, the program began lifting restrictions by permitting engine runs up to 30 percent power for engines that had completed the borescope inspections.

- On July 16, the program began permitting limited flight operations for F-35B and F-35C aircraft with stringent flight limitations and continued inspection requirements.
- Aircraft operating limitations have been incrementally revised to permit flight testing to continue. By mid-September, the flight sciences aircraft of each variant had been cleared to continue testing without engine-imposed envelope restrictions. The rest of the test fleet continues to conduct flight testing, but under a restricted flight envelope. The program plans to have all engine-imposed restrictions removed from the developmental test fleet by the end of February 2015, after modifications to the engines of each aircraft are complete.
- On October 10, the program confirmed that excessive rubbing between the hard polyamide seal of the second stage stator and the titanium interface of the integrated blade third stage rotor led to the engine failure. This excessive rubbing occurred on a previous flight while maneuvering within the limited, cleared training envelope. Friction from the rubbing created excessively high temperatures within the titanium rotor, creating small cracks that eventually led to catastrophic failure of the rotor during the take-off on June 23. It is not clear what occurred differently than expected in the air vehicle and/or engine that caused the excessive rubbing.

• Inspections of the engines on all variants led to discoveries on nine production and test aircraft requiring engine replacement.
• As of July 23, restrictions on the flight test aircraft blocked 53 percent (1,357 of 2,575) of the remaining Block 2B test points; however, test points have incrementally become available as the flight restrictions were relaxed on some of the test aircraft beginning in September after the test centers complied with actions found necessary by the root cause analysis.
• Resolution of the way forward with the engines in test and production aircraft was ongoing at the time of this report.
  - The program developed and tested an engine "rub-in" procedure. This procedure is designed to ensure the engines have sufficient clearance between the rotors and seals to prevent excessive rubbing during maneuvering. The rub-in process is accomplished through two flights during which a specific profile is flown to accomplish the procedure, followed by inspections. As flight test jets completed the rub-in procedure, they were cleared to accomplish some of the blocked test points and fly within an expanded, although still limited, flight envelope.
  - The program is developing an interim redesign of the seal, which will have grooves pre-cut in the polyamide material to provide clearance between the seal and the rotor and will prevent excessive rubbing during maneuvering. A prototype of this "pre-trenched" seal was flight tested in October and is being installed in the engines of each developmental test aircraft.
  - The program is working with the engine contractor to develop a new redesigned seal for production engines. Plans on a final design were not complete at the time of this report.

F-35A Flight Sciences

Flight Test Activity with AF-1, AF-2, and AF-4 Test Aircraft

• F-35A flight sciences testing focused on:
  - Completing the full Block 2B flight envelope
  - High angle of attack testing (clean wing for Block 2B and with external stores for Block 3)
  - Ground and flight testing of the redesigned fuel tank ullage inerting system (i.e., inerting of the space not occupied by fuel in a fuel tank), consisting of the On-Board Inert Gas Generation System (OBIGGS) and associated fuel pressurization and ventilation system
  - Start of Block 3F loads and flying qualities testing, predominantly flying with externally-loaded air-to-ground and air-to-air weapons
  - Regression testing of updated versions of vehicle systems software
  - Testing of the aerodynamic loads in the gun bay. (Note: Block 3F F-35A aircraft will have an internal gun; F-35B and F-35C aircraft will use a podded gun mounted on the center fuselage station.)
• Restrictions imposed on the fleet from the June engine failure coupled with the focus on Block 2B mission systems testing hampered progress in F-35A flight sciences testing.
• Excessive free-play in the rudder hinges on AF-2 required extended downtime for repair. These repairs occurred in July during the period of restrictions from the engine fire.

F-35A Flight Sciences Assessment

• Through the end of November, test point accomplishment in CY14 was 6 percent behind the plan for accomplishing Block 2B points and 48 percent behind for Block 3F. The test team flew 25 percent fewer test flights than planned for the year (197 flown; 262 planned). Prioritization of flight test resources to focus on mission systems flight testing for Block 2B at the Edwards AFB test center (where mission systems and F-35A flight sciences testing are conducted) reduced the opportunity for flight science testing to achieve planned progress in Block 3F testing.
• The plan for Block 2B test points was adjusted in CY14, resulting in the net reduction of 343 of 926 (37 percent) of the original points planned for the year. The program designated these points as no longer required for Block 2B fleet release.
• Restrictions imposed from the June engine failure initially blocked access to almost all (254 of 261) remaining Block 2B flight sciences test points. The program was able to relax the restrictions on an aircraft-by-aircraft basis beginning in September, providing access to some of the blocked test points; all points were available as of the end of October. The prioritization of mission systems testing coupled with the restrictions from the engine failure created a debt of flight sciences testing on the F-35A that will need to be overcome in CY15 and early CY16 for the program to maintain Block 3F flight envelope release schedule.

- The program added 236 flight sciences test points through the end of November, equating to a growth rate of 19 percent, which is near the planned growth rate of 17 percent.
- AF-4 underwent a modification from March through May, during which the redesigned fuel tank ullage inerting system was installed. This modification and testing is part of the effort to address deficiencies in lightning protection and vulnerability reduction to ballistic threats. Testing to assess on-the-ground inerting performance of the redesign and to validate modeling results was completed in May. Flight testing to assess the fuel system pressurization and ventilation capability of the redesign was mostly completed in June; dive test points were blocked by restrictions imposed by the engine failure. Further testing to assess corrections to the redesign is scheduled to occur in December 2014.
- Discoveries in F-35A flight sciences testing:
  - Higher than expected wear in the rudder hinges of AF-2 was discovered during routine inspections, following flight testing in regions of the envelope where higher dynamic loads are exerted on the rudder surfaces. Replacement of the clevis of the middle rudder hinges was necessary, and additional inspections to check rudder free play are required.
  - AF-4 encountered a blown tire and damage to the main landing gear while conducting crosswind landing testing in February, requiring a two-week down period for repairs.
  - Ground testing on aircraft AF-4 revealed that pressure from the OBIGGS inadvertently pushes fuel between tanks. Per engineering directive, the test team removed and capped the inert air distribution lines that were causing the fuel transfer as a temporary measure to permit AF-4 to continue developmental testing of other (non-OBIGGS) test requirements. Further modifications to software and the addition of a control valve were made to AF-4 in November for testing planned for December 2014.
  - Inerting the aircraft on the ground with external nitrogen forces fuel to vent from the fuel tanks under certain fuel states. The procedure to purge the fuel system with external nitrogen was introduced with the redesigned ullage inerting system to provide lightning protection on the ground. The program plans to address this fuel venting by testing two additional check valves on AF-4 for incorporation into the final design.
- Weight management of the F-35A is important for meeting air vehicle performance requirements and structural life expectations. These estimates are based on measured weights of components and subassemblies, calculated weights from approved design drawings released for build, and estimated weights of remaining components. These estimates are used to predict the weight of the first Lot 7 F-35A aircraft (AF-72), planned for delivery in August 2015, which will be the basis for evaluating contract specification compliance for aircraft weight.
  - According to these reports, the program has reduced weight by 16 pounds in CY14 (from January to October estimate). The current estimate of 29,016 pounds is 355 pounds (1.2 percent) below the planned not-to-exceed weight of 29,371 pounds.
  - The program has demonstrated positive weight management of the F-35A over the past 38 months, showing a net loss of 123 pounds in the estimates from August 2011 to October 2014. The program will need to ensure the actual aircraft weight meets predictions, as well as continue rigorous management of the actual aircraft weight beyond the technical performance measurements of contract specification in CY15 through the balance of SDD to avoid performance degradation that would affect operational capability.

F-35B Flight Sciences

Flight Test Activity with BF-1, BF-2, BF-3, BF-4, and BF-5 Test Aircraft

- F-35B flight sciences focused on:
  - Continued expansion of the Block 2B flight envelope, including weapons separation testing
  - High angle of attack testing
  - Wet runway testing (completed with BF-4 in May at Edwards AFB)
  - Testing of landing control authority in crosswind conditions
  - Testing with external air-to-air and air-to-ground weapons (Block 3F capability)
  - STOVL mode flight operations
  - Testing of fuel dump capability with a new valve and seals
  - Ground and flight testing of the redesigned ullage inerting system
  - Flight testing in support of expeditionary operations (i.e., landing on matted runways, AM-2 padding)
  - Preparations for and conducting climatic testing on BF-5 in the climatic chamber

F-35B Flight Sciences Assessment

- Through the end of November, test point accomplishment for CY14 was 5 percent behind the plan for accomplishing Block 2B points and 37 percent ahead of the plan for Block 3F points. Test flights were slightly ahead of plan (313 flown; 296 planned). The test force maintained test point productivity by accomplishing test points from the Block 3F test plan for flying qualities, air data, propulsion, and loads in the STOVL mode and with external stores. The program projects the completion of Block 2B flight sciences testing to occur by the end of December 2014, two months later than planned.
- This projection follows adjustments made by the Program Office to the plan for Block 2B test points in CY14, which resulted in the net reduction of 394 out of 1,545 (26 percent)

of the points planned for the year. These points were reviewed by the contractor and the Program Office, and designated as no longer required for Block 2B fleet release and Marine Corps IOC. This reduction brought the total 2014 plan to 1,151 points, 1,127 of which were planned to be completed by the end of November.

- Crosswind landing testing in the conventional landing mode (not vertical landing) was not completed; but sufficient testing was accomplished to clear landings up to 20 knots of crosswind, short of the ORD requirement of 25 knots of crosswind.
- BF-4 was modified with the redesigned fuel tank inerting system late in CY13. Testing to assess ground inerting performance and validate results from the fuel system simulator – a full mock-up surrogate of the F-35B fuel system – was completed in December 2013. Further testing of the tank inerting system did not occur until September 2014, as other test requirements (i.e., wet runway testing) needed to be conducted with BF-4, and known deficiencies needed to be addressed with corrections to software. Flight testing of the tank inerting system is ongoing. Regression testing to verify correction of deficiencies in the redesign discovered from ground testing (on the aircraft and in the simulator) was conducted in early October and will continue in December after updated software is released to the test aircraft for flight testing.
- Discoveries in F-35B flight sciences testing included:
  - Early fuel dump testing in 2011 discovered that fuel does not completely eject overboard, but collects in the area between the flaperons and the aircraft structure and runs inboard toward the Integrated Power Package exhaust outlet, creating a potential fire hazard. Testing of a redesigned dump nozzle, improved seals for the flaperons, and heat-shrinkable tubing added to wiring harnesses for protection in the event of fuel wetting have all contributed to a new fuel dumping procedure.
  - Inerting performance in certain fuel tanks during ground testing of the redesigned ullage inerting system did not meet the performance demonstrated during fuel system simulator testing. To address this discrepancy, an additional OBIGGS distribution line was installed on aircraft BF-4. The discovery affects all variants; retrofit kits have been developed for the F-35A and F-35C variants.
  - The redesigned ullage inerting system has the potential to generate pressure spikes when pressure in the aerial refueling manifold is released into the fuel tanks. A blanking plate was installed on BF-4 to isolate the aerial refueling manifold from the OBIGGS as a temporary measure to allow it to ferry to Edwards AFB to conduct testing on wet runways. A software modification of the valve control logic was tested in late September, allowing removal of the blanking plate.
  - The aircraft does not maintain residual inerting after flight for the required interval of 12 hours, which is a lightning protection requirement. Residual inerting is a result of the inert air produced by the OBIGGS remaining in the ullage area of the fuel tanks after a flight. The program is investigating a correction to this problem. If the residual inerting cannot be improved, aircraft maintainers will be required to purge fuel tanks with external nitrogen more frequently or alternative lightning protection strategies (e.g., lightning-protected shelters, will have to be adopted.
  - In heavy buffet conditions, which occur between 20 and 26 degrees angle of attack, faults occurred in the inertial measurement units (IMUs) in the aircraft that degraded the flight control system (two of three flight control channels become disabled), requiring a flight abort. This condition blocked 28 test points needed for the Block 2B fleet release. The program made adjustments to the flight control software, which were tested in late October and the test points were unblocked, enabling some testing in the heavy buffet conditions to continue. However, nine additional test points needed for the Block 2B fleet release remained blocked at the end of November because of high dynamic loads on the rudder at lower altitudes, in the same angle of attack range, and require additional analyses and mitigation to complete.
- Weight management of the F-35B aircraft is critical to meeting the Key Performance Parameters (KPPs) in the ORD, including the vertical lift bring-back requirement. This KPP requires the F-35B to be able to fly an operationally representative profile and recover to the ship with the necessary fuel and balance of unexpended weapons (two 1,000-pound bombs and two AIM-120 missiles) to safely conduct a vertical landing. These estimates are based on measured weights of components and subassemblies, calculated weights from approved design drawings released for build, and estimated weights of remaining components. These estimates are used to predict the weight of the first Lot 7 F-35B aircraft (BF-44), planned for delivery in August 2015, which will be the basis for evaluating contract specification compliance for aircraft weight.
  - Weight reports for the F-35B as of October show that the program added 18 pounds to the estimated weight in CY14 and a net addition of 82 pounds over the last 38 months (August 2011 to October 2014). The current estimate of 32,412 pounds is 337 pounds (1 percent) below the objective vertical lift bring-back not-to-exceed weight of 32,749 pounds.
  - Managing weight growth for the F-35B will continue to be a challenge in light of the small weight margin available and the possibility for continued discovery through the remaining SDD phase, which extends two years past the delivery of the first Lot 7 aircraft, planned for August 2015. The program will need to ensure actual weights meet predictions. Known modifications and retrofits for production aircraft in Lots 2 through 6 will add weight to those aircraft, varying from 210 pounds for the Lot 3 aircraft to 17 pounds for the Lot 6 aircraft. In

addition, the program is currently redesigning the FS496 bulkhead for Lot 9 production aircraft and later as a result of the failure of that bulkhead in the ground test article during durability testing. The effect of the redesigned bulkhead on the weight of the aircraft is not yet known.

- The following table, first displayed in the FY11 Annual Report and updated each year, describes observed door and propulsion problems by component and identifies the production cut-in of the correction or update, if known.

F-35B DOOR AND PROPULSION PROBLEMS				
Category	**Component**	**Problem**	**Design Fix and Test Status**	**Production Cut-In**
Structure	Auxiliary Air Inlet Door (AAID)	Inadequate life on door locks, excessive wear and fatigue due to the buffet environment, inadequate seal design.	New designed doors are being installed on Low-Rate Initial Production (LRIP) aircraft as part of the on-going modification plan; 14 completed through the end of September. Fatigue testing of the doors started in November 2012 and completed the planned 2 lifetimes of testing at the end of September 2014. Inspections were ongoing as of the end of November, with no discoveries. Fix appears to resolve problem.	BF-38 LRIP Lot 6 2014
Propulsion	Drive Shaft	Lift fan drive shaft is undergoing a second redesign. Original design was inadequate due to shaft stretch requirements to accommodate thermal growth, tolerances, and maneuver deflections. First redesign failed qualification testing.	New design completed qualification testing and appears to reduce the problem. Full envelope requirements are currently being met on production aircraft with an interim design solution using spacers to lengthen the early production drive shaft. New design is dependent on updated propulsion software load planned to be available by Lot 9.	BF-56 LRIP Lot 9 2016
Propulsion	Clutch	Lift fan clutch has experienced higher than expected drag heating during conventional (up and away) flight during early testing.	New clutch plate design, with more heat-tolerant material, is complete. Clutch plates are being thinned on Lot 5 and 6 aircraft, at the expense of reduced life (engagements) to the clutch, to prevent drag heating. Solutions appear to be effective; very few hot clutches are experienced in fleet wide operations now.	Tail TBD Mid-LRIP Lot 8 2015
Propulsion	Roll Post Nozzle Actuator	Roll post nozzle bay temperatures exceed current actuator capability; insulation is needed to prevent possible actuator failure during vertical lift operations.	Insulation between the roll post nozzle bay and the actuators is being installed in pre-Lot 6 aircraft to allow unrestricted operations, however the actuators must be replaced at 1,000 hour intervals. New actuators will be installed in Lot 6 aircraft and beyond, removing the requirements for the insulation and extending the service life to 4,000 hours.	BF-38 LRIP Lot 6 2015
Propulsion	Lift Fan Inter Stage Vanes (ISV)	Vanes between stages of the lift fan experience excessive vibration/flutter during mode 4 flight when temperature is below 5°F or above 107°F degrees and speed is greater than 130 knots calibrated airspeed.	Aircraft are restricted from mode 4 flight outside the temperature and speed restrictions noted. A unit level Time Compliant Technical Directive is being accomplished for 48 fielded lift fans to replace the ISVs with a new ISV made of more durable material tolerant over a greater temperature range, with production cut in on new Lift Fans.	New vanes retrograded in fielded aircraft, incorporated in new production lift fans

F-35C Flight Sciences

Flight Test Activity with CF-1, CF-2, CF-3, and CF-5 Test Aircraft

- F-35C flight sciences focused on:
  - Structural survey testing of the newly designed arresting hook system (This testing was a pre-requisite for the first developmental testing period aboard an aircraft carrier, referred to as DT-1, which was conducted in November 2014.)
  - Block 2B weapons envelope and loads testing
  - Block 2B high angle of attack testing
  - Testing with external air-to-air and air-to-ground weapons (Block 3F capability)
  - Fuel dump testing
- The program modified CF-3 and CF-5 with the new arresting hook system and modified nose landing gear, which was necessary to prepare for and accomplish the first set of ship trials, completed in November.

F-35C Flight Sciences Assessment

- Through the end of November, test point accomplishment for CY14 was 17 percent behind the plan for Block 2B points and 124 percent ahead for Block 3F points. Test flights were 10 percent ahead of the plan (286 flown; 261 planned). Similar to the F-35B, the test force has been able to maintain test point productivity by completing points from the Block 3F test plan, such as performance assessments with external weapons, which were completed earlier than planned.
- Similar to the other variants, the program adjusted the plan for Block 2B test points, resulting in a net reduction of 81 of 1,003 test points (8 percent) planned for the year. These points were designated as no longer required for Block 2B fleet release.
- Transonic Roll-Off (TRO) and airframe buffet continue to be a program concern. All three variants required

modifications of the control laws to control the effects of transonic flight and buffet producing maneuvering. In anticipation of difficulty in these flight regimes, the ability to incorporate spoilers in F-35C aircraft was provided early in the program. F-35C handling characteristics in transonic and buffet-producing regimes were in need of correction and worse than in other variants. Flight testing with the addition of spoilers is planned, but not yet started.

- CF-8 (a mission systems test aircraft assigned to the Edwards AFB test force) was scheduled to undergo modifications to include the redesigned fuel tank inerting system in June 2014; however, the modification was delayed pending conversion of CF-8 to the Block 3i configuration. The program has scheduled the modifications for February 2015, with ground and flight testing to follow soon after.
- Discoveries included:
  - The test force flew test missions with CF-2 in December 2013 and January 2014 to assess and characterize the effects of buffet and TRO on the helmet-mounted displays and handling qualities while conducting tasks associated with operational maneuvering (basic offensive and defensive fighter maneuvers). Buffet affected display symbology, and would have the greatest impact in scenarios where a pilot was maneuvering to defeat a missile shot.
  - Deficiencies in the nosewheel steering motor and the pitch pivot pin of the arresting hook system slowed testing (see ship integration section for details of the arresting hook system testing).
- Weight management is important for meeting air vehicle performance requirements, including the KPP for recovery approach speed to the aircraft carrier, and structural life expectations. These estimates are based on measured weights of components and subassemblies, calculated weights from approved design drawings released for build, and estimated weights of remaining components. These estimates are used to project the weight of the first Lot 8 F-35C aircraft (CF-28), planned for delivery in April 2016, which will be the basis for evaluating contract specification compliance for aircraft weight.
  - The weight reports show that the program has reduced weight by 62 pounds in CY14 (from January to October estimate). The current estimate of 34,519 pounds is 349 pounds (1 percent) below the planned not-to-exceed weight.
  - The program has demonstrated positive weight management of the F-35C over the past 38 months, showing a net loss of 103 pounds in the estimates from August 2011 to October 2014. The program will need to ensure the actual aircraft weight meets predictions and continue rigorous management of the actual aircraft weight beyond the technical performance measurements of contract specification in CY16 through the balance of SDD to avoid performance degradation that would affect operational capability.

Mission Systems

Flight Test Activity with AF-3, AF-6, AF-7, BF-4, BF-5, BF-17, BF-18, CF-3, and CF-8 Flight Test Aircraft and Software Development Progress

- Mission systems are developed, tested, and fielded in incremental blocks of capability.
  - Block 1. The program designated Block 1 for initial training capability and allocated two increments: Block 1A for Lot 2 (12 aircraft) and Block 1B for Lot 3 aircraft (17 aircraft). No combat capability is available in either Block 1 increment. All Lot 2 aircraft have been converted to Block 1B; the U.S. Services currently have 26 Block 1B aircraft (13 F-35A in the Air Force and 13 F-35B in the Marine Corps). Additionally, two F-35B Block 1B aircraft have been accepted by the United Kingdom and one F-35A Block 1B aircraft by the Netherlands; these aircraft are currently assigned to the training center at Eglin AFB.
  - Block 2A. The program designated Block 2A for advanced training capability and delivered aircraft in production Lots 4 and 5 in this configuration. No combat capability is available in Block 2A. The U.S. Services have 62 aircraft in the Block 2A configuration (32 F-35A in the Air Force, 19 F-35B in the Marine Corps, and 11 F-35C in the Navy). Additionally, one F-35B and one F-35A have been accepted by the United Kingdom and the Netherlands, respectively; both aircraft are assigned to the training center.
  - Block 2B. The program designated Block 2B for initial, limited combat capability for selected internal weapons (AIM-120C, GBU-32/31, and GBU-12). This block is not associated with the delivery of any production aircraft. Block 2B software has been in flight test since February 2013. Once complete with flight test and certification, Block 2B software may be retrofitted onto aircraft from production Lots 2 through 5, provided the necessary hardware modifications have been completed as well. Block 2B is planned to be the Marine Corps IOC configuration.
  - Block 3i. The program designated Block 3i for delivery of aircraft in production Lots 6 through 8, as these aircraft will be built with a set of upgraded integrated core processors (referred to as Technical Refresh 2, or TR2). The capabilities associated with Block 3i software will vary based on the production lot. Lot 6 aircraft are expected to be delivered with capabilities equivalent to Block 2A in Lot 5, aircraft in Lots 7 and 8 are planned to be delivered with capabilities equivalent to Block 2B. Block 3i software began flight testing in May 2014. The program delivered the first Block 3i aircraft, an F-35A, to Luke AFB, Arizona, in late October. Four more F-35A aircraft were delivered to Luke AFB and one F-35B to Marine Corps Air Station (MCAS) Beaufort, South Carolina, by the end of November.
  - Block 3F. The program designated Block 3F as the full SDD capability for production Lot 9 and later. Although under development, flight testing with Block 3F software on the F-35 test aircraft has not started. The program

plans to begin flight testing in early CY15. Aircraft from production Lots 2 through 5 will need to be modified, including the installation of TR2 processors, to have Block 3F capabilities.

- Mission systems testing focused on:
  - Completing flight testing of Block 2B capabilities
  - Start of flight testing of Block 3i software, which began in May
  - Start of Generation III helmet-mounted display system (HMDS) testing
  - Multi-ship data link performance (via the multi-platform advanced data link (MADL) system and Link 16)
  - Radar performance
  - Troubleshooting navigation solution problems, which caused a pause in weapon testing in August
  - Manual Ground Collision Avoidance System testing, which was added by the program in CY14 as a Block 2B capability to be delivered with fleet release
  - Flight testing six increments of Block 2B software and two increments of Block 3i software (note: the program plans to release another version of 3i software to flight test prior to the end of CY14)
  - Block 3F software – first version began testing on the Cooperative Avionics Test Bed (first flight was on July 31)
- The six mission systems flight test aircraft assigned to the Edwards AFB test center flew an average rate of 7.0 flights per aircraft per month in CY14 through November, exceeding the planned rate of 5.4 by 30 percent, and flew 121 percent of the planned flights (472 sorties accomplished compared to 390 planned).
- The program prioritized flight test activity to attempt to complete Block 2B flight testing by the end of October 2014, per the approved baseline schedule. However, as of the end of November, 87 percent of the total Block 2B mission systems baseline test points were accomplished (3,654 of 4,183 total points accomplished, 529 points remaining).
- The test team accomplished 74 percent of the planned 2014 baseline mission systems test points from test plans for Blocks 2B and 3i by the end of November (1,303 baseline test points accomplished, 1,766 planned). The team also accomplished an additional 1,072 growth test points. These points were needed for regression testing of new revisions of Block 2B software, identifying and characterizing deficiencies in mission systems performance, verification of corrections of deficiencies, and other testing the program found necessary to add to the baseline test plans. Although the program plans for some growth points during development, the rate of growth experienced for CY14 through the end of November for Block 2B testing (91 percent) was higher than the planned rate of 45 percent used by the program for CY14. The growth rate for the limited amount of Block 3i testing was 29 percent.
- Five F-35A operational test aircraft (all of which include flight test instrumentation and recording equipment identical to SDD mission systems test aircraft) were modified and loaded with a developmental test version of Block 2B software – one aircraft in July, two in August, one in September, and one in October. As a result of the decision to not conduct the Block 2B OUE, the program is able to use these aircraft to support the effort to complete Block 2B developmental testing. Depending on the availability of these aircraft after the Block 3F modifications plan is finalized, they will be available to support re-scoped Block 2B operational test activity.

Mission Systems Assessment

- Block 2B
  - Although test flight sortie goals were exceeded, and over 75 percent of planned baseline test points were accomplished as of the end of November, delivery of Block 2B capability, and thus the ability to complete development by October, was hampered by several factors:
    - The need to develop, release, and test unplanned versions of Block 2B software to improve stability and fix deficiencies.
    - Discoveries continued to occur in later versions of software.
    - Restrictions to flight test aircraft apart from those imposed due to the June engine failure reduced the accessible test points.
      - For example, flight operations with AF-6 and AF-7 mission systems test aircraft were suspended temporarily on June 20 when the program issued a stop order on F-35A production aircraft until inspections were completed on the nacelle vent inlet tube. A crack in the tube was discovered on a production F-35A aircraft at Eglin AFB following an incident where ground crews observed fuel leaking from the tube during hot pit ground refueling operations on June 11 (AF-6 and AF-7 are Lot 1 production aircraft assigned to the Edwards AFB test center).
      - Following the inspections, the program released an interim aircraft operating limitation restricting F-35A production aircraft to 3 g’s and no air refueling. This affects all fielded production aircraft as well, which carry these restrictions concurrent with the restrictions related to engine failure, until they are modified. These restrictions remained in place on AF-6 and AF-7 until the test center replaced the tubes.
  - To date, performance of 2BS5 software, which began flight testing in June, has shown improvement in startup and inflight stability compared to earlier versions. However, fusion of information from own-ship sensors, as well as fusion of information from off-board sensors is still deficient. The Distributed Aperture System continues to exhibit high false-alarm rates and false target tracks, and poor stability performance, even in later versions of software.
  - In June, the Program Office and the Services completed a review of nearly 1,500 deficiency reports accumulated since the beginning of testing to adjudicate the status

of all capability deficiencies associated with Block 2B fleet release/Marine Corps IOC. The review showed that 1,151 reports were not yet fully resolved, 151 of which were assessed as "mission critical" with no acceptable workaround for Block 2B fleet release. The remaining development and flight test of Block 2B will determine the final status of these 151 mission critical deficiencies, whether they are corrected or will add to the incomplete development work deferred to Block 3F with the less critical flaws.

- Growth in mission systems test points (regression for new software versions, testing fixes) for CY14 through the end of November was at 91 percent; that is, for every Block 2B "baseline" test point accomplished in CY14, 0.91 "growth" points have been accomplished. Growth in test points for Block 2B has slowed later in CY14 as the program has deferred fixes of deficiencies to Block 3i or Block 3F, averaging 61 percent for the period August through November. This average rate of growth, although higher than the planning rate for the year, is less than that observed in CY13 (124 percent) at the time of reporting for the FY13 DOT&E Annual Report.
- The program is eliminating test points that are designed to characterize performance (i.e., in a greater envelope than a specific contract specification condition), reducing the number of test points needed to verify the final Block 2B capability for fleet release, and deferring fixes for deficiencies to Block 3. The program has also added points for the capability required by the Services to be included in Block 2B capabilities. Formal adjustments to the 2014 test plans through the end of October resulted in a net reduction of 135 Block 2B baseline test points. In November, the program considered making further adjustments to the plan in order to complete testing necessary to support Block 2B fleet release by the end of January 2015. After reviewing the remaining 529 baseline test points, the program deemed 139 as potentially no longer required and another 147 as optional, designating only 243 of the 529 remaining points as essential for completing testing to support Block 2B fleet release. Formal adjustments of the test plans were pending as of the completion of this report. These reductions in the 2014 plan are in addition to the removal of approximately 840 test points that occurred when the program consolidated test plans for software increments prior to Block 2B with the plan for 2014, all of which were planned to be flown prior to the 2014 plan.
- The program planned to complete Block 2B mission systems flight test in October, which did not occur. The completion date of Block 2B mission systems testing will depend, in part, on realizing further reductions to baseline test points and elimination of any remaining restrictions imposed on the fleet of test aircraft due to the engine failure. As of the end of November, 529 of 4,183 Block 2B baseline test points remained. Assuming the program would continue test point productivity equal to that realized in the preceding 12 months, the program will be able to complete the remaining 529 Block 2B test points by the end of February 2015. This estimate is based on the following assumptions:
  - Modifications to upgrade any additional mission systems test aircraft from the Block 2B to Block 3i or Block 3F configuration (besides AF-3) occurs after January 2015, which is the program's current estimate for completing Block 2B development. Starting in February, two of the seven remaining mission systems test aircraft upgrade to the Block 3i configuration, while the remaining mission systems test aircraft stay in the 2B configuration to complete testing. This schedule allows other mission systems test aircraft to be modified to support testing of the Block 3i and Block 3F mission systems software, the Generation III HMDS, and OBIGGS on the F-35C variant.
  - The operating restrictions stemming from the engine failure do not restrict access to the remaining test points. These restrictions are lifted on each test aircraft after a "pre-trenched" stator is installed in the engine. Through the end of November, the engines in 6 of the 18 test aircraft had been modified with these stators and the program plans to have the entire test fleet modified by the end of February 2015.
  - No additional growth is experienced in the remainder of Block 2B flight testing, and deficiencies not currently addressed by fixes included in the final test release of Block 2B software (version 2BS5.2) will be deferred to Block 3 or not addressed.

- Block 3i
  - Block 3i was not planned to incorporate any new capability or fixes from the Block 2B development/fleet release. The first increment of Block 3i capability, designated 3iR1, is the initial release to Lot 6 aircraft and will include only Block 2A capability (inherently less capable than the final Block 2B fleet release). Subsequent increments of Block 3i software will have additional capability. However, the prospects for Block 3i progress are dependent on completion of Block 2B development and flight test, which determines:
    - When test aircraft are converted to Block 3i; two of seven mission systems aircraft – one at the Edwards test center and one at the Patuxent River, Maryland, test center – have been modified so far (flight testing can only occur on test aircraft upgraded with TR2 hardware).
    - How much incomplete development work will be inherited by Block 3i due to deficiencies deferred from Block 2B.
  - Though it eventually began in 2014, Block 3i flight test progress began late, and has progressed much slower than expected. As of the end of November 2014, the program had completed only 25 percent of the baseline Block 3i

test points, accomplishing 177 of 700 test points, which represented 64 percent of the plan for the year.

- The program temporarily modified two mission systems aircraft – CF-8 in October 2013 and AF-3 in November 2013 – with a portion of the TR2 hardware to attempt loading the first build of Block 3i software. The attempt on CF-8 failed, but the software was successfully loaded on AF-3, allowing the test center to complete ground software regression testing. AF-3 was returned to the Block 2B configuration to support testing until May 2014, when it underwent the full TR2 modification in preparation for Block 3i flight testing.
- In May, the first increment of flight test software (3iR1) was delivered to flight test approximately five months later than planned (December 2013 to May 2014). This version of the software is needed for delivery of Lot 6, TR2 equipped aircraft. The Edwards test center conducted flight testing of the Block 3i software on AF-3. The Patuxent River test center conducted one test flight of Block 3i software on BF-5, which is currently deployed to the climatic chamber for testing. No testing of Block 3i software has yet been accomplished on an F-35C test aircraft. As of the end of November, all remaining Block 3i test points were blocked, as the test centers were awaiting the next iteration of Block 3i software to proceed with flight testing.
- The test centers identified deficiencies in the 3iR1 software, five of which needed to be corrected before the software could be used in the Lot 6 production aircraft. These deficiencies were corrected and tested in the lab with an updated version of software. This final version of 3iR1 software was not flight tested at test centers, but tested by the contractor at the production facility, and is used to deliver Lot 6 aircraft.
- The second iteration of Block 3i software, 3iR4, included capability to test the new Generation III HMDS. The Edwards test center flew four test missions with 3iR4 on AF-3 in September, accomplishing regression test points and some initial test points from the Generation III HMDS test plan. This was the first testing of the new HMDS on F-35 test aircraft. The test team discovered deficiencies, particularly in the stability of the new display management computer for the helmet, and suspended further testing until software that fixes the deficiencies in the helmet system can be provided to the major contractor and included in an updated load of mission systems software.
- The third increment of Block 3i software, version 3iR5, will be used to provide production software for Lot 7 aircraft, the first lot to be delivered with the Generation III HMDS. The program plans for the production software to have the equivalent capabilities as Block 2B and plans to deliver 3iR5 software to flight test in January 2015. However, even if this occurs, since Block 2B development and flight testing were not completed as planned in October, the completion of Block 3i testing will be delayed if the equivalent capabilities from Block 2B development are to be realized in Block 3i. The program plans to convert four of the five Block 2B mission systems test aircraft at the Edwards test center to the Block 3i configuration in February 2015. Assuming this transition takes place, Block 3i flight testing could conclude by July 2015, two months later than the planned completion of May 2015. This assumes nominal growth of 66 percent is experienced during the rest of Block 3i development and flight testing, the program completes testing of the remaining baseline test points without reductions, and the program uses four of the six mission systems test aircraft at the Edwards test center for dedicated Block 3i testing. Of the two remaining mission systems test aircraft, one other test aircraft could be available for further Block 2B testing and one could be used to start Block 3F testing. Additional time will be needed to address corrections if additional deficiencies are identified in the Generation III HMDS and will add risk to the schedule.

- Block 3F
  - In order to manage and complete Block 3F development and flight testing as planned in late 2017, the program needs to complete Block 2B development and flight test as soon as possible and transition to Block 3. The program currently acknowledges four to six months "pressure" on the end of Block 3F development and test. The program needs to complete Block 2B development soon to focus resources (staffing, labs, flight test aircraft) on the development and testing of Block 3F, designated as "full warfighting capability."
  - The test centers and contractor began detailed test planning for Block 3F flight test. The draft test plan has nearly 6,000 test points. Plans completed after the 2012 re-baselining of the program showed the start of Block 3F flight testing in May 2014; however, current program plans are to start Block 3F flight test in March 2015, 10 months later than the 2012 baseline.

Mission Data Load Development and Testing

- The F-35 relies on mission data loads – which are a compilation of the mission data files needed for operation of the sensors and other mission systems components – working in conjunction with the system software data load to drive sensor search parameters and to identify and correlate sensor detections of threat radar signals. An initial set of files was produced by the contractor for developmental testing during SDD, but the operational mission data loads – one for each potential major area of operation – will be produced by a U.S. government lab, the U.S. Reprogramming Lab (USRL). These mission data loads will be used for operational testing and fielded aircraft, including the Marine Corps IOC aircraft.
- In accordance with the approved mission data optimization operational test plan, mission data loads undergo a three-phased lab development and test regimen, followed by

flight test. The current plans are to certify the first two mission data loads, which are needed to support Marine Corps IOC, in November 2015 after flight testing occurs on operational test aircraft between March and October 2015. These plans provide the mission data load later than needed for the Marine Corps' objective IOC date of July 2015. However, truncating the mission data load development and conducting open-air flight testing early on a limited open-air range for the purpose of releasing a mission data load in mid-2015 would create significant operational risk to fielded units, since the load will not have completed the planned lab testing and because the open-air range test infrastructure is capable of verifying only a small portion of the mission data. The program should complete lab testing of the mission data loads, as is planned in the mission data optimization operational test plan, prior to accomplishing the necessary flight testing to ensure the loads released to the fleet are optimized for performance. If mission data loads are released to operational units prior to the completion of the lab and flight testing required in the operational test plan, the risk to operational units must be clearly documented.

- Several items are currently creating risk to the program's ability to deliver certified mission data loads. Mission data lab equipment was held by the major contractor at their Fort Worth facility for three years past the planned delivery to the USRL to support mission systems software development for production aircraft, reducing productivity at the USRL. The USRL did not receive sufficient documentation of the equipment and software tools that were delivered by the program; this has hampered their training and slowed development. Contract issues had prevented USRL from direct communications with the subcontractor that designed both the electronic warfare system on the aircraft and the mission data programming tools. These communications were needed to understand undocumented lab and mission data file generation tool functions. The Program Office has taken steps to improve these communications. Other challenges that may affect on-time delivery of mission data include instability in the contractor-delivered mission data file generation tool, which creates the final mission data load, and slower than expected development of software analysis tools that optimize sensor performance.
- Mission data load development and testing is a critical path to combat capability for Block 2B and Block 3F. Accuracy of threat identification and location depend on how well the mission data loads are optimized to perform in ambiguous operational environments. This is difficult work given a stable software capability in the platform, adequate lab equipment, and stable/well-understood mission data file generation tools – none of which are yet available in the program.
- The current lab is essentially a copy of the mission systems integration lab used by the major contractor to integrate and test software. It is not adequate for development of mission data loads for use in operationally realistic conditions. As identified by DOT&E in early 2012, the program must plan and execute a significant upgrade to the lab in order for it to generate an operationally realistic signal environment for mission data load optimization. Though funding has been made available, plans for this upgrade, and integration with the Block 2B, Block 3i, and Block 3F mission data loads have not been finalized.

Weapons Integration

- Progress in weapons integration, in particular the completion of planned weapon delivery accuracy (WDA) events, has been very limited in 2014 compared to that planned by the program. Multiple deficiencies in mission systems, aircraft grounding, and subsequent flight restrictions caused by the June engine failure all contributed to the limited progress.
- Each WDA event requires scenario dry-runs in preparation for the final end-to-end event to ensure the intended mission system functionality, as well as engineering and data analysis requirements (to support the test centers and weapon vendors) are available to complete the missile shot or bomb drop. Per the approved TEMP, these preparatory events, as well as the end-to-end events, are to be accomplished with full mission systems functionality, including operationally realistic fire control and sensor performance.
- Mission systems developmental testing of system components required neither operation nor full functionality of subsystems that were not a part of the component under test. The individual mission system component tests were designed by the developmental teams to verify compliance with contract specification requirements rather than to test the full mission systems performance of the aircraft and complete the find-fix-ID-track-target-engage-assess kill chain for air-to-air and air-to-ground mission success. WDA events, however, were specifically designed to gather both the necessary weapons integration and fire-control characterization and performance using all the mission systems required to engage and kill targets.
- Planning and scheduling of the WDA events assumed that all associated mission systems functionality would be mature by the WDA preparatory event dates. However, due to the limitations in progress in Block 2B mission systems, this has not occurred.
  - Deficiencies in the Block 2B mission systems software affecting the WDA events were identified in fusion, radar, passive sensors, identification friend-or-foe, electro-optical targeting system, and the aircraft navigation model. Deficiencies in the datalink systems also delayed completion of some events. Overall, these deficiencies have both delayed the WDA event schedule and compromised the requirement to execute the missions with fully functional and integrated mission systems.
  - The program had planned to complete all Block 2B WDA events by October 2014. This did not occur. Through the end of November, 10 of 15 live fire events had been completed, while the program planned to have all 15 completed by the end of October. In November, the

program deferred two of the planned Block 2B WDA events to Block 3, due to deficiencies and limitations of capability in Block 2B mission systems. The adjacent table shows the planned date, completion or scheduled date, and weeks delayed as of the end of November for each of the WDA preparatory and end-to-end events. Events completed are shown with dates in bold font; events scheduled are shown with dates in italicized font. The program should complete the remaining three Block 2B WDA flight test events, using the currently planned scenarios, and ensuring full mission systems functionality is enabled in an operationally realistic manner.

WEAPONS DELIVERY ACCURACY (WDA) PROGRESS

Weapon	WDA Number	Preparatory Events			End-to-End Event		
		Planned	Completed/ *Scheduled*[1]	Weeks Delayed	Planned	Completed/ *Scheduled*	Weeks Delayed
AIM-120	102	Sep 13	**Sep 13**	2	Oct 13	**Oct 13**	2
	112	Sep 13	**Sep 13**	3	Oct 13	**Nov 13**	3
GBU-12	113	Sep 13	**Oct 13**	3	Oct 13	**Oct 13**	0
GBU-32	115	Sep 13	**Nov 13**	6	Nov 13	**Dec 13**	3
AIM-120	108	Oct 13	**Dec 13**	7	Dec 13	**Feb 14**	12
	110	Oct 13	**Aug 13**	43	Dec 13	**Nov 14**	50
	111	Dec 13	*Deferred to Block 3F*	--	Jan 14	*Deferred to Block 3F*	--
	106	Dec 13	**Sep 14**	40	Jan 14	**Nov 14**	43
GBU-31	114	Dec 13	**May 14**	45	Feb 14	**Nov 14**	41
			Jun 14				
			Oct 14				
AIM-120	104	Feb 14	**Aug 14**	30	Mar 14	*Jan 15*	44
			Sep 14				
	107	Mar 14	**Jun 14**	12	May 14	*Dec 14*	30
	101	May 14	**May 14**	17	Jun 14	*Dec 14*	26
			Sep 14				
	103	Jun 14	**Mar 14**	-8	Aug 14	**May 14**	-10
			Apr 14				
	109	Jul 14	**Jan 14**	-29	Sep 14	**Mar 14**	-27
	105	Sep 14	*Deferred to Block 3F*	--	Oct 14	*Deferred to Block 3F*	--

1. Some WDA events require more than one preparatory event.

Static Structural and Durability Testing

- Structural durability testing of all variants using full scale test articles is ongoing, each having completed at least one full lifetime (8,000 equivalent flight hours, or EFH). All variants are scheduled to complete three full lifetimes of testing before the end of SDD; however, complete teardown, analyses, and Damage Assessment and Damage Tolerance reporting is not scheduled to be completed until August 2019. The testing on all variants has led to discoveries requiring repairs and modification to production designs and retrofits to fielded aircraft.
- F-35A durability test article (AJ-1) completed 11,000 EFH on September 13, which is 3,000 hours into the second lifetime. Testing restarted on October 29, after completing non-invasive inspections, which are required at 1,000 EFH intervals.
  - Cracking of the right hand side (RHS) Fuselage Station (FS) 402, discovered after the first lifetime of testing (8,000 EFH) at the end of CY12, required repairs to the test article, production redesign for production Lot 8 and later aircraft, and retrofitting a modification for production Lot 4 through 7 aircraft.
  - Discoveries from the second lifetime of testing, which started on December 13, 2013, include:
    - Cracking of the left hand side (LHS) integrated power package shear web lug at FS503, found at 10,082 EFH
    - Cracking of the LHS FS503 frame support, found at 10,162 EFH
    - Cracking in the LHS F2 fuel floor flange, found at 11,000 EFH
  - Disposition of these discoveries and repair plans were under consideration as of the time of this report.
- F-35B durability test article (BH-1) has been halted since September 2013, when the FS496 bulkhead severed at 9,056 EFH, transferred loads to an adjacent FS518 bulkhead, and caused cracking. Root cause analysis and corrective action – for repairing the bulkheads on the test article, modification for the fielded aircraft, and redesign for production Lot 8 (and subsequent lots) – have been ongoing throughout CY14. The program planned to restart testing in late September 2014, but repairs took longer than expected. Testing had not restarted as of the end of November. According to the Program Office, the effect on fielded aircraft will be limited life for FS496 (approximately 10 years of service life) until replaced or repaired.
  - Modifications to the test article include the addition of seven splice plates to repair cracks in the FS496 and FS518 bulkheads.
  - For retrofitting/modifying FS496 in production aircraft in Lots 1 through 8, the program is considering a number of fatigue mitigation steps, including relocating system attachment points, hardening the fastener holes through a

cold working process, and the use of laser shock peening (LSP) to enhance fatigue life in sections of the bulkhead where tensile stresses are known to be concentrated. The objective of treating areas with LSP is to create compressive pre-stress states near surfaces where tensile stresses are expected to be high and hence reduce crack initiation. However, LSP has not been used on the type of aluminum alloy (AL-7085) used in manufacturing the FS496 bulkheads in the F-35B, and the ability to affect the structural life is not well understood. The program should require the contractor to conduct rigorous finite-element analyses to assess the benefit of LSP application. The main objectives are to assess the LSP effect in reducing tensile stress concentrations in critical areas and to assure limited increase of tensile stresses in the other areas. To date, the effect on AL-7085 fatigue properties due to LSP application are yet to be characterized, therefore a finite-element analysis using the existing AL-7085 fatigue property data is likely to over-estimate the effect of LSP in improving fatigue resistance, which should also be taken into account.
  - For aircraft in Lot 9 and beyond, the program is redesigning the five carry-through bulkheads in the F-35B (FS450, FS472, FS496, FS518, and FS556). The redesign will include LSP on two bulkheads, cold working of fastener holes on four, and increasing thickness in portions of all five bulkheads. The overall effect on aircraft weight increase is not yet known.
  - Because of the extensive repair required to the FS496 bulkhead, the certification path to full life will likely require additional follow-on testing.
- F-35C durability test article (CJ-1) began second lifetime testing on April 2, and completed 2,312 EFH into the second lifetime in August (10,312 EFH total), followed by inspections. Testing resumed October 28, 2014.
  - Discoveries after the first lifetime of testing caused redesigns in the FS518 fairing support frame and FS402 upper inboard frame. Repairs and redesigns were completed at 8,869 EFH and 8,722 EFH, respectively.
  - Discoveries from the second lifetime of testing include cracking of outboard wing spar #5 and cracking on both the left and right hand sides of the FS575 center arch frame. Repairs to both were completed at 10,000 EFH prior to restart of testing.

Modeling and Simulation

Verification Simulation (VSim)

- The Verification Simulation (VSim) is a man-in-the-loop, mission software-in-the-loop simulation developed to meet the OTAs' requirements for Block 3F IOT&E, as well as to provide a venue for contract compliance verification for the Program Office.
- At the beginning of CY14, the program planned to accredit the VSim for use in Block 2B contract compliance verification by the end of the year. However, lack of progress on the Verification and Validation (V&V) process, and to a lesser extent the VSim development process, caused the program to charter an independent review of VSim. This review eventually led to cancellation of the contract verification portion of Block 2B VSim planned usage. For similar reasons, after the Block 2B OUE re-scoping effort began, the JSF Operational Test Team determined that VSim would likely not support planned Block 2B operational testing in 2015 and reduced the requirements for the simulation's intended uses to support only tactics development and other activities that directly contribute to the fielding of Block 2B capabilities.
- About one-third of the validation evidence for Block 2B VSim was reviewed by the developmental and operational test stakeholders before the contractual use of VSim for Block 2B was cancelled. This review confirmed that additional time was needed before VSim V&V could potentially meet expectations. Collaborative replanning of Block 2B activities is not complete, but V&V reviews to support operational testing needs are now planned for early 2015, with accreditation of VSim for tactics development and other uses expected in October 2015.
- Exercising the V&V process for Block 2B VSim is critical to reducing risk for its use in Block 3F IOT&E. Rigorous validation will identify gaps in VSim performance, including threat modeling, in time to create the appropriate fixes for Block 3F. Creation of test and V&V procedures as well as V&V reports and accreditation documentation will provide a significantly better understanding of VSim status by the end of 2015.
- Rigorous validation depends on good source data, and the contractor and Program Office improved efforts to ensure VSim needs are met in the Block 3F flight test plan. Those plans are not finalized, but will certainly result in deficits as the enterprise-wide need for flight tests exceeds available resources. Success in validating Block 3F VSim will depend on bridging this gap with acceptable data sources.
- The contractor has increased resources on VSim V&V teams, and the quality of the V&V products is increasing. However, the rate of completing validation points (a comparison of VSim model performance to aircraft hardware performance under similar test conditions using data from flight test, avionics test bed, or labs), has been much slower than planned. This makes completing the validation reports, which analyze the points with respect to intended use, at risk to support even the reduced accreditation requirements for Block 2B. Additional resources may be required to complete the significant task of validating the complex federation of models in VSim in time for Block 3F IOT&E.
- Although the VSim validation process has improved, DOT&E has continued to highlight shortfalls in the test resources needed to gather key elements of data required for validation of the VSim for IOT&E, in particular for electronic warfare performance in the presence of advanced threats. These shortfalls are a function of limitations in the

test assets currently available to represent threat systems. DOT&E has made formal recommendations to address the shortfalls and is pursuing solutions to make the assets available in time to prepare for IOT&E in a realistic threat environment.
- Limiting VSim Block 2B validation, and use, to tactics development and evaluation will help the program progress towards V&V of Block 3F. Block 3F use of VSim for IOT&E is not optional; it is required for an adequate IOT&E.

Training System

- Pilot training continues at Eglin AFB, Florida, and expanded in September 2014 when additional F-35B training began at MCAS Beaufort, South Carolina. Additional F-35A pilot training is planned to start in May 2015 at Luke AFB, Arizona. Sixty-six student pilot training slots were available in FY14, but nine were not used due to reduced Service requirements.
- The training center began transitioning from the Block 1B to the Block 2A training syllabus for all three variants in December 2013, and completed the transition in February 2014. The ability to train in and for adverse weather conditions was added to the Block 2A syllabus during CY14. The Block 2B syllabus is planned for delivery in mid-2015, and is planned to include limited combat capability.
- Lot 5 deliveries to pilot training bases continued throughout 2014, including the first nine F-35A to Luke AFB, and an additional eight F-35A, one F-35B, and six F-35C aircraft to Eglin AFB. Lot 6 deliveries, which began in late October, included the first F-35B aircraft delivered directly to MCAS Beaufort where it joined other F-35B aircraft transferred from Eglin AFB.
- All training to date has been in Block 2A-configured aircraft, which have envelope and other restrictions that preclude high performance training events. Because of this, all pilots attending Block 2A training complete only a portion of the planned syllabus before moving to their units.
- The Training Management System (TMS) is a database that includes course material, syllabus flow, student records, and schedules for aircrew and maintainers. The academic center is using the TMS for instruction and tracking student progress. TMS functionality is relatively unchanged from that which existed during the 2012 training system OUE. For example, the TMS cannot yet be effectively used for scheduling, pilot qualification tracking, and the other typical unit functions. This year, the Program Office added funding to correct these deficiencies and improve the functionality for tracking operational unit "continuation training," which includes monthly training requirements and pilot qualifications. Planned delivery is in the 2017 timeframe, and will also require Automatic Logistics Information System (ALIS) system-level architecture modifications to achieve full capability. Until then, flying units at both training and operational bases will most likely continue to use legacy scheduling and training databases, which causes double entry into databases and impedes program-level data analysis such as annual flying hour progress.
- The training center continued to conduct maintenance training for experienced maintenance personnel for all F-35 variants during 2014. As of the end of October, more than 1,800 U.S. personnel and foreign partner students had completed training in one or more of the maintenance courses, including ALIS, to support fielded maintenance operations. For the 12-month period ending in October 2014, the contractor provided 1,018 training slots for maintenance courses, of which 701 were filled by U.S. or foreign partner students, equating to 69 percent training seat utilization rate. In addition, active duty personnel at the field units conducted training that is not included in these metrics. The Integrated Training Center at Eglin AFB currently offers 13 maintenance classes ranging from 3 to 13 weeks in length.

Live Fire Test and Evaluation

F-35B Full-Scale Structural System Vulnerability Assessment

- The F-35 LFT&E Program completed the F-35B full-scale structural test series. The Navy's Weapons Survivability Laboratory (WSL) in China Lake, California, completed 15 tests events using the BG:0001 test article. Preliminary review of the results indicates that:
  - Anti-aircraft artillery (AAA) threat-induced damage stressed the critical wing structure members, but multiple structural load paths successfully limited the damage to expected areas around the impact points while preserving the static flight load carrying capabilities. Consistent with predictions, the tests demonstrated other cascading damage effects, including threat-induced fire and damage to adjacent fuselage fuel tanks.
  - AAA and missile fragment-induced damage stressed the structural limitations of the forward fuselage fuel tanks (F-1 and F-2). Cascading effects from the F-1 tank damage included a large fuel release into the cockpit and damage to the pilot seat mounting structure. To mitigate the vulnerability to the pilot, the Program Office has recently altered the F-35B fuel burn strategy so that the F-1 tank behind the pilot empties sooner. Threat-induced damage in these fuel tank tests also caused large fuel discharge into the engine inlet, which would have likely caused engine failures due to fuel ingestion. The engine was not installed for these tests.
  - The extent of AAA-induced structural damage to the wing leading edge flap and the horizontal tail is not flight critical from a structural tolerance perspective. The leading edge tests demonstrated the potential for sustained fire, which could have flight-critical cascading effects on the wing structure.
  - The ballistic damage tolerance testing of propulsion system related structural components (variable area vane box nozzle, and hinges on the roll duct nozzle, lift fan, and auxiliary air inlet doors) revealed these components were nearly insensitive to expected threats. However, sustained fires were created in the shot into the variable area vane box nozzle due to leakage in the actuating hydraulics, and

the shot into the roll duct nozzle door due to damage to the adjacent fuel tank. These fires would ultimately have led to cascading structural damage.
  - Data support the evaluation of residual loading capabilities of the aft boom structure, including vertical tail and horizontal tail attachments, following a man-portable air defense system impact and detonation. While having fuel in the aft-most F-5 fuel tank increased structural damage due to resultant hydrodynamic ram effects and fire, flight control surfaces remained attached. Further structural analysis of the damage effects is being completed to verify the structural integrity of the aft boom structure.

F135 Engine

- F135 live fire engine testing in FY13, engine vulnerability analysis in FY13, and uncontained engine debris damage analysis in FY03 demonstrated two primary threat-induced engine damage mechanisms:
  - Penetration of the engine case and core that could cause blade removal, resulting in damage to turbomachinery leading to propulsion loss or fire
  - Damage to external engine components (e.g., fuel lines, pumps, gearbox, etc.) leading to critical component failure and fire
- Engine fuel ingestion testing in FY07 further demonstrated the potential of an engine stall providing a fire ignition source in the presence of additional fuel system damage.
- The uncontained F135 fan blade release and subsequent fuel fire in an F-35A at Eglin AFB in June provides an additional data point that needs to be reviewed and analyzed to support the F-35 vulnerability assessment.

Polyalphaolefin (PAO) Shut-Off Valve

- The Program Office tasked Lockheed Martin to develop a technical solution for a PAO shut-off valve to meet criteria developed from live fire test results. This aggregate, 2-pound vulnerability reduction feature, if installed, would reduce the probability of pilot incapacitation, decrease overall F-35 vulnerability, and prevent the program from failing one of its vulnerability requirements.
- The program has not provided any updates on the feasibility and effectiveness of the design, nor an official decision to reinstate this vulnerability reduction feature.

Fuel Tank Ullage Inerting System

- The program verified the ullage inerting design changes and demonstrated improved, inerting performance in the F-35B fuel system simulator (FSS) tests. A preliminary data review demonstrated that the system pressurized the fuel tank with nitrogen enriched air (NEA) while maintaining pressure differentials within design specifications during all mission profiles in the simulator, including rapid dives, but revealed the potential for pressure spikes from the aerial refueling manifold, as noted in the flight sciences section of this report. The Program Office will complete and document detailed data review and analyses to evaluate NEA distribution and inerting uniformity between different fuel tanks and within partitioned fuel tanks.
- The program developed a computational model to predict inerting performance in the aircraft based on the F-35B simulator test results. Patuxent River Naval Air Station completed the ground inerting test on an actual F-35B aircraft to verify the model, but a detailed comparison to F-35B FSS has not yet been completed. The program will use this model, in conjunction with the completed F-35A ground tests and F-35C ground tests planned to start in February 2015, to assess the ullage inerting effectiveness for all three variants. The confidence in the final design and effectiveness will have to be reassessed after the deficiencies uncovered in the aircraft ground and flight tests have been fully resolved.
- When effective, ullage inerting only protects the fuel tanks from lightning-induced damage. The program has made progress in completing lightning tolerance qualification testing for line-replaceable units needed to protect the remaining aircraft systems from lightning-induced currents. Lightning tolerance tests using electrical current injection tests are ongoing, and the program is expected to complete the tests by 2QFY15.

Electrical System

- DOT&E expressed a concern in FY13 for the potential loss of aircraft due to ballistically-induced shorting of power and control circuits in the F-35 flight control electrical systems. The F-35 is the first tactical fighter aircraft to incorporate an all-electric flight control system, using a 270 Volt power bus to power flight control actuator systems and a 28 Volt bus to control those actuators. The F-35 aircraft carries these voltages in wire bundles where they are in close proximity. Live fire tests of similar wire bundle configurations demonstrated the potential for arcing and direct shorts due to ballistic damage.
- Lockheed Martin completed an electrical power systems report, which included a summary of development tests to demonstrate that transient-voltage suppression diodes installed throughout the 28 Volt systems shunt high voltage (including 270 Volt) to ground, preventing the high voltage from propagating to other flight-critical components. Some components might be damaged as a result of a short, but their redundant counterparts would be protected. Testing used direct injection of the high voltage, rather than shorting from ballistic damage, but the electrical effects would be the same.

Vulnerability to Unconventional Threats

- The full-up, system-level chemical-biological decontamination test on the BF-4 test article planned for 4QFY16 at Edwards AFB is supported by two risk-reduction events:
  - The Limited Demonstration event conducted in 4QFY14 showed that the proposed decontamination shelter and liner design can sustain conditions of 160°F and 80 percent relative humidity. The high temperature alone is sufficient

to decontaminate chemical agents. The combination of high heat and humidity has been shown effective in decontaminating biological agents. Both chemical and biological decontamination techniques take 10 to 12 days to complete.
  - A System Integration Demonstration of the decontamination equipment and shelter was conducted on an F-16 test article during 1QFY15 at Edwards AFB to simulate both hot air chemical and hot/humid air biological decontamination operations. This testing will not demonstrate the decontamination system effectiveness in a range of operationally realistic environments.
- The F-35 variant of the Joint Service Aircrew Mask (JSAM-JSF) successfully passed its Preliminary Design Review in 3QFY14. The Joint Program Executive Office for Chemical and Biological Defense and the F-35 Program Office will have to integrate the JSAM-JSF with the Helmet-Mounted Display, which is undergoing a challenging design process and consequently further aggravating this integration effort.
- Planned EMP testing will evaluate the aircraft to the threat level defined in MIL-STD-2169B. Both horizontal and vertical polarization testing, as well as active, passive, and direct drive testing are planned to assess effects and/or damage of the EMP induced currents and coupling to vehicle and mission systems electronics. EMP testing on the F-35B article was completed in 1QFY15; data analysis is ongoing. Follow-on tests on other variants, including a test series to evaluate any Block 3F hardware/software changes, are planned for FY16.

Gun Ammunition Lethality and Vulnerability

- The program completed the ballistic impact response characterization of the PGU-47/U Armor Piercing Explosive (APEX) round for the partner F-35A variant using the AAA and fragment threats. Preliminary data analysis demonstrated no significant reactions or evidence of high pressures that could potentially induce sympathetic reactions from adjacent rounds loaded on the aircraft.
- The program completed the terminal ballistic testing of the PGU-48 FAP round and the PGU-32 round against a range of target-representative material plates and plate arrays. Preliminary FAP test observations indicate lower than expected levels of fragmentation when passing through multiple layer targets. PGU-32 test observations indicate that the round detonates much closer to the impact point of the first target plate than originally called out in ammunition specification. The program will determine the impact of these data on the ammunition lethality assessment.
- Ground-based lethality test planning is ongoing. All three rounds will be tested against a similar range of targets, including armored and technical vehicles, aircraft, and personnel in the open. FY15 funds are in place for all tests except those against boat targets.
- Air-to-ground lethality tests will likely begin no earlier than 1QFY16. Given the development test schedule of the APEX round, the existing flight test plan does not include this round.

Operational Suitability

- Overall suitability continues to be less than desired by the Services, and relies heavily on contractor support and unacceptable workarounds, but has shown some improvement in CY14.
  - Aircraft availability was flat over most of the past year, maintaining an average for the fleet of 37 percent for the 12-month rolling period ending in September – consistent with the availability reported in the FY13 DOT&E report of 37 percent for the 12-month period ending in October 2013. However, the program reported an improved availability in October 2014, reaching an average rate of 51 percent for the fleet of 90 aircraft and breaking 50 percent for the first time, but still short of the program objective of 60 percent set for the end of CY14. The bump in availability in October brought the fleet 12-month average to 39 percent.
  - Measures of reliability and maintainability that have ORD requirements have improved since last year, but all nine reliability measures (three for each variant) are still below program target values for the current stage of development. The reliability metric that has seen the most improvement since May 2013 is not an ORD requirement, but a contract specification metric, mean flight hour between failure scored as "design controllable" (which are equipment failures due to design flaws). For this metric, the F-35B and F-35C are currently above program target values, and F-35A is slightly below the target value, but has been above the target value for several months over the last year.

F-35 Fleet Availability

- Aircraft availability is determined by measuring the percent of time individual aircraft are in an "available" status, aggregated over a reporting period (e.g., monthly). Aircraft that are not available are assigned to one of three categories of status: Not Mission Capable for Maintenance (NMC-M); Not Mission Capable for Supply (NMC-S); and in depot.
  - The program added this third category for tracking fleet status in January 2014 as the number of aircraft entering the depot for modifications or receiving modifications or repair by a depot field team at the home station began to increase. Prior to January 2014, these aircraft were assigned as Non-Possessed (NP) or Out Of Reporting (OOR) for depot-level actions under an NMC-M status.
  - The program established new goals for all three of these unavailable statuses for 2014. The NMC-M goal is 15 percent, NMC-S is 10 percent, and depot status is 15 percent. These three non-available statuses sum to 40 percent, supporting the program's availability goal of 60 percent for the fleet by the end of CY14. The goal of 60 percent is an interim program goal and does not represent the availability needed for combat operations, nor the 80 percent needed to accomplish IOT&E in an operationally realistic manner.
- Aircraft monthly availability averaged 39 percent for the 12-month period ending October 2014 in the training and

operational fleet, with no statistical trend of improvement for the first 11 months. In October 2014, availability jumped to a reported 51 percent (fleet size of 90 aircraft), a 12 percent increase from the previous month, and the largest month-to-month change since March 2013 (fleet size of 27 aircraft). Month-to-month variance in average availability should decrease as the fleet size increases. The improved availability was seen at most operating locations, and resulted from roughly equal improvements in the NMC-M and NMC-S rates. Historically NMC-M and NMC-S have tended to move in opposite directions; the improvement in one being negated by the increase in the other.

- Aircraft availability rates by operating location for the 12-month period ending October 2014 are summarized in the table below. The first column indicates the average availability achieved for the whole period, while the maximum and minimum columns represent the range of monthly availabilities reported over the period. The number of aircraft assigned at the end of the reporting period is shown as an indicator of potential variance in the rates. Sites are arranged in order of when each site began operation of any variant of the F-35, and then arranged by variant for sites operating more than one variant.

F-35 AVAILABILITY FOR 12-MONTH PERIOD ENDING OCTOBER 2014[1]				
Operational Site	Average	Maximum	Minimum	Aircraft Assigned
Total Fleet	39%	51%	35%	90[2]
Eglin F-35A	39%	55%	32%	28
Eglin F-35B	41%	54%	25%	11
Eglin F-35C	50%	64%	24%	10
Yuma F-35B	33%	49%	24%	15
Edwards F-35A	43%	57%	19%	7
Nellis F-35A	28%	51%	2%	4
Luke F-35A[3]	50%	58%	23%	10
Beaufort F-35B[4]	37%	49%	4%	4

1. Data do not include SDD aircraft.
2. Total includes 1 OT F-35B at Edwards that is not broken out in table
3. Luke F-35A data began in April 2014
4. Beaufort F-35 B data began in July 2014.

- Sites that show extreme maximum or minimum availability values tend to have small fleet sizes; for example, Nellis AFB, Nevada, had only four F-35A aircraft for the majority of the reporting period. F-35B operations began at Edwards AFB, California, in October, when a single aircraft was transferred from Yuma MCAS. Availability of that aircraft is not broken out separately, but is included in the whole fleet calculation.
- The NMC-M rate was relatively steady at an average of 26 percent for the 12-month period ending October 2014, nearly twice the goal for 2014, excluding the depot for this entire period. A substantial amount of NMC-M down time continues to be the result of field maintenance organizations waiting for technical dispositions or guidance from the contractor on how to address a maintenance issue that has grounded an aircraft. These Action Requests (ARs) are a result of incomplete or inadequate technical information in the field, in the form of Joint Technical Data (JTD). While JTD validation has progressed (see separate section below), the complexity of AR's is increasing, leading to longer times to receive final resolution. Reducing the rate of ARs or decreasing the response time to the ARs will improve (lower) NMC-M rates. High Mean Times To Repair (MTTR), the average maintenance time to fix a single discrepancy, are experienced in all variants. This also contributes to the persistently high NMC-M rate.
- Over the same 12-month period, the NMC-S rate displayed an improving trend, peaking at 27 percent in November 2013, decreasing to rates in the high 10s to low 20s by mid-2014, and reaching a minimum of 15 percent in October. In 2013, the Program Office predicted that better contracting performance and the maturing supply system would result in improved supply support, which would in turn result in lower NMC-S rates by late 2014. Although the trend is favorable, the rate of improvement is not yet fast enough to allow the program to achieve their goal of 10 percent NMC-S by the end of 2014. If the current trend continues, the program could reach this target in early- to mid-2015.
- A large portion of the fleet began cycling through the depot for Block 2B modifications made necessary by concurrent development, exerting downward pressure on overall fleet availability. The program began reporting the percentage of the fleet in depot status starting in January 2014 at 13 percent. Since then, it has risen to as high as 18 percent in July 2014, and was at 11 percent by the end of October. Current plans show over 10 percent of the operational aircraft inventory will be in depot status for Block 2B modifications through at least mid-2015 (either at a dedicated facility or being worked on by a depot field team at the home station). If the Services elect to upgrade all early production aircraft to Block 3F capability, these aircraft will again be scheduled for depot-level modifications (operational test aircraft must be modified.) All necessary depot-level modifications are not yet identified for Block 3F, as testing and development are not complete. Therefore, the impact on availability due to Block 3F modifications in the 2016 through 2018 timeframe is unknown.
- Although depot modifications reduce overall fleet availability, they potentially improve availability once the aircraft is out of depot by replacing low reliability components with improved versions, such as the 270 Volt Battery Charger and Control Unit. Any increased availability from reliability improvements will take time to manifest in the fleet wide metrics, not showing more strongly until the majority of aircraft have been modified.
- Low availability rates, in part due to poor reliability, are preventing the fleet of fielded operational F-35 aircraft (all

variants) from achieving planned, Service-funded flying hour goals. Original Service bed-down plans were based on F-35 squadrons ramping up to a steady state, fixed number of flight hours per tail per month, allowing for the projection of total fleet flight hours.

- In November 2013, a new "modelled achievable" flight hour projection was created since low availability was preventing the full use of bed-down plan flight hours. The revised model accounted for some actual fleet maintenance and supply data, and made assumptions about many factors affecting availability in the coming years to predict the number of flight hours the fleet could generate in future months.
- Through October 30, 2014, the fleet had flown approximately 72 percent of the modelled achievable hours because availability had not increased in accordance with assumptions. Planned versus achieved flight hours, for both the original plans and the modelled achievable, through October 30, 2014, by variant, for the fielded production aircraft are shown in the table below.

F-35 FLEET PLANNED VS. ACHIEVED FLIGHT HOURS AS OF OCTOBER 30, 2014

Variant	Original Bed-Down Plan Cumulative Flight Hours			"Modelled Achievable" Cumulative Flight Hours		
	Estimated Planned	Achieved	Percent Planned	Estimated Planned	Achieved	Percent Planned
F-35A	11,500	6,347	55%	9,000	6,347	71%
F-35B	8,500	6,085	72%	7,500	6,085	81%
F-35C	1,800	910	51%	1,600	910	57%
Total	21,800	13,342	61%	18,600	13,342	72%

F-35 Fleet Reliability

- Aircraft reliability is assessed using a variety of metrics, each characterizing a unique aspect of overall weapon system reliability.
  - Mean Flight Hours Between Critical Failure (MFHBCF) includes all failures that render the aircraft not safe to fly, and any equipment failures that would prevent the completion of a defined F-35 mission. It includes failures discovered in the air and on the ground.
  - Mean Flight Hours Between Removal (MFHBR) gives an indication of the degree of necessary logistical support and is frequently used in determining associated costs. It includes any removal of an item from the aircraft for replacement with a new item from the supply chain. Not all removals are failures, and some failures can be fixed on the aircraft without a removal. For example, some removed items are later determined to have not failed when tested at the repair site. Other components can be removed due to excessive signs of wear before a failure, such as worn tires.
  - Mean Flight Hours Between Maintenance Event, unscheduled (MFHBME) is useful primarily for evaluating maintenance workload. It includes all failures, whether inherent or induced by maintenance actions, that led to maintenance and all unscheduled inspections and servicing actions.
  - Mean Flight Hours Between Failure, Design Controllable (MFHBF_DC) includes failures of components due to design flaws under the purview of the contractor, such as the inability to withstand loads encountered in normal operation. Failures of Government Furnished Equipment (GFE) and failures induced by improper maintenance practices are not included.
- The F-35 program developed reliability growth projections for each variant throughout the development period as a function of accumulated flight hours. These projections are shown as growth curves, and were established to compare observed reliability with target numbers to meet the threshold requirement at maturity, defined by 75,000 flight hours for the F-35A and F-35B, and by 50,000 flight hours for the F-35C, and 200,000 cumulative fleet flight hours. In November 2013, the program discontinued reporting against these curves for all ORD reliability metrics, and retained only the curve for MFHBF_DC, which is the only reliability metric included in the JSF Contract Specification (JCS). The growth curves for the other metrics have been re-constructed analytically and are used in the tables below for comparison to achieved values, but are not provided by the Program Office.
- As of October 2014, the F-35, including operational and flight test aircraft, had accumulated approximately 22,000 flight hours, or slightly more than 11 percent of the total 200,000-hour maturity mark defined in the ORD.
- Since May 2013, the program has reported Reliability and Maintainability (R&M) metrics on a three-month rolling window basis meaning, for example, the MFHBCF rate published for a month accounts only for the critical failures and flight hours of that month and the two previous months. Before May 2013, R&M metrics were reported on a cumulative basis. The switch to a three-month rolling window is intended to give a more accurate account of current, more production-representative aircraft performance, and eliminate the effect of early history when the SDD aircraft were very immature; however, this process can create significant month-to-month variability in reported numbers.
- A comparison of current observed and projected interim goal MFHBCF rates, with associated flight hours, is shown in the first table on the following page. Threshold at maturity and the values in the FY13 DOT&E report are shown for reference as well.
- Similar tables comparing current observed and projected interim goals for MFHBR, MFHBME, and MFHBF_DC rates for all three variants are also provided. MFHBF_DC is a contract specification, and its JCS requirement value is shown in lieu of an ORD threshold.
- The large number of flight hours and events in each three-month rolling window supporting the observed reliability metrics in the tables above provide statistical evidence that the program experienced reliability growth in

all metrics and all variants between August 2013 and August 2014.

- The critical failure rates for all three variants were below threshold values and below projected interim goals. Due to the large variability in month-to-month reported values, however, the high apparent growth for both the F-35B and F-35C from the data point values above may not be characteristic of the actual growth, with August 2013 being notably below average for those variants, and August 2014 being substantially above average.
- All variants are below their threshold values and projected interim goals for MFHBR and MFHBME.
- Design controllable failure rate is the only metric where any variants exceed the interim goal; as shown in the table with the F-35B and F-35C. For all variants, the degree of improvement in MFHBF_DC by August 2014, relative to the May 2013 value, is greater than the degree of improvement for all other reliability metrics. This indicates the improvement in the contract specification metric of MFHBF_DC is not translating into equally large improvement in the other reliability metrics, which are operational requirements.

F-35 RELIABILITY: MFHBCF (HOURS)

Variant	ORD Threshold		Values as of August 31, 2014				Values as of August 2013	
	Flight Hours	MFHBCF	Cumulative Flight Hours	Interim Goal to Meet ORD Threshold MFHBCF	Observed MFHBCF (3 Mos. Rolling Window)	Observed Value as Percent of Goal	Cumulative Flight Hours	Observed MFHBCF (3 Mos. Rolling Window)
F-35A	75,000	20	8,834	14.9	8.2	55%	4,204	4.5
F-35B	75,000	12	7,039	8.6	7.5	87%	3,286	3.0
F-35C	50,000	14	2,046	9.2	8.3	90%	903	2.7

F-35 RELIABILITY: MFHBR (HOURS)

Variant	ORD Threshold		Values as of August 31, 2014				Values as of August 2013	
	Flight Hours	MFHBR	Cumulative Flight Hours	Interim Goal to Meet ORD Threshold MFHBR	Observed MFHBR (3 Mos. Rolling Window)	Observed Value as Percent of Goal	Cumulative Flight Hours	Observed MFHBR (3 Mos. Rolling Window)
F-35A	75,000	6.5	8,834	4.8	3.1	65%	4,204	2.5
F-35B	75,000	6.0	7,039	4.3	2.5	58%	3,286	1.4
F-35C	50,000	6.0	2,046	3.9	2.3	59%	903	1.6

F-35 RELIABILITY: MFHBME (HOURS)

Variant	ORD Threshold		Values as of August 31, 2014				Values as of August 2013	
	Flight Hours	MFHBME	Cumulative Flight Hours	Interim Goal to Meet ORD Threshold MFHBME	Observed MFHBME (3 Mos. Rolling Window)	Observed Value as Percent of Goal	Cumulative Flight Hours	Observed MFHBME (3 Mos. Rolling Window)
F-35A	75,000	2.0	8,834	1.5	0.85	57%	4,204	0.78
F-35B	75,000	1.5	7,039	1.1	0.96	87%	3,286	0.46
F-35C	50,000	1.5	2,046	0.9	0.84	93%	903	0.35

F-35 RELIABILITY: MFHBF_DC (HOURS)

Variant	JCS Requirement		Values as of August 31, 2014				Values as of August 2013	
	Flight Hours	MFHBF_DC	Cumulative Flight Hours	Interim Goal to Meet JCS Requirement MFHBF_DC	Observed MFHBF_DC (3 Mos. Rolling Window)	Observed Value as Percent of Goal	Cumulative Flight Hours	Observed MFHBF_DC (3 Mos. Rolling Window)
F-35A	75,000	6.0	8,834	4.2	4.0	95%	4,204	2.8
F-35B	75,000	4.0	7,039	2.7	3.5	130%	3,286	1.9
F-35C	50,000	4.0	2,046	2.4	3.6	150%	903	1.5

- DOT&E conducted an in-depth study of reliability growth in MFHBR and in MFHBME for the period from July 2012 through October 2013. Reliability growth was modeled using the Duane Postulate, which characterizes growth by a single parametric growth rate. Mathematically, the Duane Postulate assesses growth rate as the slope of the best fit line when the natural logarithm of the cumulative failure rate is plotted against the natural logarithm of cumulative flight hours. A growth rate of zero would indicate no growth, and a growth rate of 1.0 is the theoretical upper limit, indicating instantaneous growth from a system that exhibits some failures to a system that never fails. The closer the growth rate is to 1.0 the faster the growth, but the relationship between assessed growth rates is not linear, due to the logarithmic nature of the plot. For example a growth rate of 0.4 would indicate reliability growth much higher than twice as fast as a growth rate of 0.2.
  - Only the F-35A and F-35B variants were investigated due to a low number of flight hours on the F-35C. The study evaluated the current growth rate, then, using that rate, projected the reliability metric to the value expected at maturity.

- The study also evaluated the growth rate needed to meet the ORD threshold value at maturity (75,000 hours each for the F-35A and F-35B) from the current observed value of the reliability metric. The results of the study are summarized in the following table.

Metric	Variant	October 2013 Value	Current Growth Rate from Duane Postulate	Projected Value at 75,000 FH	ORD Threshold	Projected Value as % ORD Threshold	Growth Rate Needed to Meet ORD
MFHBR	F-35A	3.30	0.129	4.19	6.5	65%	0.232
	F-35B	1.87	0.210	4.05	6.0	68%	0.305
MFHBME	F-35A	0.82	0.162	1.45	2.0	73%	0.241
	F-35B	0.64	0.347	1.74	1.5	116%	0.312

- For most of the measures, the F-35 must achieve a much faster growth rate than currently exhibited in order to meet ORD requirements by maturity. Reliability growth rates are very sensitive when calculated early in a program, with only relatively low numbers of flight hours (i.e., less than 10,000), and can differ significantly either on the up or down side from growth rates calculated once a program is more mature.
- The above growth rates were calculated with around 4,700 flight hours for the F-35A, and 3,800 for the F-35B. For comparison, observed MFHBME growth rates for several historical aircraft are shown in the table to the right.

Aircraft	MFHBME Growth Rate
F-15	0.14
F-16	0.14
F-22 (at 35,000 flight hours)	0.22
B-1	0.13
"Early" B-2 (at 5,000 flight hours)	0.24
"Late" B-2	0.13
C-17 (at 15,000 flight hours)	0.35

- The growth rates for the F-35 to comply with ORD performance by maturity have been demonstrated in the past, but only on different type aircraft and not on fighters.

• The most recent 90-day rolling averages for MFHBF_DC show more growth in this metric than for any other reliability metric for the period from May 2013 through August 2014. The following contributed to the reported growth in MFHBF_DC.
  - In June 2013, the program re-categorized nut plate failures, one of the most common failures in the aircraft, as induced failures rather than inherent failures, removing them from the calculation of MFHBF_DC. Nut plates are bonded to an aircraft structure and receive bolt-type fasteners to hold removable surface panels in place. One way nut plates can fail, for example, is when torquing a bolt down while replacing a removed panel, the nut plate dis-bonds from the aircraft structure, preventing securing the surface panel.
  - Distinguishing between inherent design failures and induced failures can be subjective in certain cases. For example, if a maintainer working on the aircraft bumps a good component with a tool and breaks it while working on a different part nearby, it is a judgment call whether that is an inherent design failure because the component could not withstand "normal" wear and tear in operational service, or if it's an induced failure because the maintainer was "too rough."
    ▪ Analysis on F-35A data including SDD and LRIP aircraft from September 2012 to April 2014 shows a generally increasing number of failures categorized as induced each month over the entire period, but a generally decreasing number of failures categorized as inherent for each month since April 2013. The decreasing inherent failure count per month is notable, as during this period, the F-35A fleet size and total hours flown per month were increasing steadily.
    ▪ Some of this is due to re-categorizing nut-plate failures. Actual reliability growth can also explain some of this, as could poor training leading to bad troubleshooting and maintenance practices. Some of this could also be due to re-categorizing failures previously scored as inherent failures as induced failures. For example, Program Office maintenance data records showed that there were twice as many inherent failures as induced failures in September 2012, and there were many more inherent failures than induced for every subsequent month through May 2013. Then in June 2013, records showed that there were more than twice as many induced failures than inherent failures, and induced failures have always been much greater than inherent failures for each month afterward. This sudden and abrupt reversal of the relationship between induced and inherent failures across the entire F-35A fleet suggests that scoring failures differently (induced vice inherent) may result in an increase in the design-controllable metric that is not manifested in other reliability metrics.
  - Due to poorer than expected initial reliability of many components, the program has started to re-design and introduce new, improved versions of these parts. Once a new version of a component is designed, it is considered the production-representative version. However, failed components may still be replaced by the old version of the component in order to keep aircraft flying until the new version is produced in enough quantity to proliferate to 100 percent of the fleet and supply stock. During this transition period, only failures of the new version of the component are counted as relevant to the reliability metrics, because the old version is no longer considered production-representative.
    ▪ This creates a situation where not all failures are counted in the calculation of mean flight hours between reliability events, but all flight hours are counted, and hence component and aircraft reliability are reported higher than if all of the failures were counted. The result is an increased estimation of reliability

compared to an estimate using all failures, and is highest at the beginning of the transition period, especially if the initial batch of re-designed components is small.

- For example, as of September 2014, an improved horizontal tail actuator component had been introduced and installed on roughly 30 aircraft out of a fleet of nearly 100. Failures of the older component were not being counted in the metrics at all anymore, but flight hours from all 100 aircraft were counted. This calculation could result in the reported reliability of that component being increased by up to a factor of three compared to reliability if all of the horizontal tail actuator failures were counted. There are hundreds of components on the aircraft, so a single component's increased estimate of reliability may have little influence on overall observed aircraft reliability. However, since multiple components are being upgraded simultaneously due to the unprecedented and highly concurrent nature of the F-35 program, the cumulative effect on the overall observed aircraft reliability of the increased estimate of reliability from all of these components may be significant.

- Tire assemblies on all F-35 variants do not last as long as expected and require very frequent replacement. However, only when a tire failure is experienced on landing is it counted as a design controllable failure. The vast majority of tires are replaced when worn beyond limits, and in these cases they are scored as a "no-defect." Thus, most tire replacements show up in the MFHBR and MFHBME metrics, but not in MFHBF_DC or MFHBCF, even though the aircraft is down for unsafe tires. The program is seeking redesigned tires for all variants to reduce maintenance down time for tire replacements.

- A number of components have demonstrated reliability much lower than predicted by engineering analysis, which has driven down the overall system reliability and/or led to long wait times for re-supply. High driver components affecting low availability and reliability include the following, grouped by components common to all variants followed by components failing more frequently on a particular variant or completely unique to it, as shown below:

HIGH DRIVER COMPONENTS AFFECTING LOW AVAILABILITY AND RELIABILITY		
	Common to All Variants	Additional High Drivers by Variant
F-35A	• Avionics Processors • Main Landing Gear Tires • Thermal Management System • Ejection Seat Assembly • Panoramic Cockpit Display Electronics Unit • Low Observable Cure Parameters • Helmet Display Unit • Seat Survival Kit • Igniter-Spark, Turbine Engine • On-Board Oxygen Generating System	• Exhaust Nozzle Assembly • Exhaust Nozzle Converging-Diverging Link
F-35B		• Upper Lift Fan Door Actuator[1] • 270 Volt DC Battery
F-35C		• Data Transfer Cartridge • Solenoid Operated Fuel Valve

1. Unique to the F-35B

Maintainability

- The amount of time spent on maintenance for all variants exceeds that required for mature aircraft. Two measures used to gauge this time are Mean Corrective Maintenance Time for Critical Failures (MCMTCF) and Mean Time To Repair (MTTR) for all unscheduled maintenance. MCMTCF measures active maintenance time to correct only the subset of failures that prevent the JSF from being able to perform a defined mission, and indicates how long it takes, on average, to return an aircraft to mission capable status. MTTR measures the average active maintenance time for all unscheduled maintenance actions, and is a general indicator of ease and timeliness of repair. Both measures include active touch labor time and cure times for coatings, sealants, paints, etc., but do not include logistics delay times such as how long it takes to receive shipment of a replacement part.
- The tables below compare measured MCMTCF and MTTR values for the three-month period ending August 2014 to the ORD threshold and the percentage of the value to the threshold for all three variants. The tables also show the value reported in the FY13 DOT&E Annual Report for reference. For the F-35A and F-35C, MCMTCF increased (worsened) over the last year while MCMTCF for the F-35B showed slight improvement. For all variants, MTTR showed improvement over the last year. Both maintainability measures for all variants are well above (worse than) the ORD threshold value required at maturity.

F-35 MAINTAINABILITY: MCMTCF (HOURS)				
Variant	ORD Threshold	Values as of August 31, 2014 (3 Mos. Rolling Window)	Observed Value as Percent of Threshold	Values as of August 2013 (3 Mos. Rolling Window)
F-35A	4.0	15.6	390%	12.1
F-35B	4.5	15.2	338%	15.5
F-35C	4.0	11.2	280%	9.6

F-35 MAINTAINABILITY: MTTR (HOURS)				
Variant	ORD Threshold	Values as of August 31, 2014 (3 Mos. Rolling Window)	Observed Value as Percent of Threshold	Values as of August 2013 (3 Mos. Rolling Window)
F-35A	2.5	8.6	344%	9.2
F-35B	3.0	7.5	250%	8.9
F-35C	2.5	6.6	264%	7.7

- More in depth trend analysis between May 2013 and August 2014 shows that the MTTR for the F-35A and F-35C variants have been decreasing slowly, while the MTTR for the F-35B has been growing slightly, with all exhibiting high month-to-month variability. Over the same period, the MCMTCF values for the F-35B and F-35C were increasing slightly and flat for the F-35A, but again with very high monthly variability.
- Several factors likely contribute to extensive maintenance time, especially long cure times for Low Observable repair materials. The Program Office is addressing this issue with

new materials that can cure in 12 hours vice 48 for example, but some of these materials may require freezer storage, making re-supply and shelf life verification in the field or at an austere operating location more difficult.

- The immaturity of the system overall, including training system immaturity, lack of maintainer experience on such a new aircraft, and incompletely written and verified, or poorly written, JTD may all also contribute to protracted maintenance times.
- Additionally, design factors of the aircraft itself make affecting certain repairs difficult and time-consuming. Field maintainers have reported poor cable routing behind panels that interferes with required maintenance, and awkward placement of some components, which makes removing and replacing them slow, and increases the chances they will induce a failure in a nearby component working with tools in confined spaces.
- Scoring also affects higher than expected MTTR values. Discrepancies for which maintainers have to attempt multiple solutions before finding a true fix are being re-scored as a single event, while in the past they were documented as multiple repair attempts, each with its own MTTR. The individual MTTRs for these attempted repairs are now rolled up into the single, re-scored event. Improved diagnostics and training can reduce MTTR by pointing maintainers to the true root cause of discrepancies more quickly.

Autonomic Logistics Information System (ALIS)

- The program develops and fields ALIS in increments similar to the mission systems capability in the air vehicle. Overall, ALIS is behind schedule, has several capabilities delayed or deferred to later builds, and has been fielded with deficiencies. The program does not have a dedicated end-to-end developmental testing venue for ALIS and has relied on feedback from the field locations for identifying deficiencies. Though some of the early deficiencies have been addressed, ALIS continues to be cumbersome to use and inefficient, and requires the use of workarounds for deficiencies awaiting correction. The program has tested ALIS software versions at the Edwards flight test center, including a formal Logistics Test and Evaluation (LT&E) of ALIS software versions 1.0.3 and 2.0.0. These formal test periods had limitations, however, as the ALIS that supports the developmental test aircraft is different than the production ALIS hardware at fielded units. As a result, the program has begun limited testing of software updates at fielded operational sites and will expand this testing in CY15. The program should ensure adequate testing of ALIS software upgrades on operationally-representative hardware is complete prior to fielding to operational units.
  - In the last year, the Program Office adjusted the schedule and incremental development plans for ALIS hardware and software capability releases three times. These adjustments were necessary to align ALIS capabilities with Service requirements to support planned IOC declaration dates.
    - In December 2013, the program re-planned the schedule and capability release of ALIS 2.0.0, the next version to be fielded, moving the initial release from November 2014 to January 2015.
    - In February 2014, the program adjusted the schedule and release plans for the follow-on version of ALIS, version 2.0.1. The schedule for fielding was adjusted by three months (from March 2015 to June 2015) and the life limited parts management (LLPM) module was deferred to later increments of ALIS. Because of delays in development, the LLPM capability was split into two increments (initial and final); the initial increment will be fielded with ALIS 2.0.2 and aligned to support Air Force IOC plans, and the final increment of LLPM will be fielded in ALIS 2.0.3.
    - In November 2014, the program adjusted the schedule and release plans again, moving the final increment of the LLPM to ALIS 3.0.0 and accelerating the integration of an upgraded processor from ALIS 3.0.0 to ALIS 2.0.2, eliminating the need for ALIS release 2.0.3. The content previously planned for ALIS 3.0.0 will be renamed 3.0.1. The program's planned release dates are July 2017 for ALIS 3.0.0 and July 2018 for ALIS 3.0.1.
    - A Windows server update has moved forward to an earlier ALIS release, from ALIS 3.0.0 to 2.0.1, which the program plans to field in June 2015.
- During CY14, the program accomplished the following with ALIS software development and fielding:
  - The program completed the migration of operational units from older versions to ALIS 1.0.3 (the current fielded version) in January 2014 as planned, followed by an updated version in February 2014 (version 1.0.3A3.3.1), which included limited fixes for deficiencies identified during testing in late CY12 and early CY13. ALIS 1.0.3A.3.3.1 has reduced screen refresh and load times compared to 1.0.3, and reduced the number of nuisance/false health reporting codes; however, time-consuming workarounds are required to determine and update the readiness of aircraft to fly missions. The following are examples of workarounds.
    - Additional steps required to process aircraft health information to be compatible with the Exceedance Management System, which is not integrated into ALIS.
    - Manual entry of information into ALIS to track consumables such as oil usage.
    - Frequent submission of formal ARs to Lockheed Martin for assistance, because troubleshooting functionality is incomplete.
    - Manual correlation of health reporting codes between ALIS domains.

- In future versions of ALIS, the program plans to address the above workarounds and include three key requirements identified by the Services as needed for IOC:
  - Integration with a new deployable ALIS standard operating unit (SOU) hardware (SOU V2, described below)
  - Support of detached, sub-squadron operations at deployment locations away from the main operating base
  - Distributed maintenance operations allowing supervisors to verify completion of maintenance operations from various locations at the main or deployed operating base (i.e., dynamic routing).
- The next major increment of ALIS software, version 2.0.0, began testing with the mission systems developmental test aircraft at Edwards AFB in September 2014. The program plans to field version 2.0.0 starting in January 2015. The ALIS 2.0.0 upgrade includes integrated exceedance management, Windows 7, recording of structural health data for use in the future development of prognostic health capabilities, and continued optimization efforts with improvements to data structures and database tuning.
  - Testing of the screen refresh times for ALIS 2.0.0 in a laboratory environment has shown improvement compared to those observed with ALIS 1.0.3A3.3.1. For example, in a simulated environment supporting 28 aircraft, squadron health management debrief time decreased from 101 seconds to less than 5 seconds after implementation of several cycles of improvements. Actual fielded performance is unknown.
  - Preliminary results from the LT&E of ALIS 2.0.0 show that multiple deficiencies from past evaluations remain unresolved, and the system demonstrated deficiencies in new capabilities. Although results have not been finalized with a deficiency review board, the initial LT&E report indicates:
    - A critical deficiency noted in the LT&E of ALIS 1.0.3 for the failure of the manual control override to work correctly, which results in the incorrect reporting of the air vehicle status as not mission capable in the squadron health management function of ALIS, has not been corrected in ALIS 2.0.0.
    - ALIS 2.0.0 demonstrated 4 additional critical deficiencies and 53 serious deficiencies.
    - Exceedance management has been integrated into ALIS 2.0.0 but exhibited processing delays.
    - The test site was unable to complete testing of all ALIS 2.0.0 functionality because the site lacks a squadron operating unit and instead relied on data transfers between Edwards AFB and Fort Worth, Texas. The test team recommended that the remaining tests be conducted at an operating location with representative hardware.
- ALIS 2.0.0 will provide the basis for incremental builds (versions 2.0.1 and 2.0.2), which are intended to be fielded in support of Marine Corps IOC and the Air Force IOC declarations, respectively.
  - The program plans to deliver ALIS 2.0.1 to the flight test center in February 2015, conduct a formal LT&E, in preparation for fielding in July 2015, which is the current objective date for Marine Corps IOC. ALIS 2.0.1 software will align with a new hardware release (SOU version 2) that will improve deployability and will include fault isolation improvements and a Windows server update.
  - To support the Marine Corps preparation for IOC, the program plans to release ALIS 2.0.1 in May 2015 to Yuma MCAS, Arizona, simultaneous with the planned delivery of the deployable ALIS hardware system for limited validation and verification testing of the software prior to release to the rest of the fielded units. Though the current ALIS release schedule leaves no margin for delay to meeting the Marine Corps IOC objective date in July, fielding ALIS 2.0.1 before formal testing and fix verification is complete may result in the continued need for workarounds to support field operations.
- The program has scheduled ALIS 2.0.2 fielding, which is required to meet Air Force IOC requirements, for December 2015. It will provide a sub-squadron reporting capability that allows air vehicle status reporting of deployed assets back to the parent SOU, and adds dynamic routing, which allows delivery of messages and data via alternate network paths. ALIS 2.0.2 will also reduce the need for propulsion contractor support by integrating the first portion of a required LLPM capability.
- ALIS 3.0.0 will complete the majority of the ALIS development effort. The schedule, which is pending approval, shows a fielding date of July 2017. This version of ALIS will include a complete LLPM capability and eliminate the need for propulsion contractor support.

• The following sections describe progress in the development and fielding of ALIS hardware and alignment with ALIS software capabilities described earlier:
  - The program continued to field ALIS hardware components at new locations during CY14 as the global sustainment bed-down and F-35 basing continued to be activated. The table on the following page shows ALIS components, location, and sustainment function for new components fielded in CY14.
  - In order to reduce post-flight data download times, the program added and fielded a new piece of hardware, the Portable Maintenance Device (PMD) reader, to operational units beginning in July 2014. The PMD reader is designed to accelerate the download of unclassified maintenance data from the aircraft without the need for a secure facility. The PMD reader permits maintenance personnel to download maintenance data only, vice waiting for full portable memory device download from the aircraft to be processed in a secure facility via the Ground Data Security

Assembly Receptacle (GDR). Testing of the PMD could not be done at the flight test center because the architecture of the ALIS supporting the developmental testing aircraft is not production-representative. The fielded PMD readers have functioned as intended. Maintenance downloads generally take less than 5 minutes using a PMD reader, while the procedure using the ground data receptacle – which downloads all data recorded on the PMD – usually takes an hour, delaying access to maintenance information.

- SOU Version 1 (SOU V1), the current ALIS unit-level hardware configuration, failed to meet the deployability requirement in the ORD due to its size, bulk, and weight. The program is developing a deployable version of the SOU, deemed SOU Version 2 (SOU V2). It will support Block 2B, Block 3i, and Block 3F aircraft, and is needed for service IOC dates. It will be incrementally developed and fielded with increasing capability over the next several years.
  - The first increment of SOU V2, a modularized and man-portable design for easier deployability, will first be made available to Marine Corps for IOC in 2015. This first increment aligns SOU V2 hardware and ALIS 2.0.1 software release. The program plans to conduct limited validation and verification testing of the ALIS 2.0.1 software on the SOU V2 once delivered to Yuma MCAS (planned for May 2015), and prior to fielding it to other units in July.
  - The second increment of SOU V2 went on contract in August 2014. This increment will address Air Force hardware requirements for sub-squadron reporting capabilities and inter-squadron unit connectivity and will align with release of ALIS software version 2.0.2. It is scheduled to begin testing at the flight test centers in July 2015.
  - The third increment of SOU V2, which also went on contract in August 2014, will address hardware requirements for decentralized maintenance, which will allow maintenance personnel to manage tasks with or without connectivity to the main SOU and allow for a Portable Maintenance Aid-only detachment; it will align with ALIS 3.0.0.

ALIS HARDWARE FIELDED IN FY14		
Component	**Location**	**Function**
Central Point of Entry	Eglin AFB	One per country to provide in-country and software and data distribution, enable interoperability with government systems at national level, and enable ALIS data connectivity between bases.
Standard Operating Unit (SOU)	Beaufort Academic Training Facility Italian FACO Italian Pilot Training Center Australian Pilot Training Center Luke AFB Pilot Training Center Nellis AFB 57th Fighter Wing Netherlands SOU (at Edwards AFB)	Supports squadron-level F-35 operations, including maintenance, supply chain management, flight operations, training, and mission planning.
Base Kit	Nellis AFB Edwards AFB	Centralizes base supply for bases operating with several squadrons.
LHD Ship Kit	USS *Wasp*	Similar to a squadron kit but permanently installed shipboard.
Deployment Kit	Luke AFB Pilot Training Center	Short of a full squadron kit but contains sufficient hardware to support four aircraft. Will become a squadron kit upon delivery of remaining hardware.
Depot Kit	Hill AFB MCAS Cherry Point	Similar to a base kit but geared to support depot operations.

- ALIS was designed to provide the analytical tools and algorithms to assess air vehicle health management using health reporting codes (HRCs) collected during flight. These functions will enable the Prognostic Health and Management (PHM) System as it matures. PHM has three major components: fault and failure management (diagnostic capability), life and usage management (prognostic capability), and data management, all of which will be an integral part of ALIS. Currently PHM has no prognostic capability, while diagnostic and data management functionality remain immature. The program plans to include the first set of prognostic algorithms in ALIS 2.0.2.
  - Diagnostic capability is designed to enable maintenance by detecting true faults within the air vehicle and accurately isolating those faults to a line-replaceable component. To date, the diagnostic functional capability has demonstrated low detection rates, poor accuracy, and high false alarm rates. The table on the following page shows metrics of diagnostic capability, the ORD threshold requirement at maturity (200,000 hours), and demonstrated performance as of May 2014. For comparison, demonstrated performance from May 2013 is also shown. While detection and isolation performance metrics improved between May 2013 and May 2014, mean flight hours between false alarm performance decreased (worsened).
  - As a result, fielded operations have had to rely on manual workarounds, such as maintainer-initiated built-in tests, extra scheduled inspections, and reliance on contractor support personnel, for more accurate diagnostics of system faults. Although these workarounds have aided troubleshooting, they increase the maintenance man-hours per flight hour and reduce sortie generation rates.

METRICS OF DIAGNOSTIC CAPABILITY			
Diagnostic Measure	Threshold Requirement	Demonstrated Performance (May 2013)	Demonstrated Performance (May 2014)
Fault Detection Coverage (percent mission critical failures detectable by PHM)	98	74	81
Fault Detection Rate (percent correct detections for detectable failures)	98	73	81
Fault Isolation Rate (percentage): Electronic Fault to One LRC	90	77	72
Fault Isolation Rate (percentage): Non-Electronic Fault to One LRC	*70*	70	79
Fault Isolation Rate (percentage): Non-Electronic Fault to 3 or Fewer LRC	90	80	85
Mean Flight Hours Between False Alarm	50	0.59	0.23
Mean Flight Hours Between Flight Safety Critical False Alarm	450	69	170

Joint Technical Data (JTD)

- Lack of verified JTD modules continues to challenge fielded operations, requiring workarounds such as ARs to the contractor for engineering dispositions on required maintenance actions. Also, maintenance personnel in the fielded units are finding that verified JTD may not be adequate to complete maintenance actions efficiently, such as an engine removal and replacement and maintenance built-in test troubleshooting.
- JTD modules are first identified as needed in the field, then developed by the contractor, and finally verified before being provided to the operating locations. Entire JTD packages (i.e., all JTD modules bundled together) are periodically distributed to field locations using ALIS, and then downloaded at the units to the Portable Maintenance Aids.
  - The current process is cumbersome, as all modules are distributed together, including modules with no changes or updates, along with new modules and those with updates. ALIS 2.0.0 should allow the program to deliver partial JTD builds (i.e., changes and amendments to existing JTD).
  - The total number of data modules identified continues to grow as the program matures and additional JTD deliveries are added in LRIP contracts. According to Program Office schedules, the development of identified JTD modules for each variant of air vehicle and for propulsion is on track to meet Service milestones. Air vehicle JTD includes time compliance technical data, depot-level technical data, air vehicle diagnostics and troubleshooting procedures, complete structural field repair series data, aircraft battle damage assessment and repair, and maintenance training equipment. Propulsion JTD development is nearly complete and on schedule. Development of Support Equipment (SE) JTD lags the Program Office schedule by 9 percent (approximately 200 modules out of 2,150 identified), primarily due to the lack of delivery of fault isolation engineering source data.
- Verification of air vehicle JTD modules is behind and has been slowed by the program's dependence on production aircraft to conduct opportunistic aircraft verification events. Because priority is given to the flight schedule, verification events are not scheduled and require support from the field to complete JTD verification. The program has identified more air vehicle JTD modules during the last year, hence the percentage of JTD modules verified has not increased substantially compared to what was reported in DOT&E's FY13 Annual Report. To reduce the number of unverified JTD modules at Marine Corps IOC declaration, the program should provide dedicated time on fielded aircraft for F-35B JTD verification teams.
  - SE JTD verification occurs as modules are developed and released in ALIS, so it lags the schedule by a similar amount as module development. SE assets at the training units at Eglin AFB are the primary source for SE verification.
  - The program placed Supportable Low Observable (SLO) JTD verification on contract in March 2014, with most verification performed using desktop analysis. SLO JTD verification for the F-35B is nearly complete. Since many of the SLO modules for the F-35A and F-35C variants are similar to those for the F-35B, the program expects the verification of SLO modules for those variants to proceed on schedule. SLO JTD verification data were not available at the time of this report; progress in identification and development of SLO modules is reported separately in the table below.
- As of the end of October, the program had verified approximately 84 percent of the identified air vehicle JTD modules for the F-35A, 74 percent for the F-35B, and 62 percent for the F-35C. The table on the following page shows the number of JTD modules identified, developed, and verified for the air vehicle (by variant), pilot flight equipment (PFE), and SE. Overall, 67 percent of the air vehicle, PFE, and SE identified modules have been verified. Propulsion JTD and SLO JTD are tracked and addressed separately.
- Propulsion JTD are current as of April 2014. More current information was not available for this report. Propulsion JTD development and verification has proceeded on schedule and the Program Office considers completion by the end of SDD as low risk.

- SLO JTD are current as of the end of October 2014. SLO JTD are tracked under a separate contract with a period of performance of February 2014 through April 2016. The Program Office did not have data showing verification of SLO JTD modules in time for this report.
- When verified JTD are not available or not adequate to troubleshoot or resolve a problem with an aircraft, maintenance personnel submit ARs to the contractor. These ARs are categorized as critical (Category 1) or severe (Category 2) and sub-categorized as high, medium, or low.
  - The contractor prioritizes and responds to ARs through an engineering team (referred to as the Lightning Support Team), which is composed of Service and contractor personnel.
  - As of October 15, 2014, 24 Category 1 ARs remained open while 617 Category 2 ARs were open. The number of open Category 1 ARs has remained relatively flat over the last year, while the number of open Category 2 ARs has decreased by two-thirds since January 2014.

F-35 JOINT TECHNICAL DATA DEVELOPMENT AND VERIFICATION STATUS
Air Vehicle, Pilot Flight Equipment (PFE), and Support Equipment (SE)
(as of October 2014)

	Module Type	Modules Identified	Modules Developed	Percent Identified Modules Developed	Modules Verified	Percent Identified Modules Verified
F-35A[1]	Unit-level	4,658	4,198	90.1%	3,893	83.6%
F-35B[1]	Unit-level	5,783	5,221	90.3%	4,300	74.4%
F-35C[1]	Unit-level	4,799	3,764	78.4%	2,949	61.5%
Common[2] (all variants)	Unit-level	322	201	62.4%	142	44.1%
PFE	Common	337	254	75.4%	250	74.2%
SE	Common	2,150	945	44.0%	604	28.1%
TOTAL		18,049	14,583	80.8%	12,138	67.3%

1. Includes field- and depot-level JTD for Operations and Maintenance, on- and off-equipment JTD, and structured field repairs.
2. Includes aircraft JTD for general repairs, sealants, bonding, structured field repairs, and non-destructive investigation.

F-35 JOINT TECHNICAL DATA DEVELOPMENT AND VERIFICATION STATUS
Propulsion
(as of October 2014)

	Module Type	Modules Identified	Modules Developed	Percent Identified Modules Developed	Modules Verified	Percent Identified Modules Verified
Propulsion	Engine and Lift Fan	3,123	2,988	95.7%	2,840	90.9%

F-35 JOINT TECHNICAL DATA DEVELOPMENT AND VERIFICATION STATUS
Supportable Low Observable (SLO)
(as of October 2014)

	Module Type	Modules Identified	Modules Developed	Percent Identified Modules Developed	Modules Verified	Percent Identified Modules Verified
SLO	F-35A	676	180	26.6%	N/A	N/A
	F-35B	550	52	9.5%		
	F-35C	547	52	9.5%		
	Common	2	0	0.0%		

Air-Ship Integration and Ship Suitability Testing

F-35B

- The program previously completed two test periods on the USS *Wasp* with developmental test aircraft, one in October 2011 and one in August 2013. These periods assessed handling qualities for take-off and landing operations at sea, and were used to develop an initial flight operating envelope for ship operations. ALIS was not deployed to the ship, and very limited maintenance operations were conducted (routine pre- and post-flight inspections, refueling operations, etc.).
- The Marine Corps began making plans to conduct another test period on the USS *Wasp* in May 2015 to assess ship integration and suitability issues, using non-instrumented production aircraft and a non-deployable version of ALIS (SOU V1) installed on the vessel. This deployment was originally a part of the Block 2B OUE; however, it is being re-scoped to support plans for the Marine Corps IOC later in 2015.
  - Up to six production aircraft are planned to be used for the deployment. These aircraft are not instrumented (as test aircraft are) and will allow the USS *Wasp* to operate its radars and communications systems in a representative manner since there is no concern with electromagnetic interference with flight test instrumentation.
  - The flight operations will not be representative of combat operations, unless the flight clearance and associated certifications enabling the deployment include clearances for weapons carriage and employment. These clearances are expected at fleet release, which the program plans to occur in July 2015, after the deployment.
  - Maintenance will be mostly military, but with contractor logistics support in line with expected 2015 shore-based operations, such as contractors for propulsion data downloads after each flight. Maintenance will be limited to that required for basic flight operations, staging necessary support equipment for engine and lift fan removals only to check if space permits, and loading and downloading demonstrations of inert ordnance on the flight deck.
  - These limitations are not representative of combat deployment operations.
- The Marine Corps and Naval Air Systems Command began exploring issues that would arise with employing more than six F-35B aircraft per Air Combat Element (ACE) on L-class

ships. ACE represents the mix of fixed- and rotary-wing aircraft assigned to the ship to conduct flight operations in support of Marine Corps combat objectives. These "heavy" ACEs could include up to 20 F-35Bs, or 12 or 16 F-35Bs plus MV-22Bs, depending on the specific L-class vessel. Through these exercises, they identified issues, many which will apply to standard-sized ACE operations as well. These issues include:

- The currently-planned service maintenance concept, where few components will be repaired underway but must be sent for repair back to a depot facility or to the Original Equipment Manufacturer (OEM) may not be achievable for initial fielding. The program is conducting a Level Of Repair Analysis (LORA) to assess the feasibility of repairing components at the Intermediate level, including onboard CVN and L-class ships.
- More than six F-35Bs in the ACE will require a more robust engine repair and resupply process than for the standard, six F-35B ACE. The Services are still investigating the best method for F135 engine re-supply at sea. Work continues on the heavy underway replenishment station and a re-designed engine storage container that can survive a drop of 18 inches while protecting the engine and weighing low enough to be transferred across the wire between the supply ship and the L-class or CVN ship. Adequate storage is needed for the engines, spare parts, and lift fans, as well as workspace for engine module maintenance within the small engine shops on L-class vessels.
- Moving an engine container, including placing an engine in or taking one out of the container, requires a 20,000 pound-class forklift and cannot be concurrent with flight ops since this item is required to be on the flight deck for crash and salvage purposes while flying. Engines can be moved around on a transportation trailer once removed from the container to enable engine maintenance in the hangar bay during flight operations.
- Adequate Special Access Program Facilities (SAPF) are required for flight planning and debriefing aboard the ship. Current modification plans for L-class vessels are expected to meet the requirements for a six F-35B ACE, but would be inadequate for an operation with more aircraft.
- Unlike many legacy aircraft, the F-35B needs external air conditioning when on battery power or an external power source. Cold fueling operations, when the engine is not turned on, will thus need an air conditioning cart. For many more F-35B's in the ACE, the logistics footprint will have to increase significantly to include more air conditioning units as many aircraft are refueled cold to achieve efficient operations.

F-35C

- The program began testing the redesigned arresting hook system on aircraft CF-3 at Patuxent River Naval Air Station in February 2014. This test aircraft is modified with unique instrumentation to monitor loads on the arresting hook system and the nose landing gear for catapult launches and arrested landings. The structural survey testing was a pre-requisite for initial carrier sea trials.
  - Testing encountered significant delays, as numerous deficiencies were discovered, some requiring new engineering designs. Testing was planned to be completed in July, to support deployment to a CVN for the first set of sea trials. The following problems caused delays:
    - In February, a hydraulic leak in the nose landing gear steering motor, caused by over-pressurization, required a redesigned valve and halted testing for 10 weeks.
    - Excessive galling of the arresting hook pitch pivot pin, which required a redesigned pin made of titanium and additional inspections after each landing.
    - Damage to the nose landing gear shock strut, which required down time for repair
  - The structural testing was partially completed in two phases, all on CF-3.
    - Phase one completed September 10, 2014, and consisted of 24 test points needed to clear a monitored envelope for carrier landings. Completion of phase one was necessary for CF-3 to conduct landings on a CVN in November.
    - Phase two consists of 20 additional test points to clear an unmonitored envelope for carrier landings. Completion of phase two testing would allow non-loads instrumented test aircraft to conduct landings on a CVN. Phase two work was ceased on September 25, with 17 of 20 phase two test points completed, but the program waived the remaining three test points to allow CF-5 to participate in DT-1.
- Carrier-based ship suitability testing is divided into three phases.
  - The first phase, DT-1, consisted of initial sea trials to examine the compatibility of F-35C with a CVN class ship and to assess initial carrier take-off and landing envelopes with steady deck conditions. DT-1 was conducted November 3 – 15, 2014; it was initially scheduled to begin in July.
    - Testers accomplished 100 percent of the threshold test points and 88 percent of the objective points during deployment, completing 33 test flights (39.2 flight hours) and 124 arrested landings, of 124 attempts, including one night flight with two catapult launches and two arrested landings. The results of the test were still in analysis at the time of this report.
    - No other aircraft deployed to the carrier, except transient aircraft needed for logistical support. All landings were flown without the aid of the Joint Precision Approach Landing System, which is planned for integration on the F-35C in Block 3F. No ALIS equipment was installed on the carrier. The test team created a network connection from the ship to the major contractor in Fort Worth to process necessary maintenance actions.

- The second and third phases, DT-2 and DT-3, consist of ship-borne operations with an expanded envelope (e.g., nighttime approaches, higher sea states than observed in DT-1, if available, and asymmetrical external stores loading). DT-2, which is currently planned for August 2015, will expand the carrier operating envelope. The third set of sea trials is planned for CY16.

- The Navy is working on the following air-ship integration issues, primarily for carriers. Each of the following integration issues also applies to F-35B on L-class ships, with the exception of Jet Blast Deflectors (JBDs):
  - Due to the higher temperature of F-35 engine exhaust compared to legacy aircraft, carrier JBDs need at least two modifications. A cooling water orifice modification enables basic operations, but additional side panel cooling must be added for higher afterburner thrust catapult launches. The Navy is accomplishing these full modifications on at least some JBDs on USS *Abraham Lincoln* (CVN-72) in preparation for IOT&E and on USS *George Bush* (CVN-77) for developmental testing, and performed the basic orifice modification on USS *Nimitz* (CVN-68) for the November DT-1.
  - The Lockheed Martin-developed F-35 ejection seat dolly failed Critical Design Review. The F-35 ejection seat has a higher center of gravity than legacy seats due to supports for the helmet-mounted display, and in the shipboard environment needs to be securely tied down in case of rolling motion from high sea states. The Navy is investigating developing less expensive adapters to the current ejection seat dolly, and determining what seat shop modifications (if any) will be required to safely tie down the dolly when a seat is installed.
  - Two separate methods for shipboard aircraft firefighting for the F-35 with ordnance in the weapon bays are being developed, one for doors open and one for doors closed. Each will consist of an adapter that can fit to the nozzle of a standard hose. The open door adapter will also attach to a 24-foot aircraft tow bar so firefighters can slide it underneath the aircraft and spray cooling water up into the bay.
    - Testing of a prototype open bay adapter was conducted in October and included use on an AV-8B hulk, propane fires, and JP-8 pool fires, as well as assessing ordnance cooling effectiveness. Mobility tests of the rig were also performed on CVN and L-class non-skid, asphalt, grass, dirt, and rough terrain. All tests indicate that the adapter provides sufficient access to the bay for water spray, and featured sufficient ease of use to place the adapter where needed quickly in all environments.
    - The closed door adapter will consist of a penetrating device to punch through the fuselage's carbon fiber skin, secure in place, and hold when water pressure is applied so deck personnel can then back away from the fire. The Navy also plans to test closed bay door firefighting testing of on-aircraft lithium ion battery fires.
  - Work on noise abatement during launch and recovery continues. The Navy is installing sound dampening material in the highest noise level areas for flight operations on the USS *Abraham Lincoln* (CVN-72) during its nuclear refueling and overhaul, and the Office of Naval Research (ONR) will analyze effectiveness compared to untreated ships. This effort will not involve treatment of all work areas, however, and may not be sufficient to allow conversational-level speech in every mission planning space during flight operations.
  - The need for improved flight deck hearing protection is not limited to the F-35, as the F-35 and F/A-18E/F Super Hornet produce similar maximum ground noise in afterburner (149 decibels for the F-35 and 150 decibels for the Super Hornet).
    - Based on an assumed F-35 noise environment of 149 decibels when in maximum thrust where personnel are normally located, 53 decibels of attenuation is required to enable 38 minutes of exposure to this worst-case noise per day before long-term hearing loss ensues. This is estimated to be equivalent to 60 launches and 60 recoveries.
    - Current expected performance for triple hearing protection only reaches into the mid 40's decibels of attenuation though, which enables less than 10 minutes exposure to maximum noise before the daily limit is reached. Workarounds may include re-positioning launch crew personnel and tighter administrative controls for exposure times.
  - The unique Integrated Power Package (IPP), and high-speed/low-thrust engine turn capability for maintenance on the F-35, may introduce new concerns for hangar bay maintenance. The Navy plans to investigate the impact of IPP exhaust emissions on hangar bay atmosphere, exhaust temperature, and the noise environment produced, to determine acceptable hangar bay maintenance practices. No IPP or engine turns were conducted during the DT-1 sea trials.

Progress in Plans for Modification of LRIP Aircraft

- Modification of production aircraft is a major endeavor for the program, driven by the large degree of concurrency between development and production, and is a burden independent of the progress made in developmental testing. Modifications are dependent on the production, procurement, and installation of modification kits, completed either at the aircraft depot locations or at the field units. The program will need to provide operationally representative Block 3F operational test aircraft for an adequate IOT&E.
- During CY14, the Program Office and Services continued planning for modification of early production aircraft to attain planned service life and the final SDD Block 3F capability, including the production aircraft that will be used to conduct operational testing. Planning had previously focused on modifying aircraft in preparation for the Block 2B OUE

and Marine Corps IOC, planned by the program to occur in mid-2015. This created challenges in obtaining long-lead items and dock availability at aircraft depots, and maintaining adequate aircraft availability to maintain pilot currency while eventually modifying all operational test aircraft into a production-representative Block 2B configuration. However, the decision to not conduct the Block 2B OUE allowed the program to focus on Marine Corps IOC aircraft requirements, while attempting to create a more efficient modification plan for operational test aircraft to achieve the Block 3F configuration.
- The Program Office has prioritized Block 2B associated modification for Marine Corps F-35B IOC aircraft over operational test aircraft. Because manufacturers could not meet the schedule demand for modification kits, not all of the operational test aircraft will be in the Block 2B configuration by early 2015 when the planned start of spin-up training for the OUE would have occurred, as was noted in the FY13 DOT&E Annual Report.
- Modification planning has also included early plans to ensure operational test aircraft scheduled for IOT&E will be representative of the Block 3F configuration. However, these plans show that the program is likely to face the same scheduling and parts shortage problems encountered in planning for Block 2B modifications of the operational test aircraft.

• Upgrading aircraft to a Block 2B capability requires the following major modifications: mission systems modifications; structural life limited parts (SLLP), referred to as Group 1 modifications; F-35B Mode 4 operations modifications, which include a modification to the three Bearing Swivel Module (3BSM) to allow F-35B aircraft to conduct unrestricted Mode 4 operations; OBIGGS; and upgrades to ALIS and the training systems to fully support Block 2B-capable aircraft.
- The program maintains a modification and retrofit database that tracks modifications required by each aircraft, production break in of modifications, limitations to the aircraft in performance envelope and service life, requirements for additional inspections until modifications are completed, and operational test requirements and concerns.
- The program uses this database to develop and update a complex flow plan of aircraft and engines through depot-level modifications, modifications completed by deployed depot field teams, and those completed by unit-level maintainers.
- The current depot flow plan shows that none of the operational test aircraft would become fully Block 2B-capable by January 2015, and only 7 of 14 will complete the necessary modifications by July 2015, which was the planned start date of the Block 2B OUE. Block 2B modifications would finally be complete on all operational test aircraft in September 2016.

• Program Office modification planning for Block 3F IOT&E has begun and shows some of the same scheduling pressures as have been observed for Block 2B; however, these would have been much worse if the OUE were conducted. The depot flow plan includes a seven-month placeholder to complete all modifications to bring each operational test aircraft to a Block 3F configuration, though the span of time required to complete these modifications, including the next increment of structural modifications (SLLP Group 2), is unknown. Additions to modification packages are possible as the potential for discoveries in flight test still exists. Although the program has prioritized for modification the aircraft planned to be used for IOT&E, the Air Force plans for at least 12 F-35A aircraft to be available for IOC declaration in 2016. These Air Force IOC aircraft will be in the Block 3i configuration from production Lot 6 or later, and may require a post-production OBIGGS modification, which could compete for resources with the aircraft scheduled for IOT&E.

• Management of the SLLP Group 2 modifications will need to be handled carefully as the program and Services prepare for IOT&E. If the program does not schedule SLLP Group 2 modifications to operational test aircraft until after IOT&E is completed, 495 flight hours must remain before reaching that life limit so aircraft can fully participate in IOT&E, per the approved TEMP.

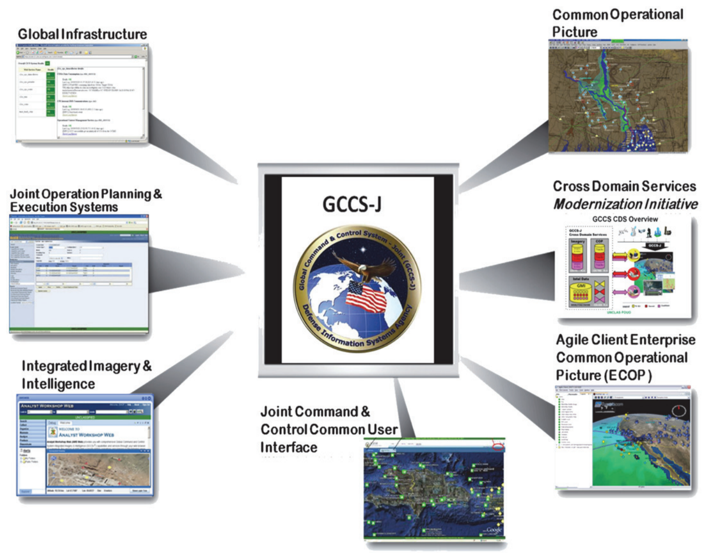
Recommendations

• Status of Previous Recommendations. The program and Services have been addressing the redesign and testing of the OBIGGS system, but performance assessment has not yet been completed. The Program Office addressed the vulnerability of the electrical power system to ballistic threats. The remaining recommendations concerning the reinstatement of the PAO shut-off valve, reinstatement of the dry-bay fire extinguisher system, design and reinstatement of fueldraulic shut-off system, improvement of the Integrated Caution and Warning system to provide the pilot with necessary vulnerability information, and a higher resolution estimate of time remaining for controlled flight after a ballistic damage event are all outstanding.
• FY14 Recommendations. The program should:
1. Update program schedules to reflect the start of spin-up training for IOT&E to occur no earlier than the operational test readiness review planned for November 2017, and the associated start of IOT&E six months later, in May 2018.
2. The program should complete lab testing of the mission data loads, as is planned in the mission data optimization operational test plan, prior to accomplishing the necessary flight testing to ensure the loads released to the fleet are optimized for performance. If mission data loads are released to operational units prior to the completion of the lab and flight testing required in the operational test plan, the risk to operational units must be clearly documented.
3. The program should complete the remaining three Block 2B weapon delivery accuracy (WDA) flight test events using the currently planned scenarios and ensuring full mission

systems functionality is enabled in an operationally realistic manner.

4. The program should require the contractor to conduct rigorous finite-element analyses to assess the benefit of LSP application for the F-35B durability test article and for the F-35B FS496 bulkhead redesign.
5. The program should provide adequate resourcing to support the extensive validation and verification requirements for the Block 3 VSim in time for IOT&E, including the data needed from flight test or other test venues.
6. To accelerate verification of JTD modules, the program should provide dedicated time on fielded aircraft for F-35B JTD verification teams.
7. Extend the full-up system-level decontamination test to demonstrate the decontamination system effectiveness in a range of operationally realistic environments.
8. The program should ensure adequate testing of ALIS software upgrades on operationally-representative hardware is complete prior to fielding to operational units.

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



Executive Summary

In FY14, Defense Information Systems Agency (DISA) development of Global Command and Control System – Joint (GCCS-J) focused on implementing high-priority capability enhancements, infrastructure improvements, and software defect corrections to both the GCCS-J Global (referred to as Global) and Joint Operation Planning and Execution System (JOPES).

Global

- DISA developed Global v4.3 to move the baseline towards a more flexible and service-oriented architecture and provide high-priority updates to the Integrated Command, Control, Communications, Computers, and Intelligence System Framework; Joint Targeting Toolbox (JTT); and Modernized Integrated Database (MIDB).
  - Operational testing of Global v4.3, conducted by the Joint Interoperability Test Command (JITC) in June and August 2013, identified several critical defects relating to the MIDB and to the T-Sync server, both of which are used to synchronize targeting data between different versions of the MIDB database.
- DISA developed Global v4.3 Update 1 to implement additional high-priority updates and improvements to JTT and incorporate fixes to critical MIDB defects. JITC conducted an operational test on Global v4.3 Update 1 in August 2014.
  - GCCS-J v4.3 Update 1 is effective for use in higher echelons where the primary interfaces are those defined as joint critical.
  - GCSS-J v4.3 is operationally suitable.
  - The National Security Agency (NSA) discovered nine major cybersecurity vulnerabilities after conducting a cooperative Blue Team assessment of the GCCS-J v4.3 baseline in April 2014. GCCS-J v4.3 Update 1 is not survivable until DISA corrects major cybersecurity vulnerabilities identified by the NSA.
- DISA approved Global v4.3 Update 1 fielding in September 2014.

JOPES

- DISA developed JOPES v4.2.0.3 to implement the required framework for interoperability and synchronization between JOPES and Defense Readiness Reporting System – Strategic (DRRS-S). DRRS-S will replace Status of Resources and Training (SORTS) as the readiness reporting system of record following successful operational testing of DRRS-S.
  - During the November 2013 operational test when JOPES v4.2.0.3 was interfaced to a test DRRS-S system, users identified nine critical defects. A JOPES regression test with DRRS-S in May 2014 supported the validation and closure of all nine critical defects.
  - During operational testing, JOPES v4.2.0.3 performed correctly with the legacy Global Status of Resources and Training (GSORTS). JOPES v4.2.0.3 was approved for fielding in June 2014, with the interface to remain with GSORTS.

System

- GCCS-J consists of hardware, software (commercial off-the-shelf and government off-the-shelf), procedures, standards, and interfaces that provide an integrated near real-time picture of the battlespace necessary to conduct joint and multi-national operations. GCCS-J consists of a client/server architecture using open-systems standards, government-developed military planning software, and an increasing use of World Wide Web technology.
- GCCS-J consists of two components:
  - Global (Force Protection, Situational Awareness, Intelligence applications)
  - JOPES (Force Employment, Projection, Planning, and Deployment/Redeployment applications).

Mission

Joint Commanders utilize the GCCS-J to accomplish command and control.

Global

- Commanders use Global:
  - To link the National Command Authority to the Joint Task Force, Component Commanders, and Service-unique systems at lower levels of command
  - To process, correlate, and display geographic track information integrated with available intelligence and

environmental information to provide the user a fused battlespace picture
  - To provide Integrated Imagery and Intelligence capabilities, which integrate imagery and other relevant intelligence into the common operational picture and allow commanders to manage and produce target data using the JTT
  - To provide a missile warning and tracking capability
- Air Operations Centers use Global:
  - To build the air picture portion of the common operational picture and maintain its accuracy
  - To correlate or merge raw track data from multiple sources
  - To associate raw Electronics Intelligence data with track data
  - To perform targeting operations

JOPES

- Commanders use JOPES:
  - To translate policy decisions into operations plans to meet U.S. requirements for the employment of military forces
  - To support force deployment, redeployment, retrograde, and re-posturing
  - To conduct contingency and crisis action planning

Major Contractors

- Government Integrator: DISA
- Software Developers:
  - Northrop Grumman – Arlington, Virginia
  - Leidos – Arlington, Virginia
  - Pragmatics – Arlington, Virginia

Activity

Global

- JITC and the Air Force conducted Global v4.3 testing at multiple echelons. JITC led testing at the higher Combatant Command echelon, conducting operational testing in June and August 2013, to support the DISA Global v4.3 fielding decision in September 2013.
- DISA developed Global v4.3 Update 1 to address deficiencies identified during Global v4.3 operational testing. Global v4.3 Update 1 provides high-priority intelligence mission updates to the Theater Ballistic Missile correlation systems, JTT, and MIDB. The update also resolves 49 defects affecting other parts of the system and implements security lockdown scripts and Information Assurance Vulnerability Alert updates.
- The NSA conducted a cooperative Blue Team assessment of GCCS-J v4.3 baseline in April 2014.
- JITC led Combatant Command-level testing, conducting operational testing of Global v4.3 Update 1 from August 13 – 21, 2014, in accordance with the DOT&E-approved operational test plan.
- DISA approved Global v4.3 Update 1 fielding in September 2014.
- DOT&E submitted an OT&E report on GCCS-J Global v4.3 Update 1 in December 2014.

JOPES

- JITC, in conjunction with DISA, conducted a system acceptance test/operational test of the DRRS-S interface to JOPES from November 12 – 22, 2013.
- JITC, in conjunction with DISA, conducted a regression test of the DRRS-S v4.6.1 interface to JOPES from May 12 – 23, 2014.
- DISA approved JOPES v4.2.0.3 fielding in June 2014.
- JITC and DISA conducted all testing in accordance with the DOT&E-approved Test and Evaluation Master Plan.
- DOT&E did not issue a report on the JOPES v4.2.0.3 system acceptance test/operational test, in accordance with DOT&E Guidelines for Operational Test and Evaluation of Information and Business Systems, September 14, 2010.

Assessment

Global

- GCCS-J v4.3 Update 1 is effective for use in higher echelons where the primary interfaces are those defined as joint critical.
  - Further operational testing is required to determine the effectiveness for lower echelons, such as Air Operations Centers, where significantly more mission-critical interfaces are required. Some of these interfacing systems will need to be updated to properly interface with the MIDB 2.2, using interfacing services provided by GCCS-J.
  - The 46th Test Squadron will test lower echelon interfaces in September through November 2014. Operational testing for lower echelons is planned for FY17.
- The Blue Team assessment of GCCS-J v4.3 baseline found nine major cybersecurity vulnerabilities.
  - Although DISA made some corrective actions to the tested baseline, they still need to address most of the vulnerabilities. In general, these vulnerabilities continue in a Plan of Action and Milestones status for Global v4.3 Update 1.
  - GCCS-J v4.3 Update 1 is not survivable until DISA corrects major cybersecurity vulnerabilities identified by NSA.
- Independent, threat-representative adversarial testing for GCCS-J v5.0 is scheduled in January 2015.
- MIDB version 2.2 corrects critical problems that existed in the MIDB 2.1 Patch 13 version that was used with GCCS-J 4.3.
  - GCCS- 4.3 Update 1 was effective for operational use in mixed GCCS-J v4.2.0.9/GCCS-J v4.3 Update 1

environments where users at multiple sites need to collaborate on targeting tasks.
  - Sharing of targeting information in mixed GCCS-J v4.2.0.9/GCCS-J v4.3 Update 1 environments occurs through the T-Sync system, which is needed to achieve MIDB data synchronization across the different MIDB versions. Synchronization between different versions of the MIDB occasionally displayed slowness, and in one case, a target list did not fully replicate.
  - Close collaboration between operators working on different versions of the MIDB to build a combined target list will be needed until legacy versions of GCCS-J Global are phased out in the FY17 timeframe.
- GCCS-J v4.3 Update 1 is operationally suitable.
  - Priority 3 defect workaround instructions were accurately updated and available to the operational community.
  - GCCS-J v4.3 Update 1 servers and clients demonstrated an operational availability of 0.99.
  - Users rated the system data as usable and useful, providing recent, relevant, data.
  - Users felt the system supported task accomplishment, agreed it was better than the legacy system, and agreed it was sufficient to conduct their mission.
  - The help desk was responsive and worked all resolvable GCCS-J problems to closure. Users rated online help favorably.

JOPES
- During the November 2013 operational test when JOPES v4.2.0.3 was interfaced to DRRS-S, users identified nine critical defects. Users found the JOPES/DRRS-S interface to be unreliable and overly complex to maintain. Users also noted there was no validated process to determine if the databases were out-of-sync, and the process to re-sync the databases was not clear. The planning community was unable to use the DRRS-S Planning and Execution Dashboards to support plan analysis. Users also reported data discrepancies between the plan data in JOPES and the data in DRRS-S. Database comparisons confirmed data accuracy with DRRS-S failed to meet the Key Performance Parameter threshold.
- The May 2014 JOPES regression test with DRRS-S supported the validation and closure of all nine critical defects. The JOPES-DRRS-S interface showed significant improvement in its ability to support the upcoming DRRS-S operational testing, which is planned for May 2015.
- During operational testing, JOPES v4.2.0.3 performed correctly with the legacy GSORTS. DISA approved JOPES v4.2.0.3 for fielding in June 2014, with the interface to remain with GSORTS. DRRS-S will replace SORTS as the readiness reporting system of record following successful operational testing of DRRS-S.

Recommendations
- Status of Previous Recommendations. DISA and the Defense Intelligence Agency successfully addressed all previous recommendations.
- FY14 Recommendations. DISA should:
  1. Correct the nine major cybersecurity vulnerabilities identified by the NSA during the cooperative Blue Team assessment of the GCCS-J v4.3 baseline.
  2. Conduct NSA Red Team testing at a Combatant Command site to assess detect, react, and restore capabilities of GCCS-J and its net defenders.

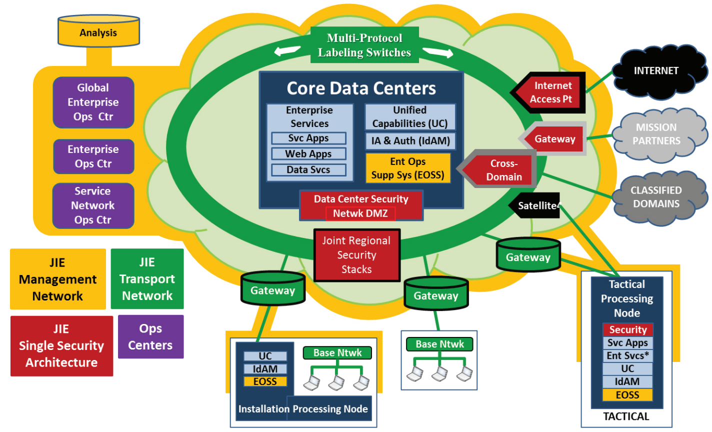
Joint Information Environment (JIE)

Executive Summary

- Following the establishment of requirements by a Chairman of the Joint Chiefs of Staff White Paper and Deputy Secretary of Defense implementation guidance in 2013, DOT&E placed the Joint Information Environment (JIE) on test and evaluation oversight in August 2013.
- JIE is not a program of record, and to date, the Defense Information Systems Agency (DISA) and the Services have not conducted any operational testing of the JIE infrastructure or components. Furthermore, the operational parameters required for DOT&E to review and evaluate JIE are still under development by U.S. Cyber Command.
- DOT&E is working with the DISA Test and Evaluation Office to plan for an early operational assessment of JIE in FY15.

Capability and Attributes

- The JIE is envisioned as a shared information technology construct for DOD to improve physical infrastructure, increase the use of enterprise services, and centralize the management of network security. The Joint Staff specifies the following enabling characteristics for the JIE capability:
  - Transition to centralized data storage
  - Rapid delivery of integrated enterprise services (such as email)
  - Real-time cyber awareness
  - Scalability and flexibility to provide new services
  - Use of common standards and operational techniques
  - Transition to a single security architecture
- The DOD plans to achieve these goals via the following interrelated initiatives:
  - Implementation of Joint Regional Security Stack (JRSS) hardware and other security constructs as part of a single security architecture. These will establish a federated network structure with standardized access and authentication management, as well as centralized defensive cyber operations and DOD Information Network defense.
  - Consolidation of applications and data into centralized data centers at the regional or global level, which are not segregated by military Service.
  - Upgrade of the physical infrastructure to include Multi-Protocol Label Switching (MPLS), which enables higher bandwidth/throughput, and faster routing capabilities.
  - Establishment of enterprise operation centers to centralize network management and defense.
- JIE is not a program of record, but is being managed by the DOD Chief Information Officer (CIO), with DISA as the principal integrator for services and testing. An Executive Committee, chaired by the CIO, U.S. Cyber Command, and the Joint Staff J6, provide JIE governance. The initial implementation of the JIE has begun both in the U.S. and in the European theater with the establishment of the first capabilities. Installations are ongoing in Europe, but implementation and cutover dates remain uncertain. Additional theaters of interest are the Pacific, Southwest Asia, and the continental United States.



Base Ntwk - Base Network
Data Svcs - Data Services
EOSS - Ent Ops Supp Sys - Enterprise Operations Support System
Ent Svcs - Enterprise Services
IdAM - IA & Auth - Information Assurance and Authentication
Netwk DMZ - Network Demilitarized Zone
Ops - Operations
Ops Ctr - Operations Center
Svc Apps - Service Applications
UC - Unified Capabilities
Web Apps - Web Applications

Activity

- The Chairman, Joint Chiefs of Staff published a White Paper on the JIE in January 2013 and the Deputy Secretary of Defense published implementation guidance for JIE in May 2013. DOT&E subsequently put the JIE initiative on test and evaluation oversight in August 2013.
- DISA has rescheduled an early operational assessment of the European theater capabilities originally planned for March 2014 to 2QFY15 to accommodate the engineering, installation, and implementation of the initial JRSS and MPLS capabilities. DISA reports that these operational capabilities will be only partially implemented in time for the first operational assessment; DOT&E plans to conduct an additional assessment when the full capabilities are implemented. The availability of test sites for JIE and component tests are limited and advanced planning for future tests is not fully matured.
- In FY14, DISA conducted extensive lab-based testing and installation/functional testing of both JRSS and MPLS at the DISA facilities at Fort Meade, Maryland, and Joint Base San Antonio, Texas. While installations of key JIE infrastructure continue in the European area, training and

development of operational procedures and concepts are ongoing. The JRSS installation at Joint Base San Antonio is now providing some services to support both Army and Air Force network operations, but has not been fully implemented as yet. No operational tests have been conducted of JIE infrastructure, components, tactics, procedures, or operational concepts to date, but DOT&E continues to monitor the development of key test plans and concepts.
- DISA has established a test and evaluation working-level Integrated Product Team in which DOT&E, the Services, USD(AT&L), and DOD CIO representatives participate.

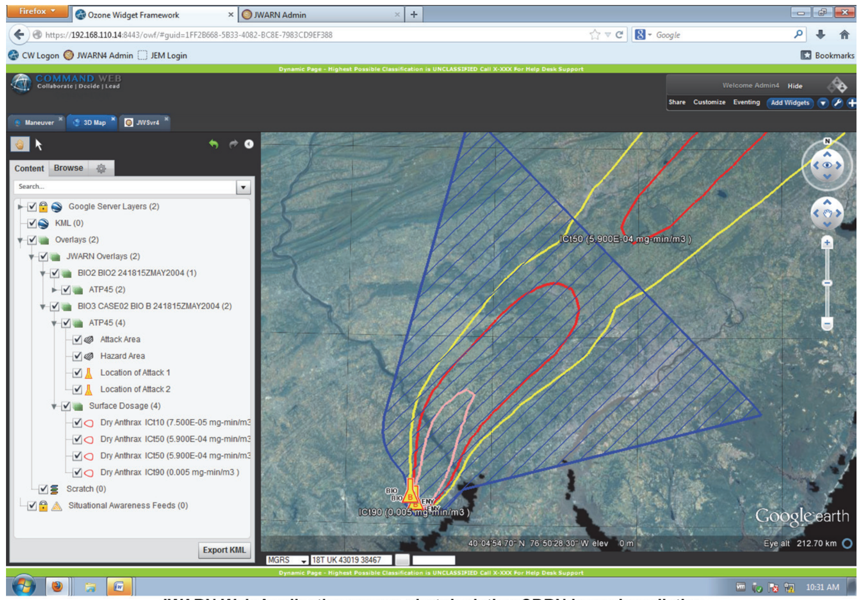
Assessment
- No operational test data are available at this point.
- Developmental and laboratory testing continues at initial JRSS sites at Joint Base San Antonio, Texas, and the DISA Enterprise Services Lab at Fort Meade, Maryland. To date, testing focuses on system functionality and DISA has not yet scheduled full cybersecurity testing.

Recommendations
- Status of Previous Recommendations. The DOD CIO and Director of DISA are addressing the previous recommendations in that test schedules and plans continue to be prepared for anticipated test events in FY15 and long-range and overarching test strategies are being developed.
- FY14 Recommendations. DISA should:
  1. Examine the availability of cyber range resources to augment the existing physical installations available for testing.
  2. Continue to develop an overarching test strategy that encompasses not only the upcoming testing of JIE in Europe, but also defines the key issues and concepts to be tested in subsequent tests and assessments. Such a plan should address the following areas of interest:
     - Overarching T&E framework and critical test issues
     - The role of both lab and fielded equipment tests in resolving those critical issues
     - Estimated schedules for test events and key issues to be tested
     - Evaluation criteria and any relevant implementation decisions points
     - Resources required
     - The role of the Services and Service-sponsored Operational Test Agencies

Joint Warning and Reporting Network (JWARN)

Executive Summary

- The Army Test and Evaluation Command (ATEC) conducted operational testing of the Joint Warning and Reporting Network (JWARN) Web Application during the Network Integration Evaluation (NIE) 14.1 from October 3 to November 17, 2013, at Fort Bliss, Texas, and during the Ulchi Freedom Guardian 14 exercise from August 17 – 29, 2014, in the Republic of Korea.
- The JWARN Web Application provides an operationally effective tool to provide nuclear, biological, and chemical situational awareness and support operational decision making to protect units operating 10 or more kilometers from the initial chemical, biological, radiological, and/or nuclear (CBRN) release.
- The JWARN Web Application is not operationally suitable due to the lack of adequate training tools for operators to maintain the high level of operator proficiency required and the complexity of JWARN Web Application installation and configuration procedures.



JWARN Web Application screen shot depicting CBRN hazard prediction overlay on common operational map

System

- The JWARN is a joint automated CBRN warning, reporting, and analysis software tool that resides on joint and Service command and control systems including the Global Command and Control System (GCCS) – Army, GCCS – Joint, GCCS – Maritime, and Command and Control Personal Computer/Joint Tactical Common Workstation.
- The JWARN Web Application is a web-based application that resides on the Battle Command and Control System server that is accessed by JWARN operators using a client computer operating within the Army Capability Set 13/14 network environment. It has been modified to operate in the Army Capability Set 11/12 network environment. The JWARN Web Application can also be installed and operate on a stand-alone computer.
- JWARN software automates the NATO CBRN warning and reporting process to increase the speed and accuracy of information sharing to support force protection decision making and situational awareness.
- JWARN uses the common operating picture of the host command and control system or computing environment to display the location of CBRN events and the predicted or actual location of hazards to support the commander's situational awareness and operational decision making.

Mission

JWARN operators support the commander's force protection and operational decisions by providing analysis of potential or actual CBRN hazard areas based on operational scenarios or sensor and observer reports; identifying affected units and operating areas; and transmitting warning reports.

Major Contractor

Northrop Grumman Mission Systems – Orlando, Florida

Activity

- ATEC conducted operational testing of the JWARN Web Application within the Army Capability Set 13/14 network environment during NIE 14.1 from October 3 to November 17, 2013, at Fort Bliss, Texas. Testing was conducted in accordance with a DOT&E-approved test plan.
- The Army Research Laboratory Survivability Lethality Analysis Directorate conducted a cybersecurity vulnerability assessment of the JWARN Web Application from June 24 – 27, 2014, at the Tactical Systems Integration Facility at Aberdeen Proving Ground, Maryland.

- ATEC conducted operational testing of the JWARN Web Application within the Army Capability Set 11/12 network environment and a stand-alone version of JWARN during the Ulchi Freedom Guardian 14 exercise from August 17 – 29, 2014 in the Republic of Korea. ATEC conducted the test during an operational exercise, which limited the ability to execute the test in accordance with the DOT&E-approved test plan. This did not preclude collecting the data necessary to resolve the key issues that the test was designed to address.

Assessment

- The JWARN Web Application is operationally effective to provide CBRN warning reports in time for units operating 10 or more kilometers from the initial CBRN release to institute force protection actions before encountering CBRN hazards. It provides enhanced nuclear, biological, and chemical situational awareness and supports operational decision making in response to CBRN threats by automating the NATO Allied Technical Publication-45 process of warning, reporting, and hazard prediction. During operational testing at NIE 14.1, the JWARN did not provide an audible alert on the operator's computer when a warning report was received or a banner alert if the warning was received from another JWARN operator. The alerting capability was implemented and successfully demonstrated during the Ulchi Freedom Guardian 14 exercise in Korea.
- The JWARN Web Application is interoperable with both Army Capability Set 11/12 and 13/14 network-operating environments.
- The JWARN Web Application is not operationally suitable due to the lack of adequate training tools for operators to maintain the high level of operator proficiency required and the complexity of JWARN Web Application installation and configuration procedures. Prior to testing during NIE 14.1, there was no formal system administrator training on installing JWARN on the network servers. This resulted in a seven-hour delay in establishing JWARN functions within the brigade test unit.
- The JWARN Web Application software is reliable and demonstrated an operational availability of 96 percent during operational testing at NIE 14.1.

Recommendations

- Status of Previous Recommendations. The program manager has addressed the previous recommendation to field computer-based training for JWARN on Command and Control Personnel Computer, GCCS – Joint, GCCS – Army, and GCCS – Maritime. However, the program manager has not yet implemented computer-based proficiency training to support the deployment of the JWARN Web Application, which requires a different approach to keep pace with continuous software upgrades and the various web-based services with which JWARN interfaces. The computer-based training includes practical exercises and tests.
- FY14 Recommendations. The Program Office should:
  1. Consider utilizing the stand-alone version of the JWARN Web Application and CBRN operational scenarios of varying complexity for use as a training tool to maintain operator proficiency.
  2. Develop and field a JWARN Web Application installation wizard to minimize errors during installation of the JWARN Web Application.

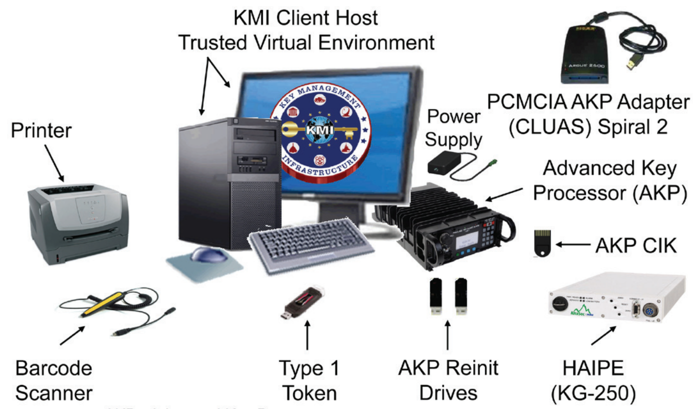
Key Management Infrastructure (KMI)

Executive Summary

- The Key Management Infrastructure (KMI) Program Management Office (PMO) and Joint Interoperability Test Command (JITC) completed the KMI Spiral 2 Test and Evaluation Master Plan (TEMP) Addendum, and DOT&E approved it on March 7, 2014.
- The National Security Agency (NSA) Senior Acquisition Executive declared a KMI program deviation on August 29, 2014, due to missing the Acquisition Program Baseline's Spiral 2, Spin 1 software release date in July 2014. The PMO's revised release date will be January 31, 2015.
- JITC conducted an operational assessment (OA) of Spiral 2, Spin 1 capabilities and the new KMI tokens in September 2014. DOT&E issued a classified OA report in November 2014.
- The OA successfully demonstrated new KMI capabilities for supporting F-22 Raptor, Advance Extremely High Frequency and Mobile User Objective System Satellite systems, Benign Keying, Secure Terminal Equipment enhanced cryptographic cards, new tokens, and transition procedures. The OA concluded with no high-priority discrepancies.
- While the OA was successful, DOT&E and JITC identified the following areas for improvement:
  - The KMI system executed the Secure Software Provisioning capability as designed; however, due to inadequate training and procedural problems, the KMI staff had difficulty uploading and titling the software packages for distribution to KMI operating accounts. Secure Software Provisioning did not perform properly for file uploads and downloads, and installation procedures were inadequate.
  - The NSA and Service help-desk manning and training observed during the OA is inadequate to meet KMI installation, network, and daily activities for Service worldwide transition and rollout of the Spiral 2, Spin 1 system.
  - Additional training and enhanced standard operating procedures are needed at the KMI sites to leverage the automated notifications in the KMI system. Those procedures need to be refined and rehearsed for routine and critical situations.

System

- KMI is intended to replace the legacy Electronic Key Management System to provide a means for securely ordering, generating, producing, distributing, managing, and auditing cryptographic products (e.g., encryption keys, cryptographic applications, and account management).



AKP - Advanced Key Processor
CIK - Crypto Ignition Key
CLUAS - Card Loader User Application Software
HAIPE - High Assurance Internet Protocol Encryptor
PCMCIA - Personal Computer Memory Card International Association
Reinit - Reinitialization

- KMI consists of core nodes that provide web operations at sites operated by the NSA, as well as individual client nodes distributed globally to enable secure key and software provisioning services for the DOD, intelligence community, and agencies.
- KMI combines substantial custom software and hardware development with commercial off-the-shelf computer components. The custom hardware includes an Advanced Key Processor for autonomous cryptographic key generation and a Type 1 user token for role-based user authentication. The commercial off-the-shelf components include a client host computer, High Assurance Internet Protocol Encryptor (KG-250), monitor, keyboard, mouse, printer, and barcode scanner.

Mission

- Combatant Commands, Services, DOD agencies, other Federal Government agencies, coalition partners, and allies will use KMI to provide secure and interoperable cryptographic key generation, distribution, and management capabilities to support mission-critical systems, the DOD Information Networks, and initiatives such as Cryptographic Modernization.
- Service members will use KMI cryptographic products and services to enable security services (confidentiality, non repudiation, authentication, and source authentication) for diverse systems such as Identification Friend or Foe, GPS, Advanced Extremely High Frequency Satellite System, and Warfighter Information Network – Tactical.

Major Contractors

- Leidos– Columbia, Maryland (Spiral 2 Prime)
- General Dynamics Information Assurance Division – Needham, Massachusetts (Spiral 1 Prime)
- BAE Systems – Linthicum, Maryland
- L3 Communications – Camden, New Jersey
- SafeNet – Belcamp, Maryland
- Praxis Engineering – Annapolis Junction, Maryland

Activity

- The PMO and JITC completed the KMI Spiral 2 TEMP Addendum, and DOT&E approved it on March 7, 2014. The KMI TEMP Addendum describes the test and evaluation strategy to support planned Spiral 2 program activities. The PMO and JITC produced the TEMP Addendum to align the formal test program with the PMO's implementation of an Agile software development methodology. The PMO is planning four software releases (one spin per year) that will lead to a Full Deployment Decision by April 2017.
- The PMO rolled out new KMI tokens in May 2014 to reduce fault modes and improve reliability. The PMO conducted reliability growth tests to evaluate the tokens, and the JITC and Service representatives evaluated the new tokens in Spiral 2, Spin 1 Developmental Test and Evaluation (DT&E) events in June and July 2014.
- The NSA Senior Acquisition Executive declared a KMI program deviation on August 29, 2014, due to missing the Acquisition Program Baseline's Spiral 2, Spin 1 software release date in July 2014. The PMO's revised release date is January 31, 2015.
- JITC conducted an OA of Spiral 2, Spin 1 capabilities and the new KMI tokens in September 2014.
- DOT&E issued a classified OA report in November 2014.
- JITC is developing plans for a Spiral 2, Spin 1 Limited User Test to be conducted in 2QFY15 to demonstrate that the KMI system operates comparably in the operational environment as it did in the OA's representative environment, and to gain Service stakeholder acceptance.

Assessment

- Users are satisfied with the existing Spiral 1 performance and capabilities, and the overall KMI capability is significantly improved and stable.
- The KMI PMO and test community devised a sound test approach to support the program's Agile development methodology and planned capability releases, resulting in the Spiral 2 KMI TEMP Addendum's approval.
- At the recommendation of DOT&E, the KMI PMO adopted and implemented automated software testing, additional KMI token testing, and reliability growth efforts that yielded substantive improvements in system performance and stability as observed during the Spiral 2, Spin 1 OA.
- In the government-led DT&E-2 in June 2014, JITC and Service test participants identified high-priority deficiencies, and the KMI PMO directed the developer to correct the problems and release an updated baseline to the KMI system.
- The subsequent DT&E-2 retest in late June 2014 identified additional, high-priority deficiencies and structural problems in the KMI database. These problems were exacerbated by inadequate schedule allocation before and after the DT&Es. The PMO resolved problems found in the DT&E-2 retest by mid-August 2014. The KMI PMO delayed the start of the OA approximately 60 days until sufficient regression testing was conducted to ensure the system was ready to move to the next phase of testing.
- A combination of 22 operationally representative Air Force, Army, Marine Corps, Navy, and civil KMI accounts participated during the OA at geographically-dispersed sites.
- The OA concluded with no high-priority discrepancies. The OA successfully demonstrated new KMI capabilities for supporting F-22 Raptor, Advance Extremely High Frequency and Mobile User Objective System Satellite systems, Benign Keying, Secure Terminal Equipment enhanced cryptographic cards, new tokens, and transition procedures.
- While the OA was successful, DOT&E and JITC identified the follows areas for improvement:
  - The KMI system executed the Secure Software Provisioning capability as designed; however, due to inadequate training and procedural problems, the KMI staff had difficulty uploading and titling the software packages for distribution to KMI operating accounts. Secure Software Provisioning did not perform properly for file uploads and downloads, and installation procedures were inadequate.
  - The NSA and Service help desk manning and training observed during the OA is inadequate to meet KMI installation, network, and daily activities for Service worldwide transition and rollout of the Spiral 2, Spin 1 system.
  - Additional training and enhanced standard operating procedures are needed at the KMI sites to leverage the automated notifications in the KMI system. Those procedures need to be refined and rehearsed for routine and critical situations.
- JITC assessed interoperability for fill devices, end cryptographic units, and the Electronic Key Management System information exchanges. The KMI Spiral 2, Spin 1 system is on pace to achieve interoperability.
- Continuity of operations planning and facility preparations are nearing completion; continued efforts are necessary to refine and test those capabilities and procedures.

- JITC did not evaluate KMI Spiral 2 cybersecurity in the OA but will in future test events in accordance with the KMI TEMP Addendum approved in March 2014.

Recommendations

- Status of Previous Recommendations. The KMI PMO satisfactorily addressed the four FY13 recommendations.
- FY14 Recommendations. The KMI PMO should:
  1. Continue to improve the KMI software development and regression processes rigor to identify and resolve problems before entering operational test events.
  2. Ensure adequate schedule time is allocated to support test preparation, regression, post-test data analysis, verification of corrections, and reporting to support future deployment and fielding decisions.
  3. Develop, codify, and distribute standard operating procedures to KMI Storefront operators and users for functions that require routine to critical coordination across the enterprise.
  4. Continue to verify increased KMI token reliability through a combination of laboratory and operational testing with automated data collection from system logs for accurate reliability and usage analysis.
  5. Fully execute the continuity of operations plan to ensure procedures and redundant facilities are adequate.

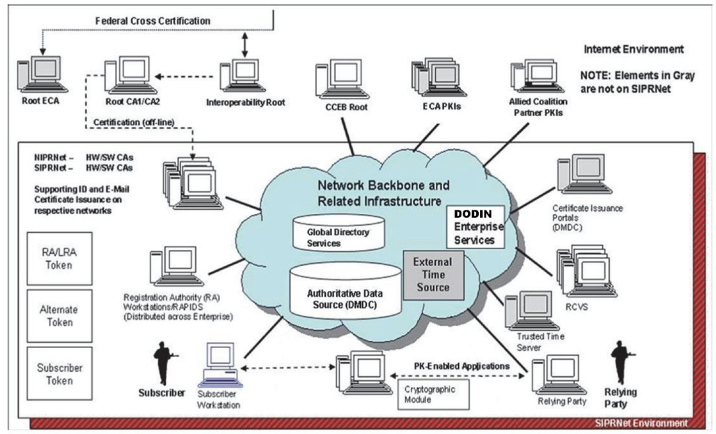
Public Key Infrastructure (PKI)

Executive Summary

- The FOT&Es I and II, conducted in January 2013, revealed effectiveness and suitability problems. Although no independent operational testing has been completed since then, the program manager has been actively addressing the requirements definition and system engineering problems that led to these deficiencies, while making program personnel and contract management process changes to improve the program. An expert token reliability team is currently addressing ongoing token reliability problems in the field.
- In October 2013, the DOD Public Key Infrastructure (PKI) program manager notified the Milestone Decision Authority, then DOD Chief Information Officer but now USD(AT&L), that it would exceed the criteria established for a critical change as defined in Title 10, United States Code (U.S.C.), section 2445c, and would be unable to achieve a Full Deployment Decision (FDD) within five years of the selection of the preferred alternative. The National Security Agency (NSA) Senior Acquisition Executive declared a schedule-related PKI program critical change in October 2013, and subsequently a cost-related change in March 2014.
- In July 2014, USD(AT&L) recertified the PKI program to Congress in accordance with 10, U.S.C., section 2445c(d), and in an Acquisition Decision Memorandum (ADM) further approved the PKI Program Management Office's (PMO's) funding obligation authorities for $10 Million through September 2014 to ensure no disruption of PKI Increment 2 program service while restructuring following the critical change.
- Due to program delays resulting from the critical change, the PKI PMO did not conduct any operational testing in FY14.
- The DOD PKI program manager has drafted an Acquisition Strategy that focuses the remaining Increment 2 Spirals (3 and 4) on 15 user-prioritized capabilities. These capabilities will improve Secret Internet Protocol Router Network (SIPRNET) token management and reporting, improve system availability, and will provide new infrastructures for the provisioning and management of the Non-secure Internet Protocol Router Network (NIPRNET) Enterprise Alternate Token System (NEATS) and certificates to Non-Person Entities (NPEs) (e.g., workstations, web servers, and mobile devices).

System

- DOD PKI provides for the generation, production, distribution, control, revocation, recovery, and tracking of public key certificates and their corresponding private keys. The private keys are encoded on a token, which is a credit-card sized smartcard embedded with a microchip.



CA – Certificate Authority
CCEB – Combined Communications Electronic Board
DMDC – Defense Enrollment Eligibility Reporting System
DODIN – Department of Defense Information Networks
ECA – External Certification Authority
LRA – Local Registration Authority
NIPRNet – Non-secure Internet Protocol Router Network
RA – Registration Authority
RAPIDS – Real-Time Automated Personnel Identification System
RCVS – Robust Certificate Validation Service
SIPRNet – SECRET Internet Protocol Router Network

- DOD PKI supports the secure flow of information across the DOD Information Networks as well as secure local storage of information.
- DOD PKI uses commercial off-the-shelf hardware, software, and applications developed by the NSA.
  - The Defense Enrollment Eligibility Reporting System (DEERS) and Secure DEERS provide the personnel data for certificates imprinted on NIPRNET Common Access Cards and SIPRNET tokens, respectively.
  - DOD PKI Certification Authorities for the NIPRNET and SIPRNET tokens reside in the Defense Information Systems Agency Enterprise Service Centers in Oklahoma City, Oklahoma, and Mechanicsburg, Pennsylvania.
- Increment 1 is complete and deployed on the NIPRNET. The NSA is developing PKI Increment 2, and the Defense Information Systems Agency is supporting PKI operations, enablement, and security solutions.
- Increment 2 is being developed and deployed in four spirals on the SIPRNET and NIPRNET. Spirals 1 and 2 are deployed, while Spirals 3 and 4 will deliver the infrastructure, PKI services and products, and logistical support required by the 15 user-prioritized capabilities.

Mission

- Military operators, communities of interest, and other authorized users will use DOD PKI to securely access, process, store, transport, and use information, applications, and networks.
- Commanders at all levels will use DOD PKI to provide authenticated identity management via personal identification,

number-protected Common Access Cards or SIPRNET tokens to enable DOD members, coalition partners, and others to access restricted websites, enroll in online services, and encrypt and digitally sign e-mail.
- Military network operators will use NPE certificates to create secure network domains, which will facilitate intrusion protection and detection.

Major Contractors
- General Dynamics C4 Systems – Scottsdale, Arizona (Prime)
- 90Meter – Newport Beach, California
- SafeNet – Belcamp, Maryland
- Red Hat – Richmond, Virginia

Activity
- In October 2013, the PKI program manager notified the Milestone Decision Authority that it would exceed the criteria established for a critical change as defined in Title 10, U.S.C., section 2445c, and would be unable to achieve an FDD within five years of the selection of the preferred alternative. The NSA Senior Acquisition Executive declared a schedule-related PKI program critical change in October 2013, and subsequently for cost in March 2014.
- The program was unable to achieve the FDD objective date of March 2013 established in the Major Automated Information System original estimate to Congress. The one-year breach occurred in March 2014, and the five-year breach occurred in April 2014.
- At the Defense Acquisition Executive Summary review in April 2014, the PKI program manager identified problems with PKI requirements, Acquisition Strategy, funding, and schedule supportability.
- In May 2014, the PKI PMO conducted initial vendor developmental tests for planned Token Management System (TMS) Release 3.0 enhancements.
- In July 2014, the USD(AT&L) recertified the PKI program to Congress in accordance with Title 10, U.S.C., section 2445c(d), and in an ADM, which further approved the PKI PMO funding obligation authorities for $10 Million through September 2014 to ensure no disruption of PKI Increment 2 program service while restructuring following the critical change.
- The PKI PMO is currently revising the PKI Acquisition Strategy and plans to complete Spirals 3 and 4 by 3QFY17.
- The PMO is also updating the PKI System Engineering Plan, Spiral 3 Test and Evaluation Master Plan (TEMP) Addendum, Life Cycle Sustainment Plan, and Transition Plan.
- In late September 2014, the USD(AT&L) signed a PKI Increment 2 restructure ADM that restored the PMO's obligation authorities and provided directives for updating important-planning documents, including the Spiral 3 and 4 TEMP Addenda.
- The PKI PMO did not conduct any operational testing in FY14. JITC will examine interoperability and information security during Limited User Tests and subsequent FOT&E events tentatively scheduled for 2015 and later.

Assessment
- The PKI PMO's contractor-led TMS Release 3.0 developmental test and evaluations (DT&Es) demonstrated increased planning and execution rigor. The PMO is planning additional government DT&Es in September and November 2014, but will not conduct TMS operational testing until September 2015.
- The FOT&Es I and II, conducted in January 2013, revealed effectiveness and suitability problems. Although no independent operational testing has been completed since then, the program manager is addressing the requirements definition and system engineering problems that led to these deficiencies, while making program personnel and contract management process changes to improve the program's ability to achieve current restructured goals. An expert token reliability team is currently addressing ongoing token reliability problems in the field.
- The NSA Information Assurance Directorate (IAD) continues efforts to improve PKI token reliability. The PKI PMO's token vendor recently developed token version 3.2 that is intended to correct several known faults in the token's operating system. However, the NSA IAD will not certify the 3.2 token's operating system prior to distributing 65,000 new tokens to the Marine Corps and Air Force by the end of September 2014. It is possible more may be distributed before the next token version 3.3 is certified.
- System reliability, availability, and maintainability of the core PKI infrastructure continue to present problems as reported by users in the field. The PMO has implemented changes to improve overall system reliability; however, these changes have not been independently verified through operational testing.
- Currently, the draft PKI Spiral 3 TEMP Addendum is improved but still has missing information, including reliability growth curves needed for planning tests to assess improvements in the reliability of SIPRNET tokens and supporting PKI infrastructure. For example, token inventory management, reporting tools, and processes are still not in place and associated requirements are not clearly defined. With infrastructure in DOD-wide use and tokens in the hands of a majority of SIPRNET users, and with the need for replacement cards for a large fraction of users whose tokens

are expiring, there is clearly a need for a robust inventory logistics management system.

- The DOD PKI program manager has drafted an Acquisition Strategy that focuses the remaining Increment 2 Spirals (3 and 4) on 15 user-prioritized capabilities. These capabilities are intended to improve SIPRNET token management and reporting, improve system availability, and will provide new infrastructures for the provisioning and management of the NEATS and certificates to NPEs (e.g., workstations, web servers, and mobile devices).
- NSA IAD is conducting formal token certification tests for version 3.3 to ensure that no vulnerabilities are exposed.
- The PKI PMO adopted a Spiral 3 and 4 approach in the program's Acquisition Strategy that more logically aligns with the capability development and testing efforts. Spiral 3 will include the TMS 3.0 through 6.0 releases, and Spiral 4 will include separate releases for NPE and NEATS.
- The PKI PMO, Service representatives, and test community are working together to refine the schedule; however, additional effort is needed to establish an event-driven test approach (versus a schedule-driven approach) that supports the draft Acquisition Strategy.

Recommendations

- Status of Previous Recommendations. The PKI PMO satisfactorily addressed the four previous recommendations.
- FY14 Recommendations. The PKI PMO should:
  1. Update the TEMP in accordance with the redefined PKI Increment 2 Acquisition Strategy to prepare stakeholders for the remaining deliveries, resource commitments, and test and evaluation goals.
     - Clearly define the strategy to address token reliability and growth in the System Engineering Plan and Spiral 3 and 4 TEMP Addenda to ensure SIPRNET token fielding decisions are informed by thorough testing.
     - Establish a reliability growth program for the PKI system's infrastructure.
     - Operationally test new SIPRNET token releases prior to fielding decisions.
     - Develop a supportable, resourced, event-driven schedule to guide both the capability development and the testing approach.
  2. Create a transition plan defining roles and responsibilities for stakeholders to support a smooth transition and ensure minimal impact to PKI operations once the program enters sustainment.
  3. Define and validate sustainment requirements for PKI capabilities.

Army Programs

Army Programs

Network Integration Evaluation (NIE)

In FY14, the Army executed two Network Integration Evaluations (NIEs) at Fort Bliss, Texas, and White Sands Missile Range, New Mexico. NIE 14.1 was conducted in October and November 2013 and NIE 14.2 was conducted in April and May 2014. The purpose of the NIEs is to provide a venue for operational testing of Army acquisition programs, with a particular focus on the integrated testing of tactical mission command networks. The Army also intends the NIEs to serve as a venue for evaluating emerging capabilities that are not formal acquisition programs. These systems, termed by the Army as "systems under evaluation" (SUEs), are not acquisition programs of record, but rather systems that may offer value for future development.

The Army's intended objective of the NIE to test and evaluate network components in a combined event is sound. The NIE events should allow for a more comprehensive evaluation of an integrated mission command network, instead of piecemeal evaluations of individual network components.

NIE 14.1

During NIE 14.1, the Army executed an FOT&E for the Joint Warning and Reporting Network (JWARN) and an operational test for the AN/PRC-117G radio. The Army intended to conduct an FOT&E for the Command Post of the Future (CPOF); however, due to system software stability problems discovered during the pilot test, this operational testing was not executed. The Army also conducted assessments of 14 SUEs. Individual articles providing assessments of JWARN and the AN/PRC-117G radio can be found separately in this Annual Report.

NIE 14.2

During NIE 14.2, the Army conducted a Multi-Service Operational Test and Evaluation for the Joint Battle Command – Platform, an FOT&E for Manpack radio, an FOT&E for Shadow Tactical Unmanned Aerial System, and the first phase of IOT&E for Nett Warrior. Individual articles on these programs are provided later in this Annual Report. The Army also conducted assessments of 13 SUEs during NIE 14.2.

NIE ASSESSMENT

NIE 14.1 and 14.2 were the sixth and seventh such events conducted to date. The Army has developed a systematic approach to preparing for and conducting NIEs, applying lessons learned from previous events. Overall, NIEs have been a satisfactory venue for conducting operational tests of individual network acquisition programs.

Operational Scenarios and Test Design. The Army Test and Evaluation Command's Operational Test Command, in conjunction with the Brigade Modernization Command, continues to develop realistic, well-designed operational scenarios for use during NIEs. Additionally, the 2d Brigade, 1st Armored Division, as a dedicated NIE test unit, is a valuable resource for the conduct of NIEs.

The challenge for future NIEs will be to continue to develop new and more taxing operational scenarios to reflect future combat operations. Future NIEs should include more challenging and stressful combined arms maneuvers against regular conventional forces. Such scenarios would place greater stress on the tactical network and elicit a more complete assessment of that network. Within resource constraints, the Army should continue to strive to create a demanding operational environment at NIEs similar to that found at the Army's combat training centers.

Balance between Testing and Experimentation. There are inherent tensions between testing and experimentation as they each have somewhat different objectives and requirements for exercise control, scenarios, and data collection. For example, experimentation tends to be more freewheeling than operational testing, as it seeks to examine possible new capabilities and tactics in a relatively unconstrained environment. Operational testing, on the other hand, requires more control over the tactical environment, as testing seeks to confirm the performance of acquisition systems with well-defined requirements and concepts of operation. Furthermore, experimental items that interact with systems undergoing operational test may negatively affect test system performance and confound the test results. The Army must continue to give priority to operational test objectives at NIEs and ensure that experimentation and training demands do not interfere with the requirements for adequate operational testing.

The Army is considering devoting one NIE a year to operational testing and the other annual NIE to experimentation and force development. Such an approach would pay dividends by focusing individual event design on the specific requirements of testing or experimentation.

Instrumentation and Data Collection. The Army should continue to improve its instrumentation and data collection procedures to support operational testing. For example, the Army's Operational Test and Evaluation Command should devote effort towards developing instrumentation to collect network data for dismounted radios, such as the Manpack radio. Additionally, the Army needs to emphasize the use of Real-Time Casualty Assessment (RTCA) instrumentation. An essential component of good force-on-force operational testing, such as that conducted at NIEs, is RTCA instrumentation, which adequately simulates direct and indirect fire effects for both friendly and threat forces. Finally, the Army should continue to refine its methodology for the conduct of interviews, focus groups, and surveys with the units employing the systems under test.

Threat Operations. An aggressive, adaptive threat intent on winning the battle is an essential component of good operational testing. The Army continues to improve threat operations during NIEs, particularly with respect to threat information operations such as electronic warfare and computer network operations. NIEs should incorporate a large, challenging regular force threat. This threat should include a sizeable armored force and significant indirect fire capabilities. The threat force should also include appropriate unmanned aerial vehicles.

Logistics. The Army should place greater emphasis during NIEs on replicating realistic battlefield maintenance and logistical support operations for systems under test. Field Service Representative (FSR) support plans, maintenance and repair parts stockage, and the quantity and management of system spares do not accurately reflect what a unit will observe upon fielding. Easy access to and over-reliance on FSR support results in the test unit not having to realistically execute its field-level maintenance actions. Failure to accurately replicate "real world" maintenance and logistics support causes operational availability rates and ease of maintenance to be overestimated in NIEs.

NETWORK PERFORMANCE OBSERVATIONS

The following are observations of tactical network performance during NIEs. These observations focus on network performance deficiencies that the Army should consider as it moves forward with integrated network development.

Complexity of Use. Network components, both mission command systems and elements of the transport layer, are excessively complex to use. The current capability of an integrated network to enhance mission command is diminished due to pervasive task complexity. It is challenging to achieve and maintain user proficiency.

Common Operating Picture (COP). Joint Publication 3-0, (Joint Operations) defines a COP as "a single identical display of relevant information shared by more than one command that facilitates collaborative planning and assists all echelons to achieve situational awareness." With current mission command systems, units have multiple individual COPs (e.g., for maneuver, intelligence, and logistics) based upon the corresponding mission command systems, instead of a single COP that is accessible on one system. The Army is seeking to resolve this problem, and these efforts should continue.

Unit Task Reorganization and Communications Security (COMSEC) Changeover. Operational units frequently change task organizations to tailor for tactical missions. The process to update the networks to accommodate a new unit task organization remains lengthy and cumbersome. Similarly, COMSEC changeover is a lengthy, burdensome process, which requires each individual radio to be manually updated. This process typically requires in excess of 24 hours for a Brigade Combat Team to complete. This is an excessive length of time for a unit conducting combat operations.

Armored Brigade Combat Team Integration. The challenge of integrating network components into tracked combat vehicles remains unresolved. Due to vehicle space and power constraints, the Army has yet to successfully integrate desired network capabilities into Abrams tanks and Bradley infantry fighting vehicles. It is not clear how the desired tactical network will be incorporated into heavy brigades.

Infantry Brigade Combat Team (IBCT) Integration. Integration of the network into the light forces will also be challenging given the limited number of vehicles in the IBCT. Most of the key network components, such as Joint Battle Command – Platform, are hosted on vehicles. The challenge of linking into the tactical network is particularly acute at company level and below, where light infantry units operate dismounted. Future NIEs should examine the IBCT tactical network, which has not been addressed to date.

Soldier Radio Waveform (SRW) Range. Testing at NIEs continues to demonstrate the shorter range of SRW vis-à-vis the legacy Single Channel Ground and Airborne Radio System (SINCGARS) waveform. This is not surprising given that SRW operates at a much higher frequency than does SINCGARS. Higher frequencies have shorter ranges and are more affected by terrain obstructions. NIE test units, particularly when operating dismounted, have consistently found SRW ranges to be unsatisfactory in supporting tactical operations and prefer using SINCGARS due to its longer range.

Dependence on FSRs. Units remain overly dependent upon civilian FSRs to establish and maintain the integrated network. This dependency corresponds directly to the excessive complexity of use of network components.

Survivability. An integrated tactical network introduces new vulnerabilities to threat countermeasures, such as threat computer network attacks and the ability of a threat to covertly track friendly operations. The Army should continue to improve its capabilities to secure and defend its tactical network. In particular, the Army should ensure that brigade-level cybersecurity teams are appropriately manned and trained.

AH-64E

Executive Summary

- The Army conducted the Lot 4 AH-64E FOT&E I at Eglin AFB, Florida, from August 4 –15, 2014. The test included training, force-on-force missions in an operational Link 16 network, adversarial cybersecurity testing, and was preceded by two years of developmental testing that included component qualification, joint interoperability, cybersecurity, and live fire testing.
- FOT&E I was adequate and demonstrated that Link 16 enhances the operational effectiveness of Lot 4 AH-64E units. Lot 4 AH-64E air weapons teams found small target formations more quickly using Link 16 target tracks than when using other onboard sensors. Air weapons teams, equipped with Link 16, enhanced overall situational awareness by providing battlefield information to the joint tactical air picture.
- Lot 4 AH-64E enhancements add 700 pounds to the aircraft compared to the Lot 1 AH-64E. AH-64E demonstrated in testing and in a recent unit deployment to Afghanistan that the aircraft can meet operational performance requirements at 6,000 feet pressure altitude and 95 degrees Fahrenheit if permitted to use all available engine power.
- The Lot 4 AH-64E remains operationally suitable and demonstrated improvements in reliability, availability, and maintainability compared to Lot 1 AH-64E operational test results.
- The Lot 4 AH-64E remains as survivable as the Lot 1 AH-64E against ballistic threats. Survivability against infrared threats is degraded compared to the Lot 1 AH-64E. Radar and laser-warning systems degrade pilot situational awareness.
- Lot 4 AH-64E aircraft ballistic vulnerability and personnel force protection is comparable to the Lot 1 AH-64E.

System

- The Army received an approved mission design series change renaming the AH-64D Apache Block III to AH-64E in September 2012.
- The AH-64E is a modernized version of the AH-64D Attack Helicopter. The Army intends to sustain the Apache fleet through the year 2040. The AH-64E is organized in Attack/Reconnaissance Battalions assigned to the Combat Aviation Brigades. Each Battalion has 24 aircraft.
- The AH-64E's advanced sensors, improved flight performance, and ability to integrate off-board sensor information provide increased standoff and situational awareness in support of the joint force.
- The major Lot 1 AH-64E capability improvements included:

  - The AH-64E aircrew's ability to control the flight path and the payload of an Unmanned Aircraft System
  - Improved aircraft performance with 701D engines, composite main rotor blades, and an improved rotor drive system
  - Enhanced communication capability, which includes satellite communication and an integrated communication suite to meet global air traffic management requirements
- Lot 4 AH-64E retains Lot 1 capabilities and adds hardware and software for Link 16 network participation.
- The Army acquisition objective is to procure 690 AH-64E aircraft: 634 remanufactured and 56 new-build aircraft.

Mission

AH-64E-equipped units shape the area of operations and provide the Joint Force Commander and Ground Maneuver Commander the ability to defeat the enemy at a specified place and time. The Attack/Reconnaissance Battalions assigned to the Combat Aviation Brigade employ the AH-64E to conduct the following types of missions:

- Attack
- Movement to contact
- Reconnaissance
- Security

Major Contractors

- Aircraft: The Boeing Company Integrated Defense Systems – Mesa, Arizona
- Sensors and Unmanned Aircraft System datalink: Longbow Limited – Orlando, Florida, and Baltimore, Maryland

Activity

- The Army conducted ballistic testing of the Lot 4 AH-64E Reduced-size Crashworthy External Fuel System (RCEFS) in May 2013 in accordance with the military standard for evaluation of fuel tanks on rotary-wing aircraft.
- The 46th Test Squadron conducted waveform conformance testing of the Small Tactical Terminal Radio, version 2.9.2 at Eglin AFB, Florida, in February 2014.
- The Joint Interoperability Test Command completed joint interoperability testing of the Small Tactical Terminal Radio version 3.1.2 at Mesa, Arizona, in May 2014. The AH-64E exchanged the required Lot 4 Link 16 messages to joint participants.
- The Army conducted a cooperative cybersecurity assessment of the Lot 4 AH-64E configuration from June 24 – 26, 2014, at Redstone Arsenal, Alabama.
- The Army conducted the Lot 4 AH-64E FOT&E I in accordance with the DOT&E-approved test plan from August 4 – 15, 2014, at Eglin AFB, Florida. FOT&E I consisted of a unit equipped with Lot 4 Apache aircraft conducting force-on-force missions against a dedicated opposing force and supported by an operational Link 16 network.
  - AH-64E Air Weapons Teams equipped with two Lot 4 AH-64E aircraft flew 120 hours conducting 22 force-on-force missions under varying environmental conditions, with and without Link 16 targeting information, against small (less than 10 vehicles) and large (10 or more vehicles) target formations.
  - AH-64E Air Weapons Teams provided support to friendly maneuver forces in vehicles, dismounted, and aboard a large transport watercraft. Enemy forces employed fast-attack craft, a large mine-laying boat, armored vehicles, mechanized air defense vehicles, dismounted infantry with small arms and man-portable air defense systems, mortar teams, and technical vehicles. Both friendly and enemy forces were instrumented with Real-Time Casualty Assessment equipment to ensure operational realism.
  - The Army Threat Systems Management Officer conducted an adversarial cybersecurity assessment from August 11 – 15, 2014. The test team investigated deficiencies identified during the IOT&E in 2012, and conducted passive scans of the AH-64E and its associated networks.
- The Army completed system-level ballistic vulnerability and personnel protection analyses of the Lot 4 AH-64E with RCEFS and the latest armor configuration and provided a draft report in August 2014.
- The Army conducted infrared survivability testing in September 2014 at Redstone Arsenal, Alabama. The test compared the susceptibility of the Lot 4 AH-64E equipped with Aircraft Survivability Product Improvements (ASPI) with the susceptibility of the Lot 4 AH-64E without ASPI to infrared threat seekers.

Assessment

- FOT&E I was adequate and demonstrated that Link 16 enhances the operational effectiveness of Lot 4 AH-64E-equipped units.
  - Air Weapons Teams equipped with Link 16 enhanced joint interoperability. The aircrews exchanged Link 16 message sets indicating their location, heading, weapons, and fuel status with live and simulated Air Force fighters and command and control aircraft.
  - Lot 4 AH-64E Air Weapons Teams found small-target formations on average seven minutes faster using Link 16 target tracks than when using other onboard sensors. Large target formations with five or more vehicles were detected just as quickly with other onboard sensors as when using Link 16 data.
  - Link 16 targeting data cluttered the aircrew's display and increased pilot workload when five or more targets were present. In an environment with less than five targets, Link 16 targeting data aided the aircrew's target acquisition and reduced pilot workload. Total aircrew workload during the test, including the use of Link 16, was low.
  - Lot 4 AH-64E aircrews used the Small Tactical Terminal Radio to participate in a joint Link 16 environment with live and simulated Air Force fighters and command and control aircraft. The Small Tactical Terminal Radio experienced no critical or operational mission failures, remained synchronized with the network 87 percent of the time, and demonstrated a 95 percent message completion rate.
- Air-to-Air-to-Ground video transfer enhanced the Lot 4 AH-64E Air Weapons Team's situational awareness. The aircrews transmitted video between aircraft in flight and to the maneuver operations center on the ground. Aircrews provided favorable feedback on the video quality and utility.
- The Enhanced Image Intensified Television mode of the Pilot Night Vision System enhanced performance and improved the pilot's ability to see light sources and avoid obstacles at night.
- The adversarial cybersecurity assessment found that a vulnerability of the Apache electronics architecture identified during the IOT&E in 2012 has been addressed and identified new cybersecurity vulnerabilities on the Lot 4 AH-64E and interfacing systems.
- The Lot 4 AH-64E remains operationally suitable and demonstrated improvements in reliability, availability, and maintainability compared to Lot 1 AH-64E operational test results. Transfer of in-flight maintenance data to a ground-based maintenance section while the aircraft is in mission profile was successful. The System-Level Embedded Diagnostics aided in aircraft recovery after mission completion.
- The Lot 4 AH-64E remains as survivable as the Lot 1 AH-64E against ballistic threats. Survivability against infrared threats is degraded compared to the Lot 1 AH-64E. Infrared threat acquisition ranges are unchanged or increased. Flare

effectiveness is decreased depending on the threat and the flight profile of the aircraft.

- Consistent with the IOT&E evaluation, radar- and laser-warning systems were not effective during FOT&E I and degraded pilot situational awareness. Threat-warning systems performed poorly and are not effectively integrated on the aircraft. Aircrews received frequent false alarms, had no selective volume control of the warning systems, and experienced cluttered or conflicting threat displays. Aircrews ignored radar- and laser-warning systems that continuously announced inaccurate threat identifications.
- Lot 4 AH-64E enhancements add 700 pounds to the aircraft compared to Lot 1 AH-64E.
- External fuel tanks met ballistic survivability requirements and supported all FOT&E I missions. The RCEFS revealed no threat of sustained fire or catastrophic structural failures.
- The updated system-level vulnerability and force protection assessments for the Lot 4 AH-64E showed sustained ballistic protection of the aircraft and crew.

Recommendations

- Status of Previous Recommendations. The Army has addressed some recommendations from the FY12 Apache Block III Annual Report. The following recommendations have not been fully implemented:
  1. Consider incorporating improvements to current threat-warning systems as they are developed. Upgrade radar- and laser-warning systems and provide for adjustable controls for each warning system.
  2. Address pilot's confidence concerns with regard to the transmission design. Investigate the feasibility of alternate transmission designs that provide redundant hydraulic and electrical power in the event of loss of power to the tail rotor.
  3. Perform a structural analysis of the composite main rotor blades to better understand the load-carrying capabilities of the blade that was damaged during ballistic testing.
- FY14 Recommendations. The Army should:
  1. Improve infrared countermeasures performance, upgrade radar- and laser-warning systems, and improve integration of aircraft survivability equipment on the Lot 4 AH-64E.
  2. Address demonstrated cybersecurity vulnerabilities. Plan and conduct unconstrained exploitation of vulnerabilities during adversarial cybersecurity testing.
  3. Modify aircraft performance charts and aircraft software to allow mission planning using actual engine performance ratings.
  4. Continue development of Link 16 capabilities and conduct follow-on testing during FOT&E II.
  5. Develop procedures to establish and maintain independent Link 16 training networks.

AN/PRC-117G

Executive Summary

- The Army has fielded the AN/PRC-117G radio to combat units in Afghanistan. Testing of the full capabilities in a realistic operational environment was not conducted on the AN/PRC-117G radio prior to fielding. DOT&E placed the AN/PRC-117G radio on oversight on October 4, 2012, and directed the Army to conduct an operational test in calendar year 2013.
- The Army Test and Evaluation Command conducted operational testing of the AN/PRC-117G as part of the Network Integration Evaluation (NIE) 14.1 at Fort Bliss, Texas, in November 2013.
- During the operational test, a Threat Computer Network Operations Team consisting of members from the Army Research Laboratory/Survivability Lethality Analysis Directorate and Threat Systems Management Office (TSMO) conducted cybersecurity assessments on the AN/PRC-117G radio. The TSMO conducted an electronic warfare campaign including direction finding and open-air jamming of both the Soldier Radio Waveform (SRW) and Adaptive Networking Wideband Waveform (ANW2).
- As a result of the OT&E conducted in November 2013, DOT&E recommended the Army evaluate the overall network architecture to improve the range, reliability, and survivability of the network and simplify network management.

System

- The AN/PRC-117G radio is a single channel voice and data radio that is capable of operating in a frequency range of 30 Megahertz to 2 Gigahertz. Operational configurations include manpack, vehicular-mounted, or base-station operations.
- The primary AN/PRC-117G waveform is the ANW2, which is a Harris Corporation proprietary waveform.
- The AN/PRC-117G is capable of simultaneously transmitting both Voice over Internet Protocol and digital data on a single channel. Digital data include file transfers, chat, streaming video, and position location reports.
- The Army procured and fielded the AN/PRC-117G as a tactical satellite radio and to provide a networking radio bridge capability until the Manpack Radio and Mid-Tier Networking Vehicular Radio (MNVR) programs of record are available.

Mission

- The Army intends for tactical units to employ the AN/PRC-117G as a data radio. Specifically, the ANW2 allows units to use Internet Protocol routing to transmit medium to high bandwidth data traffic over tactical Very-High Frequency, Ultra-High Frequency, and L-band radio networks.
- AN/PRC-117G will be an interim commercial off-the-shelf solution until the MNVR is developed and fielded. The Army intends for the MNVR to replace the cancelled Joint Tactical Radio System Ground Mobile Radios program.

Major Contractor

Harris Corporation – Rochester, New York

Activity

- The Army is purchasing the AN/PRC-117G as a commercial off-the-shelf item to fill a capability gap for a tactical digital radio. With the October 2011 cancellation of the Joint Tactical Radio System Ground Mobile Radio program, the Army sought an interim solution to fill Brigade Combat Teams as a part of Capability Set 13. The Army used an existing General Services Administration contract to purchase the AN/PRC-117G.
- In 2011, the Army placed a $63 Million order for 16,000 AN/PRC-117G radios.
- The Army has fielded the AN/PRC-117G radio to combat units in Afghanistan. Testing of the full capabilities in a realistic operational environment was not conducted on the AN/PRC-117G radio prior to fielding. DOT&E placed the AN/PRC-117G radio on oversight on October 4, 2012, and directed the Army to conduct an operational test in calendar year 2013.
- The Army Test and Evaluation Command conducted operational testing of the AN/PRC-117G as part of the

Army's NIE 14.1 at Fort Bliss, Texas, in November 2013, in accordance with a DOT&E-approved test plan.

- As part of the operational test, a Threat Computer Network Operations Team, consisting of members from the Army Research Laboratory/Survivability Lethality Analysis Directorate and TSMO, conducted cybersecurity assessments on the AN/PRC-117G radio. The TSMO conducted an electronic warfare campaign including direction finding and open-air jamming of both the SRW and ANW2. All threats portrayed during operational testing were in accordance with the accredited Threat Training Support Package for the AN/PRC-117G radio.
- DOT&E published an Operational Assessment report on the AN/PRC-117G in September 2014.

Assessment

During the NIE, problems with the network architecture contributed to the communications problems experienced by the test unit. The AN/PRC-117G-hosted networks were able to support some stationary missions, such as base and area defense at short ranges and for a fraction of the users. Mobile missions at longer ranges presented a challenge to the radio networks. A majority of Soldiers reported that voice communications were acceptable.

- The operational ranges for AN/PRC-117G data transfers were too short to support their combat missions at echelons above platoon; as designed, the network cannot support battalion- and company-level communications as tactical units require.
- No requirements document exists for the AN/PRC-117G because it is not a program of record. The operational test conducted during the NIE, along with the assessment conducted in Afghanistan, demonstrated the radio could not meet the MNVR Wideband Networking Waveform requirement of 80 percent "connection availability" at 6-10 kilometers.
- The operational range of the legacy Single Channel Ground and Airborne Radio System (SINCGARS) waveform on the AN/PRC-117G did not meet Soldiers' mission needs. A range of 300 meters was reported for dismounted Soldiers, and 2 kilometers when communicating between a dismounted Soldier and a vehicle-mounted AN/PRC-117G. For comparison, a legacy SINCGARS radio demonstrated a 20-kilometer range during the Manpack radio Multi-Service Operational Test and Evaluation.
- The AN/PRC-117G demonstrated a long Mean Time Between Essential Function Failure (497 hours for the SRW and 1,054 hours for the ANW2), which indicates a low failure rate.
- During the NIE, the Soldiers reported the following:
  - The size and weight of the radio made it portable.
  - There were numerous instances of the radio falling out of its vehicle mount.
  - The training and materials provided were not sufficient for them to use to troubleshoot and repair the systems.
- Cybersecurity vulnerabilities on the AN/PRC-117G permitted access to networks by the cyber Red Team. These networks contained information critical to Blue Force operations. During the operational test, the Opposing Force Commander used electronic detection of Blue Force radios to provide situational awareness of the Blue Force locations. The Opposing Force Commander used electronic jamming to disrupt the Blue Force scheme of maneuver. Test unit Soldiers received no training on how to identify and respond to electronic warfare or cybersecurity attacks.

Recommendations

- Status of Previous Recommendations. The Army addressed the previous recommendation.
- FY14 Recommendations. The Army should:
  1. Harden the radio against unauthorized use in order to prevent the cybersecurity vulnerabilities.
  2. Increase the transmission range of ANW2 to support operations at the company and above echelons by using a lower transmission frequency, increasing antenna size, and/or increasing output power.
  3. Improve the range and reliability of the SINCGARS waveform. The performance of the waveform on the AN/PRC-117G radio should be comparable with the performance of the legacy SINCGARS radio.
  4. Provide operations and maintenance manuals for the AN/PRC-117G and adequate training to enable unit Soldiers to operate and maintain the radio under normal operational conditions without the use of Field Service Representatives. Training should include procedures for identifying and responding to adversarial electronic and cybersecurity attacks.
  5. Improve the design of the AN/PRC-117G vehicle mount to prevent the radio from falling out of the mount during vehicle operations.
  6. Evaluate the overall network architecture to improve the range, reliability, and survivability of the network and simplify network management.

C-17 Increased Gross Weight (IGW) and Formation Spacing Reduction (FSR)

Executive Summary

- In September 2013, the Army Test and Evaluation Command, with support from the Air Force Air Mobility Command, conducted Increased Gross Weight testing for a single C-17 Globemaster III aircraft with a full paratrooper load. This was Part 1 of a three-part test.
- On April 25, 2014, DOT&E published an Operational Assessment report on Part 1.
- Increasing the gross weight of a single C-17 from 385,000 to 400,000 pounds, when deploying a full paratrooper load with the T-11 parachute system in mass exit configuration, does not increase the risk to paratrooper or aircraft beyond acceptable levels for airborne operations.
- Parts 2 and 3 of the test effort are not funded.

System

- C-17 Increased Gross Weight and Formation Spacing Reduction are proposed changes to airborne tactics, techniques, and procedures.
- The Army hypothesizes that the introduction of the new T-11 parachute may allow for the following changes in order to increase unit effectiveness and reduce vulnerability to aircraft and paratroopers:
  - Increased Gross Weight: Increase C-17 gross weight by 15,000 pounds (from 385,000 to 400,000) at the time of a parachute drop. This will allow increased range for refueling aircraft and projection of the airborne force further into a hostile environment.
  - Formation Spacing Reduction: Reduce formation spacing within and between aircraft elements to the minimum safe distance, which will decrease delivery time of the airborne force, decrease enemy air defense reaction time, and increase paratrooper concentration and unit cohesion on the ground.
- The T-11 Advanced Tactical Parachute System is a personnel parachute system consisting of the main parachute, reserve parachute, and harness. The main parachute deployment system uses a drogue/sleeve and a mesh slider to control the rate of canopy opening and minimize aircraft exit interference problems. The T-11 replaced the T-10 parachute.
- The C-17 Globemaster III aircraft is one of the Air Force's main long-range, heavy transport aircraft. It can deploy 102 paratroopers from two troop doors in a single pass.

Mission

Airborne forces execute parachute assaults to destroy enemy forces and seize and hold key objectives until linkup with follow-on forces. Airborne assaults are used in forced entry operations to deliver Soldiers with speed and surprise into hostile territory.

Major Contractors

- T-11:
  - BAE Systems – Phoenix, Arizona
  - Aerostar International – Sioux Falls, South Dakota
  - Airborne Systems North America – Santa Ana, California
- C-17: The Boeing Company, Integrated Defense Systems – Long Beach, California

Activity

- The Army Test and Evaluation Command, with support of the Air Force Air Mobility Command, executed the single C-17 Increased Gross Weight test in September 2013 at Fort Bragg, North Carolina. This was the first of a three-part test.
- In April 2014, the Army and Air Force began collecting and analyzing vortex data to populate the Vortex Modeling Tool that will be used in the development of C-17 formations for Parts 2 and 3 of the test.
- DOT&E published an Operational Assessment report on Part 1 of the test on April 25, 2014.
- The Army and Air Force conducted all testing in accordance with DOT&E-approved test plans.

- Parts 2 and 3, which will test multiple aircraft at increased gross weight and formation spacing reduction, are scheduled for FY15.
- Required Army resources for Parts 2 and 3 of the test effort are not funded.

Assessment

- Increasing the gross weight of a single C-17 from 385,000 to 400,000 pounds, when deploying a full paratrooper load with the T-11 parachute system in mass exit configuration, does not increase the risk to paratroopers or aircraft beyond acceptable levels for airborne operations. During the test:
  - Test evaluators did not observe, nor did test participants report, any Soldier-to-Soldier interactions after exiting the aircraft until parachute stabilization of T-11-equipped paratroopers deploying from a single C-17 at a gross weight of 400,000 pounds.
  - Test evaluators did not observe any T-11 parachute problems at 400,000 pounds aircraft weight.
  - There was no damage to the T-11 parachute system caused by deployment from a C-17 at 400,000 pounds.
  - Modeling and simulation predicted T-11-equipped paratroopers deploying from C-17 at 400,000 pounds would be closer during parachute deployment than T-11 or T-10-equipped paratroopers at 385,000 pounds. The jumper separation distance predicted is better than the C-141 aircraft, the original benchmark for paratrooper safety.
- The current airdrop flight profile of a single C-17 at 385,000 pounds can be maintained at 400,000 pounds while conducting dual-door mass exit operations with the T-11.
- Paratroopers and C-17 aircrews used current single aircraft tactics, techniques, procedures and training to execute mass exit operations at 400,000 pounds.

Recommendations

- Status of Previous Recommendations. This is the first annual report for this program.
- FY14 Recommendations. The Army and Air Force should:
  1. Populate the Vortex Modeling Tool with empirical data to support C-17 aircraft formation spacing at increased aircraft gross weights and operational jump altitudes (training and combat) with different environmental conditions.
  2. Progress to Parts 2 and 3 of the test, multiple aircraft at increased gross weight and formation spacing reduction, after completing post-model analysis with the new data.
  3. Conduct verification, validation, and accreditation of the Vortex Modeling Tool in order to make confident predictions of vortex interactions under conditions not included in the test effort, such as combat jump altitudes.
  4. Include validation testing of the current approved formation geometry at an aircraft gross weight of 400,000 pounds during Part 2 of testing.

Distributed Common Ground System – Army (DCGS-A)

Executive Summary

- To resolve problems discovered during the IOT&E in 2012, the Army reconfigured the system as Release 1 with only the Secret enclave components. OSD approved the full deployment of this configuration. The Army developed Release 2 to address the capabilities that did not work effectively in Release 1, to include re-adding the Top Secret/Sensitive Compartmented Information (TS/SCI) enclave.
- The U.S. Army Electronic Proving Ground tested Distributed Common Ground System – Army (DCGS-A) Release 2 in two developmental test (DT) phases:
  - DT1: A lab test conducted at Aberdeen Proving Ground, Maryland, from January 30 through February 28, 2014. The Program Office conducted regression testing to resolve Priority 1 and 2 software problems, which were discovered during DT1.
  - DT2: Conducted September 13 – 27, 2014, at Fort Huachuca, Arizona, using a representative operational network.
- DOT&E intends to issue an operational assessment of DCGS-A based on the DT2 results.
- DOT&E will make a full evaluation of the operational effectiveness, operational suitability, and survivability of DCGS-A Release 2 after the Army completes the DCGS-A operational test planned for May 2015 during the Network Integration Evaluation 15.2 event.

System

- DCGS-A provides an organic net-centric Intelligence, Surveillance, and Reconnaissance (ISR) capability at the brigade level by combining 16 stove-piped legacy applications into one comprehensive network, including TS/SCI.
- To resolve problems discovered during the IOT&E in 2012, the Army reconfigured the system as Release 1 with only the Secret-level components. OSD approved the full deployment of this configuration.
- The Army developed Release 2 to address the capabilities that did not work effectively with Release 1. Release 2 is intended to provide enhanced capabilities to include:
  - TS/SCI capability

ISR Fusion Server (in Secret Collateral enclave) with NSA tools (in TS/SCI enclave) | Intelligence Processing Center (in Secret Collateral enclave) | DCGS-A Geospatial Intelligence Workstation (in Secret Collateral enclave) | Tactical Ground Station (in Secret Collateral enclave)

  - Workflows that are based on how an intelligence section would employ the system
  - Methods for transferring entity data within the system and between systems more efficiently
  - New entity database structure
  - Enhanced fusion software for correlation of entity data
  - New geospatial intelligence configuration
  - New materiel solution for transfer of information across security domains
- On December 4, 2014, USD(AT&L) approved modification to the acquisition strategy to allow Increment 1 to end with Release 2. Requirements that were allocated to Release 3, to include a cloud computing capability to support worldwide intelligence analysis and database synchronization, including disconnected or low-bandwidth environments, will now be allocated to Increment 2.

Mission

Army intelligence analysts use DCGS-A to perform: receipt and processing of select ISR sensor data, intelligence synchronization, ISR planning, reconnaissance and surveillance integration, fusion of sensor information, and direction and distribution of relevant threat, non-aligned, friendly and environmental (weather and geospatial) information.

Major Contractors

- Lead System Integrator: Intelligence and Information Warfare Directorate, U.S. Army Communications – Electronics Research, Development, and Engineering Center – Aberdeen Proving Ground, Maryland
- Northrop Grumman Electronic Systems – Linthicum, Maryland

Activity

- From January 30 through February 28, 2014, the Army conducted DT1 for DCGS-A Increment 1, Release 2 at Aberdeen Proving Ground, Maryland.
- The Army planned DCGS-A DT2 in response to the December 14, 2012, Full Deployment Decision Acquisition Decision Memorandum that required “a plan

for a developmental test with a representative operational test network structure using the scenarios and data collection/reduction tools expected to be used for the operational test."

- The Army conducted DT2 in Fort Huachuca, Arizona, from September 13 – 27, 2014. The Program Office resolved all Priority 1 and 2 software problems before starting DT2.
- The Electronic Proving Ground will publish a DT2 test report, and the Army Evaluation Center (AEC) will publish a DT2 assessment report. Further analysis of the DT2 data may lead to the requirement for additional corrective actions.

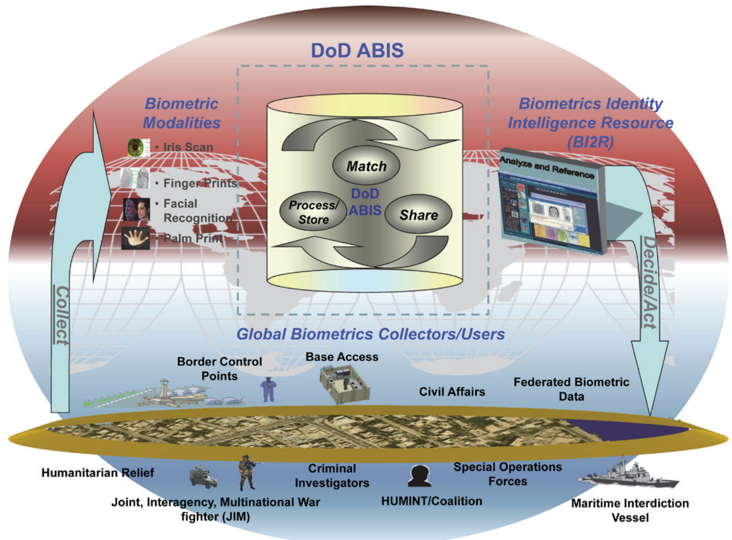
Assessment

- After DT1, the Program Office continued regression testing for software fixes delivered through multiple fix cycles.
- There are cybersecurity issues that need to be addressed. Cybersecurity testing was conducted during the last week of DT2 to provide an update to the cybersecurity status.
- There are 121 Priority 3 and 293 Priority 4 software problems. All of these will need a workaround written and trained. The program is working on these actions but if not completed in a timely fashion, the performance in operational test could be affected.
- As of December 4, 2014, the AEC has yet not used DT2 data to assess key DCGS-A measures of performance in order to help evaluate system performance. As of this report, it is not clear the quality and quantity of data from AEC will be sufficient to evaluate key measures allocated to DT2 in the approved Test and Evaluation Master Plan. Any unanswered measures must be addressed during the Limited User Test planned for 2015.
- DOT&E will publish an operational assessment report based on the DT2 results, and will make a full evaluation of the operational effectiveness, operational suitability, and survivability of DCGS-A Release 2 after the Army completes the DCGS-A Limited User Test planned for May 2015 during the Network Integration Evaluation 15.2 event.

Recommendations

- Status of Previous Recommendations. The Army addressed all previous recommendations.
- FY14 Recommendation.
  1. The Army should conduct the Limited User Test incorporating the lessons learned from the DT2.

DOD Automated Biometric Identification System (ABIS)



Executive Summary

- The Program Manager Biometrics fielded the DOD Automated Biometric Identification System (ABIS) 1.0 to the Biometrics Identity Management Activity (BIMA) in January 2009 as a quick reaction capability to support storing, matching, and sharing of collected biometric data primarily obtained during Operation Iraqi Freedom and Operation Enduring Freedom.
- The Army chartered the Program Management Office (PMO) in 2007 to foster the establishment of ABIS as a formal program of record to be known as the Biometrics Enabling Capability (BEC) Increment 0.
- In January 2011, USD(AT&L) issued an Acquisition Decision Memorandum establishing ABIS 1.2 as the baseline for the BEC 0 upon completion of a Full Deployment Decision (originally scheduled for FY11).
- In October 2014, the PMO deployed ABIS 1.2 successfully and it remains the authoritative source for biometric transactions upon completion of the two-phased IOT&E that was conducted from August through October 2014.
- Prior to the IOT&E, the Army Test and Evaluation Command (ATEC) performed a customer test in February and March 2014. The test operated at multiple sites, with the primary site being the BIMA facility located in Clarksburg, West Virginia. The purpose of this test was to independently verify the system readiness of the DOD ABIS 1.2 system prior to an operational test. Upon completion of the customer tests, ATEC conducted a two-phased operational test, with Phase One held August 7 – 28, 2014, and Phase Two held October 17 – 22, 2014.
- An independent Red Team assessment in August 2014 revealed significant cybersecurity vulnerabilities that must be addressed. ATEC has planned a cybersecurity assessment to be held during the 2015 FOT&E to demonstrate resolution of critical cybersecurity findings.

System

- The DOD ABIS is an authoritative database that uses software applications to:
  - Process and store biometrics modalities (i.e., fingerprints, palm prints, iris scans, and facial recognition data) from collection assets across the globe
  - Update the biometric database repository with new biometrics data
  - Produce biometrics match results (against stored data)
  - Share responses among approved DOD, interagency, and multi-national partners, in accordance with applicable law and policy
  - Provide tools to monitor the health and status of the system
- For biometric submissions that are unable to produce a match using automated processes, biometric examiners (subject matter experts) use ABIS workstations with specialized software to attempt to manually match submissions.
- ABIS interfaces with global biometrics data collectors and users, as well as outside databases.
  - Military Services and Combatant Commands collect biometrics data (fingerprint, palm print, iris scans, and facial scans) from persons of interest in the field using portable collection devices and submit these data to ABIS.
  - Intelligence analysts analyze and fuse biometrics information via the Biometric Identity Intelligence Resources, an automated database outside the ABIS, and provide information back to the users in the field.
- ABIS 1.2 uses a set of commercial off-the-shelf and custom components including:
  - A transaction manager for managing customer submission workflows
  - A portal allowing authorized operators to perform user management, system configuration, real-time system monitoring, submission tracking, and report generation
- The U.S. Army BIMA currently operates ABIS on the DOD Non-secure Internet Protocol Router Network (NIPRNET).
- The PMO developed ABIS 1.2 as an enhancement to the previously fielded version, ABIS 1.0. The new system is intended to address hardware and software obsolescence and scalability limitations in ABIS 1.0, and increased throughput and storage capacity of biometric submissions and responses.

Mission

- Military Services and U.S. Combatant Commands rely on ABIS to provide timely, accurate, and complete responses indicating whether persons of interest encountered in the field have a prior history of derogatory (e.g. criminal) activity, to assist in identifying potential threats to U.S. forces and facilities.
- The Federal Bureau of Investigation, the National Ground Intelligence Center, Department of Homeland Security, and other Federal agencies interface with ABIS to identify biometrics matches in support of U.S. criminal cases, border control, and intelligence watchlists, respectively.

Major Contractor

Northrop Grumman, Information Technology (NGIT) – Fairmont, West Virginia

---

Activity

- ABIS was first developed as a prototype in 2004 in response to a Joint Urgent Operational Need Statement. ABIS 1.0 was deployed to BIMA in January 2009 as a prototype system to provide multi-modal and multifunctional biometric capabilities to assist in the Global War on Terrorism and subsequently in Overseas Contingency Operations.
- Since 2004, DOT&E designated all biometrics programs be placed on the T&E oversight list as pre-Major Automated Information Systems. As such, although not a formal program of record, ABIS is included on DOT&E oversight.
- In January 2011, USD(AT&L) issued an Acquisition Decision Memorandum establishing ABIS 1.2 as the baseline for BEC 0 upon completion of a Full Deployment Decision (originally scheduled for FY11).
- Between December 2012 and June 2013, the PMO conducted a number of customer (developmental) tests to determine if ABIS 1.2 enabled the operators to access the functions they needed to perform their duties and if the system would react with consistent, accurate, and useful reports, displays, or other responses.
- In August 2013, the PMO deployed ABIS 1.2 as the system of record directly supporting real-world operations for 10 days. During the August 2013 deployment, U.S. Special Operations Command (USSOCOM) documented 31 high-priority deficiencies and U.S. Central Command (USCENTCOM) documented 11 high-priority deficiencies that affected mission accomplishment due to deficiencies in the ABIS 1.2 baseline affecting the effectiveness and suitability of the system. Following the August 2013 deployment, senior-level user representatives from both USSOCOM and USCENTCOM issued memoranda requesting that formal operational testing be conducted on future ABIS upgrades prior to deploying the upgrades, to help prevent further deployments that negatively affect missions.
- In February and March 2014, ATEC performed a customer test. The test operated at multiple sites with the primary site being BIMA. The customer test used a variety of recorded data submissions that were modified to allow submission to operational handheld biometric devices and sample stored submissions selected or designed to cause the system to perform reviews and produce responses in accordance with the user cases related to the specific problems under test.
- ATEC performed a two-phased operational test on ABIS 1.2. The first phase of the operational test was conducted August 7 – 28, 2014. The second phase was conducted October 17 – 22, 2014. The lack of proper Program Office test planning resulted in a compressed operational test plan review and approval timeline. ATEC submitted the test plan for DOT&E approval on August 1, just six days prior to the planned test start date. To correct key test plan shortcomings, on August 5, 2014, DOT&E provided critical comments to ensure test adequacy. DOT&E formally approved ATEC's test plan on August 12, 2014, in time to support Phase 1 of the operational test, which the Army decided to begin on August 7. Due to the compressed timeline, Phase 1 of the operational test was allowed to proceed even though an adequate test plan to address Phase 2 had not been approved by DOT&E.
- The second phase of the test, which was supposed to begin directly following the first phase, was delayed to address problems discovered during the first phase of testing.

Assessment

- During the August 2013 deployment, testing revealed that the interfaces between the current 1.0 system and its customers are not fully defined and documented. Interfaces have been created and sustained on an ad-hoc basis by BIMA in support of mission needs. Documentation of the interfaces and services required by ABIS 1.2 has required close collaboration between operators and the system engineers responsible for the 1.0 and 1.2 systems. The Joint Interoperability Test Command is tasked with verification of interoperability of ABIS 1.2 and testing is scheduled to be conducted from November 3 – 14, 2014.
- During the ATEC customer test performed in February and March 2014, ABIS 1.2 operated throughout the period with no significant system disruptions. The customer test was conducted in a non-operational environment in which data submissions were made using previously recorded submission data whose flow can be controlled by the system under test. The system processed all of the submitted transactions and ingested all those transactions, satisfying the processing specifications. Although there were some initial problems with some configuration settings, the Watchdesk operators, who handle customer requests and monitor submissions and

responses, or system administrators were able to correct issues such as account and/or computer settings. In order to properly receive responses to submissions from the users, correct message templates are required. During the customer test, some discrepancies were noted in selected responses that required changes to certain message templates for the responses to be properly received as expected.

- During Phase 1 of the IOT&E, the following problems were observed:
  - Discrepancies between ABIS 1.0 and ABIS 1.2 watchlist hits. ABIS 1.0 and ABIS 1.2 were not fully consistent in identifying individuals on the watchlist. Correctly matching individuals to the watchlist is a critical ABIS function. Review of 107 watchlist hits during Phase 1 found 17 watchlist hit discrepancies. Further analysis of the discrepancies attributed the discrepancies to timing of ingestion of daily watchlists between DOD ABIS 1.2 and DOD ABIS 1.0 and differences between the contents of the daily watchlists.
  - Discrepancies in the number of identities contained in the Custom Biometrically Enabled Watchlists (BEWLs) generated by ABIS 1.0 and ABIS 1.2. Custom BEWLs are smaller subsets of the full set of identities contained in BEWL, which are used in the field to determine the course of action when a person of interest is detained. Custom BEWLs generated after Phase 1 were reviewed and all identities provided for the Custom BEWL were present.
  - Phase 1 also demonstrated ABIS 1.2 problems that (1) negatively affected successful completion of Latent and Biometric examination workflows, (2) prevented a significant amount of data sharing with the Federal Bureau of Investigation upon deployment, and (3) affected the ability of the Watchdesk and Examiners from effectively completing some tasks. During Phase 2, the software patches and changes in standard operating procedures resolved the problems noted in these areas during Phase 1.

Recommendations

- Status of Previous Recommendations. The PMO has not adequately addressed all of the previous recommendations. The PMO still needs to:
  1. Conduct a baseline assessment, to include the definition of external interfaces to the current system and customers.
  2. Institutionalize a formal standards conformance program, listing external systems that have been independently verified to be interoperable with the biometrics enterprise.
- FY14 Recommendation.
  1. The Army should resolve cybersecurity findings from the IOT&E Red Team assessment and complete an adversarial assessment of ABIS 1.2 during FOT&E.

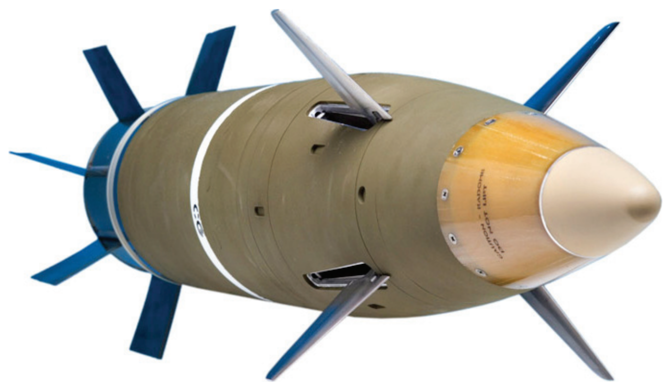
Excalibur Increment 1b M982E1

Executive Summary

- The Army conducted the Excalibur Increment 1b IOT&E at Yuma Proving Ground, Arizona, in January and February 2014. DOT&E published the combined IOT&E/LFT&E report on June 18, 2014.
- The Excalibur Increment 1b projectile is operationally effective. Relative to standard projectiles, its accuracy and lethality allow cannon artillery units to effectively engage more point targets with better effects using fewer projectiles in complex urban terrain.
- The Excalibur Increment 1b is operationally suitable. Excalibur Increment 1b met its 90 percent reliability requirement by demonstrating a system reliability point estimate of 97 percent in the IOT.
- The Army awarded a full-rate production contract for 757 projectiles on June 27, 2014.

System

- Excalibur Increment 1b is a precision-guided, extended-range, 155-millimeter unitary, high-explosive artillery projectile. It is fin-stabilized and glides to a target.
- Excalibur uses GPS and an Inertial Measurement Unit to attack point targets with accuracy of less than 10 meters from the desired aim point (in an unjammed environment).
- The Army developed the High-Explosive, Unitary (Block I) projectile in three spirals of increasing capability (Ia-1, Ia-2, and Ib). The Ia-1 projectiles use aerodynamic lift generated by canards to extend range out to 24 kilometers without the maximum propellant charge. The Ia-2 and Ib projectiles add base bleed technology and use of the maximum propellant charge to further increase range to beyond 35 kilometers. Increment Ib projectiles improve reliability and reduce cost.



Mission

Field Artillery units use Excalibur:

- To attack enemy targets in support of maneuver operations at a greater range and with increased accuracy than standard high-explosive munitions.
- To support the close fight in urban and complex environments, striking critical targets that must be engaged at extended ranges or in areas where minimal collateral damage is desired.
- To support fire missions against personnel and point targets such as threat forces emplacing IEDs, light material, and personnel within structures.

Major Contractor

Raytheon Missile Systems – Tucson, Arizona

Activity

- In December 2013, the Army conducted the Excalibur Increment 1b First Article Test with low-rate initial production projectiles.
- The Army conducted the Excalibur Increment 1b IOT&E at Yuma Proving Ground, Arizona, from January through February 2014.
- On June 18, 2014, DOT&E published an IOT&E/LFT&E report in support of the Army's June 2014 Full-Rate Production decision.
- The Army Acquisition Executive approved full-rate production for Excalibur Increment 1b on June 25, 2014.
- The Army awarded a full-rate production contract for 757 projectiles on June 27, 2014.
- The Army conducted all testing in accordance with DOT&E-approved Test and Evaluation Master Plan and operational test plan.

Assessment

- Excalibur Increment 1b test plan execution was adequate to assess operational effectiveness, suitability, lethality, and survivability.
- The Excalibur Increment 1b projectile is operationally effective.
  - Relative to standard projectiles, its accuracy and lethality allow cannon artillery units to engage point targets with precision effects using fewer projectiles in complex, urban terrain, limiting collateral damage.
  - DOT&E has reviewed Army combat reporting that showed units in Operation New Dawn and Operation Enduring Freedom effectively used Excalibur Increment 1a-1 and 1a-2 projectiles for timely engagement of targets in complex urban environments with minimal collateral damage.

- Excalibur Increment 1b achieved required accuracy irrespective of the presence or absence of GPS jamming. During operational testing, Excalibur Increment 1b demonstrated a median miss distance of 3.7 meters for projectiles fired at 32-kilometer ranges in an unjammed environment. The median miss distance for all projectiles was 2.0 meters. The Army requires Excalibur Increment 1b target accuracy of 10 meters.
- Live fire testing and analyses concluded the Excalibur Increment 1b projectile is more lethal against personnel targets and light material targets than standard high-explosive projectiles.
- The Excalibur Increment 1b is operationally suitable. The projectile is reliable when fired at all ranges up to its maximum range of 35 kilometers. The Army requires a system reliability of 90 percent. During operational testing, Excalibur Increment 1b met the requirement and demonstrated a system reliability estimate of 97 percent.

Recommendations

- Status of Previous Recommendations. The Army addressed all previous recommendations.
- FY14 Recommendations. The Army should continue to address recommendations from DOT&E's June 2014 Report:
  1. Optimize Advanced Artillery Tactical Data System software to employ a special sheaf with aim points equally spaced from the target center when the achieved target location error reported by an observer is less than 10 meters to maximize the effects of multiple Excalibur projectiles fired against a single point target.
  2. Update the Forward Observer System software so that fire support teams at company level and above can specify Excalibur or Precision Guidance Kit munitions when transmitting observer-initiated fire mission requests for precision-guided munitions to a firing unit. The current Forward Observer System version does not provide the option to select specific precision munition shell/fuze combinations.
  3. Modify current metrics to better assess lethality against different types of construction prevalent in theaters of operation.
  4. Collect and examine data on the effects of varied terrain, vegetation, and body armor on Excalibur lethality and other blast-fragmentation projectiles with similarly small fragment sizes.

Guided Multiple Launch Rocket System – Alternate Warhead (GMLRS-AW) XM30E1

Executive Summary

- The M30E1 Guided Multiple Launch Rocket System – Alternate Warhead (GMLRS-AW) surface-to-surface rocket will meet the DOD unexploded ordnance policy requirements and replace the non-compliant GMLRS Dual-Purpose Improved Conventional Munitions rocket.
- In FY14, the Army conducted GMLRS-AW developmental testing/operational testing (DT/OT) in which Soldier crews fired 15 rockets during 3 tactical-fire missions against threat-representative targets.
- The M30E1 GMLRS-AW IOT&E was executed from October through November 2014. DOT&E will submit a combined IOT&E/LFT&E Report to support the Army's planned March 2015 Full-Rate Production decision.

System

- The M30E1 GMLRS-AW rocket uses Inertial Measurement Unit and GPS guidance to engage area targets out to 70 kilometers.
- GMLRS-AW uses the same rocket motor, guidance system, and control system as the existing M31A1 GMLRS Unitary warhead rocket.
- The GMLRS-AW rockets can be fired from the tracked M270A1 Multiple Launch Rocket System and the wheeled High Mobility Artillery Rocket System (HIMARS).
- The 200-pound GMLRS-AW high-explosive warhead contains approximately 160,000 preformed tungsten fragments. This warhead change eliminates the unexploded ordnance found in the GMLRS Dual-Purpose Improved Conventional Munitions rockets.
- GMLRS-AW meets the dud rate requirement as defined by the current DOD Policy on Cluster Munitions and Unintended Harm to Civilians memorandum dated June 19, 2008.
- The procurement objective is 18,072 GMLRS-AW rockets. The Army plans to enter full-rate production in March 2015 following IOT&E.

Mission

Commanders will use GMLRS-AW rockets to engage area- or imprecisely-located targets without the hazard of unexploded submunitions. The target set includes counterfire, air defense, command posts, assembly areas, light materiel, and other high payoff targets.

Major Contractor

Lockheed Martin Missiles and Fire Control – Dallas, Texas

Activity

- From October 2013 to April 2014, the Army completed the Production Qualification Test (PQT) flight test series, which consisted of 5 missions and 17 GMLRS-AW rockets fired at short, medium, and long ranges (16.8, 37.4, and 65.7 kilometers, respectively). PQT missions were launched from M270A1 launchers and M142 HIMARS launchers. Four of the five missions were fired at elements of targets that will be used in the IOT&E: a towed howitzer battery including personnel, a forward command post, and a surrogate SA-6 radar.
- During FY14, the GMLRS-AW Program Office conducted PQT ground testing, including static arena tests to evaluate warhead lethality, temperature shock and vibration testing, software development testing, and system integration tests.
- In June 2014, Soldiers from the 214th Fires Brigade at Fort Sill, Oklahoma, conducted an integrated DT/OT at

White Sands Missile Range, New Mexico, consisting of three, tactical-fire missions. There were 15 rockets fired from a HIMARS launcher.
- During the DT/OT period, the Army conducted a cybersecurity vulnerability assessment of the HIMARS and M270A1 launchers and the Advanced Field Artillery Tactical Data System.
- The GMLRS-AW IOT&E was executed from October through November 2014.
- DOT&E will submit a combined IOT&E/LFT&E report to support the Army's planned March 2015 Full-Rate Production decision.
- The Army conducted the PQT and DT/OT in accordance with the DOT&E-approved Test and Evaluation Master Plan and test plans.

Assessment

- GMLRS-AW munition is accurate and reliable. DOT&E is evaluating the effectiveness and lethality of the GMLRS-AW munition. GMLRS-AW munition contains no submunitions minimizing the unintended harm to civilians and infrastructure associated with unexploded ordnance from cluster munitions.
- The PQT demonstrated the GMLRS-AW rocket is reliable (17 successes in 17 flights) and accurate (median miss distance of 2.1 meters). Reliability and accuracy were further demonstrated in the June 2014 DT/OT (15 successes in 15 flights, and median miss distance of 2.7 meters). There is no system requirement for accuracy. The contractor specification is less than 15 meters Circular Error Probable.
- During DT/OT, Soldier crews were able to process and execute GMLRS-AW fire missions using the HIMARS launcher and the Advanced Field Artillery Tactical Data System command and control software.
- The GMLRS-AW system met the requirement for the three fire missions in the DT/OT, including one fire mission where GPS jamming occurred.

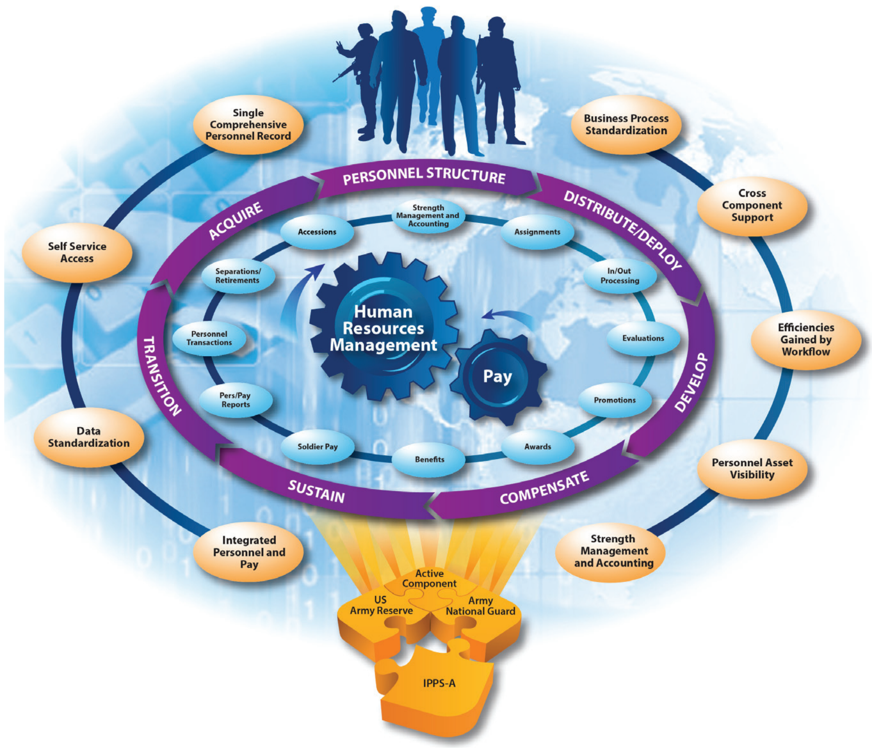
Recommendations

- Status of Previous Recommendations. The Army addressed all previous recommendations.
- FY14 Recommendations. None.

Integrated Personnel and Pay System – Army (IPPS-A)

Executive Summary

- Integrated Personnel and Pay System – Army (IPPS-A) is a two increment program that streamlines Army Human Resources processes and enhances the efficiency and accuracy of Army personnel and pay procedures to support Soldiers and their families. Through a three phased-delivery approach, Increment 1 of the IPPS-A program provides the foundational data for a single, integrated military personnel and pay system for all three Army components: the active-duty Army, the Army Reserve National Guard (ARNG), and the Army Reserve.
- The Army Test and Evaluation Command (ATEC) and ARNG conducted an IOT&E event on February 19 – 21, 2014, at the ARNG Bureau in Arlington, Virginia, in accordance with an ATEC-approved test plan. IPPS-A, as it exists in Increment 1, is effective and survivable. A suitability assessment is deferred until Increment 2. The capabilities available in this increment are limited; the program should continue to improve IPPS-A in order to deliver the full set of necessary capabilities.
- The IPPS-A Increment 1 system demonstrated the capability to produce its primary product, a Soldier's Record Brief (SRB), which is a single, integrated compilation of personnel and pay data collected from various, external authoritative sources.



System

- IPPS-A is a two increment program that streamlines Army Human Resources processes and enhances the efficiency and accuracy of Army personnel and pay procedures to support Soldiers and their families. Increment 1 interfaces with legacy applications to create a trusted, foundational database. All authoritative data remain in the legacy systems for Increment 1. Increment 2 will become the authoritative data source as the necessary functionality of the legacy systems to be subsumed is incorporated.
- It is a web-based tool, available 24 hours a day, accessible to Soldiers, Human Resources professionals, Combatant Commanders, personnel and pay managers, and other authorized users throughout the Army. IPPS-A improves the delivery of military personnel and pay services and also provides internal controls and audit procedures to prevent erroneous payments and loss of funds.
- IPPS-A interfaces with 15 other Army and DOD systems to acquire personnel and pay data, which it integrates into a single record for each Soldier. These systems include the Defense Enrollment Eligibility Reporting System – Personnel Data Repository, Electronic Military Personnel Office, Standard Installation and Division Personnel Reporting System – Guard, and Total Army Personnel Data Base – Reserve. IPPS-A's SRB acts as a trusted, but non-authoritative, display of data contained in the various external systems; any changes required to the data must be made within the existing 15 Army and DOD Personnel systems and cannot be accomplished within IPPS-A. The SRB displays a Soldier's military career personal information, qualification skills, training, assignment history, and various other Soldier attributes.

Mission

Soldiers will use IPPS-A as a single, integrated personnel and pay system that will provide personnel and pay management functionality for all Army Components. Army Components will use IPPS-A to manage their members across the full operational spectrum during peacetime, war, through mobilization and demobilization, capturing timely and accurate data throughout. Additionally, Commanders will possess a comprehensive system for accountability and information to support command decisions regardless of component or geographic location.

Major Contractor

EDC Consulting LLC – McLean, Virginia

Activity

- ATEC conducted a risk assessment of Increment 1 on June 19, 2014, in accordance with DOT&E Information and Business Systems Policy. Due to the low risk of the capabilities being delivered in Increment 1, the risk assessment allowed for the delegation of test plan approval to ATEC.
- ATEC and ARNG executed the IOT&E event on February 19 – 21, 2014, at the ARNG Bureau in Arlington, Virginia.
  - The three-day event consisted of user training on SRB access, observations of user utilization of IPPS-A to view their SRB, and user response to the survey questions.
  - One hundred and ninety ARNG Soldiers received training on February 19, 2014, in order to login using their Common Access Cards, view their SRB, and complete an online survey and print out their SRB.
- Prior to the IOT&E event on February 12 – 13, 2014, the Threat Systems Management Office conducted cybersecurity testing on IPPS-A in accordance with the DOT&E Information Assurance policy.

Assessment

- IPPS-A Increment 1, as delivered, provides an SRB that is viewable through a web interface and can be printed out. Increment 1 does not provide the capability to add or edit personnel data. The ability to edit personnel and pay data will be phased in during the four releases in Increment 2.
- The results of the online survey indicate the system was easy to use and the resources necessary to obtain and interpret the data on the SRB were adequate. The results also indicate that the training received and online resources available were sufficient for most Soldiers. Very few of the Soldiers used the help desk, and the associated survey results did not provide a significant response as to whether they were satisfied with the help desk support.
- Out of 190 participants surveyed during the IOT&E, 181 (95.2 percent) reported errors in their SRB. Developmental testing verified that IPPS-A accurately ingests, processes, and displays personnel data in the SRB. Therefore, any data errors within the SRB discovered during this test reflect incorrect data received from the external, legacy systems.
- The Army is working to correct the errors in the various databases, which feed IPPS-A. The Army G-1 is tracking the data correction process and intends to provide a report prior to the end of fielding IPPS-A Increment 1.
- The SRB can be categorized into 11 sections and the Header and Footer sections. Participants found data errors in all 11 sections and the Header and Footer sections of the SRB. Sections where more than 50 percent of the participants had data errors include Personal/family data, Civilian Education, and Military Education. Preliminary analysis shows the legacy sources contributing to most errors are Army Training Requirements and Resources System, Reserve Component Manpower System, and Standard Installation and Division Personnel Reporting System.
- The results of the Cyber Vulnerability testing found 6 Category 1 and 86 Category 2 deficiencies. Cybersecurity results from a subsequent verification of fixes event indicate that all major vulnerabilities discovered during the IOT&E have been mitigated.

Recommendations

- Status of Previous Recommendations. This is the first annual report for this program.
- FY14 Recommendations.
  1. The Army should continue to track satisfaction with help desk procedures and support to determine actual satisfaction with help desk services provided to Soldiers to support successful fielding of Increment 1 to the active-duty Army and Army reserve.
  2. To ensure successful development and fielding of Increment 2, the Army should:
     - Continue to pursue correction of personnel data in the 15 Army and DOD systems that provide the data necessary to create correct SRBs.
     - Confirm the data verification process successfully updates records in external systems, which will enable IPPS-A to display an accurate SRB.

Joint Battle Command – Platform (JBC-P)

Executive Summary

- DOT&E released a November 2013 IOT&E report that assessed Joint Battle Command – Platform (JBC-P) software build 5.0 as operationally effective, not operationally suitable, and not survivable. This report was based upon the May 2013 JBC-P software build 5.0 IOT&E.
- In November 2013, the Army approved a fielding decision for JBC-P software build 5.1 based upon the May 2013 JBC-P IOT&E and demonstrated corrections to discovered deficiencies.
- In May 2014, the Army and Marine Corps conducted a JBC-P software build 6.0 Multi-Service Operational Test and Evaluation (MOT&E) to support fielding decisions in both Services. While software build 6.0 delivered several enhanced capabilities, it introduced deficiencies which significantly detracted from mission capabilities and led to a change in the assessment. DOT&E assessed JBC-P software build 6.0 as:
  - Not operationally effective due to low message completion rates, phantom Mayday messages, inaccurate representation of blue force icons, and the poor performance of JBC-P Logistics (Log)
  - Not operationally suitable due to reliability that was below the Army's requirement for five of seven JBC-P hardware variants, deficiencies in training provided to Soldiers, and lack of a force structure to support JBC-P Log
  - Not survivable due to cybersecurity vulnerabilities

System

- JBC-P is a networked battle command information system that enables units to share near real-time friendly and enemy situational awareness information, operational maps and graphics, and command and control (C2) messages. The Army and Marine Corps intend JBC-P to achieve platform-level interoperability for ground vehicles, dismounted Soldiers/Marines, and aviation assets operating in land/littoral and joint operational environments.
- JBC-P is an upgrade to the Force XXI Battle Command Brigade and Below Joint Capabilities Release and provides the following improvements:
  - Tactical chat combined with chat room capability, providing enhanced collaboration for commanders
  - Improved mission command applications for planning and execution
  - A more intuitive graphical user interface with improved display of maps and images
  - Enhanced blue force situational awareness between mobile platforms, Tactical Operational Centers, and dismounted Soldiers equipped with Nett Warrior
  - JBC-P Log provides tracking of logistics cargo within the unit's area of operations through the use of Radio Frequency Identification tags

1 - JBC-P on Mounted Family of Computer Systems (MFoCS)
2 - JBC-P on Joint Version - 5 (JV-5) Block 2
3 - JBC-P Screen Shot
4 - JBC-P LOG on Military Rugged Tablet Plus (MRT+)
5 - JBC-P on JV-5 Block 2

  - Hybrid capability to connect JBC-P across different networks through the use of its Network Services Gateway and associated terrestrial and satellite radios
- JBC-P is fielded in both mobile and command post versions. JBC-P communications is supported by:
  - Blue Force Tracker 2 satellite communications for mobile operations
  - Tactical radios for connectivity between JBC-P-equipped vehicles and to support dismounted operations
  - Tactical Internet for command post operations

Mission

Army, Marine Corps, and Special Operations Forces commanders use JBC-P to provide integrated, on-the-move, near real-time battle command information and situational awareness from brigade to maneuver platform to dismounted Soldiers/Marines.

Major Contractor

Software Engineering Directorate, U.S. Army Aviation & Missile Research, Development & Engineering Center – Huntsville, Alabama

Activity

- During the October 2013 Network Integration Evaluation 14.1, the Army conducted a JBC-P software build 5.1 customer test to demonstrate correction of the May 2013 JBC-P IOT&E software build 5.0 deficiencies.
- In November 2013, DOT&E released a JBC-P IOT&E report to support the Army's JBC-P software 5.1 fielding decision.
- In November 2013, the Army completed a fielding decision for JBC-P software build 5.1, based upon the May 2013 IOT&E and correction of noted deficiencies. The fielding decision was contingent upon completion of Army Interoperability Certification.
- During FY14, the program received a conditional material release, and completed Army and Joint Interoperability Certifications on JBC-P software build 5.1.
- During the May 2014 Network Integration Evaluation 14.2, the Army and Marine Corps conducted a JBC-P software build 6.0 MOT&E to support fielding decisions for both Services. The test was conducted according to a DOT&E-approved Test and Evaluation Master Plan and test plan, and employed an Army brigade with an attached Marine Corps battalion conducting missions under operationally realistic conditions.
- DOT&E will publish an MOT&E report in FY15.

Assessment

- Based on results from the 2013 JBC-P software build 5.0 IOT&E, DOT&E released a JBC-P IOT&E report in November 2013, which assessed JBC-P as:
  - Operationally effective in supporting Army commanders and Soldiers with situational awareness, C2 messages, and chat when operating from Tactical Operational Centers and on-the-move in tactical vehicles. JBC-P served as the Soldiers' primary tool for C2 when on-the-move.
  - Not operationally suitable due to poor reliability (less than the Army's reduced requirement) and deficiencies in training provided to Soldiers.
  - Not survivable due to Information Assurance vulnerabilities.
- Based upon MOT&E, DOT&E assessed the effectiveness of the JBC-P software build 6.0 for combat operations. While software build 6.0 delivered several enhanced capabilities, it introduced deficiencies which significantly detracted from mission capabilities and led to an assessment that the JBC-P was now not effective. During MOT&E, JBC-P:
  - Demonstrated the ability to pass situational awareness messages.
  - Provided effective chat communications between all echelons of the brigade.
  - Did not meet message completion and timeliness requirements for C2 and survivability data.
  - Generated numerous false Mayday messages and provided inaccurate representations of blue force icons, which reduced the Soldiers' confidence in the system.
  - Did not provide an effective means to track logistics cargoes using JBC-P Log.
- Based upon MOT&E, DOT&E assessed JBC-P as not operationally suitable and highlighted the following deficiencies:
  - The majority of JBC-P hardware did not meet the Mean Time Between Essential Function Failure reliability requirement of 290 hours. Two of the seven JBC-P hardware variants met their Mean Time Between Essential Function Failure reliability requirement, the JV-5 (469 hours lower confidence bound) and JV-5 Block II (895 hours lower confidence bound).
  - Soldiers experienced problems with spontaneous reboots and shared user displays within Warfighter Information Network – Tactical-equipped vehicles.
  - Although improved since IOT&E, training does not afford Soldiers and leaders the ability to use all of the features of JBC-P. Soldiers require more hands-on training and leaders require extended leader training.
  - Logistics units did not have signal Soldiers required to configure, operate, and maintain JBC-P Log. Units diverted Soldiers from other unit missions (e.g. fuel handler) to perform this duty.
- The JBC-P MOT&E demonstrated the system as not survivable against threat computer network operations. While improved compared to IOT&E results, the Army needs to further improve JBC-P's cybersecurity.

Recommendations

- Status of Previous Recommendations. The Army made improvements in deficiencies noted during IOT&E, yet still needs to improve JBC-P reliability, training, and cybersecurity.
- FY14 Recommendations. The Army should:
  1. Improve JBC-P effectiveness by correcting MOT&E deficiencies to include low message completion rates, phantom Mayday messages, inaccurate blue force icon representation, and poor JBC-P Log performance.
  2. Improve JBC-P reliability by improving hardware variants that did not meet requirements and correcting software build 6.0 deficiencies.
  3. Assess Army force structure to support JBC-P and JBC-P Log, and provide necessary Soldiers to configure, operate, and maintain the system.
  4. Improve JBC-P leader and Soldier training.
  5. Correct cybersecurity survivability deficiencies demonstrated during the JBC-P MOT&E.

Joint Light Tactical Vehicle (JLTV) Family of Vehicles (FoV)

Executive Summary

- Army and Marine Corps units equipped with Joint Light Tactical Vehicles (JLTVs) with inherent armor demonstrated the ability to execute air assault missions.
- Based on developmental test/operational test (DT/OT), Marine Corps units equipped with JLTVs demonstrated the ability to execute amphibious assault missions.
- The JLTVs have large visual signature and their slow maneuver time from ship to shore prevents a Marine Expeditionary Unit from executing assault missions with tactical surprise, increases the time to close combat power ashore, and renders the unit vulnerable to threats. Testing showed that JLTVs are slower to load, prepare for fording, and transition to maneuver ashore than HMMWV due to their larger vehicle size, delays that occur while awaiting suspension mode, and other vehicle adjustments (e.g., tire pressure).
- In September 2014, the Army and Marines conducted the JLTV Family of Vehicles (FoV) Limited User Test (LUT) at Fort Stewart, Georgia.
- From November 2013 through October 2014, the Army conducted Engineering Manufacturing and Development (EMD) system-level ballistic testing of the JLTV designs.
- The program will begin Source Selection Board activities to down select to a single contractor in January 2015 and is expected to be completed by July 2015.
- The Milestone C Low-Rate Initial Production decision is planned for July 2015.
- The Army conducted all testing in accordance with a DOT&E-approved test plan and Test and Evaluation Master Plan (TEMP).

AM General JLTV

Lockheed Martin Systems JLTV

Oshkosh Corporation JLTV

System

- The JLTV FoV is the Marine Corps and Army partial replacement for the High Mobility Multi-purpose Wheeled Vehicle (HMMWV) fleet. The Services intend the JLTV to provide increased crew protection against IED and underbody attacks, improved mobility, and higher reliability than the HMMWV.
- The JLTV FoV consists of two vehicle categories: the JLTV Combat Tactical Vehicle, designed to seat four passengers; and the JLTV Combat Support Vehicle, designed to seat two passengers.
- The JLTV Combat Tactical Vehicle has a 3,500-pound payload and 3 mission package configurations:
  - Close Combat Weapons Carrier Vehicle
  - General Purpose Vehicle
  - Heavy Guns Carrier Vehicle
- The JLTV Combat Support Vehicle has a 5,100-pound payload and 2 configurations:
  - Utility Prime Mover
  - Shelter Carrier
- The JLTV program is using a competitive prototype acquisition strategy. During the EMD phase, the program tested vehicles from three contractors.

Mission

- Military units employ JLTV as a light, tactical-wheeled vehicle to support all types of military operations. JLTVs are used by airborne, air assault, amphibious, light, Stryker, and heavy forces as reconnaissance, maneuver, and maneuver sustainment platforms.
- Small ground combat units will employ JLTV in combat patrols, raids, long-range reconnaissance, and convoy escort.

Major Contractors

- AM General – South Bend, Indiana
- Lockheed Martin Corporation – Grand Prairie, Texas
- Oshkosh Corporation – Oshkosh, Wisconsin

Activity

- In April 2014, the Army and Marine Corps units executed air assault missions during DT/OT at Aberdeen Proving Ground, Maryland, using CH-47F and CH-53E helicopters. The Marine Corps unit executed amphibious assault missions at Joint Expeditionary Base Little Creek, Fort Story, Virginia, using Landing Craft Utility ships.
- In July 2014, the Army Test and Evaluation Command (ATEC) conducted reliability, availability, and maintainability testing on all three vendors' JLTVs at Aberdeen Proving Ground and Yuma Proving Ground, Arizona. The objective of testing was to discover failure modes, implement corrective actions, and assess whether the vendors' vehicles could meet the required Mean Miles Between Hardware Mission Failure (MMBHMF) prior to the Milestone C decision.
- In August 2014, the ATEC completed automotive testing on the vendors' JLTVs.
- The Marine Corps demonstrated its automotive performance requirements when outfitted with the Army's higher level of underbody protection during testing. The Marine Corps removed their separate, lower underbody protection requirement. In the future production and deployment phase, all vehicles tested will be armored to meet a single set of under-vehicle protection requirements.
- The program began developing the JLTV FoV Milestone C TEMP to reflect the T&E activities for the production and deployment phase in June 2014.
- In September 2014, the Army and Marines conducted the JLTV LUT at Fort Stewart, Georgia. When the LUT ended in November 2014, the Army test unit had completed three, 96-hour scenarios and the Marine Corps test unit had completed one, 96-hour scenario at an operational tempo consistent with the JLTV Operational Mode Summary/Mission Profile. Analysis of the JLTV LUT data is ongoing.
- The program will begin Source Selection Board activities to down select to a single contractor in January 2015 and is expected to be completed by July 2015.
- ATEC completed the EMD phase of system-level live fire testing (50 tests total across the three vendors) in October 2014.
- The Milestone C Low-Rate Initial Production decision is planned for July 2015.
- The Army conducted all testing in accordance with a DOT&E-approved test plan and TEMP.

Assessment

- Vendors' JLTVs demonstrated between 528 and 2,194 MMBHMF during reliability growth testing. The vehicles were required to demonstrate 3,196 MMBHMF prior to the JLTV LUT.
- Based on the DT/OT, Army and Marine Corps units equipped with the JLTVs with inherent armor can execute air assault missions. The three JLTV contractor vehicles were more difficult to rig, de-rig, and load weapons due to vehicle height and lack of vehicle handholds and footholds than HMMWV. They had limited space to carry crew, mission essential equipment, weapons, and their sustainment load because of the small interior compartment.
- Marine Corps units equipped with the JLTVs demonstrated the ability to execute amphibious assault missions during DT/OT.
- The JLTVs have large visual signature, and their slow maneuver time from ship to shore prevents a Marine Expeditionary Unit from executing assault missions with tactical surprise, increases the time to close combat power ashore, and renders the unit vulnerable to threats. Testing showed that JLTVs are slower to load, prepare for fording, and transition to maneuver ashore than HMMWV due to their larger vehicle size, delays that occur while awaiting suspension mode, and other vehicle adjustments (e.g., tire pressure).
- During DT/OT, the JLTVs demonstrated more maneuverability in soft soil and better fording capability than HMMWV. Crews have less visibility in JLTVs than HMMWV because of smaller windows, placement of mission equipment, and positioning of window panels.
- Analysis of the JLTV EMD ballistic test data is ongoing. These data will be used to make a final assessment of threshold-level force protection Key Performance Parameter for all three vendors.

Recommendations

- Status of Previous Recommendations. There were no previous recommendations for this program.
- FY14 Recommendation.
    1. The program should develop a plan to correct JLTV performance deficiencies discovered during the JLTV DT/OT and LUT before production.

Joint Tactical Network (JTN)

Executive Summary

- In January 2014, the Defense Acquisition Executive approved the Joint Tactical Networking Center (JTNC) charter that defines the responsibilities of the Program Manager-Joint Tactical Networks (PM-JTN) to develop and maintain the Joint Enterprise Network Manager (JENM); report on program acquisition and sustainment status to the JTNC Board of Directors; and develop a plan to transition waveform development to the Services by 4QFY15.
- In May 2014, DOT&E assessed the JENM as a part of the Manpack radio FOT&E during the Network Integration Evaluation (NIE) 14.2.
  - Soldiers using JENM were able to plan mission configuration files and load them onto Manpack radios.
  - The network planning process is cumbersome and loading radios is too slow for the unit's operational tempo.
  - Soldiers were able to monitor the network using JENM, but the monitoring function provides little operational utility to the unit.
- PM-JTN is currently developing a Test and Evaluation Master Plan (TEMP) that describes testing of the JENM and waveforms in coordination with the host radio programs.

System

- The PM-JTN provides software applications that enable software-defined radio sets to provide communications to tactical forces. The software applications include software-defined waveforms and enterprise network management.
- Software-defined waveforms are loaded into and considered a part of a radio set. JTN is responsible for the following software-defined waveforms:
  - Soldier Radio Waveform (SRW)
  - Wideband Networking Waveform (WNW)
  - Single-Channel Ground and Airborne Radio System (SINCGARS)
  - Mobile User Objective System (MUOS)
  - Link 16
- The JENM is a set of software applications that allow the Services to plan, configure, and monitor software-defined radio networks. The JENM is separate from the radio sets and is deployed on a Joint Tactical Networking Environment Network Operations Toolkit computer. The current JENM, version 1.2.8.1, configures SRW radio networks using Manpack and Rifleman radios. Future releases will configure radios for WNW and MUOS networks.

- The JENM functions include planning, loading, monitoring, controlling, and reporting.
  - The planning function develops network parameters and creates a Radio Mission Data Set (RMDS) file.
  - The loading function transfers the RMDS file into the radio sets to configure them for network operation.
  - The monitoring function provides a near real-time display of the WNW or SRW network status and condition of the network radios.
  - The controlling function allows the signal Soldier to make changes to the network, to include sending commands to radio operators, changing the configuration parameters of the radio sets, or conducting cryptographic functions (rekey, zeroize, and transfer).
  - The reporting function records all network management events and logs the data for analysis.

Mission

- Forward-deployed military forces use the software-defined radios to communicate and create networks to exchange voice, video, and data during all aspects of tactical military operations.
- Signal staffs intend to use the JENM to:
  - Plan, load, monitor, control, and report on network operations involving software-defined radio sets running SRW and WNW.
  - Load the RMDS file for the initial provisioning of a MUOS terminal to connect to a MUOS satellite network.

Major Contractor

The Boeing Company, Phantom Works Division – Huntington Beach, California

---

Activity

- In January 2014, the Defense Acquisition Executive approved the JTNC charter, which defines the responsibilities of both the JTNC and PM-JTN following the dissolution of the Joint Tactical Radio System Network Enterprise Domain. PM-JTN was given responsibility to:
  - Develop and maintain the JENM
  - Report on program acquisition and sustainment status to the JTNC Board of Directors
  - Transition waveform development and sustainment responsibilities to the designated Services (by waveform) by 4QFY15
- From January through February 2014, the Army assessed JENM loading on the Manpack radio during the Manpack radio Government Development Test 4 at Fort Huachuca, Arizona.
- During the May 2014 NIE 14.2, the Manpack radio FOT&E assessed Soldiers using the JENM to plan, configure, load, and monitor Manpack radio networks. The Army conducted this test according to a DOT&E-approved test plan.
- The program is developing a TEMP to describe testing activities to fulfill the responsibilities described within the JTNC charter.

Assessment

- During Government Development Test 4, the JENM:
  - Allowed Soldiers to load and reconfigure radios with four of five threshold waveforms and network presets
  - Demonstrated partial capability to monitor a radio network
  - Enabled Soldiers to access and view the status of Manpack radio configurations and Communications Security (COMSEC) keys
- During the Manpack radio FOT&E at NIE 14.2:
  - Soldiers using JENM were able to plan mission configuration files and load them onto Manpack radios. JENM's planning of the mission configuration files was not easy and required several attempts before success. Network planners encountered difficulty with network complexity due to the large number and multiple variants of networking radios within Army units.
  - JENM was slow when loading radios. Soldiers using JENM and a Simple Key Loader to load a Manpack radio with mission configuration files and COMSEC keys experienced load times of 30 minutes and greater per radio. Loading all radios within a company can take as long as 24 hours. This time requirement is not practical for a reload that must occur once a month, per COMSEC guidelines.
  - JENM's network monitoring function provided little operational utility for the unit. Companies do not have a Soldier assigned to monitor the network and the distance from the headquarters to the radio network often exceeded radio transmission range.
  - One signal Soldier per company was not sufficient to accomplish network management, operation, and maintenance required for the unit's communications equipment. Units tasked Soldiers from other mission areas to assist.

Recommendations

- Status of Previous Recommendations. This is the first annual report for this program.
- FY14 Recommendations. The Army should:
  1. Complete a JTN TEMP that describes testing of the JENM and waveforms (until the waveforms transition to designated Services).
  2. Correct the deficiencies noted during the Manpack radio FOT&E and validate corrections during future testing.
  3. Evaluate the force structure requirements of adding software-defined, networking radios and network management responsibilities into company-level organizations.

M80A1 7.62 mm Cartridge

Executive Summary
- Forces will use the M80A1 cartridge, fired by several different weapons systems, to defeat targets with improved lethality compared to the current M80 ball cartridge.
- The Army successfully completed live fire testing of the M80A1 in July 2014. DOT&E assessed the M80A1 as lethal.
- The Army authorized fielding in September 2014.

System
- The 7.62 mm M80A1 cartridge is intended to replace the lead-based projectile contained in the current M80 ball cartridge with a projectile utilizing environmentally-friendly materials. It is designed to provide improved lethality compared to the current M80 ball cartridge.
- The M80A1 cartridge is compatible with the M240 series of machine guns, the M134 "mini gun," the Mk48 machine gun, and the M110, MK17, M40A5, and M14 series rifles. This new cartridge is intended to be a direct replacement for the currently fielded M80 cartridge.
- The M80A1 is a three-part projectile consisting of a steel penetrator, a copper slug, and a reverse-drawn copper jacket.

Mission
Forces equipped with weapons that fire the M80A1 will engage enemy combatants during tactical operations in accordance with applicable tactics, techniques, and procedures to accomplish assigned missions.

Major Contractors
- Alliant-Techsystems, Small Caliber Systems – Independence, Missouri
- Olin Winchester – East Alton, Illinois

Activity
- The Army successfully completed live fire testing of the M80A1 in July 2014. Testing was conducted in accordance with the DOT&E-approved live fire strategy and test plans.
- The Army used gelatin targets to obtain data as inputs for complex computer modeling of M80A1 performance. Testing also included shots against light material barriers and other targets to determine the projectile's ability to perforate the target.
- The Army approved fielding of the M80A1 as an Enhanced Performance Round via an Engineering Change Proposal to the M80 in September 2014.
- DOT&E will publish a classified lethality report for the M80A1 in January 2015.

Assessment
- The M80A1 demonstrated adequate performance and lethality.
- The classified DOT&E lethality report provides a detailed description of the M80A1's performance.

Recommendations
- Status of Previous Recommendations. This is the first annual report for this program.
- FY14 Recommendations. None

M109 Family of Vehicles (FoV) Paladin Integrated Management (PIM)

Executive Summary
- In FY14, the Army conducted multiple test phases as part of the M109 Family of Vehicles (FoV) Paladin Integrated Management (PIM) LFT&E program, including follow-on ballistic hull testing, component ballistic tests, and fire survivability testing.
- The assessment of results for each of the test phases is ongoing. Preliminary assessments of the fire survivability tests indicate potential vulnerability issues with one PIM vehicle's automatic fire extinguishing system.
- Underbody blast testing will not be accomplished until high-fidelity prototypes and full-up systems are available.

System
- The M109 FoV PIM consists of two vehicles: the Self-Propelled Howitzers (SPH) and Carrier, Ammunition, Tracked (CAT) resupply vehicles.
  - The M109 FoV SPH is a tracked, self-propelled 155 mm howitzer designed to improve sustainability over the legacy M109A6 howitzer fleet. The full-rate production howitzers will have a newly designed hull, modified Bradley Fighting Vehicle power train and suspension, and a high-voltage electrical system. The SPH is operated by a crew of four and can engage targets at ranges of 22 kilometers using standard projectiles and 30 kilometers using rocket-assisted projectiles.
  - The M109 FoV CAT supplies the SPH with ammunition. The full-rate production ammunition carriers will have a common chassis with the SPH. The ammunition carriers are designed to carry 12,000 pounds of ammunition in various configurations and a crew of four Soldiers.
- The Army will equip the SPH and CAT with two armor configurations to meet two threshold requirements for force protection and survivability – Threshold 1 (T1) and Threshold 2 (T2).
  - The base T1 armor configuration is integral to the SPH and CAT. The T2 configuration is intended to meet protection requirements beyond the T1 threshold with add-on armor kits.
  - The Army plans to employ PIM vehicles in the T1 configuration during normal operations and will equip the SPH and CAT with T2 add-on armor kits during combat operations.
- The M109 FoV SPH can fire the PGK and the Excalibur precision munition to increase delivery accuracy. The Army developed the PGK to reduce the dispersion of unguided projectiles and the Excalibur precision munition to provide Field Artillery units a precision engagement capability.
- The Army intends to employ the M109 FoV as part of a Fires Battalion in the Armored Brigade Combat Team and Artillery Fires Brigades with the capability to support any Brigade Combat Team.
- The Army plans to field up to 557 sets of the M109 FoV with full-rate production planned for FY17.

Mission
Field Artillery units employ the M109 FoV to destroy, defeat, or disrupt the enemy by providing integrated, massed, and precision indirect fire effects in support of maneuver units conducting unified land operations.

Major Contractor
BAE Systems – York, Pennsylvania

Activity
- The Army conducted multiple test phases as part of the M109 FoV PIM LFT&E program at Aberdeen Proving Ground, Maryland, including follow-on ballistic hull testing, component ballistic tests, and fire survivability testing.
  - In FY13, initial exploitation testing against SPH and CAT ballistic structures to characterize the protection they provide against specified threats revealed multiple vulnerable areas in the systems' T1 and T2 armor

configurations. The Program Office addressed each of these vulnerabilities, and proposed corrective actions for most of them. In 3QFY14, the Army conducted follow-on ballistic hull (retrofit) testing to validate proposed corrective actions.
  - In 3QFY14, the Army conducted component ballistic tests of the SPH and CAT high-voltage electrical systems to characterize their performance and unexpected vulnerabilities after being subjected to a threat impact.
  - In 4QFY14, the Army conducted fire survivability testing of the SPH. The Army will complete all fire survivability testing by May 2015.
- The Army conducted all test phases in accordance with DOT&E-approved test plans.
- The Army has designed and will test a separate underbelly kit (not a component of the T1 and T2 armor configurations) to determine the potential protection an SPH and CAT can provide against IEDs similar to those encountered in Iraq and Afghanistan. That testing is expected to occur in FY15-16 when the high-fidelity prototypes and full-up systems are available.

Assessment

- Assessment of results from the follow-on SPH and CAT ballistic hull testing and component ballistic tests of the high voltage electrical systems on the systems is ongoing. DOT&E will include that assessment in a final LFT&E report to Congress.
- Preliminary results of the SPH's fire survivability tests indicate potential vulnerability issues with the platform's automatic fire extinguishing system. The specific details are classified. DOT&E will include that assessment in a final LFT&E report to Congress.

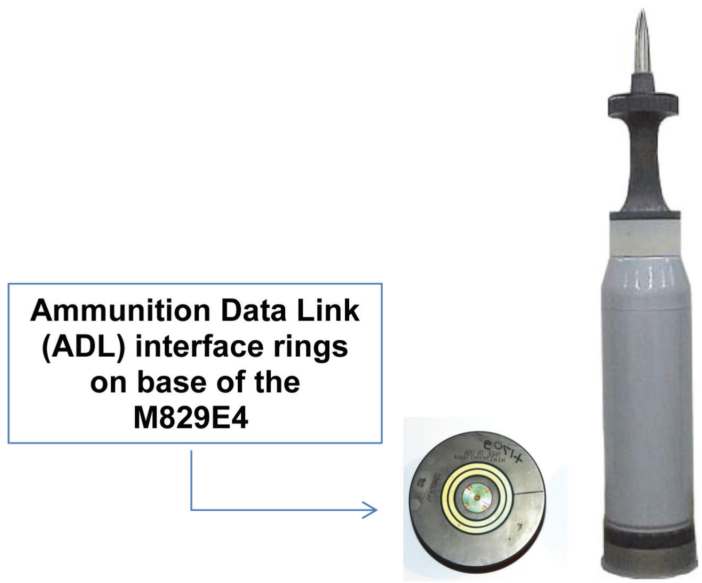
Recommendations

- Status of Previous Recommendations. The Army has successfully addressed one previous recommendation and made progress on two. However, they still need to implement and validate planned armor configuration changes for Low-Rate Initial Production vehicles prior to full-up system-level testing.
- FY14 Recommendation.
  1. The Army should correct the deficiencies identified in fire survivability testing and validate those fixes in test.

M829E4 Armor Piercing, Fin Stabilized, Discarding Sabot – Tracer (APFSDS-T)

Executive Summary

- The M829E4 120 mm cartridge is a line-of-sight kinetic energy cartridge designed for the Abrams main battle tank.
- During Integrated Test and Evaluation (IT&E), in-bore structural failures (IBSFs) occurred in the ambient zone temperature range (60-86 degrees Fahrenheit). The program manager stopped testing and conducted a formal failure analysis.
- Preliminary testing indicates the M829E4 cartridge is demonstrating an overall reliability of 94 percent as a result of IBSFs. The reliability requirement is 98 percent.
- The failure analysis identified reliability problems with the production process of the cartridge. The program has implemented production process changes to address reliability deficiencies and is in the process of conducting additional testing to verify the effectiveness of the changes.
- On June 30, 2014, the Program Executive Officer Ammunition approved the M829E4 cartridge for Milestone C with provisions.
- The Milestone Decision Authority authorized 910 M829E4 cartridges for low-rate initial production (LRIP) on June 30, 2014.



System

- The M829E4 120 mm cartridge is a line-of-sight kinetic energy cartridge designed for the Abrams main battle tank. It is the materiel solution for the Abrams' lethality capability gap against threat vehicles equipped with 3rd Generation Explosive Reactive Armor.
- The M829E4 cartridge is an Armor-Piercing, Fin-Stabilized, Discarding Sabot, with Tracer cartridge consisting of a depleted uranium long-rod penetrator with a three-petal composite sabot.
- The flight projectile includes a low-drag fin with a tracer, windshield, and tip assembly.
- The propulsion system of the M829E4 cartridge is a combustible cartridge case similar to that of the currently fielded suite of Abrams' 120 mm tank cartridges.
- The M829E4 has comparable characteristics to its predecessor, the M829A3, in length, weight, and center of gravity. The visible difference between the two cartridges is the Ammunition Data Link (ADL) interface rings on the base of the M829E4. The rings serve as the interface between the Abrams' fire control system and the M829E4. The ADL enables the Abrams' fire control system to send information to the M829E4.

Mission

Armored Brigade Combat Teams equipped with the M829E4 120 mm cartridge will have the ability to defeat current and projected threat main battle tanks equipped with third generation explosive reactive armor and active protection systems. The Army intends the M829E4 to provide enhanced lethality beyond its predecessor, the M829A3, and will enhance the Joint Forces Commander's capability to conduct decisive operations during Unified Land Operations.

Major Contractor

Alliant Techsystems Inc. (ATK) – Plymouth, Minnesota

Activity

- ATEC conducted a Design Engineering Test consisting of 50 M829E4 cartridges at Yuma Test Center, Arizona, from June through November 2013.
- ATEC conducted two phases of IT&E at Yuma Test Center; Redstone Test Center, Alabama; and Aberdeen Test Center, Maryland, from December 2013 through mid-June 2014.

- During Phase 1, IBSFs occurred. The program manager stopped testing and conducted a formal failure investigation.
- The Army produced subsequent M829E4 cartridges that incorporated design configuration and production process changes to correct the IBSFs.
- During Phase 2 of IT&E, 100 M829E4 cartridges with the design configuration and production process changes were fired. IBSFs continued to occur. The program manager again stopped testing and conducted another formal failure investigation.

- ATEC conducted vulnerability live fire testing on the Abrams uploaded with M829E4 cartridges to ensure that stored cartridges do not pose a threat when an Abrams tank is engaged by enemy fire from March through June 2014.
- ATEC conducted DOT&E-approved live fire tests to support a lethality assessment from June 16 – 25, 2014.
  - Due to the IBSFs observed during Phase 2 of IT&E, the Army ceased live fire testing. The potential for an IBSF during a live fire test presented an unacceptable risk to the live fire facility.
  - The Army will resume live fire testing when the risk to the live fire test facility related to IBSFs is mitigated and production-representative rounds are available.
- The Army conducted the M829E4 User Excursion at Aberdeen Proving Ground, Maryland, in accordance with a DOT&E-approved Test and Evaluation Master Plan on May 22, 2014.
  - The User Excursion utilized an ADL-equipped Abrams tank and qualified Abrams tank crew, who performed select engagements of a Tank Table VI gunnery event.
  - The gunnery event involved eight M829E4 engagements against moving and stationary targets.
  - The User Excursion was designed to confirm M829E4 cartridge transparency of employment and provide supplemental data for accuracy, performance, and reliability.
- The Program Executive Officer Ammunition approved the M829E4 cartridge for Milestone C with provisions on June 30, 2014.
  - The provisions require that the Army investigate fixes to the failures identified in IT&E, and verify those fixes in ATEC-approved follow-on testing prior to the Full-Rate Production Decision Review/Material Release, per the Milestone C Acquisition Decision Memorandum.
- The Milestone Decision Authority authorized 910 M829E4 cartridges for LRIP on June 30, 2014.
  - The Acquisition Decision Memorandum directed additional reliability testing to validate that LRIP cartridges meet reliability requirements.
- The Army conducted another formal failure investigation into the failures experienced during the second phase of IT&E and identified potential production process and design configuration changes to correct the IBSFs from June through August 2014.
  - Results of the formal failure investigation led the Army to produce two configurations (Configuration A and Configuration B) M829E4 cartridges to correct IBSFs.
  - Configuration A incorporated four production process changes.
  - Configuration B incorporated two design configuration changes and the four Configuration A production process changes.
- The Army conducted testing (Verification #1) at Yuma Proving Ground, Arizona, involving Configuration A and B cartridges on October 27, 2014.
  - Thirty events employing Configuration A cartridges. All 30 Configuration A cartridges fired successfully.
  - Twenty-six events employing Configuration B cartridges. Two of the 26 Configuration B cartridges experienced IBSF, and 24 cartridges fired successfully.
- Based on Verification #1 test results, the Army approved the Configuration A cartridge for Verification #2 testing in February 2015.
  - After Verification #2 testing is complete and yields successful results, the Army will resume live fire testing, production, and First Article Acceptance Testing.

Assessment

- Preliminary testing indicates the M829E4 cartridge is demonstrating an overall reliability of 94 percent. The reliability requirement is 98 percent.
  - During IT&E testing, the cartridge experienced IBSFs in the ambient zone temperature range. The M829E4 cartridge reliability was assessed by firing the cartridge within three temperature zone conditions: cold (-25 to 19 degrees Fahrenheit), ambient (60 to 86 degrees Fahrenheit), and hot (120 to 145 degrees Fahrenheit).
  - In ambient zone temperatures, the cartridge demonstrated 91.6 percent reliability. In cold zone temperatures, the cartridge demonstrated 94.6 percent reliability, and in hot zone temperatures, the cartridge demonstrated 97.2 percent reliability. Overall reliability is 94 percent.
  - The program has proposed additional design configuration changes to address reliability deficiencies and is in the process of testing to verify the effectiveness of the changes.
- Effectiveness is based on the Single Shot Probability of Kill metric computed using the Passive Vehicle Target Model (PVTM). Cartridge reliability is an input to PVTM, along with accuracy and lethality. Because reliability is an input to the PVTM model, effectiveness is sensitive to reliability results.
- DOT&E will submit an evaluation after completion of the production process changes and additional testing.

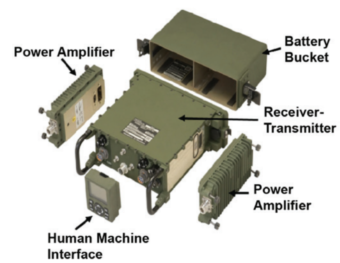
Recommendations

- Status of Previous Recommendations. This is the first annual report for this program.
- FY14 Recommendations. The Army should:
  1. Conduct an FOT&E event for the M829E4 and Abrams' production-representative hardware and software as part of the FY16 Ammunition Data Link Qualification event at Aberdeen Proving Ground, Maryland.
  2. Conduct Verification #2 testing to demonstrate that production process changes enable the cartridge to meet reliability requirements in a DOT&E-approved test prior to the Full Material Release decision.
  3. Complete live fire tests specified in the live fire strategy. If major design changes occur to the M829E4 cartridge to correct IBSFs experienced during IT&E, the Army should conduct live fire tests germane to the cartridge's design changes.
  4. Update PVTM with results from Verification #2 testing and the remaining live fire tests, and use the updated effectiveness model to evaluate M829E4 lethality against relevant threat targets.

Manpack Radio

Executive Summary

- In December 2013, the Defense Acquisition Executive (DAE) approved an additional low-rate initial production (LRIP) lot of 1,500 Manpack radios. This brought the total number of Manpack radios procured through LRIP to 5,326.
- In April through May 2014, the Army conducted a Manpack radio FOT&E as part of the Network Integration Evaluation 14.2 at Fort Bliss, Texas, in accordance with a DOT&E-approved test plan. DOT&E assessed the Manpack radio as not operationally effective when employed in dismounted operations, operationally effective for mounted operations, and not operationally suitable.
- In May 2014, the DAE approved a new Manpack radio acquisition strategy. This strategy specifies that the Army will conduct a full and open competition, open to all industry vendors, for the full-rate production phase of the Manpack radio program. The Army is currently developing a Test and Evaluation Master Plan (TEMP) to support the new Manpack radio acquisition strategy.



System

- The Army's Handheld, Manpack, and Small Form Fit (HMS) program evolved from the Joint Tactical Radio System program and provides software-programmable digital radios to support the Army's tactical communications requirements. The two radios that comprise the HMS program are the Manpack radio and the Rifleman Radio. (Rifleman Radio is a separate program of record, with a separate article later in this Annual Report.)
- The Manpack radio is a two-channel software-defined radio capable of transmitting both voice and data communications.
- Manpack radio has an operating spectrum of 2 to 512 Megahertz with a 20-watt power output, or 512 Megahertz to 2.5 Gigahertz with a 10-watt power output.
- Manpack radio is capable of employing multiple waveforms:
  - Soldier Radio Waveform (SRW)
  - Single Channel Ground and Airborne Radio System (SINCGARS) waveform
  - Ultra-High Frequency Satellite Communications (UHF-SATCOM) 181B
  - Demand Assigned Multi-Access UHF-SATCOM waveforms 182A and 183A
- The Services intend the Manpack radio to eventually host the Mobile User Objective Satellite waveform, which is still in development.

Mission

Army tactical units will use Manpack radios to provide networked voice and data communications during all tactical operations. The Manpack radio can operate in one of three modes: dismounted, vehicle mounted, or mounted in a kit for use in a Tactical Operations Center.

Major Contractors

- General Dynamics, C4 Systems – Scottsdale, Arizona
- Rockwell Collins – Cedar Rapids, Iowa

Activity

- In December 2013, the DAE approved an additional LRIP lot of 1,500 Manpack radios. This brought the total number of Manpack radios procured through LRIP to 5,326.
- In January through February 2014, the Army conducted Government Developmental Test 4 (GDT 4) at Fort Huachuca, Arizona.
  - GDT 4 tested corrective actions applied to the Manpack radio in response to deficiencies identified in previous test events, including the Multi-Service Operational Test and Evaluation conducted in May 2012. Among the previously identified deficiencies were both unsatisfactory SINCGARS waveform performance and poor reliability.
  - The test was also designed to assess capabilities that had not been previously tested. These additional capabilities included route and retransmission and additional satellite communications waveforms (Demand Assigned Multi-Access UHF-SATCOM 182A and 183A). Route and retransmission refers to the radio function that enables traffic coming into the radio on one channel to be

"cross-banded" within the radio and re-transmitted out on the other channel, either on the same waveform or on a different waveform.
- In April through May 2014, the Army conducted a Manpack radio FOT&E as part of the Network Integration Evaluation 14.2 at Fort Bliss, Texas, in accordance with a DOT&E-approved test plan. During this FOT&E, infantry and cavalry units employed the Manpack radio in executing both mounted and dismounted tactical operations. The purpose of this test was to evaluate in a realistic operational environment the correction of Manpack radio deficiencies identified in the Multi-Service Operational Test and Evaluation, as well as the additional capabilities that had yet to be demonstrated in an operational test.
- In May 2014, the DAE approved a new Manpack radio acquisition strategy. This strategy specifies that the Army will conduct a full and open competition, open to all industry vendors, for the full-rate production phase of the Manpack radio program.
- The Army is currently developing a TEMP to support the new Manpack acquisition strategy.

Assessment
- Based upon the results of the 2014 FOT&E, DOT&E made the following assessment:
  - The Manpack radio is not operationally effective when employed in dismounted operations. This assessment is the result of the SRW providing insufficient range to support dismounted company and platoon-level operations. SRW is the waveform the Army has selected for both voice and data communications at these tactical echelons. SRW demonstrates a shorter range vis-à-vis the legacy SINCGARS waveform it is replacing in this network. This result is not surprising given that SRW operates at a much higher frequency than does SINCGARS. Higher frequencies have shorter ranges and are more affected by terrain obstructions.
  - The Manpack radio is operationally effective for mounted operations. As tested, vehicular-mounted Manpack radios overcame the SRW range limitations due to higher vehicle antennas. Additionally, the mounted test unit had a higher density of radios, and hence a denser network, aiding communications in comparison to the dismounted test unit.
  - The Manpack radio is not operationally suitable. The radio's weight hinders dismounted operations. For a 24-hour operation, the Manpack radio weighs—inclusive of batteries and antennas—approximately three times what the legacy SINCGARS Advance System Improvement Program radio weighs (35 pounds versus 12 pounds). The Manpack radio generates heat at a level, which, while technically meeting the Military Standard for prolonged exposure, adversely affected dismounted operators. During the FOT&E, SRW on the Manpack radio was reliable, exceeding its reliability requirement of 477-hour Mean Time Betwen Essential Function Failure. Although the SINCGARS waveform did not meet its reliability requirement, its reliability did not adversely affect the test unit's ability to execute the mission. SATCOM waveform 183A also did not meet its reliability requirement. SATCOM waveforms 181B and 182A had insufficient operating time during the FOT&E to reach a conclusion as to their reliability.
- During GDT 4:
  - All Manpack waveforms performed satisfactorily with respect to voice quality and data speed of service.
  - The Manpack radio successfully demonstrated simultaneous dual-channel operations, with the exception of the SINCGARS-SINCGARS waveform combination, which demonstrated an unsatisfactory call completion rate and poor voice quality.
  - The Manpack radio successfully demonstrated its route and retransmission capability for both voice and data, with the exception of SINCGARS voice route and retransmission. SINCGARS voice was not tested due to radio interference emanating from unrelated testing nearby.
  - Manpack radio reliability was below the requirement, demonstrating a Mean Time Between Essential Function Failure of 217 hours versus the requirement of 477 hours.
  - Test scenarios were considerably less challenging than those experienced during the FOT&E. For example, radio operations were largely conducted from static positions with good line-of-sight.

Recommendations
- Status of Previous Recommendations. The Army addressed the FY13 recommendations.
- FY14 Recommendation.
  1. The Army should develop a TEMP that satisfactorily addresses the developmental and operational testing supporting the new Manpack radio acquisition strategy.

Mine Resistant Ambush Protected (MRAP) Family of Vehicles (FoV) – Army

Executive Summary
- The Army will retain 8,585 Mine Resistant Ambush Protected (MRAP) vehicles in its enduring fleet that includes MaxxPro Dash, MaxxPro Ambulance, and MRAP All-Terrain Vehicle (M-ATV) variants.
- Early live fire testing conducted in 4QFY14 suggests that the MaxxPro Ambulance variant will meet its required level of performance; however, additional testing remains to be executed in FY15.
- The MaxxPro Dash with Independent Suspension System (ISS) and the MaxxPro Survivability Upgrade (MSU) kit installed provides protection beyond the MRAP Capabilities Production Document 1.1 requirements.

System
- The MRAP Family of Vehicles (FoV) is designed to provide increased crew protection and vehicle survivability against current battlefield threats, such as IEDs, mines, small arms fire, rocket-propelled grenades, and explosively formed penetrators. MRAPs are employed by units in current combat operations in the execution of missions previously accomplished with the High Mobility Multi-purpose Wheeled Vehicle.
- In FY14, the MRAP Joint Program Office was dissolved, and the Army and the Marine Corps became the lead Services responsible for their respective MRAP variants. In 2013, the Army defined its enduring MRAP fleet that it will retain post-transition from a Joint Program Office to an Army-led program manager. Per the Army MRAP III study, 8,585 MRAP vehicles will be retained in the Army enduring fleet:
  - MaxxPro Dash with ISS and MSU kit (2,633 vehicles),
  - MaxxPro Long Wheel Base (LWB) Ambulance with ISS (301 vehicles)
  - M-ATV with Underbelly Improvement Kit (5,651 vehicles).
- This report covers the MaxxPro Dash with MSU and the MaxxPro LWB Ambulance.
  - The Dash variant with the MSU kit is a shortened version of the MaxxPro LWB variant. The Dash variant is designed to provide improved underbody blast protection, can transport six persons, and is equipped with an ISS.
  - The MaxxPro LWB Ambulance variant is designed to transport a driver and two crewmembers (one of which is a medic) with the ability to carry a combination of two litter-bound or four ambulatory patients. This variant is equipped with an ISS.

MaxxPro Long Wheel Base (LWB) Ambulance

MaxxPro Dash with MaxxPro Survivability Upgrade (MSU)

Mission
Multi-service and special operations units equipped with the MRAP FoV conduct mounted patrols, convoy patrols, convoy protection, reconnaissance, and communications, as well as command and control missions to support combat and stability operations in highly-restricted rural, mountainous, and urban terrain.
- Units equipped with Dash vehicles will conduct small unit combat operations such as mounted patrols and reconnaissance.

- Units equipped with the MaxxPro LWB Ambulance variant will provide enhanced medical evacuation capabilities with protection against ballistic threats that may be encountered while transporting Soldiers during evacuation.

Major Contractor

Navistar Defense – Warrenville, Illinois

Activity

MaxxPro Dash with MSU

- The Army completed the LFT&E of the MSU-equipped Dash in 3QFY14. This testing focused on the underbody blast threat. The results from the legacy Dash LFT&E test program relative to other tested threats such as IEDs, indirect fire, and small arms, are applicable to the MSU-equipped Dash.

MaxxPro LWB Ambulance

- The Army commenced LFT&E on the MaxxPro LWB Ambulance in 4QFY14 and completed in 1QFY15. LFT&E of the MaxxPro LWB Ambulance is focused on the changes to the vehicle specific to the ambulance configuration, including the patient litter and medical equipment.
- The Army conducted all testing in accordance with DOT&E-approved test plans.

Assessment

MaxxPro Dash with MSU

- Early LFT&E of the MSU equipped Dash revealed problems with MSU kit integration that required engineering changes to the platform. Testing and evaluation of changes to the MSU kit to address these problems is complete, and the solution will be integrated into affected vehicles during their reset.
- The MSU kit performs as intended, mitigating certain structural issues identified from combat events.
- The MSU-equipped Dash provides underbody blast protection well beyond the original MRAP Capabilities Production Document 1.1 requirements.

MaxxPro LWB Ambulance

- Testing is ongoing, but early LFT&E indicates the vehicle provides protection at its required levels. Additional testing and analysis are required before a full evaluation can be made.

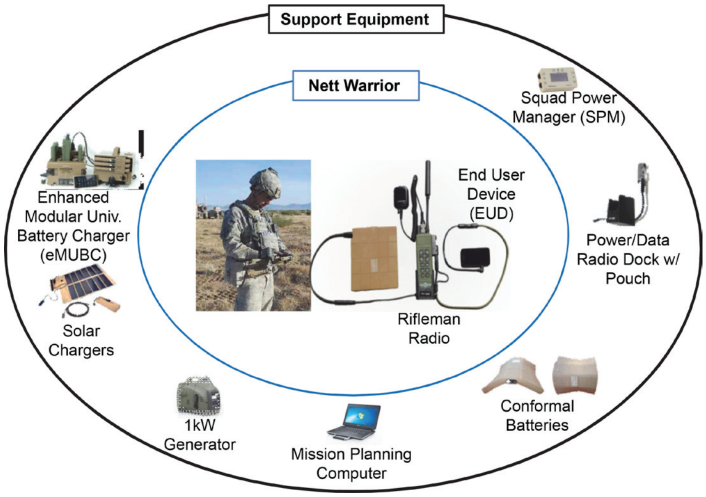
Recommendations

- Status of Previous Recommendations. There was no live fire or operational testing conducted on the M-ATV in FY14; therefore, none of the FY13 recommendations apply to the vehicles tested in FY14.
- FY14 Recommendations. None.

Nett Warrior

Executive Summary

- In 3QFY14, the Assistant Secretary of the Army for Acquisition, Logistics, and Technology authorized an additional low-rate initial production (LRIP) for 5,115 Nett Warrior systems to support fielding to Capability Set 15 and Capability Set 16.
- The Army Test and Evaluation Command (ATEC) executed an IOT&E in two phases:
  - A mounted Calvary troop executed Phase 1 during Network Integration Evaluation 14.2 at Fort Bliss, Texas (May 2014).
  - A dismounted rifle company executed Phase 2 at Fort Polk, Louisiana (November 2014).
- Nett Warrior improved situational awareness at the platoon level and continues to enhance pre-mission planning tasks, land navigation, and command and control.
- Nett Warrior is reliable, demonstrating a reliability point estimate of 445 operating hours during Phase 1 and a reliability point estimate of 175.4 operating hours during Phase 2.
- DOT&E intends to publish an IOT&E report in 2QFY15 to support the 3QFY15 Full-Rate Production Decision Review.



System

- The Nett Warrior is a dismounted leader situational awareness system for use during combat operations. Nett Warrior consists of the following:
  - End User Device (EUD), a commercial off-the-shelf Samsung Note smartphone
  - Government-furnished Rifleman Radio (AN/PRC-154A) (Rifleman Radio is a separate program of record, with a separate article later in this Annual Report.)
  - Conformal battery
  - Connecting cables
  - Supporting charging equipment
- Periodic Nett Warrior enhancements integrate improved commercial EUD technologies.
- The Nett Warrior graphically displays the location of an individual leader, other leaders, friendly vehicles, battlefield messages, and enemy activity on a digital geo-referenced map image. The Nett Warrior is connected through a secure radio to the Soldier Radio Waveform (SRW) network to communicate among different echelons using voice, data, and position location information messages.

Mission

- Leaders within the Brigade Combat Team use Nett Warrior to provide improved situational awareness, command and control, and enhanced communications.
- Combatant Commanders employ Nett Warrior-equipped infantry and cavalry dismounted leaders as part of a Brigade Combat Team to conduct operations (offensive, defensive, stability, and defense support of civil authorities) against conventional or unconventional enemy forces in all types of terrain and climate conditions.

Major Contractors

- EUD: Samsung – Seoul, South Korea
- Rifleman Radio:
  - General Dynamics C4 Systems – Scottsdale, Arizona
  - Thales Communications Inc. – Clarksburg, Maryland

Activity

- In 3QFY14, the Assistant Secretary of the Army for Acquisition, Logistics, and Technology authorized an additional LRIP for 5,115 Nett Warrior systems to support fielding to Capability Set 15- and 16-fielded units. This additional LRIP allowed the program manager to buy 41 percent of the Approved Acquisition Objective.
- ATEC executed an IOT&E in two phases:
  - Phase 1, conducted by a mounted cavalry troop during Network Integration Evaluation 14.2 at Fort Bliss, Texas, in May 2014.
  - Phase 2, conducted by a dismounted rifle company at Fort Polk, Louisiana, in November 2014.

- DOT&E intends to publish an IOT&E report in 2QFY15 to support the Full-Rate Production Decision Review in 3QFY15.
- The Army conducted all testing in accordance with the DOT&E-approved Test and Evaluation Master Plan and test plans.

Assessment

IOT&E Phase 1

- The Nett Warrior was effective in a mounted reconnaissance formation. The Nett Warrior improved situational awareness at the platoon and troop level and enhanced pre-mission planning tasks, land navigation, and command and control.
- Testing revealed interoperability problems between Nett Warrior and the Joint Battle Command – Platform (JBC-P). The Nett Warrior could not consistently transmit and receive survivability data messages in the variable message formats used with JBC-P. Free Text messages were the most common type of command and control messages sent between Nett Warrior and JBC-P.
- Nett Warrior demonstrated a reliability point estimate of 445 operating hours, exceeding the threshold and objective requirement of 148 and 291 hours, respectively. Nett Warrior demonstrated 92 percent operational availability, exceeding the 90 percent requirement.
- The Rifleman Radio battery heated to temperatures exceeding 120 degrees Fahrenheit. Soldiers experienced discomfort from hot batteries. The Rifleman Radio battery life did not meet the same results observed in developmental testing. During the IOT&E, battery life was 2 to 6 hours as opposed to 6 to 8 hours during developmental testing. Post-test analysis showed the battery stopped charging when it reached a temperature of 118 degrees Fahrenheit, but still provided power. For further information, see the FY14 Annual Report article on Rifleman Radio.

IOT&E Phase 2

- The Nett Warrior was effective in light infantry platoon formations. Use of the Nett Warrior improved situational awareness at the platoon level and continues to enhance pre-mission planning tasks, land navigation, and command and control.
- The infantry company was hampered by the short range of the SRW on the AN/PRC-155 Manpack radio in woodland terrain.
- The Manpack radio connected the Nett Warrior systems of the leaders between platoons to each other and to the Nett Warrior systems in the company headquarters. The infantry company did not have complete situational awareness because the Manpack radio did not transmit position location information in a consistent manner. SRW is the waveform the Army has selected for both voice and data communications at these tactical echelons. SRW demonstrates a shorter-range vis-à-vis the legacy Single Channel Ground and Airborne Radio System (SINCGARS) waveform it is replacing in this network. This result is not surprising given that SRW operates at a much higher frequency than does SINCGARS, as higher frequencies have shorter ranges and are more affected by terrain obstructions.
- The test unit experienced challenges with managing battery charging and resupply at the company level. The company had to use a 3-kilowatt generator from battalion headquarters to charge all the batteries required to support the company's Nett Warrior systems and Manpack radios. The generators fielded with the Nett Warrior were insufficient to support the company.
- The Army corrected the deficiency of the radio battery not charging in high temperatures by modifying the battery firmware setting to allow charging at higher temperature limits, up to the high-temperature exposure limit of Military Standard-1472 (140 degrees Fahrenheit versus 118 degrees Fahrenheit).
- Nett Warrior is suitable. Nett Warrior demonstrated a reliability point estimate of 175.4 operating hours, exceeding the threshold requirement of 148.
- DOT&E will publish a Nett Warrior IOT&E report in 2QFY15.

Recommendations

- Status of Previous Recommendations. The Army addressed all previous recommendations.
- FY14 Recommendation.
  1. The Army should continue to improve the SRW network and associated radios to increase the range at which Soldiers and leaders can use Nett Warrior.

Patriot Advanced Capability-3 (PAC-3)

Executive Summary

- The Army participated in the second and final Medium Extended Air Defense System (MEADS) Flight Test (FT) using three Patriot Advanced Capability-3 (PAC-3) Missile Segment Enhancement (MSE) missiles in November 2013. The missiles successfully engaged a short-range ballistic missile and aircraft target.
- The DOD decided not to field MEADS and concluded U.S. involvement in the design and development phase of the MEADS program in FY14.
- DOT&E approved the latest Patriot System Test and Evaluation Master Plan (TEMP) in December 2013.
- The Defense Acquisition Executive approved the PAC-3 MSE missile to enter low-rate initial production in 2QFY14.

System

- Patriot is a mobile air and missile defense system that counters missile and aircraft threats.
- The system includes the following:
  - C-band phased-array radars for detecting, tracking, classifying, identifying, and discriminating targets
  - Battalion and battery battle management elements
  - Communications Relay Groups and Antenna Mast Groups for communicating between battery and battalion assets
  - A mix of PAC-3 hit-to-kill missiles and PAC-2 blast fragmentation warhead missiles for negating missile and aircraft threats
- The newest version of the Patriot missile is the PAC-3 MSE. The PAC-3 MSE missile provides increased battlespace defense capabilities and improved lethality over prior configuration Patriot missiles.
- Earlier versions of Patriot missiles include the Patriot Standard missile, the PAC-2 Anti-Tactical Missile, the Guidance Enhanced Missile (GEM) family (includes the GEM-T and GEM-C missile variants intended to counter tactical ballistic missiles and cruise missiles, respectively), the PAC-3 (baseline), and the PAC-3 Cost Reduction Initiative variant.
- The DOD intended MEADS to replace the Patriot system. The DOD decided not to field MEADS and concluded U.S. involvement in the design and development phase of the MEADS program in FY14.

Mission

Combatant Commanders use the Patriot system to defend deployed forces and critical assets from missile and aircraft attack and to defeat enemy surveillance air assets (such as unmanned aerial vehicles) in all weather conditions, and in natural and induced environments.

Major Contractors

- Prime: Raytheon Company, Integrated Defense Systems – Tewksbury, Massachusetts
- PAC-3 Interceptors: Lockheed Martin Corporation, Missile and Fire Control – Dallas, Texas

Activity

- During MEADS FT-2 in November 2013 at White Sands Missile Range, New Mexico, two MSE interceptors engaged a short-range ballistic missile target and a third MSE interceptor engaged a full-scale aircraft target.
- DOT&E approved the latest Patriot System TEMP in December 2013. The Army conducted all testing in accordance with the DOT&E-approved TEMP.
- The PAC-3 MSE missile was approved to enter low-rate initial production in 2QFY14.
- The Army conducted fragment penetration phenomenology tests and planned high-explosive initiation tests to provide data for validation of PAC-3 lethality models.
- In September 2014, the Army conducted an MSE developmental lethality test against a ballistic missile warhead in preparation for live fire lethality testing in 2015 at the Holloman AFB high-speed test track.
- The Army planned to conduct the next Patriot operational test, the Post-Deployment Build-8 IOT&E, beginning

in 2015, per the DOT&E-approved TEMP. However, this date is likely to slip to at least 2016 and a new TEMP is under development to reflect this change. The IOT&E will provide information to support the Patriot Full-Rate Production decision (including the MSE missile).

Assessment

- During MEADS FT-2, MEADS demonstrated the capability to detect, track, engage, intercept, and kill both a tactical ballistic missile target and a full-scale aircraft target with MSE missiles.
  - The first MSE missile in the ripple method of fire intercepted and killed the ballistic missile target at the planned altitude and range.
  - The second MSE missile performed nominally throughout its flight and properly self-destructed after the first MSE intercepted the target.
  - The third MSE missile intercepted and killed the full-scale aircraft target at the planned altitude and range.
- The MSE developmental lethality test in September 2014 at the Holloman AFB high-speed test track met the lethality objective.
- Patriot ground system reliability does not meet the threshold requirement because the radar performance was below threshold. The Project Office plans to replace the Patriot radar, but this is not scheduled to occur until after the IOT&E. The schedule is driving entry into the operational test prior to implementing the fix, and resources/funding are not available to implement the fix. Management has decided to accept the risk to the operational test assessment of not implementing the fix.
- Patriot training remains inadequate to prepare operators for complex Patriot engagements. Resources/funding are not available to fix this issue and management has decided to accept the risk to the operational test assessment.

Recommendations

- Status of Previous Recommendations. The Army satisfactorily addressed 14 of the previous 23 recommendations. The Army should continue to address the following recommendations:
  1. Conduct Patriot air and missile defense testing during joint and coalition exercises that include large numbers of different aircraft types, sensors, battle management elements, and weapons systems. Conduct Red Team penetration testing during these exercises to test Patriot cybersecurity.
  2. Conduct a Patriot flight test against an anti-radiation missile target to validate models and simulations.
  3. Improve Patriot training to ensure that Patriot operators are prepared to use the system in combat.
  4. Have Patriot participate with live missiles in Terminal High-Altitude Area Defense (THAAD) flight testing to determine Patriot-to-THAAD interoperability and the capability for Patriot to intercept tactical ballistic missile targets that are not intercepted by THAAD.
  5. Collect reliability data on Patriot systems in the field so that the Mean Time Between Critical Mission Failure can be calculated.
  6. Use test units for future Patriot operational tests that have operationally representative distributions in Soldier proficiency.
  7. Conduct future operational flight tests with unannounced target launches within extended launch windows.
  8. Improve Patriot radar reliability.
  9. Obtain the data required to validate GEM interceptor blast lethality in the Lethality Endgame Simulation.
- FY14 Recommendations. None.

Precision Guidance Kit (PGK)

Executive Summary

- The Army conducted a Limited User Test of the Urgent Materiel Release version of the Precision Guidance Kit (PGK) in 2014 to support a Full Materiel Release (FMR). The August 2014 FMR decision supported the use of the Urgent Material Release PGK in training and future contingency operations.
- In September 2014, DOT&E published an Operational Assessment report in support of FMR of the Urgent Material Release PGK. The Urgent Material Release PGK met the Army's key requirements for accuracy, reliability, and compatibility for early fielding.
- During the Program of Record PGK First Article Acceptance Tests (FAAT), the project manager discovered production quality and process deficiencies at the program's West Virginia production facility.
- The Army rescheduled the Program of Record PGK IOT&E from 2QFY14 to 3QFY15.
- The contractor moved the Program of Record PGK low-rate initial production (LRIP) to its original location at the contractor's production facility in Minnesota. LRIP articles produced in Minnesota will undergo FAAT in 1QFY15.

System

- The PGK is a combined fuze and GPS guidance kit that improves the ballistic accuracy of the current stockpile of high-explosive, field artillery projectiles.
- The Army plans to develop PGK for 155 mm, high-explosive projectiles (M795 and M549A1) with threshold accuracy of 50 meters Circular Error Probable and objective accuracy of 30 meters Circular Error Probable.
- The PGK will operate with existing and developmental artillery systems that have digital fire control systems and inductive fuze setters such as the M777A2 Lightweight Towed Howitzer, the M109A6 Paladin Self-Propelled Howitzer, and the M109A7 Paladin Integrated Management Self-Propelled Howitzer.

Mission

Field Artillery units employ PGK-fuzed projectiles in support of maneuver units to provide indirect fires with 50-meter accuracy. PGK-fuzed projectile accuracy allows Field Artillery units to fire fewer projectiles to achieve comparable effects of conventionally-fuzed artillery ammunition.

Major Contractor

Alliant-Techsystems Advanced Weapons Division – Plymouth, Minnesota

Activity

- PGK entered FY14 with two active program tracks. The first track is the Urgent Material Release PGK, which focused on meeting an Army-directed requirement for deployed forces. The second track is the Program of Record PGK with full-rate production planned for 4QFY14.

Urgent Material Release PGK

- In October 2013, the Army successfully completed the final Lot Acceptance Test and Urgent Material Release PGK production. The government accepted nearly 3,135 Urgent Material Release PGKs for the Army and Marines, and fielded just under 1,300 PGKs to deployed units in combat.
- In 1QFY14, the Army announced the planned end of deployed operations and the return of approximately 1,100 Urgent Material Release PGKs to the U.S.
- In February 2014, the Army executed a Limited User Test of the Urgent Material Release PGK at Yuma Proving Ground, Arizona. The authorization to field Urgent

Material Release PGKs to deployed forces restricted the use of these PGKs to support Operation Enduring Freedom. The Army identified the need to obtain an FMR for the Urgent Material Release PGKs so Soldiers could use them in training and future contingency operations. An FMR for the Urgent Material Release PGKs required a favorable Operational Test Agency Evaluation Report.
- The Army approved FMR of the Urgent Material Release PGK in August 2014.
- DOT&E published an Operational Assessment report supporting the FMR of the Urgent Material Release PGK in September 2014.

Program of Record PGK
- Following the March 2013 Milestone C Decision Review, which approved the Program of Record PGK for LRIP, the Army moved the PGK production line from Minnesota to the contractor's planned production facility in West Virginia.
- The Program of Record PGK entered FY14 with a combined PGK and Excalibur Increment 1b IOT&E scheduled for February 2014 at Yuma Proving Ground, Arizona.
- In November 2013, the contractor delivered the First Article sample of Program of Record PGKs from the West Virginia production line to the government. The Army rejected the initial First Article sample because 14 failures occurred in 80 of the PGKs fired.
- The Army cancelled Program of Record PGK participation in the scheduled IOT&E and initiated a comprehensive Failure Analysis and Corrective Actions investigation. The Army moved LRIP back to the Minnesota production facility and rescheduled the Program of Record PGK IOT&E for 3QFY15.
- In April 2014, the PGK Milestone Decision Authority approved an updated PGK Acquisition Program Baseline Agreement. This agreement identified the timeframe for FMR of the Program of Record PGK as September 2015 to May 2016.
- The PGK Program Management Office provided DOT&E an overview of a testing schedule to validate corrective actions and ensure readiness of PGK to enter IOT&E in 3QFY15.
- The Army conducted all testing in accordance with the DOT&E-approved Test and Evaluation Master Plan.

Assessment

Urgent Material Release PGK
- In operational testing, the PGK fuzes demonstrated, with confidence, accuracy results well within the accuracy requirement of a 50-meter Circular Error Probable. A median radial miss distance of 21.8 meters demonstrated PGK accuracy exceeds the requirement established for obtaining an FMR for the purpose of supporting new equipment training and fielding to the Global Response Force.

Program of Record PGK
- The results of the Army's comprehensive Failure Analysis and Correction Actions attributed failure modes to quality and process deficiencies at the West Virginia production plant facility. The Army has not validated design and production process changes implemented on the Minnesota production line in government testing. FAAT, which is a prerequisite for entry into IOT&E, will be conducted in 1QFY15.

Recommendations
- Status of Previous Recommendations. The Army addressed previous recommendations.
- FY14 Recommendations. The Army should:
  1. Continue test planning to validate corrective actions that address performance and production shortfalls and demonstrates PGK's readiness for IOT&E.
  2. Provide an updated Test and Evaluation Master Plan that documents the program's strategy for validating corrective actions to address performance and production shortfalls.

Q-53 Counterfire Target Acquisition Radar System

Executive Summary

- In April and May 2014, the Army conducted the Q-53 radar IOT&E at Yuma Proving Ground, Arizona. Soldier crews operated four Q-53 radars during four, continuous 72-hour record test scenarios observing mortar, artillery, and rocket fires. Soldiers conducted counterfire operations, based on the tactical scenario presented.
- Based on IOT&E results, DOT&E emerging results found the Q-53 to be operationally suitable, not operationally effective, and not survivable. The Army plans to conduct additional operational testing and DOT&E is working with them to develop the scope and details of that testing. DOT&E will then re-evaluate the Q-53 based on the changes made to the radar software in a future operational test.
- The Army will conduct a series of developmental cyber tests, to include threat realistic cyber attacks, and the tests will culminate in an operational cyber event.
- The Army Program Executive Officer for Missile and Space conducted a Q-53 radar program review on March 17, 2014, and approved the procurement of Lot 4 (13 systems).

System

- The Q-53 Counterfire Target Acquisition Radar System is a mobile radar system designed to detect, classify, and track projectiles fired from mortar, artillery, and rocket systems using a 90-degree or continuous 360-degree sector search.
- The Army intends the radar to provide target location of threat indirect fire systems with sufficient timeliness and accuracy for effective counterfire.
- The Q-53 is designed to operate with the Counter – Rocket, Artillery, Mortar system and the future Indirect Fire Protection Capability system.
- The Army intends to field the Q-53 radar to the target acquisition platoons in Brigade Combat Teams and target acquisition batteries in Fire Brigades to replace the legacy AN/ PQ-36 and AN/TPQ-37 Firefinder radars.
- The Q-53 is operated by a crew of five Soldiers and transportable by C-17 aircraft. Two Family of Medium Tactical Vehicle trucks provide battlefield mobility.
- The Army contracted with Lockheed Martin Missile Systems and Sensors to develop and field 38 Quick Reaction Capability radars to support an Urgent Material Release. The Army intends to produce 136 Program of Record Q-53 radars.

Mission

Field Artillery units employ the Q-53 radar to protect friendly forces by determining accurate location of threat rocket, artillery, and mortar systems for defeat with counterfire engagements. Air Defense Artillery units integrate the Q-53 radar into the Counter – Rocket, Artillery, Mortar and Indirect Fire Protection Capability System to warn friendly forces and to engage incoming threat indirect fires.

Major Contractor

Lockheed Martin Missile Systems and Sensors – Syracuse, New York

Activity

- The Army began training in October 2013 for a planned IOT&E the same month. Due to the FY14 Federal Government shutdown and lack of a Defense Appropriation, travel restrictions forced the Army to postpone the IOT&E until April 2014.
- The Army completed Developmental Test Phase 3 from December 2013 through February 2014 at Yuma Proving Ground, Arizona. Developmental testing focused on reliability of the IOT&E software.
  - Civilian crews conducted continuous, 72-hour operations employing the radar in 90- and 360-degree modes with tactical maneuver.
  - After each 72-hour period, and as the schedule permitted, crews operated the radars additional hours without movements. The radars accumulated 1,033 hours in six test cycles.
  - The Army conducted tests characterizing the radar's performance in the 90-degree normal, long-range

optimized mode, short-range optimized mode, and 360-degree modes.
- The Army Program Executive Officer for Missile and Space conducted a Q-53 radar program review on March 17, 2014, and approved the procurement of Lot 4 (13 systems).
- In April and May 2014, the Army conducted the Q-53 radar IOT&E at Yuma Proving Ground, Arizona, in accordance with a DOT&E-approved Test and Evaluation Master Plan and test plan.
  - Soldier crews operated four Q-53 radars during a 72-hour pilot test and four 72-hour record test scenarios observing mortar, artillery, and rocket fires.
  - The radars operated in 90- and 360-degree modes throughout the IOT&E.
  - Based on the tactical scenario presented, Soldiers in the counterfire cell managed the radars and conducted counterfire operations.
- The contractor is implementing software fixes for problems discovered in operational testing. The Army will conduct a series of developmental cyber tests, to include threat realistic cyber attacks, which will culminate in an operational cyber event. DOT&E is working with the Army to develop the details of the operational cyber test.
- The Army plans to conduct IOT&E2 in FY15.
- DOT&E intends to publish an IOT&E report in FY15 and is currently working with the Army to develop the scope and details of follow-on testing.

Assessment

- Based on IOT&E results, DOT&E emerging resilts found the Q-53 to be operationally suitable, not operationally effective, and not survivable. DOT&E will re-evaluate the Q-53 changes made to the radar in a future operational test.
  - The Q-53 radar is operationally suitable because the radar was available to complete its mission 99 percent of the time. The Army requires the radar to be operationally available 95 percent of the time.
  - The Q-53 radar did not meet the Army's reliability requirement. During the IOT&E, there were 10 system aborts during 1,152 operating hours. Based on these test results, there is an 80 percent chance the radar will average greater than 84 hours between system aborts. The Army requires the system to have an 80 percent chance of averaging greater than 185 hours between system aborts. Soldiers fixed the majority of the failures, which were software problems, in less than 30 minutes, resulting in a small amount of downtime and high availability.
  - In the 90-degree mode and 360-degree mode, the radar met accuracy requirements for single-fired artillery, mortar, and rocket projectiles.
  - The counterfire cell was able to manage the radars and conduct counterfire missions in a timely fashion. The Army discovered in a past operational test, Soldiers did not receive sufficient training in the counterfire cell to employ the radar effectively. Prior to the IOT&E, the Army adjusted the counterfire cell training and replaced some personnel with experienced Advanced Field Artillery Tactical Data System operators in the counterfire cell.
  - The radar is not operationally effective because of the large number of false targets reported by the radar in the IOT&E. While in the 90-degree normal, short-range optimized mode and 360-degree modes, the radar averaged 20, 32, and 7 false targets per 12 radiating hours. The Army's requirement is 1 false target per 12 radiating hours. The Army is continuing to investigate the cause of the high-false location rates. The contractor developed software fixes for false target problems and continues to assess the software changes.
  - The radar is not operationally effective because it had difficulty locating volley-fired projectiles in both 90- and 360-degree modes. Currently, there is no written requirement for the radar to perform against volley-fired weapons. Volley-fire is a well-established indirect fire technique. When volley-fired projectiles were located, the radar was accurate in both 90- and 360-degree modes. DOT&E added the volley-fire mission in addition to the single-fire mission to increase the test's operational realism; however, because the user determined there is no Q-53 requirement for volley-fired projectiles, the Program Office has no current plans to address the issue.
  - The radar is not survivable against a persistent cyber threat. The contractor has implemented software fixes for problems discovered during testing and the Army will conduct an operational test to verify those fixes.

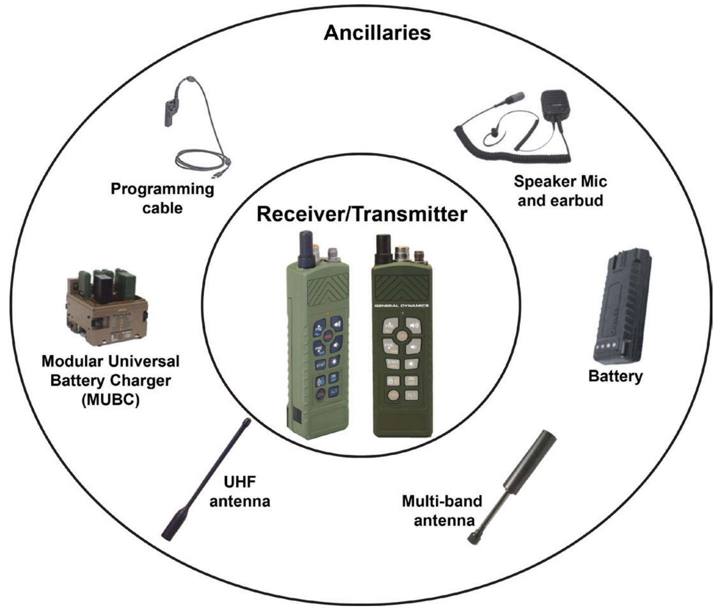
Recommendations

- Status of Previous Recommendations. The Army addressed one of the three previous recommendations; however, the following remain outstanding:
  1. Confirm and characterize suspected radar-to-radar degradation caused by violating radar contractor positioning guidance. Develop and test techniques to overcome radar degradation if contractor positioning guidance is confirmed.
  2. Determine if there is a valid requirement for Q-53 radar performance against threat munitions fired in volleys.
- FY14 Recommendations. The Army should:
  1. Continue to investigate the cause of the high-false target rates observed in the IOT&E.
  2. Continue to test and improve the radar's cyber defenses.
  3. Continue to improve the radar's capability of detecting volley-fired projectiles in both 90- and 360-degree modes.

Rifleman Radio

Executive Summary

- The Army tested the AN/PRC-154A Rifleman Radio as part of the Nett Warrior IOT&E Phases 1 and 2 in accordance with DOT&E-approved test plans:
  - Phase I occurred in May 2014 during Network Integration Evaluation (NIE) 14.2 at Fort Bliss, Texas.
  - Phase II occurred in November 2014 at Fort Polk, Louisiana.
- The Army plans to use test results from the Nett Warrior IOT&E to support a materiel release of the currently fielded Low-Rate Initial Production Rifleman Radios.
- Voice communications are good when the radio has line-of-sight with other radios in open terrain.
- At the Nett Warrior IOT&E Phase II in November 2014, the AN/PRC-154A Rifleman Radio supported the operations of the infantry company's rifle platoons in woodland and urban terrain.



System

- The Handheld, Manpack, and Small Form Fit (HMS) program evolved from the Joint Tactical Radio System program and provides software-programmable digital radios to support the Army's tactical communications requirements. The two radios that comprise the HMS program are the AN/PRC-154A Rifleman Radio and the AN/PRC-155 Manpack radio (Manpack radio has a separate article earlier in this Annual Report).
- The Rifleman Radio is a handheld networking radio, with National Security Agency Type 1 encryption suitable for Secret communications and data.
- In addition to functioning as a stand-alone, handheld radio, the Army intends the Rifleman Radio to be the radio used as part of the Nett Warrior program. The Army is developing a vehicle-mounting kit for the radio.
- The Rifleman Radio is a single-channel radio with a commercial GPS receiver to:
  - Operate at various transmission frequencies using the Soldier Radio Waveform (SRW), which enables the radios to form an ad-hoc data and voice communications network with other SRW-capable radios
  - Provide 5 watts maximum power output in handheld, and 20 watts maximum power output in vehicle mount.
  - Allow Soldiers to transmit position location information across the SRW network. The position location capability of the Rifleman Radio is disabled when connected to Nett Warrior.

Mission

Army leaders and Soldiers use Rifleman Radios to communicate and create networks to exchange voice, video, and data using the SRW during all aspects of military operations.

Major Contractors

- General Dynamics, C4 Systems – Scottsdale, Arizona
- Thales Communications, Inc. – Clarksburg, Maryland

Activity

- The Army tested the AN/PRC-154A Rifleman Radio in accordance with DOT&E-approved test plans. Testing was conducted as part of Nett Warrior IOT&E Phases 1 and 2:
  - Phase I occurred in May 2014 during NIE 14.2 at Fort Bliss, Texas.
  - Phase II occurred in November 2014 at Fort Polk, Louisiana.
- The Army plans to use test results from the Nett Warrior IOT&E to support a material release of the currently fielded Low-Rate Initial Production Rifleman Radio.
- The Army is conducting a full and open competition of the Rifleman Radio as required by the Defense Acquisition Executive for IOT&E and the Full-Rate Production decision.

- The Army continues preparation for a future Rifleman Radio operational test on the Rifleman Radio variant chosen during the full and open competition.

Assessment
- At the Nett Warrior IOT&E Phase 1 in May 2014 during NIE 14.2, leaders stated that voice communications were good until a terrain feature blocked line-of-sight.
- Soldiers had problems with the radio battery.
  - The battery temperature caused first-degree burns and discomfort. Sixty percent of the Soldiers reported that the temperature was in excess of 120 degrees Fahrenheit.
  - The battery stopped charging with the excessive temperatures. Post-test analysis discovered that by design, the battery stops charging at 118 degrees Fahrenheit, but still provided power.
- The radio continues to demonstrate the following suitability problems, which contributed to Soldiers concluding this radio was not yet acceptable for combat in its current Nett Warrior configuration:
  - Lack of a display screen for radio status as Soldiers change channels or prepare radio for operation
  - Battery not charging at temperatures above 118 degrees Fahrenheit and rapid battery depletion
- At the Nett Warrior IOT&E Phase 2 in November 2014, the Rifleman Radio supported the infantry company's rifle platoons as they operated in woodland terrain with both voice and data communications.
- The Army corrected the deficiency of the radio battery not charging in high temperatures by modifying the battery firmware setting to allow charging at higher temperature limits, up to the high-temperature exposure limit of Military Standard-1472 (140 degrees Fahrenheit versus 118 degrees Fahrenheit).
- DOT&E will include a Rifleman Radio assessment in the Nett Warrior IOT&E report, which will be published in 2QFY15.

Recommendations
- Status of Previous Recommendations. The Army addressed the previous recommendations.
- FY14 Recommendations. The Army should:
  1. Continue to complete necessary Rifleman Radio documentation, including a Test and Evaluation Master Plan, to support future developmental and operational testing as part of the full and open competition.
  2. Continue to execute all future Rifleman Radio operational testing to support Full-Rate Production decisions with the Nett Warrior system.

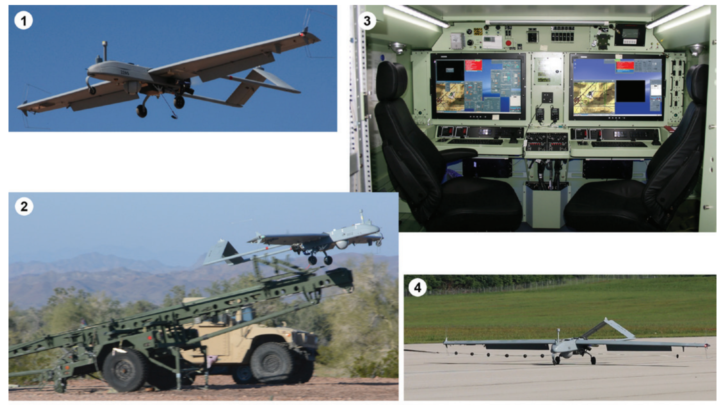
RQ-7BV2 Shadow Tactical Unmanned Aircraft System (TUAS)

Executive Summary

- The Shadow Tactical Unmanned Aircraft System (TUAS) program completed IOT&E in May 2002, supporting a Full-Rate Production decision in September 2002. Since that milestone, the Shadow TUAS Program Office has fielded 119 Shadow systems. The Army has received 104; the Marine Corps, 13; and the Australian Army (via Foreign Military Sales), 2. The Shadow fleet has flown over 900,000 flight hours.
- The program employs a block upgrade and an evolutionary acquisition approach and has to date produced four versions. The four versions are designated the RQ-7A, RQ-7B, RQ-BV1, and the RQ-7BV2. The latest version, the RQ-7BV2, is the subject of this report. To complement this acquisition approach, the T&E Working Integrated Product Team is using a corresponding test strategy as part of a continuous evaluation as the system receives upgrades in capability. DOT&E approved the Shadow TUAS Test and Evaluation Master Plan (TEMP) update in May 2014.
- The Army conducted the Shadow TUAS FOT&E at Fort Bliss, Texas, and the White Sands Missile Range, New Mexico, in May 2014 during the Network Integration Evaluation (NIE) 14.2 and the Joint Tactical Exercise Bold Quest.
- DOT&E concludes that during the FOT&E, the RQ-7BV2 Shadow TUAS-equipped unit was effective at employing the system and demonstrated it is capable of providing effective support to combat units; the Shadow TUAS is operationally suitable, but not reliable; and as assessed after the 2002 IOT&E, the Shadow TUAS is not survivable in the presence of an air threat for reconnaissance and surveillance missions. Through developmental testing, it has been determined that the Shadow TUAS is survivable in the presence of older, less capable electronic warfare threats, but further testing is required to determine Shadow's performance in the presence of the latest electronic warfare threats.

System

- The Army designed the Shadow RQ-7BV2 to provide coverage to a brigade area of interest for up to 7 hours at a range out to 50 kilometers from the launch and recovery site. The maximum range is 125 kilometers (limited by datalink capability). Operations are generally conducted from 8,000 to 10,000 feet above ground level during the day and 6,000 to 8,000 feet above ground level at night.



1 - RQ-7BV2 Aircraft in Flight
2 - RQ-7BV2 Aircraft Being Launched
3 - Inside of the Univeral Ground Control Station
4 - RQ-7BV2 Aircraft Landing Using the Arresting Cable Hook System

- The Laser Range Finder/Designator provides the ground maneuver Brigade Commander the capability to conduct cooperative HELLFIRE missile engagements.
- Shadow RQ-7BV2 consists of the following major components:
  - Four small, high-winged, unmanned aircraft, each equipped with an electro-optical (EO)/Infrared (IR) payload. Two of the four EO/IR payloads are equipped with a Laser Range Finder/Designator capability. The RQ-7BV2 aircraft is larger than the RQ-7BV1 model primarily through an extended wing modification that increased the wingspan of the aircraft from 14 to 20.4 feet, added additional fuel capacity, and increased aircraft weight from 375 to 460 pounds.
  - Two Ground Control Stations designated as the Universal Ground Control Station (UGCS) each with a Universal Ground Data Terminal (UGDT).
  - One Portable Ground Control Station (PGCS) with a Portable Ground Data Terminal (PGDT).
  - An integral Single Channel Ground and Airborne Radio System (SINCGARS) communications relay capability on each aircraft.
  - Two One-System Remote Video Terminals (OSRVT).
- The Shadow unit is a platoon-size organization with 27 personnel authorized.
- The aircraft uses a hydraulic/pneumatic launcher and is recovered on a runway using the Tactical Automatic Landing System. An arresting cable/arresting hook system shortens the necessary runway landing length.

Mission

The Shadow TUAS platoon is to provide responsive Reconnaissance, Surveillance, and Security; Cooperative Attack; Battle Damage Assessment; and Communications Relay support to the brigade.

Major Contractor

Textron Systems – Hunt Valley, Maryland

Activity

- The Shadow TUAS program completed IOT&E in May 2002, supporting a Full-Rate Production decision in September 2002. Since that milestone, the Shadow TUAS Program Office has fielded 119 Shadow systems. The Army has received 104; the Marine Corps, 13; and the Australian Army (via Foreign Military Sales), 2. The Shadow fleet has flown over 900,000 flight hours with over 755,000 of those hours being flown in support of combat operations. As of September 2014, seven deployed systems currently support combat operations.
- The program employs a block upgrade and evolutionary acquisition approach. To complement this approach, the T&E Working Integrated Product Team is using a corresponding test strategy as part of a continuous evaluation as the system receives upgrades in capability. DOT&E approved the Shadow TUAS FOT&E Operational Test Plan on April 8, 2014, and the Shadow TEMP update on May 27, 2014.
- The Army conducted the Shadow TUAS FOT&E at Fort Bliss, Texas, and the White Sands Missile Range, New Mexico, in May 2014 during NIE 14.2 and the Joint Tactical Exercise Bold Quest, in accordance with the DOT&E-approved TEMP and test plan. The FOT&E enabled the evaluation and assessment of the unit's ability to employ the system with upgrades, such as the UGCS, Tactical Common Data Link, and the extended-wing configuration of the aircraft in an operational environment. The test provided the opportunity to conduct an operational assessment of the OSRVT-40 block configuration and its contributions to the supported unit's situational awareness. The test was supported by two AH-64D Longbow Aircraft and the Brigade Combat Team fires battalion provided indirect fire support during call-for-fire missions. The Shadow test unit flew 260 flight hours during the FOT&E.
- DOT&E published a report on the RQ-7BV2 Shadow TUAS FOT&E and OSRVT operational assessment in December 2014.

Assessment

- During FOT&E, the Shadow TUAS-equipped unit was effective at employing the system and demonstrated it is capable of providing effective support to combat units. An example of this support occurred during one two-day mission during FOT&E. A supported Infantry Battalion utilized the Shadow TUAS and the OSRVT to defeat the enemy force in detail.
- The Shadow TUAS has more capability and functionality today than it demonstrated in previous operational testing. Significant increases in capability demonstrated in the May 2014 FOT&E include:
  - The ability to conduct aircraft operations via encrypted Tactical Common Data Link
  - Increased aircraft flight endurance due to the extended-wing configuration
- The Shadow TUAS is operationally suitable.
  - The Shadow system demonstrated an operational availability of 88.6 percent for the duration of FOT&E, exceeding the requirement of 85 percent.
  - During FOT&E, the Shadow TUAS demonstrated its ability to meet its normal operational tempo requirement of providing 16, non-continuous hours of on-station time in a 24-hour period.
  - The RQ-7BV2-configured Shadow platoon is also required to support surge operations consisting of 72 hours of continuous time on-station. High winds throughout the test prevented the system from executing a 72-hour surge. By design, the Army provides each Shadow platoon with the personnel and equipment required to support 72-hour surge operations. In an attempt to assess this capability, a Monte Carlo simulation (repeated random sampling of reliability, availability, and maintainability data to obtain numerical results for the amount of on-station time achieved during any 72-hour surge period) calculates that 90 percent of the time, Shadow should provide 64.1 hours of coverage during a 72-hour surge period (an 89 percent coverage capability).
  - The unit achieved the operational availability requirement in spite of failing to meet its reliability requirement due to subsystem redundancy.
- During FOT&E, the Shadow demonstrated a Mean Time Between System Abort (MTBSA) point estimate of 8.7 hours versus a 20-hour MTBSA requirement.
- The unit demonstrated the ability to conduct cooperative HELLFIRE missile engagements with AH-64D Longbow helicopter crews. The Plug-In Optical Payload (POP) 300D (Laser Range Finder/Designator capable) payload continues to support cooperative engagements with laser-guided munitions.
- The Median Target Location Error (TLE) for the POP 300D payload improved from 74 meters observed during the 2010 Limited User Test to 25 meters observed during FOT&E. The POP 300D payload TLE requirement is 50 meters.

- During FOT&E, DOT&E observed that in order to more readily anticipate ground commander mission support, the Shadow Platoon Leader sought to have a laser designator capable payload on every mission. As reflected in the description above, the system is fielded with two of the four payloads having this capability. During the test, Shadow maintenance personnel switched payloads from one aircraft to another 21 times in order to have the most laser designator capable flights. This frequent swapping of payloads increases the probability of maintainer-induced damage to the component or aircraft as well as increasing maintainer workload.
- The Shadow-equipped unit continues to demonstrate the capability of conducting effective call for and adjust fire artillery missions via the Advanced Field Artillery Tactical Data System electronic messaging system.
- The Shadow TUAS communications relay capability is provided by the use of two SINCGARS radios onboard the aircraft, one in each wing tip. During FOT&E it was observed:
  - That maintenance personnel on the ground initially developed and continually refined pre-flight procedures for the communications relay capability to make sure it was operational prior to launch.
  - In the four times the communications relay package was employed operationally during the test, it worked successfully three times. Shadow operators communicated with AH-64 aircraft during two cooperative engagement missions and on one other occasion, communicated with their forward-based ground unit to coordinate aircraft movements into and out of restricted airspace. In the one instance when the communications relay package did not work, Shadow operators could hear elements of the 1-6 Infantry unit loud and clear, but Shadow transmissions to 1-6 Infantry were broken and unreadable. Unable to communicate by voice with the Shadow unit, the 1-6 Infantry commander coordinated mission support using chat.
  - The FOT&E provided no data to evaluate the communications relay capability between two ground units. Given the flat terrain and the digital communications focus of the NIE exercise, supported units did not need or were not aware of the Shadow communications relay capability. Additional testing is required to support a complete assessment of this capability.
- The Shadow TUAS demonstrated the capability of meeting its 8-hour flight endurance requirement. During test, its longest flight was 9.2 hours.
- The UGCS reduces operator work load when compared with the legacy One System Ground Control Station. The checklist steps required to start the UGCS and launch the Shadow aircraft have decreased from 514 to 456, a 13 percent reduction. Start-up checklists remain time consuming and unforgiving of error and deviations. Start-up procedures, especially for the configuration of the encryption datalink, added to workload and system reliability deficiencies.
- As assessed after the 2002 IOT&E, the Shadow TUAS is not survivable in the presence of an air threat for reconnaissance and surveillance missions. Since the 2002 IOT&E, there has been significant development and proliferation of electronic warfare threats on the battlefield. Through developmental testing, it has been determined that the Shadow TUAS is survivable in the presence of older, less capable electronic warfare threats, but further testing is required to determine Shadow's performance in the presence of the latest electronic warfare threats. Cybersecurity testing demonstrated that the Shadow system has exploitable vulnerabilities that could impact Shadow operations. Cybersecurity testing did not address Detect, React, or Restore capabilities of the unit equipped with the Shadow system nor did it test the cybersecurity of the UGCS to aircraft control datalinks. Further details can be found in the classified annex to the Shadow Operational Assessment report.
- The OSRVT-40 system has more capability and functionality today than it demonstrated in previous operational testing. Its software is now "plug and play," which increases user friendliness. Additionally, the system has increased range (mostly through the use of the Mobile Directional Antenna System) and it supported unit Intelligence, Surveillance, and Reconnaissance and current operations.

Recommendations

- Status of Previous Recommendations. The Army satisfactorily addressed the four recommendations from the FY10 DOT&E Annual Report. There was no annual report written for this system in FY11-13 due to lack of operational testing during that time period.
- FY14 Recommendations. The Army should:
  1. Increase the number of POP-300D payloads issued to the Shadow platoon from two to four to reduce maintainer workload and increase Shadow platoon flexibility.
  2. Reduce the number of UGCS checklist steps (and automate the process to the greatest degree possible) to reduce the amount of time required to start-up the system and launch an aircraft.
  3. Conduct continued developmental testing to further characterize Electronic Warfare threats against the Shadow.
  4. Conduct additional cybersecurity testing to fully assess detect, react, and restore system capabilities of units equipped with the Shadow TUAS. Conduct cybersecurity testing on the UGCS-to-aircraft control datalinks.

Warfighter Information Network – Tactical (WIN-T)

Executive Summary

- In September 2013, the Defense Acquisition Executive (DAE) conducted a Warfighter Information Network – Tactical (WIN-T) Increment 2 Full-Rate Production (FRP) Defense Acquisition Board (DAB) based upon the May 2013 WIN-T Increment 2 FOT&E. DOT&E presented an FOT&E report that assessed:
  - Most WIN-T Increment 2 configuration items were operationally effective. The Soldier Network Extension (SNE), Tactical Radio – Tower (TR-T), and High Band Networking Waveform (HNW) were not operationally effective.
  - Most WIN-T Increment 2 configuration items were operationally suitable. The SNE and Point of Presence (PoP) were not operationally suitable.
  - WIN-T Increment 2 demonstrated improvement in survivability, but requires further improvement in cybersecurity.
- As a result of the September 2013 DAB, the DAE published an Acquisition Decision Memorandum (ADM) that:
  - Authorized the acceptance of the 2012 low-rate initial production (LRIP) and procurement of another LRIP without SNEs.
  - Directed the Army to reduce SNE and PoP complexity, improve PoP reliability, fix survivability, correct deficiencies discovered during the FOT&E, and demonstrate these improvements in a second FOT&E.
- During FY14, the Army conducted two WIN-T Increment 2 developmental tests, which demonstrated improvements in SNE and PoP operations, but did not provide confidence that the SNE and PoP would meet reliability requirements during the planned second FOT&E. The Army has again reduced its approved reliability requirements for selected WIN-T components, including the SNE, to levels now likely to be consistent with demonstrated performance.
- The Army conducted a second WIN-T Increment 2 FOT&E (FOT&E2) during Network Integration Evaluation (NIE) 15.1 from October to November 2014.
- The program updated the WIN-T Increment 2 Test and Evaluation Master Plan (TEMP) to support the second FOT&E and completed a WIN-T Increment 2 TEMP annex that outlines the remaining WIN-T Increment 3 test activities.

System

- The Army designed the WIN-T as a three-tiered communications architecture (space, terrestrial, and airborne) to serve as the Army's high-speed and high-capacity tactical communications network.
- The Army intends WIN-T to provide reliable, secure, and seamless communications for units operating at theater level and below.
- The WIN-T program consists of four increments. In May 2014, the DAE approved the Army's request to stop development of the Increment 3 aerial tier of networked airborne communications relays and limit Increment 3 to network management and satellite waveform improvements. The Army intends to increase procurement of WIN-T Increment 2 configuration items to satisfy capability set requirements previously planned for Increment 3. Increment 4 is currently not funded.
  - Increment 1: "Networking At-the-Halt" enables the exchange of voice, video, data, and imagery throughout the tactical battlefield using a Ku- and Ka-satellite-based network. The Army has fielded WIN-T Increment 1 to its operational forces.
  - Increment 2: "Initial Networking On-the-Move" provides command and control on-the-move down to the company level for maneuver brigades and implements an improved network security architecture. WIN-T Increment 2 supports on-the-move communications for commanders with the addition of the PoP and the SNE and provides a mobile network infrastructure with the Tactical Communications Node.
  - Increment 3: "Full Networking On-the-Move" provides full mobility command and control for all Army field commanders, from theater to company level. Network reliability and robustness are enhanced with the addition of the air tier transport layer, which consists of networked airborne communications relays.

- Increment 4: "Protected Satellite Communications On-the Move" includes access to the next generation of protected communications satellites while retaining all previous on-the-move capabilities.

Mission

Commanders at theater level and below will use WIN-T to:

- Integrate satellite-based communications capabilities into an everything-over-Internet Protocol network to provide connectivity, while stationary, across an extended, non-linear battlefield and at remote locations (Increment 1)
- Provide division and below maneuver commanders with mobile communications capabilities to support initial command and control on-the-move (Increment 2)
- Provide all maneuver commanders with mobile communications capabilities to support full command and control on-the-move, including the airborne relay and protected satellite communications (Increments 3 and 4)

Major Contractor

General Dynamics, C4 Systems – Taunton, Massachusetts

Activity

- In response to a September 2012 DAB, the Army conducted the WIN-T Increment 2 FOT&E in May 2013 as part of NIE 13.2. The test employed the 2nd Brigade, 1st Armored Division under operationally realistic conditions at Fort Bliss, Texas, and White Sands Missile Range, New Mexico.
- In September 2013, DOT&E published a WIN-T Increment 2 FOT&E report to support a September 2013 FRP DAB. This report assessed:
  - Most WIN-T Increment 2 configuration items were operationally effective. The SNE, TR-T, and HNW were not operationally effective.
  - Most WIN-T Increment 2 configuration items were operationally suitable. The SNE and PoP were not operationally suitable.
  - WIN-T Increment 2 demonstrated improvement in survivability, but requires further improvement in cybersecurity.
- In September 2013, the DAE conducted a WIN-T Increment 2 FRP DAB. The resulting ADM:
  - Authorized the acceptance of the 2012 LRIP and the procurement of another LRIP without SNEs.
  - Directed additional developmental testing followed by FOT&E2 to confirm correction of deficiencies noted during FOT&E and to demonstrate—
    - The PoP meets threshold reliability requirements.
    - Significant reductions in the complexity of start-up, troubleshooting, and shutdown procedures for the SNE and PoP.
    - Significant reductions in the complexity of the SNE Combat Network Radio (CNR) Gateway operations.
- In May 2014, the DAE approved the Army's proposed restructure of the WIN-T Increment 3 program to defer the air tier, the Joint Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (JC4ISR) radio, and cease all efforts associated with development of unique hardware items. The program will complete development of the Net Centric Waveform 10.X software upgrade, and network operations software, and transition these capabilities to WIN-T Increments 1 and 2. The program will demonstrate the HNW version 3.0 waveform (supports the JC4ISR radio) and then store the waveform in the DOD Waveform Repository.
- The Army redesigned the user interface for the SNE, PoP, and CNR Gateway to reduce complexity and exhibited these improvements at a demonstration event at Aberdeen Proving Ground, Maryland.
- During 2-3QFY14, the Army conducted two developmental tests at Aberdeen Proving Ground, Maryland, and Fort Bliss, Texas. These events were designed to verify the corrective actions to address SNE and PoP usability and reliability prior to FOT&E2. The second developmental test employed Soldiers operating SNE and PoP variants of Mine Resistant Ambush Protected and Stryker vehicles under a rigorous test scenario.
- Per ADM direction, the program updated the WIN-T Increment 2 TEMP to support FOT&E2 and completed a WIN-T Increment 2 TEMP annex that outlines the remaining WIN-T Increment 3 test activities.
- On October 9, 2014, the Army approved a revised WIN-T Increment 2 reliability requirement, Mean Time Between Essential Function Failure (MTBEFF), which reduced the reliability requirements for the majority of WIN-T Increment 2 configuration items. The Army modified the requirement by adjusting WIN-T system utilization rates within a 72-hour mission duration based upon previous operational testing. This adjustment resulted in the following changes to MTBEFF requirements:
  - SNE decreased from 250 to 184 hours.
  - PoP decreased from 182 to 144 hours.
  - Vehicle Wireless Package increased from 45 to 97 hours.
  - Tactical Communications Node decreased from 314 to 303 hours.
  - Network Operations and Security Center decreased from 218 to 216 hours.
  - TR-T decreased from 146 to 142 hours.
- Since the original 2008 WIN-T Increment 2 Capability Production Document MTBEFF requirement of 900 hours for all systems except SNE and TR-T (300 hours), the Army has reduced its reliability requirements three times in advance of operational testing based upon the following modifications.

- Prior to the May 2012 IOT&E, reduced mission duration from 96 to 72 hours.
- Prior to the May 2013 FOT&E, reduced probability of mission completion from 90 to 80 percent.
- Prior to the October 2014 FOT&E2, adjusted system utilization rates.

- From October to November 2014, the Army conducted the WIN-T Increment 2 FOT&E2 during NIE 15.1 at Fort Bliss, Texas, and White Sands Missile Range, New Mexico. FOT&E2 included operational testing to assess the integration of SNE and PoP equipment into Stryker combat vehicles.

Assessment

- The Army's demonstration of an improved user interface for the SNE, PoP, and CNR gateway presented an intuitive, easy-to-use method for operations and troubleshooting.
- During the two developmental test events, WIN-T Increment 2 demonstrated:
  - Improved SNE and PoP usability, which Soldiers viewed as easier to operate.
  - Reduced SNE and PoP startup and shutdown time.
  - Simplified SNE and PoP troubleshooting.
  - Improved the CNR Gateway interface, which simplifies operations and troubleshooting.
  - Although improved since FOT&E, reliability results do not provide confidence of the SNE and PoP meeting reliability requirements during FOT&E2.
- The program validated fixes for all identified failure modes during the FOT&E and the first developmental test, and intended to demonstrate these fixes during FOT&E2. The assessment is ongoing.
- The Army continues to test WIN-T Increment 2 in a brigade configuration and has not conducted an operational test on a complete division. With each release of software, WIN-T Increment 2 has experienced new failure modes during operational test.
- WIN-T Increment 2 continues to demonstrate cybersecurity vulnerabilities. This is a complex challenge for the Army since WIN-T is dependent upon the cyber defense capabilities of all systems connected to the network, for example, Distributed Common Ground System – Army and Joint Warning and Reporting Network.

Recommendations

- Status of Previous Recommendations. The program addressed one of three previous recommendations. They still need to improve the range of HNW and demonstrate recommended improvements during the WIN-T Increment 2 FOT&E2, conducted during NIE 15.1. The assessment is ongoing.
- FY14 Recommendations. The Army should:
  1. Assess the results of the WIN-T Increment 2 FOT&E2 and conduct an operational test to demonstrate correction of deficiencies noted during test.
  2. Conduct an operational test to assess the Net Centric Waveform and network operations capabilities provided by WIN-T Increment 3.
  3. Conduct an operational test to assess the future integration of WIN-T Increment 2 into combat vehicles.
  4. Improve HNW and TR-T to gain better transmission range from the radio and increase the number of TR-Ts available to support units in dispersed operations.

Navy Programs

Aegis Modernization Program

Executive Summary

- The Navy is modernizing the Aegis Weapon System (AWS) installed on Baseline 3 USS *Ticonderoga* (CG 47) class cruisers and the Flight I USS *Arleigh Burke* (DDG 51) destroyers to the AWS Advanced Capability Build 2012 (Baseline 9A and 9C, respectively). New construction DDGs, beginning with USS *John Finn* (DDG 113), will be equipped with Baseline 9C as well.
- In September 2014, the Navy completed cruiser integrated air defense and Undersea Warfare developmental and operational testing on USS *Normandy* and USS *Chancellorsville*. Data from these tests will supplement data from the dedicated operational test in FY15.
- During developmental testing, a BQM-74E anti-ship cruise missile (ASCM) target drone struck USS *Chancellorsville*. The time required to repair the ship delayed the start of cruiser operational testing, originally planned for 4QFY14, until 2QFY15.
- The lack of an adequate modeling and simulation (M&S) suite of the Aegis Combat System, as well as the lack of an Aegis-equipped Self-Defense Test Ship (SDTS) where the ship's full self-defense kill chain can be tested, precludes assessment of the Baseline 9 Probability of Raid Annihilation (PRA) requirement.
- The Navy will not fully assess Aegis Integrated Air and Missile Defense (IAMD) until a validated M&S test bed is developed and validated. The test bed is planned to be available by 2020, but there is no agreed upon strategy to validate the model to support assessment of the close-in, self-defense battle space. A limited IAMD assessment will be made during Baseline 9C operational testing on DDGs. One live firing event is planned to include live firing of Standard Missile-2 (SM-2) and SM-3 missiles against threat representative targets in an IAMD engagement.
- During developmental testing in June 2014, the Navy successfully conducted three, at-sea live fire tests of the Naval Integrated Fire Control – Counter Air From-the-Sea (NIFC-CA FTS) Increment I capability. The Navy will field the NIFC-CA FTS Increment I capability when it deploys the first E-2D and Aegis Baseline 9-equipped Carrier Strike Group in FY15. NIFC-CA FTS Increment I has demonstrated a basic capability, but its effectiveness under operationally realistic conditions is undetermined.

System

- The Navy's Aegis Modernization program provides updated technology and systems for existing Aegis guided missile cruisers (CG 47) and destroyers (DDG 51). This planned, phased program provides similar technology and systems for new construction destroyers.
- The AWS, carried on DDG 51 guided missile destroyers and CG 47 guided missile cruisers, integrates the following components:
  - AWS AN/SPY-1 three-dimensional (range, altitude, and azimuth) multi-function radar
  - AN/SQQ-89 Undersea Warfare suite that includes the AN/SQS-53 sonar, SQR-19 passive towed sonar array (DDGs 51 through 78, CGs 52 through 73), and the SH-60B or MH-60R Helicopter (DDGs 79 Flight IIA and newer have a hangar to allow the ship to carry and maintain its own helicopter)
  - Close-In Weapon System
  - Five-inch diameter gun
  - Harpoon ASCMs (DDGs 51 through 78, CGs 52 through 73)
  - Vertical Launch System that can launch Tomahawk land-attack missiles, Standard surface-to-air missiles, Evolved SeaSparrow Missiles, and Vertical Launch Anti-Submarine Rocket missiles
- The AWS on Baseline 3 USS *Ticonderoga* (CG 47) class cruisers and Flight I USS *Arleigh Burke* destroyers is being upgraded to Baseline 9A and 9C, respectfully. Baseline 9 will provide the following new capabilities:
  - Full SM-6 integration
  - IAMD to include simultaneous Air Defense and Ballistic Missile Defense missions on Aegis destroyers equipped with the new Multi-Mission Signal Processor
  - NIFC-CA FTS capability
  - Starting with USS *John Finn* (DDG 113), the AWS on new construction Aegis guided missile destroyers is Baseline 9C

Mission

The Joint Force Commander/Strike Group Commander employs AWS-equipped DDG 51 guided missile destroyers and CG 47-guided missile cruisers to conduct:

- Area and self-defense Anti-Air Warfare in defense of the Strike Group
- Anti-Surface Warfare and Anti-Submarine Warfare
- Strike Warfare when armed with Tomahawk missiles
- Offensive and defensive warfare operations simultaneously
- Independent operations or with Carrier or Expeditionary Strike Groups, as well as with other joint or coalition partners

Major Contractors

- General Dynamics Marine Systems Bath Iron Works – Bath, Maine
- Huntington Ingalls Industries (formerly Northrop Grumman Shipbuilding) – Pascagoula, Mississippi
- Lockheed Martin Maritime Systems and Sensors – Moorestown, New Jersey

---

Activity

- In June 2014, the Navy successfully conducted three NIFC-CA FTS Increment I engineering demonstration tests on USS *John Paul Jones* (DDG 53). Although not part of a DOT&E-approved test plan, DOT&E observed and collected performance data on the NIFC-CA FTS Increment I capability.
- The Navy successfully conducted the Baseline 9A Cruiser integrated air defense and Undersea Warfare developmental and operational testing on USS *Normandy* (CG 60) and USS *Chancellorsville* (CG 62) in accordance with the DOT&E-approved test plan. Data from these tests will supplement data from the dedicated operational test in FY15.
- During developmental testing, a BQM-74E ASCM target drone struck USS *Chancellorsville* (CG 62). The time required to repair the ship delayed that start of operational testing, originally planned for 4QFY14, until 2QFY15.
- Aegis Destroyer Baseline 9C dedicated operational testing is scheduled for FY16.
- The Navy conducted Baseline 9A cybersecurity operational testing onboard USS *Chancellorsville* (CG 62) in November and December 2014.

Assessment

- Baseline 9A and 9C testing completed to date is not sufficient to support an assessment of operational effectiveness or suitability before the first ship deploys in FY15. Operational testing is planned to continue throughout FY15/16. Upon the decision to deploy Baseline 9A in FY15, DOT&E will submit an Early Fielding Report.
- The Navy will not fully assess Aegis IAMD until a validated M&S test bed is developed and validated. The test bed is planned to be available by 2020, but there is no agreed upon strategy to validate the model to support assessment of the close-in, self-defense battle space. A limited IAMD assessment will be made during Baseline 9C operational testing on DDGs. One live firing event managed by the Missile Defense Agency is planned to include live firing of SM-2 and SM-3 missiles against threat representative targets in an IAMD engagement in FY15.
- As appropriate, and until the full capability may be operationally tested, DOT&E will provide periodic capability assessments to inform Navy and OSD leadership, as well as Congress, on the progress of test and evaluation of the IAMD mission area.
- Until an Aegis-equipped SDTS is available for testing, it is neither possible to characterize the self-defense capabilities of the Aegis cruisers and destroyers, nor possible to accredit an M&S suite to determine if the ships satisfy their PRA requirements.
- The Navy's FY14 NIFC-CA FTS Increment I events were sufficient to demonstrate basic capability; however, these demonstrations were not conducted under operationally realistic conditions or against aerial targets representative of modern threats. Additionally, the executed scenarios were not sufficiently challenging to demonstrate the NIFC-CA requirements defined in the Navy's September 2012 NIFC-CA Testing Capability Definition Letter.
- Combined Aegis Baseline 9 and SM-6 FOT&E test events to date have been successful with no integration issues revealed. The Navy plans to conduct six SM-6/Baseline 9 test flights in FY15.
- The Navy's Aegis Baseline 9A cybersecurity testing revealed significant problems, which are classified. The nature of these problems is such that they could pose significant risk to the cybersecurity for the FY15 deployment.

Recommendations

- Status of Previous Recommendations. The Navy has not addressed two of the three previous recommendations. The Navy still needs to:
  1. Continue to improve Aegis ships' capability to counter high-speed surface threats in littoral waters.
  2. Synchronize future baseline operational testing and reporting with intended ship-deployment schedules to ensure that testing and reporting is completed prior to deployment.
- FY14 Recommendations. The Navy should:
  1. Continue to develop an end-to-end M&S suite of the Aegis Combat System that may be used, in conjunction with operationally realistic testing conducted on an

Aegis-equipped SDTS, to assess the PRA requirements of the Aegis cruisers and destroyers.

2. Provide the necessary funding to support the procurement of an Advanced Air and Missile Defense Radar and Aegis-equipped SDTS that is needed to support Aegis Modernization, Advanced Air and Missile Defense Radar, DDG 51 Flight III, and Evolved SeaSparrow Missile Block 2 operational testing.
3. Characterize Aegis Baseline 9A/C and soon-to-be-deployed NIFC-CA FTS Increment I capability against operationally realistic ASCM threats as soon as possible.
4. Continue to improve Aegis ship's capability to counter high-speed, surface threats in littoral waters.
5. Submit, for DOT&E approval, a Test and Evaluation Master Plan that describes and resources adequate operational testing of future NIFC-CA FTS increments before such capabilities are deployed.
6. For Baseline 9A, develop and deploy necessary cybersecurity corrective actions and verify correction with a follow-on operational cybersecurity test.

AGM-88E Advanced Anti-Radiation Guided Missile (AARGM) Program

Executive Summary

- The Advanced Anti-Radiation Guided Missile (AARGM) remains operationally suitable, but not operationally effective due to multiple deficiencies discovered during IOT&E in FY11-12.
- The contractor completed test flights during FY14 and delivered sequential software versions R1.0, R2.0, and R2.1 to the Navy.
- In August 2014, the program conducted an Integrated Test Readiness Review. Based on the delivery of software version R2.1, AARGM performance during contractor test flights, and modeling and simulation analysis, the AARGM program manager authorized entry into integrated testing.
- There were no operational test events scheduled or conducted during FY14.

System

- AARGM is the follow-on to the AGM-88B/C High-Speed Anti-Radiation Missile (HARM) using a new guidance section and modified HARM control section and fins. The Navy intends to employ AARGM on F/A-18C/D/E/F and EA-18G platforms.
- AARGM incorporates digital Anti-Radiation Homing, GPS, Millimeter Wave guidance, and a Weapon Impact Assessment transmitter.
- Anti-Radiation Homing improvements include an increased field-of-view and increased detection range compared to HARM.
- The GPS allows position accuracy in location and time; the Weapons Impact Assessment capability allows transmission of real-time hit assessment via a national broadcast data system.
- Millimeter Wave radar technology allows target discrimination and guidance during the terminal flight phase.
- The Navy expects the AARGM Block 1 Upgrade to deliver Full Operational Capability, including Block 0 capability improvements and software changes to provide deferred capability requirements and address deficiencies identified during IOT&E.

Mission

Commanders employ aircraft equipped with AARGM to conduct pre-planned, on-call, and time-sensitive reactive anti-radiation targeting for the suppression, degradation, and destruction of radio frequency-enabled surface-to-air missile defense systems. Commanders receive real-time Weapons Impact Assessments from AARGM via a national broadcast data system.

Major Contractor

Alliant Techsystems, Defense Electronics Systems Division – Northridge, California

Activity

- There were no operational test events scheduled or conducted during FY14.
- During FY14, the Program Office and the Commander, Operational Test and Evaluation Force (COTF), with DOT&E oversight, developed an FOT&E framework and Integrated Test Plan to adequately test deferred capabilities and deficiencies discovered during developmental test and evaluation and IOT&E.
- COTF is currently reviewing the AARGM Test and Evaluation Master Plan for Block 1 FOT&E, which should reflect the agreed-upon framework.
- The contractor conducted flight tests in FY14 and delivered sequential software versions R1.0, R2.0, and R2.1 to the Navy. In August 2014, the AARGM program conducted an Integrated Test Readiness Review. Based on the delivery of software version 2.1 and AARGM performance during contractor testing and modeling and simulation analysis, the AARGM program manager authorized AARGM to enter integrated testing.
- AARGM entered integrated test in August 2014 and completed four captive-carry test events. During analysis of the missile performance data, the Navy determined that a software update

is required and delayed the planned captive-carry and live fire test events for the remainder of 1QFY15. Integrated test flights are expected to resume in 2QFY15.

Assessment

- The FY14 status remains unchanged from the FY13 report.
- AARGM is operationally suitable, but not operationally effective. The details of these deficiencies are discussed in the classified DOT&E IOT&E report published in August 2012.
- The AARGM program has entered integrated test based on the delivery of the R2.1 software and contractor and developmental testing. The test design and identified resources should provide a rigorous evaluation of the corrections of deficiencies discovered in IOT&E and the deferred Key Performance Parameter. The early integrated testing of captive-carry and live-fire events are designed to provide insight and exposure to all capabilities and conditions. These initial test events should give an early indication of the performance of the missile and stability of the system.

Recommendations

- Status of Previous Recommendations. The Navy satisfied the previous recommendation.
- FY14 Recommendations. The Navy should:
  1. Complete the integrated test period as planned for FY15.
  2. Complete the detailed plan for FOT&E based on the utility of integrated test data for operational test objectives.

AIM-9X Air-to-Air Missile Upgrade

Executive Summary
- On June 9, 2014, the Program Executive Officer (PEO) recertified AIM-9X Block II to resume IOT&E. The Navy and Air Force executed 18 operational test live missile shots (5 conducted as integrated test events), including 2 repeated shots due to a previous failure, and 21 captive-carry events. Of the 18 live missile shots attempted, 14 met test objectives, one misfired, one experienced a known hardware failure, and 2 resulted in wide misses.
- AIM-9X Block II with Operational Flight Software (OFS) 9.313 has over 950 operating hours with zero recorded failures. Testing results to date are encouraging; however, insufficient data were available to provide statistical confidence in the system reliability. DOT&E will continue to track reliability in the IOT&E.
- The Navy and Air Force originally began AIM-9X Block II IOT&E with OFS 9.311 on April 27, 2012. On July 29, 2013, the PEO formally decertified AIM-9X Block II due to two major deficiencies discovered and documented during IOT&E that affected missile performance. An extensive government and contractor investigation identified hardware reliability deficiencies with the inertial measurement unit. The contractor implemented an improved production process and updated the missile software (OFS 9.313) to address the two primary deficiencies, as well as several other performance issues.

System
- AIM-9X is the latest generation short-range, heat-seeking, air-to-air missile. The currently fielded version of the missile is AIM-9X Block I, OFS 8.220, which includes limited lock-on-after-launch, full envelope off boresight capability without a helmet-mounted cueing system, and improved flare rejection performance.
- AIM-9X is highly maneuverable, day/night capable, and includes the warhead, fuze, and rocket motor from the previous AIM-9M missile.
- AIM-9X added a new imaging infrared seeker, vector controlled thrust, digital processor, and autopilot.
- F-15C/D, F-16C/D, and F/A-18C/D/E/F aircraft are capable of employing the AIM-9X.
- The AIM-9X Block II is the combination of AIM-9X-2 hardware and OFS 9.3.
  - AIM-9X-2 is the latest hardware version and is designed to prevent parts obsolescence and provide processing capability for the OFS 9.3 upgrade. The AIM 9X-2 missile includes a new processor, a new battery, an electronic ignition safe/arm device, and the DSU-41/B Active Optical Target Detector fuze/datalink assembly.
  - OFS 9.3 is a software upgrade that is intended to add trajectory management to improve range, datalink with the launching aircraft, improved lock-on-after-launch, target re-acquisition, and improved fuzing.

Mission
Air combat units use the AIM-9X to:
- Conduct short-range offensive and defensive air-to-air combat
- Engage multiple enemy aircraft types with passive infrared guidance in the missile seeker
- Seek and attack enemy aircraft at large angles away from the heading of the launch aircraft

Major Contractor
Raytheon Missile Systems – Tucson, Arizona

Activity
- At the beginning of FY14, the Navy and Raytheon Missile Systems were continuing investigations into AIM-9X Block II deficiencies found during IOT&E that had resulted in PEO decertification of the program from testing on July 29, 2013. Between the start of IOT&E on April 27, 2012, and decertification, the Navy originally completed 18 of 22 planned captive carry events, 5 of 9 planned live missile shots, and 1 repeat test shot. The Air Force originally completed 18 of 22 captive-carry events and 6 of 8 live missile shots. Of the 12 live missile shots conducted during IOT&E

prior to decertification, 7 terminated within lethal radius of the target.

- The Program Office and Raytheon Missile Systems completed the investigation and implemented hardware and software solutions to address the two primary deficiencies. From March 20 through May 13, 2014, the Navy and Air Force executed 5 successful integrated test live missile shots and 13 captive-carry missions to test missile performance with changes to the inertial measurement unit hardware and the OFS.
- On June 5, 2014, the Navy completed an Operational Test Readiness Review and the PEO certified AIM-9X Block II with OFS 9.313 for IOT&E. DOT&E approved a test plan change reducing the number of captive-carry missions to 28 (14 per Service) and removed one of the 17 live missile tests from the originally approved IOT&E plan.
- The Navy completed 9 of 14 planned captive-carry events and 9 of 9 live missile shots, plus 2 repeated shots. The Air Force completed 12 of 14 planned captive-carry events and 7 of 7 live missile shots. Of the 18 live missile shots, 14 terminated within lethal radius of the target, 2 resulted in wide misses, 1 experienced a known hardware failure, and 1 misfired. These results include the five integrated test live missile shots, which terminated within lethal radius.
- The Program Office conducted the IOT&E in accordance with the DOT&E-approved Test and Evaluation Master Plan.

Assessment

- Prior to decertification from testing, 7 of 12 operational test AIM-9X Block II (OFS 9.311) shots guided to within lethal radius of the drone. The developmental testing record was 9 of 12 shots within lethal radius; however, 1 missile did not receive a fuze pulse.
- The aircrew reported that AIM-9X Block II Helmet-less High Off-Boresight performance with OFS 9.313 is on par with AIM-9X Block I performance. The Capability Production Document requires Block II performance be equal to or better than baseline AIM-9X performance.
- Based upon live missile testing performance with enhanced inertial measurement unit production processes and OFS 9.313, the Navy and Raytheon have resolved the previously identified fly-out deficiency that significantly affected Probability of Kill.
- The results of AIM-9X Block II testing with OFS 9.313 to date are encouraging; however, insufficient data were available to provide statistical confidence in system reliability. The Navy and Air Force accomplished over 950 operating hours with zero recorded failures. When the PEO decertified AIM-9X Block II from IOT&E, the Navy and Air Force had conducted 6,353 total operating hours with 22 failures, resulting in a Mean Time Between Critical Failure of 288.79 hours. This was well below the reliability growth curve to achieve the requirement of 500 hours Mean Time Between Critical Failure at 80,000 hours. DOT&E will continue to track reliability in the IOT&E.

Recommendations

- Status of Previous Recommendations. The Navy addressed the previous recommendations.
- FY14 Recommendation.
  1. The Navy should work closely with DOT&E and the Service Operational Test Agencies to establish the plan, requirements, and resources for OFS 9.400 testing, including the associated Test and Evaluation Master Plan update.

AN/SQQ-89A(V)15 Integrated Undersea Warfare (USW) Combat System Suite

Executive Summary

- Operational testing of the Advanced Capability Build 2011 (ACB-11) variant began in FY14 and is expected to conclude in FY15. However, the Navy has not yet scheduled all required IOT&E events. The Navy completed limited, at-sea testing in FY14 in conjunction with two fleet-training events.
- In December 2014, DOT&E issued a classified Early Fielding Report on the ACB-11 variant of AN/SQQ-89A(V)15 Integrated Undersea Warfare Combat System Suite. The report was submitted due to the installation of the ACB-11 variant on ships that deployed prior to IOT&E. From the data collected, DOT&E concluded the system demonstrated some capability to detect submarines and incoming U.S. torpedoes in deep water. However, no data were available to assess its capability in shallow water, an area of significant interest due to the prevalence of submarines operating in littoral regions. Also, no data were available to assess performance against threat torpedoes.

System

- AN/SQQ-89A(V)15 is the primary Undersea Warfare system used aboard U.S. Navy surface combatants to locate and engage threat submarines. AN/SQQ-89A(V)15 is an open architecture system that includes biannual software upgrades (ACBs) and four-year hardware upgrades called Technology Insertions.
- AN/SQQ-89A(V)15 uses active and passive sonar to conduct Anti-Submarine Warfare (ASW) search. Received acoustic energy is processed and displayed to support operator detection, classification, localization, and tracking of threat submarines.
- AN/SQQ-89A(V)15 uses passive sonar (including acoustic intercept) to provide early warning of threat torpedoes.
- The Navy intends for the program to provide improvement in sensor display integration and automation, reduction in false alerts, and improvement in onboard training capability to better support operation within littoral regions against multiple sub-surface threats.
- The system consists of:
  - Acoustic sensors – hull-mounted array, multi-function towed array (TB-37) including a towed acoustic intercept array, calibrated reference hydrophone, helicopter, and/or ship deployed sonobuoys

  - Functional segments used for processing and display of active, passive, and environmental data
  - Interface to Aegis Combat System for Mk 46 and Mk 54 torpedo prosecution using surface vessel torpedo tubes, Vertical Launch Anti-Submarine Rocket, or SH-60B/MH-60R helicopters
- The system is deployed on a DDG 51 class destroyer or CG 47 class cruiser host platform.

Mission

- Maritime Component Commanders employ surface combatants with AN/SQQ-89A(V)15 as escorts to high-value units to protect against threat submarines during transit.
- Maritime Component Commanders use surface combatants with AN/SQQ-89A(V)15 to conduct area clearance and defense, barrier operations, and ASW support during amphibious assault.
- Theater Commanders use surface combatants with AN/SQQ-89A(V)15 to support theater ASW prosecution of threat submarines.
- Unit Commanders use AN/SQQ-89A(V)15 to support self-protection against incoming threat torpedoes.

Major Contractor

Lockheed Martin Mission Systems and Training – Manassas, Virginia

Activity

- In January 2013, DOT&E sent a memorandum to the Assistant Secretary of the Navy (Research, Development, and Acquisition) outlining the need for a threat torpedo surrogate to support operational testing of the AN/SQQ-89A(V)15. In October 2013, the Navy commenced a formal study to identify gaps in currently available torpedo surrogates' capability to represent threat torpedoes. The study was also intended to provide an analysis of alternatives for either the modification of current surrogates or the development of new surrogates to overcome these identified gaps.
- In August 2014, DOT&E approved the Test and Evaluation Master Plan covering the ACB-11 variant. ACB-11 operational testing will include at-sea evaluations focusing on ASW and torpedo detection, particularly in shallow-water (generally defined as water that is less than 100 fathoms in depth), littoral environments that have not been evaluated in prior variants. Testing will also include a cybersecurity evaluation.
- In December 2014, DOT&E issued a classified Early Fielding Report for the ACB-11 variant of AN/SQQ-89A(V)15 Integrated Undersea Warfare Combat System Suite. The report was issued due to the installation of the ACB-11 variant on ships that deployed prior to IOT&E.
- The Commander, Operational Test and Evaluation Force commenced IOT&E on the ACB-11 variant in May 2014. Testing was conducted in accordance with a DOT&E-approved test plan and included ASW transit search and area search operations using AN/SQQ-89A(V)15 onboard a DDG 51 class destroyer. Testing was conducted in conjunction with the following two fleet events:
  - Submarine Command Course 40 Anti-Surface Warfare events at the Navy's Atlantic Undersea Test and Evaluation Center.
  - Submarine Command Course 40 ASW events at the Fort Pierce, Florida, Operations Area. This testing focused on torpedo employment in shallow water.
- The Navy has not yet scheduled the dedicated IOT&E.

Assessment

- The final assessment of ACB-11 is not complete, as testing is expected to continue through FY15. DOT&E's classified Early Fielding Report concluded the following regarding performance:
  - The ACB-11 variant appears to be meeting program performance metrics for submarine detection and classification in deep-water environments. This assessment is made with low confidence due to limited data collection. Also, the data were insufficient to determine if this detection capability and accompanying operator classifications would translate to an effective prosecution of the threat submarine.
  - The ACB-11 variant demonstrated some capability to detect U.S. torpedoes at a program-defined range that is intended to support a meaningful torpedo evasion. However, the data were insufficient to determine if the observed torpedo detection ranges will support effective torpedo evasion. No data were available to assess performance against quieter, modern torpedoes.
  - The ACB-11 variant is currently not suitable due to low operational availability. Extensive logistic delays limited system capability throughout the majority of the time frame evaluated. A primary contributor was a significant delay in the repair of the Multi-Function Towed Array (MFTA) because of a limited inventory of spare arrays; array repair is primarily achieved through replacement of the MFTA in port.
  - Insufficient data were collected to confidently determine performance for the ACB-11 variant against real-world, diesel submarines and nuclear submarines. Further, no assessment can be made against the smaller midget and coastal diesel submarines due to the Navy having no test surrogates to represent this prevalent threat.
- Analysis of the few completed IOT&E events is ongoing. Preliminary analysis indicates that the ACB-11 variant has some capability to detect submarines in shallow water. However, the fleet exercise did not support the necessary ranges to assess detection against system requirements.
- The ability of surface combatants employing the ACB-11 variant to avoid torpedoes can only partially be assessed due to significant differences in U.S. torpedoes and torpedoes employed by other nations.

Recommendations

- Status of Previous Recommendations. The Navy is making progress and should continue to address FY13 recommendations. The Navy has started the process for identifying existing gaps between threat torpedoes and available torpedo surrogates in operational testing. However, the Navy still needs to:
  1. Complete an analysis and develop a plan to overcome gaps between threat torpedoes and torpedoes available for operational testing.
  2. Schedule and complete dedicated IOT&E test events in shallow water.
- FY14 Recommendations. The Navy should:
  1. Develop and integrate high-fidelity trainers and realistic, in-water test articles to improve training and proficiency of operators in ASW search and track of threat submarines, including midget and coastal diesel submarines.
  2. Include and assess capability of AN/SQQ-89A(V)15 during all opportunities against real-world diesel submarines to determine performance differences from that observed against U.S. nuclear submarines.
  3. Pre-position spare TB-37 MFTA and spare MFTA modules at appropriate forward-operating ports to minimize logistic delays.
  4. Address the four additional classified recommendations listed in the December 2014 Early Fielding Report.

Armored Tactical Vehicles – Naval

Executive Summary

- The Marine Corps has developed a special purpose kit to improve protection from under-vehicle attacks for the Logistics Vehicle System Replacement (LVSR) truck. For the wrecker variant, the Underbody Improvement Kit (UIK) has several unique design features to accommodate the self-recovery winch.
- The Marine Corps completed two LVSR system-level underbody blast tests in June 2014 at Aberdeen Test Center, Maryland; the data indicate that the UIK increases crew protection.
- The ballistic test phase addressed the crew/occupant vulnerabilities of the Medium Tactical Vehicle Replacement (MTVR) Engineering Change Proposal (ECP) vehicles against specific underbody threats. These events were selected for the MTVR ECP vehicles based on the previous live fire testing of the MTVR, and designed to provide comparative data for evaluation of seating performance and crew force protection.
- The Marine Corps completed two of the three planned MTVR ECP test events in March 2014 at Aberdeen Test Center, Maryland, before the test series was stopped for assessment and redesign.

LVSR - Logistics Vehicle System Replacement

MTVR - Medium Tactical Vehicle Replacement

System

- The Marine Corps Armored Tactical Vehicle Programs include the LVSR and the MTVR trucks.
- The LVSR is a family of heavy trucks, including the LVSR Cargo and Tractor platforms and the LVSR Wrecker variant. LVSRs are capable of transporting 18 tons off-road and 22.5 tons on-road. The LVSR Wrecker has several unique design characteristics to accommodate the self-recovery winch. To improve the vehicles' survivability against underbody blast threats, a UIK is being designed by the Marine Corps, though not currently planned for procurement.
- The MTVR is a family of medium trucks, equipped with armor protection kits, which are capable of transporting 6 tons off-road and 12.2 tons on-road. Other ECPs include energy-absorbing seats and floor mats, emergency egress windshields, and an automatic fire extinguishing system.

Mission

The Marine Corps employs truck systems as multi-purpose transportation and unit mobility vehicles in combat, combat support, and combat service support units.

- The LVSR is the heavy lift transport capability within all elements of the Marine Air Ground Task Force, which includes transporting bulk fuel and water, ammunition, cargo, tactical bridging, containers, combat engineer vehicles, and heavy wrecker capability.
- The MTVR is the prime mover for the howitzer, fuel and water assets, troops, and a wide variety of equipment.

Major Contractor

LVSR and MTVR: Oshkosh Defense – Oshkosh, Wisconsin

Activity

- Developmental and system-level testing of the LVSR Wrecker UIK integration concluded in 3QFY14. These tests included two underbody blast events conducted at Aberdeen Test Center, Maryland. The LVSR Program Office provided two surrogate wrecker assets to test and characterize the force protection capabilities and vehicle vulnerability against underbody blast threats.

- The Program Manager Medium and Heavy Tactical Vehicles (PM M&HTV) started an effort to evaluate ECP components for the MTVR. This test phase is designed to demonstrate blast performance of candidate MTVR energy-absorbing seats and floor mats, and verify blast-induced shock resistance and safety of other integrated changes, including:
  - Command, Control, Communications, Computers, and Intelligence equipment
  - The selected emergency egress windshields
  - An automatic fire extinguishing system
- The Marine Corps conducted two of the three planned MTVR underbody blast test events at Aberdeen Test Center, Maryland, in 2QFY14.

Assessment

- Testing and analysis confirm that the LVSR Wrecker UIK increases crew protection against some under-vehicle mine strikes. The program manager has no plans to procure and field the LVSR UIK.
- Designs of the UIK have been refined and qualified through the recent LVSR UIK testing, and the Cargo, Tractor, and Wrecker vehicles with UIKs added have shown improved crew survivability against underbody blast events.
- Results from the initial MTVR ECP testing in 2QFY14 indicated no noticeable improvement in crew survivability and therefore testing was stopped. PM M&HTV is currently considering a redesign of the legacy survivability kit and ECP (seat and floor mat) components and will notify DOT&E if it plans to proceed with further changes to the vehicle.

Recommendations

- Status of Previous Recommendations. The Marine Corps addressed the previous recommendations by conducting live fire testing of armor upgrades and design changes.
- FY14 Recommendations.
  1. As the Marine Corps has decided to delay procurement of the LVSR UIKs, future missions requiring LVSR vehicles with UIK should evaluate expected threats for changes prior to fielding.
  2. PM M&HTV should reevaluate MTVR energy-absorbing seat upgrade options and plan for additional tests of these options when ready.

Cobra King
(formerly Cobra Judy Replacement)

Executive Summary

- The Air Force Operational Test and Evaluation Center and the Navy, Commander Operational Test and Evaluation Force conducted a Multi-Service Operational Test and Evaluation (MOT&E) of Cobra King from September 2013 through April 2014.
- Testing included data collection activities on balloon-borne calibration spheres, satellites, and two domestic intercontinental ballistic missile launches.
- On March 31, 2014, the Air Force accepted Cobra King as an Initial Operational Capability.
- In July 2014, DOT&E published a classified MOT&E report that assessed Cobra King as operationally effective and operationally suitable, matching or exceeding the legacy Cobra Judy performance.

System

- Cobra King is a mobile radar suite installed on the USNS *Howard O. Lorenzen.*
- Cobra King replaces the original Cobra Judy system, which has been deployed since 1981 and has reached the end of its service life.
- The Cobra King radar suite consists of steerable S- and X-band phased arrays, which expand the data collection capability over the original system. The S-band radar primarily conducts large-volume searches and is capable of performing radar tracks and collections on a large number of radar targets. The X-band radar provides high-resolution data on specific radar objects of interest and also has a search capability.
- The ship's crew consists of civilian or contracted Military Sealift Command personnel responsible for the navigation, operations, and maintenance of the ship; a small, specialized group of contractors are utilized for radar operations. An Air Force officer serves as the mission commander.

Mission

The DOD uses Cobra King to conduct treaty monitoring and verification activities. Additionally, Cobra King can be used to provide data for comparison with other sources during domestic ballistic missile tests.

Major Contractors

- Raytheon Integrated Defense Systems – Sudbury, Massachusetts
- Northrop Grumman Electronic Systems – Baltimore, Maryland
- VT Halter Marine – Pascagoula, Mississippi

Activity

- From September 2013 through April 2014, the U.S. Air Force Operational Test and Evaluation Center and the Commander, Operational Test and Evaluation Force conducted an MOT&E for Cobra King.
- Testing included data collection activities on balloon-borne calibration spheres, satellites, and two domestic intercontinental ballistic missile launches. Testing was executed in accordance with a DOT&E-approved Test and Evaluation Master Plan and test plan.
- On March 31, 2014, the Air Force accepted Cobra King as an Initial Operational Capability.
- In July 2014, DOT&E published a classified MOT&E report that assessed Cobra King test adequacy, operational effectiveness, and suitability.

Assessment

- The Cobra King test program achieved a successful balance between the use of modeling and simulation and the observation of balloon-borne spheres, satellites, and live ballistic missile targets. Testing was adequate to support an evaluation of operational effectiveness and operational suitability.

- Cobra King is operationally effective to accomplish its mission, matching or exceeding the legacy Cobra Judy performance in relevant mission areas (i.e., preparation and transit, loiter, data collection, data analysis and exchange, storage and archiving, and cybersecurity) during MOT&E.
- Cobra King is operationally suitable to accomplish its mission. Based upon test performance during MOT&E, Cobra King is expected to match the legacy Cobra Judy system in reliability, availability, and interoperability.

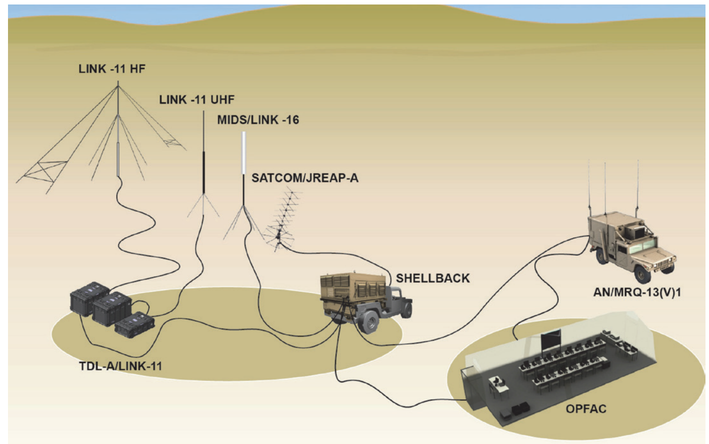
Recommendations

- Status of Previous Recommendations. There are no previous recommendations from the FY13 Cobra Judy Replacement Annual Report.
- FY14 Recommendation.
  1. The program should continue to address the deficiencies identified during MOT&E – and outlined in DOT&E's classified report – to further improve the system's operational effectiveness and suitability.

Common Aviation Command and Control System (CAC2S)

Executive Summary
- In December 2013, the Test and Evaluation Master Plan (TEMP) for Common Aviation Command and Control System (CAC2S) Increment I was updated by the CAC2S Program Office to support the planned Milestone C review, currently scheduled for 2QFY15.
- In October 2014, the Marine Corps Operational Test and Evaluation Activity conducted an operational assessment (OA) of CAC2S Increment I, Phase 2 during the Weapons and Tactics Instructors' (WTI) exercise at Marine Corps Air Station Yuma, Arizona, to assess its ability to support the Direct Air Support Center (DASC), Tactical Air Operations Center (TAOC), and Tactical Air Command Center (TACC) missions. The OA was conducted in accordance with a DOT&E-approved test plan, and the results will be used to support a Low-Rate Initial Production (LRIP) decision during the Milestone C review.
- During the OA, CAC2S, Increment I, Phase 2 demonstrated the ability to support mission accomplishment of the three Marine Corps aviation C2 missions. CAC2S Increment I, Phase 2 also demonstrated the ability to provide data fusion of real time, near-real time, and non-real time information onto a single tactical display.

System
- CAC2S consists of tactical shelters, software, and common hardware. The hardware components are expeditionary, common, modular, and scalable, and may be freestanding, mounted in transit cases, or rack-mounted in shelters and/or general-purpose tents that are transported by organic tactical mobility assets.
- CAC2S Increment I is being delivered in two phases. Phase I previously delivered hardware and software to fully support the DASC mission requirements and partially support TAOC mission requirements. Phase 2 combines the three legacy Phase 1 systems into two functional subsystems and fully supports the requirements of the DASC, TACC, and TAOC.
  - The Communication Subsystem (CS) provides the capability to interface with internal and external communication assets and the means to control their operation.
  - The Aviation Command and Control System (AC2S) provides:
    - The operational command post and functionality to support mission planning, decision making, and execution tools in support of all functions of Marine Aviation
    - An open architecture interface capable of integrating emerging active and passive sensor technology for organic and non-organic sensors to the Marine Air Command and Control System (MACCS)



HF - High Frequency
JREAP - Joint Range Extension Application Protocol
MIDS - Multi-Functional Information Distribution System
OPFAC - Operations Facility
SATCOM - Satellite Communications
TDL - Tactical Data Link
UHF - Ultra High Frequency

    - The capability for the display of real time, near-real time, and non-real time sensor data to support C2 of Marine Air-Ground Task Force (MAGTF) aviation assets

Mission
- The MAGTF Commander will employ Marine Corps aviation C2 assets to include the DASC, the TAOC, and the TACC equipped with CAC2S to integrate Marine Corps aviation into joint and combined air/ground operations in support of Operational Maneuver from the Sea, Sustained Operations Ashore, and other expeditionary operations.
- The MAGTF Commander will execute C2 of assigned assets afloat and ashore in a joint, allied, or coalition operational environment by using CAC2S capabilities to:
  - Share mission-critical voice, video, sensor, and C2 data and information in order to integrate aviation and ground combat planning and operations
  - Display a common, real, and near-real time integrated tactical picture with the timeliness and accuracy necessary to facilitate the control of friendly assets and the engagement of threat aircraft and missiles
  - Provide fusion of real time, near-real time, and non-real time information in support of the MAGTF
  - Access theater and national intelligence sources from a multi-function C2 node
  - Standardize Air Tasking Order (ATO) and Airspace Control Order generation, parsing, interchange, and dissemination throughout the MAGTF and theater forces by using the joint standard for ATO interoperability

Major Contractors

- Phase 1
  - Government Integrator:
    Naval Surface Warfare Center – Crane, Indiana
  - Component Contractor:
    Raytheon-Solipsys – Fulton, Maryland
  - Component Contractor:
    General Dynamics – Scottsdale, Arizona
- Phase 2
  - Prime Contractor (no Government Integrator):
    General Dynamics – Scottsdale, Arizona

Activity

- The Marine Corps awarded the Engineering, Manufacturing and Development contract for CAC2S Phase 2 to General Dynamics C4 Systems.
- The CAC2S Program Office held a Critical Design Review for Phase 2 during 1QFY14.
- The CAC2S Program Office completed Developmental Test (DT) B-1, DT B-2, and DT B-3 between 1Q-4QFY14.
- In December 2013, the CAC2S Program Office updated the TEMP for CAC2S Increment I to support the planned Milestone C review. DOT&E approved the TEMP in January 2014.
- In October 2014, the Marine Corps Operational Test and Evaluation Activity conducted an OA of CAC2S Increment I, Phase 2 during the WTI exercise at Marine Corps Air Station Yuma, Arizona. The OA evaluated the ability of CAC2S Increment I, Phase 2 to support the DASC, TAOC, and TACC missions. The OA was conducted in accordance with a DOT&E-approved test plan, and the results will be used to support a LRIP decision during the Milestone C review.
- Milestone C for CAC2S Phase 2 is scheduled for 2QFY15.

Assessment

- Based on qualitative evaluation during the OA, CAC2S Increment I, Phase 2 successfully demonstrated the ability to support the primary mission areas for all three agencies: direct air support for the DASC, control of aircraft and missiles for the TAOC, and providing C2 aviation and planning support for the MAGTF commander in the TACC.
- Increment I, Phase 2 support of the TACC was limited primarily to the current operations cell due to the scope of the exercise scenario.
- During the OA, CAC2S Increment I, Phase 2 also demonstrated an ability to fuse real time, near-real time, and non-real time data onto a single tactical display, at medium operational tempo densities of aircraft and targets against older/current generation threats. However, because system interfaces are still in development, CAC2S connectivity to the Marine Corps' Composite Tracking Network was not demonstrated.
- Reliability, availability, and maintainability data were collected during the OA and the data indicate that CAC2S is making progress toward meeting its reliability growth objectives.
- The OA did not assess interoperability/integration of CAC2S with the Ground/Air Task Oriented Radar as that system is still undergoing development. However, the OA did demonstrate the ability to connect the AN/TPS-59 radar sensor directly to CAC2S displaying both radar plot and track data.

Recommendations

- Status of Previous Recommendations. DOT&E previously recommended that a balanced use of air and ground combat forces be used during future test venues to provide a better assessment of CAC2S support to the MAGTF and that 24-hour operations be conducted to ensure adequate hours for assessment of system reliability. Additionally, DOT&E also recommended that a Service-level preventative maintenance plan be developed prior to conducting the Increment I, Phase 2 IOT&E. The Marine Corps is actively addressing these recommendations. All other previous recommendations have been addressed.
- FY14 Recommendations. The Marine Corps should:
  1. Ensure that IOT&E of CAC2S' data fusion capability include the most current and the likely projected air threat available and that the scenario used is operationally realistic and of sufficient operational tempo to adequately stress the system.
  2. Conduct interoperability and integration testing with the Composite Tracking Network and Ground/Air Task Oriented Radar in an operationally realistic environment if these systems are sufficiently mature to reduce IOT&E risk.
  3. Conduct a Field User Evaluation as IOT&E risk reduction that includes all divisions/sections within the TACC in order to adequately stress the system and ensure that CAC2S capabilities meet the user mission planning requirements.

CVN-78 *Gerald R. Ford* Class Nuclear Aircraft Carrier

Executive Summary

- DOT&E's assessment of CVN-78 remains consistent with the report DOT&E issued in December 2013, which was based on data obtained during a DOT&E-approved Commander, Operational Test and Evaluation Force (COTF) operational assessment completed in December 2013.
- The Navy submitted the LFT&E Management Plan, Revision B in July 2014. Although the plan was adequate with respect to the Total Ship Survivability Trial (TSST) on CVN-78 and the Analytical Bridge, DOT&E returned the plan to the Navy because it called for the Full Ship Shock Trial (FSST) on CVN-79 instead of CVN-78. The original Alternative Live Fire Strategy prepared by the Navy and approved by DOT&E on December 9, 2008, stated the FSST would be conducted on CVN-78. The Navy unilaterally reneged on the approved strategy on June 18, 2012. The Navy has not submitted an updated Test and Evaluation Master Plan (TEMP) to DOT&E. The last approved TEMP was TEMP 1610 Revision B, which was approved in 2007.
- TEMP 1610 Revision C, which is in revision, improves integrated platform-level developmental testing, reducing the likelihood that platform-level problems will be discovered during IOT&E. In addition, the Program Office is in the process of refining the post-delivery schedule to further integrate testing.
- CVN-78 incorporates newly designed catapults, arresting gear, weapons elevators, and radar, which are all critical for flight operations.
- Reliability for the catapult and arresting gear systems have not been reported on in over a year. Before the Navy stopped tracking/reporting on catapult and arresting gear performance, both systems were performing well below their projected target to achieve required reliability. Reliability test data are not available for the radar and the weapons elevators. DOT&E assesses that the poor or unknown reliability of these critical systems will be the most significant risk to CVN-78's successful completion of IOT&E.
- Testing at the Electromagnetic Aircraft Launching System (EMALS) functional demonstration test site at Joint Base McGuire-Dix-Lakehurst, New Jersey, discovered an excessive EMALS holdback release dynamics during F/A-18E/F and EA-18G catapult launches with wing-mounted 480-gallon external fuel tanks (EFTs). This discovery, if uncorrected, would preclude the Navy from conducting normal operations of the F/A-18E/F and EA-18G from CVN-78. The Navy has no plan to address this discovery in FY15.
- The CVN-78 design is intended to reduce manning. As manning requirements have been further developed, analysis indicates the present design has insufficient berthing for some ranks requiring re-designation/redesign of some spaces as a possible solution. The ship will not be delivered with sufficient empty berthing for the CVN-78's Service Life Allowance (SLA). The SLA would provide empty bunks to allow for changes in the crew composition over CVN-78's expected 50-year lifespan, as well as surge capacity, and ship riders for repairs, assists, and inspections.
- The CVN-78 combat system for self-defense is derived from the combat system on current carriers and is expected to have similar capabilities and limitations.
- The Navy continues to work on integration challenges related to the F-35 Joint Strike Fighter (F-35) and its fleet of aircraft carriers, including CVN-78.
- It is unlikely that CVN-78 will achieve its Sortie Generation Rate (SGR) (number of aircraft sorties per day) requirement. The target threshold is based on unrealistic assumptions including fair weather and unlimited visibility, and that aircraft emergencies, failures of shipboard equipment, ship maneuvers, and manning shortfalls will not affect flight operations. Discovery of EMALS excessive holdback release dynamics, as well as possible solutions, could significantly limit the carriers' SGR. DOT&E plans to assess CVN-78 performance during IOT&E by comparing to the demonstrated performance of the *Nimitz* class carriers as well as to the SGR requirement.
- Although CVN-78 will include a new Heavy underway replenishment (UNREP) system that will transfer cargo loads of up to 12,000 pounds, the Navy plans to install Heavy UNREP systems on resupply ships beginning in FY21 with T-AO(X).
- The Navy began CVN-78 construction in 2008, and the ship was christened November 9, 2013. The schedule to deliver the ship has slipped from September 2015 to March 2016. The development, construction, and testing of EMALS, Advanced Arresting Gear (AAG), Dual Band Radar (DBR), and Integrated Warfare System will continue to drive the timeline.

System

- The CVN-78 *Gerald R. Ford* class nuclear aircraft carrier program is a new class of nuclear-powered aircraft carriers that replaces the previous CVN-21 program designation. It has the same hull form as the CVN-68 *Nimitz* class, but many ship systems, including the nuclear plant and the flight deck, are new.
- The newly designed nuclear power plant is intended to operate at a reduced manning level that is 50 percent of a CVN-68 class ship and produce significantly more electricity.
- The CVN-78 will incorporate EMALS (electromagnetic, instead of steam-powered) and AAG, and will have a smaller island with a DBR (a phased-array radar, which replaces/combines several legacy radars used on current aircraft carriers serving in air traffic control and in ship self-defense).
- The Navy intends for the Integrated Warfare System to be adaptable to technology upgrades and varied missions throughout the ship's projected operating life including increased self-defense capabilities compared to current aircraft carriers.
- The Navy redesigned weapons stowage, handling spaces, and elevators to reduce manning, increase safety, and increase throughput of weapons.
- CVN-78 has design features intended to enhance its ability to launch, recover, and service aircraft, such as a slightly larger flight deck, dedicated weapons handling areas, and increased aircraft refueling stations. The Navy set the SGR requirement for CVN-78 to increase the sortie generation capability of embarked aircraft to 160 sorties per day (12-hour fly day) and to surge to 270 sorties per day (24-hour fly day) as compared to the CVN-68 *Nimitz* class SGR demonstration of 120 sorties per day/240 sorties for 24-hour surge.
- The Consolidated Afloat Networks and Enterprise Services (CANES) program replaces five shipboard legacy network programs to provide a common computing environment for command, control, intelligence, and logistics.
- CVN-78 is intended to support the F-35 and future weapons systems over the expected 50-year ship's lifespan.
- The Navy plans to declare CVN-78 Initial Operational Capability in FY17 and achieve Full Operational Capability in FY19 (during IOT&E and after the Type Commander certifies that CVN-78 is Major Combat Operations Ready).

Mission

Carrier Strike Group Commanders will use the CVN-78 to:

- Conduct power projection and strike warfare missions using embarked aircraft
- Provide force and area protection
- Provide a sea base as both a command and control platform and an air-capable unit

Major Contractor

Huntington Ingalls Industries, Newport News Shipbuilding – Newport News, Virginia

---

Activity

Test Planning

- The CVN-78 *Gerald R. Ford* class carrier Program Office revised the TEMP to align planned developmental tests with corresponding operational test phases and to identify platform-level developmental testing.
- The Program Office released an updated Post Delivery Test and Trials schedule.
- The Navy continues to develop the CVN-78 SGR test modeling. The Navy is conducting weekly Configuration Review Board meetings to refine requirements for model development through FY17. The ship's SGR requirement is based on a 30-plus-day wartime scenario. The Navy intends to update the wartime scenario. The Navy designed a test to demonstrate the SGR with 6 consecutive 12-hour fly days followed by 2 consecutive 24-hour fly days. This live testing will be supplemented with modeling and simulation from the Virtual Carrier (VCVN) model to extrapolate results to the 30-plus-day SGR requirement. DOT&E concurs with this approach.

EMALS

- The EMALS functional demonstration test site at Joint Base McGuire-Dix-Lakehurst, New Jersey, continues to test the new electromagnetic catapult system. Aircraft compatibility testing was completed in April 2014. A total of 452 aircraft launches were conducted using EA-18G, F/A-18E, F/A-18C, E-2D, T-45, and C-2A aircraft. The testing discovered excessive EMALS holdback release dynamics during F/A-18E/F and EA-18G catapult launches with wing-mounted 480-gallon EFTs. Aircraft dynamics are considered excessive if they exceed stress limits of the airframe, internal, or external stores. This discovery, if uncorrected, would preclude normal employment of the F/A-18E/F and EA-18G from CVN-78. There is no funding at this time to correct this deficiency.
- The Navy has also conducted over 3,000 dead-load launches (non-aircraft, weight equivalent, and simulated launches). EMALS is currently undergoing laboratory environmental qualification testing and testing of engineering changes to correct observed failures. Shipboard testing began on August 11, 2014, with below decks components. Approximately 94 percent of the EMALS equipment has been delivered to the shipyard. All linear motors are planned to be installed by the end of 1QFY15 to include the main power cables on catapults 1, 2, and 3.

AAG

- The Navy continues testing the AAG on a jet car track at Joint Base McGuire-Dix-Lakehurst, New Jersey, with 528 arrestments completed by August 2014. Testing has prompted system design changes. A failure in the water twister suspended testing in November 2013; the Navy authorized return-to-test in January 2014. Dead-load testing resumed in May to validate performance of modifications to the mechanical brake. Runway Arrested Landing Site (RALS) preparation began using equipment planned for CVN-78. The Navy de-scoped the number 4 AAG engine, reducing the total arresting gear engines on the ship, including the barricade, to three, and diverted the following equipment to RALS in Lakehurst: the water twisters, electric motors, purchase cable drum assemblies, and cable shock absorbers for the number 4 arresting gear engine. Approximately 94 percent of the remaining AAG equipment has been delivered to the shipyard.

CANES

- The Navy has scheduled developmental and follow-on operational testing of the force-level CANES configuration used on the *Nimitz* and *Gerald R. Ford* classes for 2Q and 3QFY15.
- The Navy conducted operational testing in accordance with a DOT&E-approved test plan.
- The Navy conducted integrated testing and IOT&E of the unit-level Aegis destroyer configuration in 3Q and 4QFY14.

DBR

- The Navy installed a production Multi-Function Radar and reactivated the Engineering Development Model of the Volume Search Radar at the Surface Combat System Center at Wallops Island, Virginia. The Navy planned to begin testing in January 2013; however, the testing has slipped repeatedly, and to date, no live testing with the full production DBR has been completed. The first government-led integrated test events began in 1QFY14. The first developmental testing of DBR began in 4QFY14 at Wallops Island.

Manning

- The Navy conducted CVN-78 Manning War Game III in July 2014 to identify CVN-78 unique Manpower, Personnel, Training, and Education planning and execution concerns. The results of the War Game have not been published.

JPALS

- The Joint Precision Approach and Landing System (JPALS) is no longer funded for CVN-78.
- In June 2014, following a Nunn-McCurdy breach, USD(AT&L) rescinded Milestone B approval for the sea-based Increment 1A of the JPALS land- and sea-based multiple-increment JPALS program. USD(AT&L) directed the Navy to restructure the multiple-increment program into a single increment focusing on sea-based requirements primarily supporting F-35 and future Unmanned Carrier-Launched Airborne Surveillance and Strike (UCLASS) aircraft.
- Under the restructured program, the Navy will complete the development phase for precision approach and landing capability for JPALS-equipped manned aircraft at sea with the addition of risk reduction efforts to prepare for future manned and unmanned auto-land capability. The actual production phase of JPALS will be deferred until it is required for F-35 and UCLASS aircraft. There will be no retrofitting of legacy aircraft with JPALS. The Navy will need to maintain both the legacy approach and landing system and JPALS onboard each ship designated to receive future JPALS-equipped aircraft.

F-35

- The Navy is working to address several F-35 integration challenges on its aircraft carriers. In general, these issues affect all of the Navy's carriers, not just CVN-78.
- In FY12, a test of the F-35 arresting hook system identified problems with the design. After failing to engage the arresting cable and demonstrating insufficient load-carrying capacity, the Navy has redesigned the arresting hook system. Testing at Joint Base McGuire-Dix-Lakehurst began in April 2014 and completed in September 2014, followed by shipboard trials onboard USS *Nimitz* in 1QFY15. The re-designed hook has been successful in arresting the aircraft. The Navy is redesigning the cooling system in the CVN 78's Jet Blast Deflectors (JBDs). The JBDs deflect engine exhaust during catapult launches. The redesign is needed to handle F-35 engine exhaust and will include improvements in cooling flow and eventual addition of side-cooling panels. Until side-cooling panels are installed, the F-35 will be thrust and weight limited for take-off, with associated penalties in payload and/or range. Side cooling panels are expected to be installed on CVNs in the early 2020's.
- CVN-78 will receive the new Heavy UNREP system. To use the Heavy UNREP capability, both the carrier and the resupply ship must be equipped with the system. This new Heavy UNREP system, along with heavy vertical lift aircraft not embarked on carriers, are the only systems currently capable of resupplying the F-35 containerized engine while the carrier is underway. Today, only one combat logistic ship has Heavy UNREP, USNS *Arctic*. The Navy plans to have Heavy UNREP systems installed on resupply ships starting with T-AO(X) in FY21. The current acquisition strategy has one T-AO ship delivery every year after that for a total of 17 ships.
- The Navy is designing separate charging and storage lockers for the lithium-ion batteries required for the F-35 and for F-35 weapons loading support equipment. This includes aircraft battery accommodations below decks and ready service lockers for weapons loader batteries on the flight deck. The Navy is also designing a new storage locker for pilot flight equipment as the F-35 helmet is larger and more fragile than legacy helmets.
- The Navy has completed F-35 cyclic thermal strain testing and concluded that repeated F-35 sortie generation at

combat rated thrust, i.e., afterburner, will not cause cyclic thermal strain on the CVN-78 flight deck structure.

- Unlike current fleet aircraft, the F-35 carries ordnance in internal bays. This will require changes to aircraft firefighting techniques for the F-35. The Navy is developing new firefighting equipment to attach to existing hose nozzles, including a tow-bar mounted spray device for open bay firefighting, and a penetrating device to punch through the aircraft skin for closed bay scenarios.
- The F-35 Joint Program Office has initiated a tire redesign for the F-35B due to higher than predicted wear rates. The Navy has not yet settled on a strategy for dealing with a possible higher tire storage requirement.
- The F-35 is very loud aircraft. The noise level in some operating envelopes is presently being tested on the flight deck. The Navy has determined the problem of aircraft noise on the flight deck is significantly worse than they originally thought. This may require the installation of noise abatement material below the flight deck to allow for conversational speech in work spaces located on the O3 level. The Navy plans to investigate noise levels during shipboard trials in 1QFY15 to help determine a solution.
- The F-35 ejection seat has a higher center of gravity than legacy seats, requiring additional tie downs for heavy seas when installed in the maintenance dolly. The F-35 program is planning to use the Navy Aircrew Common Ejection Seat (NACES) Seat Dolly and will provide an adaptor for its seat. The Navy and F-35 Program Office will assess the need for changes to the seat shop when the drawings for the adaptor are completed. The use of the NACES Seat Dolly is anticipated to eliminate the need to change the seat shop. The Navy is currently determining what modifications this will require for the seat shop.

LFT&E

- The Navy submitted the LFT&E Management Plan, Revision B in July 2014. Although the plan was adequate with respect to the TSST on CVN-78 and the Analytical Bridge, DOT&E returned the plan to the Navy because it called for the FSST on CVN-79 instead of CVN-78 as stipulated in the original Alternate Live Fire Strategy approved on December 9, 2008.

Assessment

Test Planning

- A new TEMP is under development to address problems with the currently-approved TEMP. The TEMP in the approval process improves integrated platform-level developmental testing, reducing the likelihood that platform-level problems will be discovered during IOT&E. In addition, the Program Office is in the process of refining the post-delivery schedule to further integrate testing.
- The current state of the VCVN model does not fully provide for an accurate accounting of SGR due to a lack of fidelity regarding manning and equipment/aircraft availability. Spiral development of the VCVN model continues in order to ensure that the required fidelity will be available to support the SGR assessment during IOT&E.
- The Navy plans to take delivery CVN-78 in March 2016. The ship's post-shipyard shakedown availability will follow delivery in late 2016. During the post-shipyard shakedown availability installations of some systems will be completed. The first at-sea operational test and evaluation of CVN-78 will begin in September 2017.

Reliability

- CVN-78 includes several systems that are new to aircraft carriers; four of these systems stand out as being critical to flight operations: EMALS, AAG, DBR, and the Advanced Weapons Elevators (AWEs). Overall, the uncertain reliability of these four systems is the most significant risk to the CVN-78 IOT&E. All four of these systems will be tested for the first time in their shipboard configurations aboard CVN-78. Reliability estimates derived from test data were provided last year for EMALS and AAG and are discussed below. The Navy has stated that in the last year, they did not assess EMALS and AAG reliability due to systems' redesign and investigative and developmental testing. For DBR and AWE, estimates based on test data are not available and only engineering reliability estimates are available.

EMALS

- EMALS is one of the four systems critical to flight operations. While testing to date has demonstrated that EMALS should be able to launch aircraft planned for CVN-78's air wing, present limitations on F/A-18E/F and EA-18G configurations as well as the system's reliability remains uncertain. As of December 2013, at the Lakehurst, New Jersey, test site, over 1,967 launches had been conducted with 201 chargeable failures. At that time, the program estimates that EMALS has approximately 240 Mean Cycles Between Critical Failure in the shipboard configuration, where a cycle represents the launch of one aircraft. Based on expected reliability growth, the failure rate for the last reported Mean Cycles Between Critical Failure was five times higher than should have been expected. As of August 2014, the Navy has reported that over 3,017 launches have been conducted at the Lakehurst test site, but have not provided DOT&E with an update of failures. The Navy intends to provide DOT&E an update of failures in December 2014.

AAG

- AAG is another system critical to flight operations. Testing to date has demonstrated that AAG should be able to recover aircraft planned for the CVN-78 air wing, but as with EMALS, AAG's reliability is uncertain. At the Lakehurst test site, 71 arrestments were conducted early in 2013 and 9 chargeable failures occurred. The Program Office last provided reliability data in December 2013 and estimated that AAG had approximately 20 Mean Cycles Between Operational Mission Failure in the shipboard configuration, where a cycle represents the recovery of one aircraft. Following these tests, the Navy modified the system and has yet to score reliability of AAG. Based on expected reliability growth as of 2013, the failure rate was 248 times higher than should have been expected.

DBR

- Previous testing of Navy combat systems similar to CVN-78's revealed numerous integration problems that degrade the performance of the combat system. Many of these problems are expected to exist on CVN-78. The previous results emphasize the necessity of maintaining a DBR/CVN-78 combat system asset at Wallops Island. The Navy is considering long-term plans (i.e., beyond FY15) for testing DBR at Wallops Island, but it is not clear if resources and funding will be available. Such plans are critical to delivering a fully-capable combat system and ensuring life-cycle support after CVN-78 delivery in 2016.

SGR

- It is unlikely that CVN-78 will achieve its SGR requirement. The target threshold is based on unrealistic assumptions including fair weather and unlimited visibility, and that aircraft emergencies, failures of shipboard equipment, ship maneuvers, and manning shortfalls will not affect flight operations. DOT&E plans to assess CVN-78 performance during IOT&E by comparing it to the SGR requirement as well as to the demonstrated performance of the *Nimitz* class carriers.
- During the operational assessment, DOT&E conducted an analysis of past aircraft carrier operations in major conflicts. The analysis concludes that the CVN-78 SGR requirement is well above historical levels and that CVN 78 is unlikely to achieve that requirement. There are concerns with the reliability of key systems that support sortie generation on CVN-78. Poor reliability of these critical systems could cause a cascading series of delays during flight operations that would affect CVN-78's ability to generate sorties, make the ship more vulnerable to attack, or create limitations during routine operations. DOT&E assesses the poor or unknown reliability of these critical subsystems will be the most significant risk to CVN-78's successful completion of IOT&E. The analysis also considered the operational implications of a shortfall and concluded that as long as CVN-78 is able to generate sorties comparable to *Nimitz* class carriers, the operational implications of CVN-78 will be similar to that of a *Nimitz* class carrier.

Manning

- Current manning estimates have shortages of bunks for Chief Petty Officers (CPOs) and do not provide the required 10 percent SLA for all berthing. The Navy plans to re-designate/design some officer rooms as CPO berthing spaces. Per the Office of the Chief of Naval Operations Instruction 9640.1B, Shipboard Habitability Program, all new ships are required to have a growth allowance of 10 percent of the ship's company when the ship delivers. The SLA provides empty bunks to allow for changes in the crew composition over CVN 78's expected 50-year lifespan and provides berthing for visitors and Service members temporarily assigned to the ship.

JPALS

- As the Navy reformulates the JPALS Test and Evaluation Master Plan, it faces significant challenges in defining how it will demonstrate the operational effectiveness and operational suitability of the restructured system without a representative aircraft platform.

F-35

- The arresting hook system remains an integration risk as the F-35 development schedule leaves no time for discovering new problems. The redesigned tail hook has an increased downward force as well as sharper design that may induce greater than anticipated wear on the flight deck.
- F-35 noise levels remain moderate to high risk in F-35 integration and will require modified carrier flight deck procedures.
  - Flight operations normally locate some flight deck personnel in areas where double hearing protection would be insufficient during F-35 operations. To partially mitigate noise concerns, the Navy will procure new hearing protection with active noise reduction for flight deck personnel.
  - Projected noise levels one level below the flight deck (03 level), which includes mission planning spaces, will require at least single hearing protection that will make mission planning difficult. The Navy is working to mitigate the effects of the increased noise levels adjacent to the flight deck.
- Storage of the F-35 engine is limited to the hangar bay, which will affect hangar bay operations. The impact on the F-35 logistics footprint is not yet known.
- Lightning protection of F-35 aircraft while on the flight deck will require the Navy to modify nitrogen carts to increase their capacity. Nitrogen is filled in fuel tank cavities while aircraft are on the flight deck or hangar bay.
- F-35 remains unable to share battle damage assessment and non-traditional Intelligence, Surveillance, and Reconnaissance information captured on the aircraft portable memory device or cockpit voice recorder in real-time. In addition, the CVN-78 remains unable to receive and display imagery transmitted through Link 16 because of bandwidth limitations; this problem is not unique to F-35. These capability gaps were identified in DOT&E's FY12 Annual Report. The Combatant Commanders have requested these capabilities to enhance decision-making.

LFT&E

- The Navy has made substantial progress on defining the scope of the TSST and the Analytical Bridge task. While these portions of the LFT&E Management Plan were adequately defined in the Revision B document, DOT&E returned the LFT&E Management Plan to the Navy solely on the basis of the FSST on CVN 79 verses CVN-78.

- CVN-78 has many new critical systems, such as EMALS, AAG, and DBR, that have not undergone shock trials on other platforms. Unlike past tests on other new classes of ships with legacy systems, the performance of CVN-78's new critical systems is unknown.
- The Navy proposes delaying the shock trial by five to seven years because of the approximately four- to six-month delay required to perform the FSST. The benefit of having test data to affect the design of future carriers in the class outweighs the delay in delivery of CVN-78 to the fleet to conduct this test. The delay is not a sufficient reason to postpone the shock trial.

Recommendations

- Status of Previous Recommendations. The Navy should continue to address the eight remaining FY10, FY11, and FY13 recommendations.
  1. Adequately test and address integration challenges with F-35; specifically:
     - Logistics (unique concerns for storage and transportation)
     - Changes required to JBDs
     - Changes to flight deck procedures due to heat and noise
     - Autonomic Logistics Information System integration
  2. Finalize plans that address CVN-78 Integrated Warfare System engineering and ship's self-defense system discrepancies prior to the start of IOT&E.
  3. Continue aggressive EMALS and AAG risk-reduction efforts to maximize opportunity for successful system design and test completion in time to meet required in-yard dates for shipboard installation of components.
  4. Continue development of a realistic model for determining CVN-78's SGR, while utilizing realistic assumptions regarding equipment availability, manning, and weather conditions for use in the IOT&E.
  5. Provide scheduling, funding, and execution plans to DOT&E for the live SGR test event during the IOT&E.
  6. Continue to work with the Navy's Bureau of Personnel to achieve adequate depth and breadth of required personnel to sufficiently meet Navy Enlisted Classification fit/fill manning requirements of CVN-78.
  7. Conduct system-of-systems developmental testing to preclude discovery of deficiencies during IOT&E.
  8. Address the uncertain reliability of EMALS, AAG, DBR, and AWE. These systems are critical to CVN-78 flight operations, and are the largest risk to the program.
- FY14 Recommendations. The Navy should:
  1. Aggressively fund and address a solution for the excessive EMALS holdback release dynamics during F/A-18E/F and EA-18G catapult launches with wing-mounted 480-gallon EFTs.
  2. Plan for fully integrated, robust, end-to-end testing of the restructured JPALS onboard both manned high-performance and unmanned aircraft, including operations in neutral and potentially hostile electronic warfare environments.

DDG 51 Flight III Destroyer/Air and Missile Defense Radar (AMDR)/Aegis Modernization

Executive Summary

- On March 6, 2014, the Deputy Secretary of Defense (DEPSECDEF) issued a Resource Management Decision memorandum directing the Navy to develop a plan to conduct at-sea testing of the self-defense capability of the DDG 51 Flight III Destroyer with the Air and Missile Defense Radar (AMDR) and Aegis Combat System. The plan was to be approved by DOT&E and then adequately funded by the Navy. However, the Navy has not provided any plan to DOT&E or planned funding to facilitate the testing.
- On April 23, 2014, DOT&E issued a memorandum to USD(AT&L) stating the intention to not approve any operational test plan for an Early Operational Assessment (EOA) of the AMDR due to non-availability of the required AMDR hardware and software.
- On September 10, 2014, DOT&E issued a classified memorandum to USD(AT&L) with a review of the Navy Program Executive Office for Integrated Warfare Systems Design of Experiments study. The study attempted to provide a technical justification to show the test program did not require using a Self-Defense Test Ship (SDTS) to adequately assess the self-defense capability of the DDG 51 Flight III Class Destroyers. DOT&E found the study presented a number of flawed rationales, contradicted itself, and failed to make a cogent argument for why an SDTS is not needed for operational testing.

System

- The DDG 51 Flight III Destroyer will be a combatant ship equipped with the:
  - AMDR three-dimensional (range, altitude, and azimuth) multi-function radar
  - Aegis Combat System
  - AN/SQQ-89 Undersea Warfare suite that includes the AN/ SQS-53 sonar
  - MH-60R helicopter
  - Close-In Weapon System
  - Five-inch diameter gun
  - Vertical Launch System that can launch Tomahawk, Standard Missiles (SM-2, -3, and -6), and Evolved SeaSparrow Missiles (ESSMs)
- The Navy is developing the AMDR to provide simultaneous sensor support of integrated air and missile defense (IAMD) and air defense (including self-defense) missions. IAMD and air defense require extended detection ranges and increased radar sensitivity against advanced threats with high speeds and long interceptor fly-out times. The three major components of AMDR are:
  - The AMDR S-band radar will provide IAMD, as well as search, track, cueing, missile discrimination, air defense non-cooperative target recognition, S-band missile communications, surveillance capability for ship self defense and area air defense, and S-band kill assessment support functions.
  - The AMDR X-band radar (AMDR-X) will provide horizon and surface search capabilities in addition to navigation and periscope detection/discrimination functions. The Navy is delaying development of the AMDR-X. The existing AN/SPQ-9B radar will provide these X-band functions in the interim.
  - The Radar Suite Controller will provide radar resource management and coordination, as well as an open interface with the ship combat system.
- The Aegis Combat System is an integrated naval weapons system that uses computers and radars to form an advanced command and decision capability, and a weapon control system to track and guide weapons to destroy enemy targets.
  - The Navy's Aegis Modernization program is a planned, phased program that provides updated technology and combat systems for existing Aegis-guided missile cruisers (CG 47) and destroyers (DDG 51) as well as the DDG 51 Flight III Destroyers.
  - The Aegis Modernization program will provide an improved Advanced Capability Build combat system variant for the DDG 51 Flight III Destroyers equipped with the AMDR.

Mission

- The Navy will use the DDG 51 Flight III Destroyer equipped with the Aegis Combat System and AMDR to provide joint battlespace threat awareness and defense capability to counter current and future threats in support of joint forces ashore and afloat.
- The Navy will use the AMDR S-band radar/Radar Suite Controller with the AN/SPQ-9B and the Aegis Modernization Program to support the following DDG 51 Flight III Destroyer missions:
  - Area air defense (to include self-defense) to counter advanced air and cruise missile threats and increase ship survivability
  - Detect, track, discriminate, and provide missile engagement support (including kill assessment) to counter ballistic missile threats
  - Surface surveillance, precision tracking, and missile and gun engagements to counter surface threats
  - Undersea Warfare with periscope detection and discrimination
  - Detect and track enemy artillery projectiles to support combat system localization of land-battery launch positions by the DDG 51 Flight III Combat System
  - Detect and track own-ship gun projectiles in support of surface warfare and naval surface fire support

Major Contractors

- DDG 51 Flight III Destroyer: General Dynamics Marine Systems Bath Iron Works – Bath, Maine
- AMDR: Raytheon – Sudbury, Massachusetts
- Aegis Combat System: Lockheed Martin Marine Systems and Sensors – Moorestown, New Jersey

---

Activity

- On March 6, 2014, DEPSECDEF issued a Resource Management Decision memorandum directing the Navy to develop a plan to conduct at-sea testing of the self-defense capability of the DDG 51 Flight III Destroyer with the AMDR and Aegis Combat System. The plan was to be approved by DOT&E and then adequately funded by the Navy. To date, the Navy has not provided any plan to DOT&E or funding in response to this direction.
- On April 23, 2014, DOT&E issued a memorandum to USD(AT&L) stating the operational test plan for an EOA of the AMDR could not be approved because the required AMDR hardware and software were not available as planned, per the 2010 DOT&E- and Navy-approved Test and Evaluation Strategy, and as briefed to the Deputy Assistant Secretary of Defense (Strategic and Tactical Systems) in 2012. A prototype AMDR array, coupled to an upgraded radar controller using basic software for radar control and simple search and track functionality, was expected to be available. The lack of this hardware and software would have limited the EOA to a "table-top" review of program documentation, program plans, and available design data, which would, in DOT&E's view, not have been a worthwhile use of resources.
- On September 10, 2014, DOT&E issued a classified memorandum to USD(AT&L) that provided a review of the Navy Program Executive Office for Integrated Warfare Systems Design of Experiments study. The study attempted to provide a technical justification to show the test program did not require using an SDTS to adequately assess the self-defense capability of the DDG 51 Flight III Class Destroyers. DOT&E found the study presented a number of flawed rationales, contradicted itself, and failed to make a cogent argument for why an SDTS is not needed for operational testing.

Assessment

- DOT&E's assessment continues to be that the operational test programs for the AMDR, Aegis Modernization, and DDG 51 Flight III Destroyer programs are not adequate to fully assess their self-defense capabilities in addition to being inadequate to test the following Navy-approved AMDR and DDG 51 Flight III requirements.
  - The AMDR Capability Development Document describes AMDR's IAMD mission, which requires AMDR to support simultaneous defense against multiple ballistic missile threats and multiple advanced anti-ship cruise missile (ASCM) threats. The Capability Development Document also includes an AMDR minimum track range Key Performance Parameter.
  - The DDG 51 Flight III Destroyer has a survivability requirement directly tied to meeting a self-defense requirement threshold against ASCMs described in the Navy's Surface Ship Theater Air and Missile Defense Assessment document of July 2008. It clearly states that area defense will not defeat all the threats, thereby demonstrating that area air defense will not completely attrite all ASCM raids and that individual ships must be capable of defeating ASCM leakers in the self-defense zone.
- Use of manned ships for operational testing with threat representative ASCM surrogates in the close-in, self-defense battlespace is not possible due to Navy safety restrictions because targets and debris from intercepts pose an unacceptable risk to personnel at ranges where some of the engagements will take place. The November 2013 mishap on the USS *Chancellorsville* (CG 62) involving an ASCM surrogate target resulted in even more stringent safety constraints.

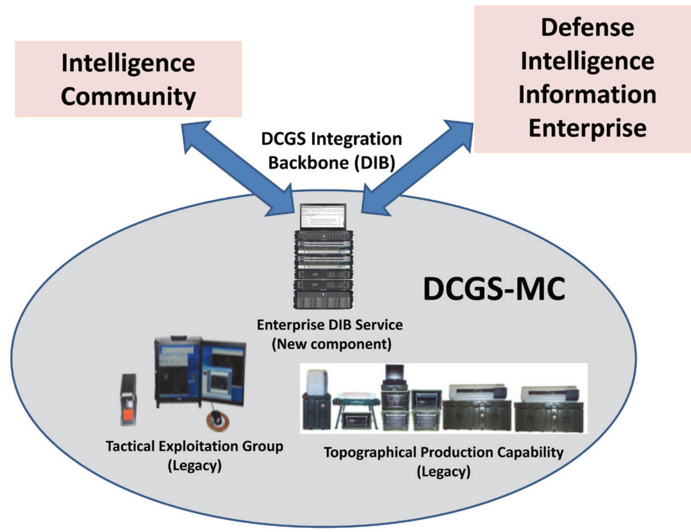
  - In addition to stand-off ranges (on the order of 1.5 to 5 nautical miles for subsonic and supersonic surrogates, respectively), safety restrictions require that ASCM targets not be flown directly at a manned ship, but at some cross-range offset, which unacceptably degrades the operational realism of the test.
  - Similar range safety restrictions will preclude manned ship testing of eight of the nine ASCM scenarios contained in the Navy-approved requirements document for the Aegis Modernization Advanced Capability Build 16 Combat System upgrade as well as testing of the AMDR minimum track range requirement against supersonic, sea-skimming ASCM threat-representative surrogates at the land-based AMDR Pacific Missile Range Facility test site.
  - To overcome these safety restrictions for the LHA-6, Littoral Combat Ship (LCS), DDG 1000, LPD-17, LSD-41/49, and CVN-78 ship classes, the Navy developed an Air Warfare/Ship Self Defense Enterprise modeling and simulation (M&S) test bed that uses live testing in the close-in battlespace with targets flying realistic threat profiles and manned ship testing for other battlespace regions and softkill capabilities to validate and accredit the M&S test bed. The same needs to be done for the DDG 51 Flight III Destroyer with its AMDR. Side-by-side comparison between credible live fire test results and M&S test results form the basis for the M&S accreditation. Without an SDTS with AMDR and an Aegis Combat System, there will not be a way to gather all of the operationally realistic live fire test data needed for comparison to accredit the M&S.
- The Navy needs to improve its Aegis Weapon System (AWS) models that are currently provided by Lockheed Martin's Multi-Target Effectiveness Determined under Simulation by Aegis (MEDUSA) M&S tool.
  - MEDUSA encompasses several components of the AWS including the SPY-1 radar, Command and Decision, and Weapon Control System. MEDUSA models AWS performance down to the system specification and the Navy considers it a high-fidelity simulation of AWS.
  - However, it is not a tactical code model, so its fidelity is ultimately limited to how closely the specification corresponds to the Aegis tactical code (i.e., the specification is how the system is supposed to work while the tactical code is how the system actually works). This adds to the need for realistic live fire shots to support validation efforts.
  - Earlier test events highlight the limitations of specification models like MEDUSA. During Aegis Advanced Capability Build 08 testing in 2011, five AWS software errors were found during live fire events and tracking exercises. Three software errors contributed to a failed SM-2 engagement, one to a failed ESSM engagement, and one to several failed simulated engagements during tracking exercises. Since these problems involved software coding errors, it is unlikely that a specification model like MEDUSA (which assumes no software errors in tactical code) would account for such problems and hence it would overestimate the combat system's capability.
  - By comparison, the Air Warfare/Ship Self Defense Enterprise M&S test bed used for assessing USS S*an Antonio's* (LPD-17) self-defense capabilities used re-hosted Ship Self-Defense System Mk 2 tactical code.
- Since Aegis employs ESSM in the close-in, self-defense battlespace, understanding ESSM's performance is critical to understanding the self-defense capabilities of the DDG 51 Flight III Destroyer.
  - Past DOT&E annual reports have stated that the ESSM's operational effectiveness has not been determined. The Navy has not taken action to adequately test the ESSM's operational effectiveness.
  - Specifically, because safety limitations preclude ESSM firing in the close-in self-defense battlespace, there are very little test data available concerning ESSM's performance, as installed on Aegis ships, against supersonic ASCM surrogates.
  - Any data available regarding ESSM's performance against supersonic ASCM surrogates are from a Ship Self-Defense System-based combat system configuration, using a completely different guidance mode or one that is supported by a different radar suite.
- The cost of building and operating an Aegis SDTS is small when compared to the total cost of the AMDR development/procurement and the eventual cost of the 22 (plus) DDG 51 Flight III ships that are planned for acquisition ($55+ Billion). Even smaller is the cost of the SDTS compared to the cost of the ships that the DDG 51 Flight III Destroyer is expected to protect (approximately $450 Billion in new ship construction over the next 30 years).
  - If DDG 51 Flight III Destroyers are unable to defend themselves, these other ships are placed at substantial risk.
  - Moreover, the SDTS is not a one-time investment for only the AMDR/DDG 51 Flight III IOT&E, as it would be available for other testing that cannot be conducted with manned ships (e.g., the ESSM Block 2) and as the combat system capabilities are improved.

Recommendations

- Status of Previous Recommendations. There are three previous recommendations that remain valid. The Navy should:
  1. Program and fund an SDTS equipped with the AMDR and DDG 51 Flight III Aegis Combat System in time for the DDG 51 Flight III Destroyer IOT&E.
  2. Modify the AMDR, Aegis Modernization, and DDG 51 Flight III Test and Evaluation Master Plans to include a phase of IOT&E using an SDTS equipped with the AMDR and DDG 51 Flight III Combat System.
  3. Modify the AMDR, Aegis Modernization, and DDG 51 Flight III Test and Evaluation Master Plans to include a credible M&S effort that will enable a full assessment of the AMDR and DDG 51 Flight III Combat System's self-defense capabilities.

- FY14 Recommendation.
  1. The Navy should comply with the DEPSECDEF direction to develop and fund a plan, to be approved by DOT&E, to conduct at-sea testing of the self-defense of the DDG 51 Flight III Destroyer with the AMDR and Aegis Combat System.

Distributed Common Ground System – Marine Corps (DCGS-MC)



Executive Summary

- The Marine Corps Operational Test and Evaluation Activity conducted the Distributed Common Ground System – Marine Corps (DCGS-MC) IOT&E July 21 – 31, 2014, at Camp Lejeune, North Carolina, in accordance with the DOT&E-approved test plan.
- During IOT&E, DCGS-MC successfully connected to the DCGS Integrated Backbone (DIB), allowing Marines to search and download intelligence from joint and intelligence community users. However, as tested, the DCGS-MC Increment 1 did not enhance the user's ability to produce intelligence products.
- The Marine Corps Information Assurance Red Team discovered significant cybersecurity vulnerabilities during the IOT&E that require correction before fielding. Details are provided in DOT&E's classified IOT&E report.
- The DCGS-MC did not meet availability or reliability requirements and users found the system difficult to use.

System

- DCGS-MC is an Acquisition Category III program. The DCGS-MC is a multi-level secure, integrated family-of-systems. The system is composed of a new Enterprise DIB Service node that delivers web application software on commercial off-the-shelf hardware, integrated with legacy Tactical Exploitation Group and Topographic Production Capability.
- The DCGS-MC provides Marine intelligence analysts access to the DIB. The DIB provides the framework that allows sharing of intelligence services and data via web services. The Army, Navy, Air Force, and intelligence agencies developed and fielded their own versions of DCGS. Via the DIB, intelligence analysts can search for and download intelligence information and post the intelligence product they produce for others to use.

Mission

- Marine intelligence analysts will use the DCGS-MC Enterprise system to produce geospatial intelligence products through the processing, exploitation, and analysis of data derived from all Marine Corps organic intelligence sources, nontraditional/battlefield observation/collection of joint, multi-national (coalition/allied) partners in support of Marine Corps operations, and tailored theater and national systems.
- The Marine Air Ground Task Force will use the DCGS-MC to connect intelligence professionals with multi-discipline data sources, analytic assessments, and collection assets via the DIB.

Major Contractors

- Lead System Integrator: Space and Naval Warfare Systems Command (SPAWAR) Systems Center Atlantic – Charleston, South Carolina
- SAIC – Charleston, South Carolina

Activity

- The DCGS-MC Program Office completed four developmental tests between August 2012 and November 2013, followed by a period of fixes and subsequent regression testing through May 2014. The Program Office used the developmental test information to determine that the system was ready to enter operational test.
- The Marine Corps Operational Test and Evaluation Activity conducted the IOT&E from July 21 –31, 2014, at Camp Lejeune, North Carolina, in accordance with the DOT&E-approved test plan. Marine Corps intelligence analysts answered requests for information using operationally representative systems connected to networks providing access to intelligence information. Analysts used the DCGS-MC to search for and download files from the DIB, modify the files, and then upload the modified files back to the DIB.
- In September 2014, the Marine Corps System Command indefinitely postponed the Full Deployment Decision.

Assessment

- During the IOT&E, the intelligence analysts using the DCGS-MC did not demonstrate improved mission performance over the intelligence analysts using the legacy systems. The intelligence analysts using the DCGS-MC answered requests for information (RFIs) with the same quality and response time as the intelligence analysts using the legacy systems. This might be partially attributable to the RFIs not requiring extensive use of external intelligence information. If the Marine Corps implemented updated concept of operations and doctrine to take advantage of the extensive external intelligence available via the DIB, DCGS-MC might show more operational value.
- Marine Corps Information Assurance Red Team adversarial activities and on-site cybersecurity compliance checks and penetration testing identified significant cybersecurity problems that introduce vulnerabilities and reduce the security of the system.
- DCGS-MC did not satisfy availability and reliability requirements, but did satisfy the time to repair requirement.
  - The web-portal on the DIB server froze regularly. The root cause of the problem was not discovered during the developmental test.
  - The DCGS-MC servers were not synchronized to a universal time standard; performance was degraded when drifting occurred.
- Marine Corps intelligence analysts considered the DCGS-MC to be more difficult to use than the current systems. Surveys revealed that they generally preferred the legacy systems.
- On October 31, 2014, DOT&E issued a classified report on the DCGS-MC IOT&E.

Recommendations

- Status of Previous Recommendations. This is the first annual report for this program.
- FY14 Recommendations. The Program Office should:
  1. Correct the cybersecurity vulnerabilities discovered during IOT&E and verify via testing.
  2. Execute a reliability growth program with testing to confirm improvement.
  3. Provide a plan to implement changes to improve system usability that includes verifying improvements using the standard System Usability Scale survey.
  4. Update concept of operations and doctrine to take advantage of external intelligence information available via the DIB.

E-2D Advanced Hawkeye

Executive Summary

- The first E-2D FOT&E period (OT-D1) started in 2QFY14 to evaluate the E-2D Advanced Hawkeye Initial Operational Capability hardware/software configuration, Delta System/Software Configuration (DSSC) Build 1, as well as carrier suitability. Testing is scheduled to complete in 1QFY15.
- The E-2D Advanced Hawkeye has been designated an Acquisition Category 1C program. On August 8, 2014, the Deputy Assistant Secretary of Defense for Developmental Test and Evaluation (DASD(DT&E)) approved the developmental test and evaluation plan within the E-2D Test and Evaluation Master Plan (TEMP) and removed the E-2D from active DASD(DT&E) oversight.
- The E-2D TEMP revision D supports the FOT&E, but does not state requirements or resources for integrated or operational testing of Naval Integrated Fire Control-Counter Air (NIFC-CA) From-The-Air (FTA). Change 1 to revision D is expected to address this in DSSC Build 2. Change 1 to revision D will be published to address NIFC-CA FTA areas relevant to E-2D only, and to support DSSC Build 2 FOT&E in FY16.
- Commander, Operational Test and Evaluation Force (COTF) conducted a Verification of Correction of Deficiencies (VCD) assessing the program's progress in addressing deficiencies found during IOT&E. The VCD completed in 1QFY14. Not all of the problems identified in the DOT&E IOT&E report were resolved during the VCD. The Navy intends to address many of the problems through a series of hardware and software changes that will be incorporated and tested through FY19.
- USD(AT&L) approved the E-2D for a multi-year procurement contract after successful VCD completion in 1QFY14.

System

- The E-2D Advanced Hawkeye is a carrier-based Airborne Early Warning and Command and Control aircraft.
- Significant changes to this variant of the E-2 include upgraded engines to provide increased electrical power and cooling relative to current E-2C aircraft; a strengthened fuselage to support increased aircraft weight; replacement of the radar system, the communications suite, and the mission computer; and the incorporation of an all-glass cockpit, which permits the co-pilot to act as a tactical fourth operator in support of the system operators in the rear of the aircraft.

- The radar upgrade replaces the E-2C mechanically-scanned radar with a phased-array radar that has combined mechanical and electronic scan capabilities.
- The upgraded radar provides significant improvement in littoral and overland detection performance and Theater Air and Missile Defense capabilities.
- The E-2D Advanced Hawkeye System includes all simulators, interactive computer media, and documentation to conduct maintenance, as well as aircrew shore-based initial and follow-on training.

Mission

The Combatant Commander, whether operating from the aircraft carrier or from land, will use the E-2D Advanced Hawkeye to accomplish the following missions:

- Theater air and missile sensing and early warning
- Battlefield management, command, and control
- Acquisition, tracking, and targeting of surface warfare contacts
- Surveillance of littoral area objectives and targets
- Tracking of strike warfare assets

Major Contractor

Northrop Grumman Aerospace Systems – Melbourne, Florida

Activity

- The E-2D Advanced Hawkeye has been designated an Acquisition Category 1C program. On August 8, 2014, the DASD(DT&E) approved the developmental test and evaluation plan within the E-2D TEMP and removed the E-2D from active DASD(DT&E) oversight.
- In 4QFY13-1QFY14, COTF conducted a VCD to assess the program's progress in addressing deficiencies found during IOT&E at Naval Air Station (NAS) Patuxent River, Maryland; NAS Fallon, Nevada; and Point Mugu, California. DOT&E reported the results of the VCD in March 2014 to inform the

Defense Acquisition Board decision on Full-Rate Production Lot 2.
- USD(AT&L) approved the E-2D for a multi-year procurement contract after successful VCD completion in 1QFY14.
- In 3QFY14, COTF started the E-2D's first FOT&E period (OT-D1 phase) to assess the E-2D's operational effectiveness and suitability to support the Theater Air and Missile Defense mission. Testing also evaluated the operational effectiveness and suitability of hardware and software changes incorporated in DSSC Build 1. The Navy conducted testing at NAS Patuxent River, Maryland; Holloman AFB, New Mexico; White Sands Missile Range (WSMR), New Mexico; and Point Mugu, California. FOT&E will complete in FY15.
- Limited E-2D carrier testing was conducted in IOT&E. Carrier testing to determine carrier suitability was conducted as part of FOT&E in September and October 2014.
- Not all of the problems identified in the DOT&E IOT&E report were resolved during the VCD. The Navy intends to address many of these problems through a series of hardware and software changes that will be incorporated and tested through FY19.
- The Navy continued to correct deficiencies with E-2D-Cooperative Engagement Capability performance with a plan to have deficiencies remedied in FY17 with fielding of DSSC Build 3.

Assessment
- DOT&E provided a classified assessment of the VCD results in March 2014. Testing was limited and the data collected were insufficient to resolve major problems stated in the classified February 2013 E-2D Advanced Hawkeye IOT&E report. However, the VCD data did provide information on training not assessed during IOT&E. Complete training on all parts of the E-2D system was not satisfactory. A full assessment of E-2D operational capabilities will require future operational tests and systematic updates.
- The E-2D TEMP revision D supports the FOT&E, but does not state requirements or resources for integrated or operational testing of NIFC-CA FTA. Change 1 to revision D is expected to address this in DSSC Build 2.
- FOT&E testing is not complete. DOT&E is currently observing test events and analyzing data from the testing.

Recommendations
- Status of Previous Recommendations. The Navy continues efforts to improve radar and mission system performance, and radar and overall weapon system reliability and availability as previously recommended.
- FY14 Recommendation.
  1. The Navy should provide complete training on all components of the E-2D system and missions.

F/A-18E/F Super Hornet and EA-18G Growler

Executive Summary

- From FY12 into FY14, the Navy conducted Software Qualification Testing (SQT) of System Configuration Set (SCS) H8E for the F/A-18E/F Super Hornet and EA-18G Growler aircraft. The testing was conducted in two phases. The first phase tested software improvements in SCS H8E, while the second phase tested improvements in the APG-79 Active Electronically Scanned Array (AESA) radar. DOT&E intends to issue a single report covering both phases of SCS H8E testing in FY15.
- Although the reliability of the APG-79 radar improved in both phases of testing, problems with software stability in the AESA radar resulted in failure to meet reliability and built-in test (BIT) performance requirements.
- The F/A-18E/F Super Hornet weapon system continues to demonstrate operational effectiveness and suitability for most threat environments; however, the platform is not operationally effective in specific threat environments, which are detailed in previous DOT&E classified reports.
- The EA-18G Growler weapons system equipped with SCS H8E is operationally suitable and operationally effective with the same radar limitations as the E/F.
- The Navy began SQT of SCS 25X for early-model F/A-18 aircraft in July 2014.

System

F/A-18E/F Super Hornet

- The Super Hornet is the Navy's premier strike-fighter aircraft and is a more capable follow-on replacement to the F/A-18A/B/C/D and the F-14.
- F/A-18E/F Lot 25+ aircraft provide functionality essential for integrating all Super Hornet Block 2 hardware upgrades, which include:
  - Single pass multiple targeting for GPS-guided weapons
  - Use of off-board target designation
  - Improved datalink for target coordination precision
  - Implementation of air-to-ground target aim points
- Additional systems include:
  - APG-73 or APG-79 radar
  - Advanced Targeting Forward-Looking Infrared System
  - AIM-9 infrared-guided missiles and AIM-120 and AIM-7 radar-guided missiles
  - Multi-functional Information Distribution System for Link 16 tactical datalink connectivity
  - Joint Helmet-Mounted Cueing System
  - Integrated Defensive Electronic Countermeasures

EA-18G Growler

- The Growler is the Navy's land- and carrier-based, radar and communication jamming aircraft.

- The two-seat EA-18G replaces the four-seat EA-6B. The new ALQ-218 receiver, improved connectivity, and linked displays are the primary design features implemented to reduce the operator workload in support of the EA-18G's two-person crew.
- The Airborne Electronic Attack (AEA) system includes:
  - Modified EA-6B Improved Capability III ALQ-218 receiver system
  - Advanced crew station
  - Legacy ALQ-99 jamming pods
  - Communication Countermeasures Set System
  - Expanded digital Link 16 communications network
  - Electronic Attack Unit
  - Interference Cancellation System that supports communications while jamming
  - Satellite receive capability via the Multi-mission Advanced Tactical Terminal
- Additional systems include:
  - APG-79 AESA radar
  - Joint Helmet-Mounted Cueing System
  - High-speed Anti-Radiation Missile
  - AIM-120 radar-guided missiles

System Configuration Set (SCS) Software

- Growler and Super Hornet aircraft employ SCS operational software to enable major combat capabilities. All EA-18Gs and Block 2 F/A-18s (production Lot 25 and beyond) use high-order language or "H-series" software, while F/A-18E/F prior to Lot 25 and all legacy F/A-18 A/B/C/D aircraft use "X-series" software.
  - The Navy released H8E Phase I this year and is currently flying 23X in earlier lot aircraft.
  - H8E Phase II (H-series) has recently completed test and 25X (X-series) is currently under test.

Mission

- Combatant Commanders use the F/A-18E/F to:
  - Conduct offensive and defensive air combat missions
  - Attack ground targets with most of the U.S. inventory of precision and non-precision weapon stores
  - Provide in-flight refueling for other tactical naval aircraft
  - Provide the fleet with an organic tactical reconnaissance capability
- Combatant Commanders use the EA-18G to:
  - Support friendly air, ground, and sea operations by countering enemy radar and communications
  - Jam integrated air defense systems
  - Support non-integrated air defense missions and emerging non-lethal target sets
  - Enhance crew situational awareness and mission management
  - Enhance connectivity to national, theater, and tactical strike assets
  - Provide enhanced lethal suppression through accurate High-speed Anti-Radiation Missile targeting
  - Provide the EA-18G crew air-to-air self-protection with the AIM-120

Major Contractor

The Boeing Company, Integrated Defense Systems – St. Louis, Missouri

---

Activity

- The Navy conducted F/A-18E/F and EA-18G H8E SQT in two phases. Phase I testing, which focused on system software improvements, occurred between June 2012 and May 2013. Test aircraft equipped with SCS H8E accumulated 1,296.0 flight hours.
- SCS H8E Phase II testing focused on APG-79 improvements. Super Hornet aircraft equipped with the APG-79 radar accumulated 1,884.4 flight hours during Phase II testing, which took place between October 2013 and June 2014.
- The Navy began testing SCS 25X in July 2014, for use on earlier model F/A-18 aircraft, with completion expected in FY15. Developmental delays pushed the start of this test back for a year from the original schedule.
- The Navy has continued to defer development of the AESA's full electronic warfare capability to later software builds and plans to test this capability in SCS H12.

Assessment

- SCS H8E demonstrated incremental improvements in capability in Phase I. APG-79 reliability improved during both Phases I and II testing compared to previous operational tests and provides improved performance compared to the legacy APG-73 radar employed on earlier F/A-18 aircraft. Nonetheless, key deficiencies in operational performance remain to be addressed.
- While the AESA radar demonstrated improved reliability, radar software instability resulted in failure to meet reliability and BIT performance requirements.
- The Navy has begun to address long-standing deficiencies in air warfare during H8E. The F/A-18E/F Super Hornet weapons system is operationally effective and suitable for some threat environments. However, as noted in previous DOT&E classified reports, there are current, more stressing threat environments in which the F/A-18 remains not operationally effective.
- The EA-18G Growler remains operationally effective and suitable subject to the same threat environment limitations as the E/F. SCS H8E testing indicates that geolocation accuracy and timeliness has improved since the H6E testing, but timeliness with the jammers off still has room for improvement.
- SCS H8E testing did not include an end-to-end multi-AIM-120 missile shot. This Navy operational capability has not been demonstrated previously in a successful test. The Navy tentatively plans to conduct a multi-missile shot as part of SCS H12 testing.

Recommendations

- Status of Previous Recommendations. The Navy has made progress on addressing FY13 recommendations to continue to improve the reliability and BIT functionality of the APG-79 radar, but that recommendation remains valid. Additionally, recommendations to conduct an operationally representative end-to-end missile test to demonstrate APG-79 radar and system software support for a multiple AIM-120 missile engagement and to develop and characterize the full electronic warfare capability of the APG-79 radar remain unchanged.
- FY14 Recommendations. None.

Global Command and Control System – Maritime (GCCS-M)

Executive Summary

- The Navy's Commander, Operational Test and Evaluation Force (COTF) conducted the IOT&E of the Global Command and Control System – Maritime (GCCS-M) version (v4.1) Group Level variant onboard the USS *Milius* from May 28 through June 13, 2014. GCCS-M v4.1 occasionally experiences a low memory condition, making the system run too slowly to be operationally effective. Users performed a preemptive 12-minute reboot of the GCCS-M v4.1 client prior to daily operational exercise participation to prevent this condition. DOT&E determined that the Group Level variant is operationally effective (with the operational workaround for the low memory condition) and operationally suitable.
- The Navy Information Operations Command (NIOC) Red Team attempted to penetrate and exploit the GCCS-M v4.1 system during the IOT&E and identified two major and two minor cybersecurity deficiencies. The two major deficiencies were attributed to the Consolidated Afloat Networks and Enterprise Services (CANES) program, which interfaces with GCCS-M v4.1. The two minor deficiencies were a result of inadequate system documentation and a non-responsive helpdesk, which prevented the user from restoring the system. DOT&E determined that the Group Level variant is not survivable until cybersecurity deficiencies have been corrected.

System

- GCCS-M is a command, control, communications, computers, and intelligence system consisting of software, procedures, standards, and interfaces that provide an integrated near real-time picture of the battlespace used to conduct joint and multi-national maritime operations.
- The Navy is developing GCCS-M Increment 2 at the Force, Group, and Unit Levels. Force Level includes aircraft carrier (CVN), amphibious assault (LHA and/or LHD), and command ships (LCC). Group Level includes guided missile cruisers (CG), destroyers (DDG), and submarines. Unit Level includes guided missile frigates, dock landing ships, amphibious transport docks, and patrol coastal craft.
- GCCS-M Increment 2 consists of two distinct types of software:
  - Aircraft carrier, amphibious command ship (LCC), and amphibious assault ship capability based on the GCCS-Joint software baseline
  - Guided missile cruiser and below capability based on the eXtensible Common Operational Picture software baseline
- The Navy intends to release the Group and Unit Level solution in a three configuration phased approach, starting with the patrol coastal ships, then the full Unit Level ships, and finally the Group Level ships.

Mission

- U.S. maritime commanders utilize GCCS-M to exercise command and control over forces in support of maritime operations.
- Commanders at all echelons use GCCS-M to:
  - Integrate scalable command and control, communications, and intelligence capabilities
  - Support the decision-making process
  - Process, correlate, and display geographic track information on friendly, hostile, and neutral land, sea, air, and space forces, integrated with available intelligence and environmental information

Major Contractor

Northrop Grumman Mission Systems – San Diego, California

Activity

- COTF conducted the IOT&E of GCCS-M v4.1 Group Level variant onboard the USS *Milius* from May 28 through June 13, 2014, in accordance with the DOT&E-approved IOT&E Plan.
  - The USS *Milius* was pier-side at Naval Base San Diego, California, from May 28 through June 8, 2014, and underway in the Southern California Operations Area for the remainder of the test period.
  - Combat Information Center Battle Force Team Trainer and Surface-Launched Attack Missile Exercise scenarios were executed to stimulate the GCCS-M v4.1 system.
- Concurrently with IOT&E, a NIOC Red Team performed a cybersecurity assessment that included system scans, penetration testing, and malicious insider analysis.
- DOT&E intends to publish an IOT&E report in FY15.

Assessment

- The Group Level variant of the GCCS-M v4.1 system is operationally effective, with the operational workaround for the low memory condition. GCCS-M v4.1 performed its command, control, and communications mission well during IOT&E.
  - USS *Milius* maintained an integrated common operating picture with the Commander, Third Fleet Maritime Operations Center (MOC) successfully exchanging, processing, and displaying near real-time track data.
  - Users successfully created, displayed, and stored overlay tactical decision aids in the Common Tactical Picture Manager and exchanged them with the Third Fleet MOC.
  - GCCS-M v4.1 received and displayed historical and current Blue Force Tracking data from the Joint Tactical Terminal.
  - GCCS-M v4.1 received position and intended movement data over the Navigation Sensor System Interface (NAVSSI).
- Testing identified four defects affecting operational effectiveness.
  - First, GCCS-M v4.1 occasionally experiences a low memory condition, making the system run too slowly to be operationally effective. Users performed a preemptive 12-minute reboot of the GCCS-M v4.1 client prior to daily operational exercise participation to prevent this condition.
  - Second, during Undersea Warfare (USW) operations, GCCS-M v4.1 did not transmit tracks and overlay messages to the Tactical Decision Support System (TDSS). The mission impact was minor because TDSS was the primary decision aid for USW operations and relied on the USW Combat System as the primary source for track messages.
  - Third, 10 surface training tracks out of 80 randomly displayed incorrect courses and speeds; 5 of the 10 affected tracks stopped displaying. Users were able to reintroduce tracks into the common operating picture to accomplish training objectives. This defect was isolated to local training tracks, as operational tracks were not affected.
  - Fourth, GCCS-M v4.1 sometimes starts up in a condition where it is unable to accept own ship position information from the NAVSSI. Since this condition occurs randomly and infrequently, the system is recoverable by performing a 12-minute reboot.
- The Group Level variant of the GCCS-M v4.1 system is operationally suitable. GCCS-M v4.1 met reliability, maintainability, and availability requirements.
  - The GCCS-M v4.1 Mean Time Between Operational Mission Failure was 372 hours (100 hours or greater required).
  - GCCS-M v4.1 corrective maintenance for one operational mission failure was 12 minutes (40 minutes or less required).
  - Operational availability was 0.99 (0.95 or greater required).
  - GCCS-M v4.1 training provides the knowledge necessary to operate GCCS-M in its typical missions, when supplemented with on-the-job training. Program Office processes and procedures used to identify, track, and correct system defects were effectively used to support and sustain the system.
- DOT&E determined that the Group Level variant is not survivable until cybersecurity deficiencies have been corrected. NIOC identified two major and two minor cybersecurity deficiencies during IOT&E. The two major deficiencies were attributed to the CANES program, which interfaces with GCCS-M v4.1. The two minor deficiencies were a result of inadequate system documentation and a non-responsive helpdesk, which prevented the user from restoring the system.

Recommendations

- Status of Previous Recommendations. The Navy addressed all previous recommendations.
- FY14 Recommendations. The Navy should:
  1. Correct the following GCCS-M v4.1 Group Level deficiencies—
     - Occasional low memory condition requiring daily reboot
     - Lack of tracks and overlay messages to the TDSS
     - Displaying incorrect surface training track information
     - Unable to accept own ship position information from the NAVSSI upon startup
     - Two cybersecurity deficiencies relating to system restoration
  2. Review CANES-equipped ships to ensure the two major cybersecurity deficiencies are corrected.
  3. Implement an operational workaround to periodically reboot the GCCS-M v4.1 client to prevent a low memory condition, until the defect can be corrected.

Infrared Search and Track (IRST)

Executive Summary

- The first flight of the Engineering Development Model (EDM) Infrared Search and Track (IRST) system pod on the F/A-18E/F took place on February 12, 2014.
- The Commander, Operational Test and Evaluation Force (COTF) conducted an operational assessment (OA) to inform a December 2, 2014, Milestone C decision.
- DOT&E reported on the OA results in a classified report to the Milestone Decision Authority, the Principal Military Deputy to the Assistant Secretary of the Navy for Research, Development and Acquisition (ASN(RDA)) in December 2014. DOT&E found that the system was progressing towards meeting reliability requirements. The system did not demonstrate tracking performance needed for weapons employment.
- The Milestone C decision will consider approval of 14 Block I low-rate initial production units and a plan to transition to Acquisition Category (ACAT) I status.

System

- The IRST system consists of a passive long-wave infrared receiver (IRR), a processor, inertial measurement, and environmental control unit.
- The Navy designed the IRST to be flown on the F/A-18E/F and it will be built into a modified centerline fuel tank.
- The Navy is developing and fielding the system in two blocks: Block I will reach Initial Operational Capability (IOC) in FY18 and use components from the F-15K/SG IRR that derive from the F-14 IRST system. Block II will begin after the Block I Full-Rate Production Decision Review and will include an improved IRR and updated processors.
- The Navy intends to produce a total of 170 IRST systems. There will be 60 Block I sensors, which will eventually be updated to the Block II configuration; the Navy will build an additional 110 Block II sensors.

Mission

Commanders will use IRST in a radar-denied environment to locate and destroy enemy forces. The IRST system is intended to allow the F/A-18E/F to operate and survive against existing and emerging air threats by enhancing situational awareness and providing the ability to acquire and engage targets beyond visual range.

Major Contractors

- The Boeing Company – St Louis, Missouri
- Lockheed Martin – Orlando, Florida

Activity

- COTF conducted an OA in two phases in accordance with DOT&E-approved test plans.
- Phase I of the OA consisted of contractor flight testing on a flying test bed between July and October 2013 and events flown by operational test pilots October 29 – 31, 2013, in Boeing's manned simulator facilities.
- The first flight of the EDM IRST pod on the F/A-18E/F took place on February 12, 2014.
- Phase II of the OA included a maintenance demonstration on April 2, 2014, and six flights on IRST-equipped F/A-18E/F developmental test aircraft between May 14 and July 16, 2014. The OA served both developmental and operational test objectives.
- DOT&E approved the Milestone C Test and Evaluation Master Plan (TEMP) in October 2014.
- In December 2014, DOT&E reported on the OA results in a classified report to the Milestone Decision Authority, the Principal Military Deputy to the ASN(RDA).

Assessment

- IRST, as tested in the OA, demonstrated unsatisfactory tracking performance. The individual problems seen vary in the degree to which they can be addressed through incremental improvements and are reflective of immature system design. Present track quality represents a significant risk that the system to be tested in IOT&E may not be effective. No decision has been made whether entry into IOT&E will be delayed in order to fix these problems. Further details can be found in DOT&E's classified report to the Navy acquisition executive.

- Prior to the OA, the F/A-18E/F mission computer's multi-sensor integration (MSI) software had difficulty integrating IRST data with data from other sensors (e.g., radar). This is to be expected given the poor quality of information provided by IRST; however, how MSI will perform with better information from IRST is unknown. As a result, COTF did not test MSI during the OA. Historically, integration of information from disparate sensors has been difficult; thus, IRST MSI will require careful developmental testing and analysis to ensure the successful integration of IRST track data.
- The Key Performance Parameter (KPP) for detection and tracking does not adequately represent the operational environment where the Navy will employ IRST. Presently, the KPP can only be met in an environment that does not reflect realistic fighter employment and tactics.
- Although data are limited, reliability and maintainability as demonstrated during the OA flights and prior developmental testing are consistent with a system with a rigorous reliability growth program.
- No hardware failures were experienced during flight test on F/A-18E/F prior to or during the OA. While software reliability requires significant improvement prior to IOT&E, fixes have been identified for the problems seen and the Program Office has a process in place to track and correct errors as they are encountered. Most software reliability problems were related to Built-in Test (BIT), which exhibited a high frequency of false alarms. The most serious issue was tracker process failures not detected by BIT. The program has identified a fix for this problem and is currently in flight test for evaluation.
- A maintenance demonstration indicates removal and replacement times should be adequate to meet requirements. The demonstration identified improvements to technical documentation and system design that should be incorporated.
- Line-of-sight estimation algorithms (known as servo-transfer alignment) are not working and have required an alternate approach for boresighting the system. A mechanical boresight procedure was used for the OA and might serve as a permanent solution if the servo-transfer alignment algorithm cannot be improved. An assessment is being made to determine what the logistical impact would be. The assessment will examine how long the manual boresight is expected to hold and whether new support equipment will be required to re-boresight the system aboard ship.

Recommendations

- Status of Previous Recommendations. This is the first annual report for this program.
- FY14 Recommendations. The Navy should:
  1. Explicitly state detection and tracking requirements for the range of operational conditions in which the Navy expects to employ the system.
  2. Improve detection and tracking performance prior to entry into IOT&E.

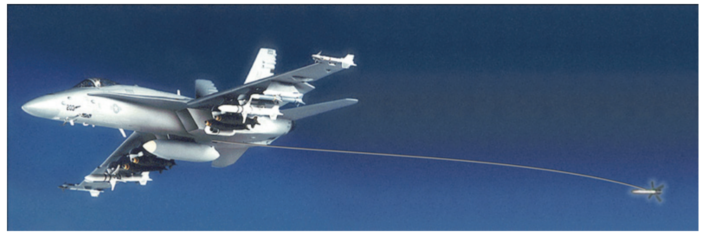
Integrated Defensive Electronic Countermeasures (IDECM)

Executive Summary

- The Navy began the Integrated Defensive Electronic Countermeasures (IDECM) Block IV integrated tests in July 2013 and completed the planned testing in April 2014.
  - The integrated tests included laboratory testing at the Navy's Electronic Combat System Evaluation Laboratory, Point Mugu, California, against two classified threats, as well as a dense emitter scenario and flight testing at the Electronic Combat Range (ECR), China Lake Naval Air Station, California, and the Nevada Test and Training Range (NTTR).
- The Navy has convened an F/A-18 wingman compatibility working group that has members from multiple Navy program offices to investigate and resolve deficiencies associated with the aircraft radar, which may be caused by other sub-systems such as IDECM.
- The Navy accomplished an Operational Test Readiness Review (OTRR) for IDECM Block IV FOT&E on June 16, 2014. DOT&E concurred with the Navy in commencing operational testing, but DOT&E had three points of concern:
  - The ambitious schedule for completing flight test at NTTR in only two range periods
  - Only two F/A-18C/D aircraft being available for tests, which could create schedule delays if F/A-18C/D maintenance problems occurred
  - The potential the schedule would need to be extended since threat hardware at both ECR and NTTR had been experiencing failures
- FOT&E began in June 2014 and is scheduled to end in February 2015. DOT&E will produce a classified FOT&E report assessing system operational effectiveness and suitability after the conclusion of the IDECM Block IV FOT&E.

System

- The IDECM system is a radio frequency, self-protection electronic countermeasure suite on F/A-18 aircraft. The system is comprised of onboard and off-board components. The onboard components receive and process radar signals and can employ onboard and/or off-board jamming components in response to identified threats.
- There are four IDECM variants: Block I (IB-1), Block II (IB 2), Block III (IB-3), and Block IV (IB-4). All four variants include an onboard radio frequency receiver and jammer.
  - IB-1 (fielded FY02) combined the legacy onboard receiver/jammer (ALQ-165) with the legacy (ALE-50) off-board towed decoy.



  - IB-2 (fielded FY04) combined an improved onboard receiver/jammer (ALQ-214) with the legacy (ALE-50) off-board towed decoy.
  - IB-3 (fielded FY11) combined the improved onboard receiver/jammer (ALQ-214) with a new (ALE-55) off-board fiber-optic towed decoy that is more integrated with the ALQ-214.
  - IB-4 (currently in test) is intended to replace the onboard receiver/jammer (ALQ-214(V)3) with a lightweight, repackaged onboard jammer (ALQ-214(V)4 and ALQ-214(V)5). IB-4 also replaces the ALQ-126B to provide advanced, carrier-capable jamming to the F/A-18C/D for the first time.
- An additional program to provide IDECM Block IV the capability to deny or delay targeting of the F/A-18 by enemy radars, known as the Software Improvement Program, is in early development.
- The F/A-18E/F installation includes off-board towed decoys. The F/A-18C/D installation includes only the onboard receiver/jammer components and not the towed decoy.

Mission

- Combatant Commanders will use IDECM to improve the survivability of Navy F/A-18 strike aircraft against radio frequency-guided threats while flying air-to-air and air to ground missions.
- The Navy intends to use IB-3's and IB-4's complex jamming capabilities to increase survivability against modern radar-guided threats.

Major Contractors

- ALE-55: BAE Systems – Nashua, New Hampshire
- ALQ-214: Exelis, Inc. – Clifton, New Jersey
- ALE-50: Raytheon Electronic Warfare Systems – Goleta, California

Activity

IDECM Block III

- DOT&E completed its IDECM Block III IOT&E report in June 2011, assessing the system as operationally effective and suitable for combat. The Navy authorized IDECM Block III full-rate production in July 2011.
- The Navy held In Process Review #3 in March 2012 and decided to begin implementing the IDECM Block IV change proposal so that in April 2012, the IDECM Block III production line transitioned to producing IDECM Block IV systems (production lot buy 9).

IDECM Block IV

- The Navy held In Process Review #5 in January 2014 to determine if the IDECM Block IV system should be approved for production lot buy 11 (the program is in full-rate production and In Process Reviews support lot buy decisions). The Navy approved the FY14 production decision and directed the Program Office to accomplish another In Process Review (#6) to support the next production lot buy decision after FOT&E had completed.
- The Navy began the IDECM Block IV integrated testing in July 2013 and completed the planned testing in April 2014.
  - The integrated tests included laboratory testing at the Navy's Electronic Combat System Evaluation Laboratory, Point Mugu, California, against two classified threats as well as a dense emitter scenario, and flight testing at ECR and NTTR. DOT&E will use operationally relevant data from the integrated testing period in conjunction with data from the FOT&E to assess the IDECM Block IV system. The results will be reported in DOT&E's classified IDECM Block IV FOT&E report.
- In May 2014, the Navy accomplished a limited-scope maintenance demonstration at Naval Air Station China Lake, California. The results will be included in DOT&E's classified IDECM Block IV FOT&E report.
- On June 16, 2014, the Navy accomplished an OTRR for IDECM Block IV FOT&E. DOT&E concurred with the Navy in commencing operational testing, with the following caveats:
  - DOT&E expressed concern about the ambitious schedule for completing flight test at NTTR in only two range periods. DOT&E recommended the Navy plan for a third range period.
  - DOT&E expressed concern that the Navy had only two F/A-18C/D aircraft available for test, which could create schedule delays if F/A-18C/D maintenance problems occurred. DOT&E recommended at least three aircraft be available to support testing since many of the runs required at least two aircraft per test event.
  - DOT&E expressed concern that there was the potential the schedule would need to be extended since threat hardware at both ECR and NTTR had been experiencing failures.
- The FOT&E began in June 2014 and is scheduled to end in February 2015. The Navy is conducting testing in accordance with the DOT&E-approved test plan. Numerous schedule delays have occurred due to threat hardware problems on the test ranges, aircraft maintenance problems, and limited fleet aircraft availability to support testing.
- The Navy has convened an F/A-18 wingman compatibility working group that has members from multiple Navy program offices to investigate and resolve deficiencies associated with the aircraft radar, which may be caused by other sub-systems such as IDECM.

Assessment

- DOT&E assessed the IDECM Block IV system was ready for operational test at the OTRR. The Navy had adequately addressed most of the software immaturity and interoperability deficiencies at that time.
- Laboratory testing was adequate, but using higher fidelity radar cross section (RCS) data for the F/A-18 would provide more operationally realistic results.
- The Navy corrected the deficiency caused by interaction between the ALR-67(V)2 and (V)3 radar-warning receivers and IDECM Block IV system, which caused false threat symbols to be displayed. However, the Navy deferred correcting the deficiency in which the APG-79 radar is falsely identified to the ALQ-214(V)4 by the ALR-67(V)2 and (V)3 radar-warning receivers to a wingman compatibility working group composed of multiple program offices.
- DOT&E will produce a classified FOT&E report assessing system operational effectiveness and suitability after the conclusion of the IDECM Block IV FOT&E.

Recommendations

- Status of Previous Recommendations. The Navy has adequately addressed some previous recommendations; however, the following remain outstanding:

  IDECM System

  1. The Navy should restructure and reorganize the complex and poorly organized IDECM system software code. This will minimize potential software problems yet to be discovered and simplify future modifications.
  2. The Navy should develop hardware and/or software changes to provide pilots with correct indications of whether a decoy was completely severed. This recommendation does not apply to the F/A-18C/D installation since that installation does not include a towed decoy.
  3. The Navy should investigate the effects of IDECM on threat missile fuses.

  Electronic Warfare Warfighting Improvements

  4. In coordination with the Defense Intelligence Agency, the Navy should update the threat lethal radii and/or the evaluation processes that are used to determine whether simulated shots are hits or misses.
- FY14 Recommendation.
  1. The Navy should use the highest fidelity F/A-18 RCS data available when accomplishing analysis of laboratory testing, and develop accredited RCS models that account for the entire F/A-18 airframe configuration.

Joint High Speed Vessel (JHSV)

Executive Summary

- The Navy completed IOT&E and LFT&E of the Joint High Speed Vessel (JHSV) in January 2014. Additionally, the Navy conducted the first of two FOT&E events in June and October 2014. The first event consisted of mooring operations with the Mobile Landing Platform with the Core Capability Set (MLP (CCS)). The second test event will consist of launching and retrieving the seal delivery vehicle from the JHSV while at sea.
- DOT&E issued the classified combined IOT&E and LFT&E report on July 17, 2014, and found JHSV effective and suitable with the following limitations:
  - JHSV did not meet its fully loaded transit speed and distance requirement (600 short tons at 35 knots for 1,200 nautical miles). Testing results support 600 short tons at 31 knots for 858 nautical miles.
  - USNS *Spearhead* (JHSV-1) had an unexplained weight growth of over 47 short tons (specific ship weights may vary hull to hull), which contributed to the fully loaded transit range deficit since it limited the amount of fuel the ship could carry without exceeding maximum draft.
  - JHSV is slightly limited in self-deployment range, with test results supporting a 4,000 nautical mile unrefueled transit compared to the 4,700 nautical mile requirement.
  - Small boat operations from JHSV are limited to Sea State 2 or less until procedures are identified to allow higher Sea State boat operations.
  - JHSV's cybersecurity is not satisfactory because of numerous significant Information Assurance deficiencies.
  - Initial observations and assessment indicate deficiencies exist with skin-to-skin mooring operations with MLP (CCS). In the first test, several mooring lines parted, precluding completion of the test event. In the second test, the mooring line issue was resolved but the JHSV ramp suffered a casualty, precluding completion of the test.
  - JHSV is survivable only if used in a non-hostile environment. The ship has no self-defense capability other than crew-served weapons; it requires augmentation with a Navy self-protection team (Embarked Security Team), and is built to commercial, high-speed craft specifications that do not include hull, equipment, or personnel protection features necessary to survive weapons effects. The ship has only rudimentary capability for crew protection in chemical or biological threat environments.
  - Although JHSV testing shows overall ship operation suitability, the ship service diesel electric generators did not meet its anticipated reliability.

System

- The JHSV is a high-speed, shallow-draft surface vessel designed for intra-theater transport of personnel and medium payloads of cargo for the joint force. It bridges the gap between large capacity low-speed sealift and small capacity high-speed airlift.
- JHSV is a redesign of a commercial catamaran capable of accessing relatively austere ports. Classified as a non combatant, JHSV has limited self-protection capability. Design characteristics include the following:
  - Propulsion provided by four water jets powered by diesel engines
  - At-sea refueling capability
  - Support for 312 embarked troops for up to 96 hours or 104 troops for 14 days
  - Integrated ramp capable of load/off-load of military vehicles including combat-loaded main battle tanks (M1A2)
  - Flight deck with helicopter refueling capability

Mission

Combatant Commanders will use the JHSV to support the flexible, agile maneuver and sustainment of combat forces between forward operating bases, ports, austere littoral access points, and the sea base. Specifically, Combatant Commanders may employ the JHSV in a transport/resupply role in benign, non-hostile environments to:

- Rapidly transport medium payloads of Marine Corps or Army cargo and combat-ready troops over intra-theatre distances between shore nodes
- Deliver troops, combat-loaded vehicles, and equipment ready to be employed, requiring only ports with pier or quay wall access and no other infrastructure
- Support sustainment of forces between forward operating bases, ports, and austere littoral access points that would be prohibitive for larger ships to access

Major Contractor

Austal USA – Mobile, Alabama

Activity

- The Navy's Commander, Operational Test and Evaluation Force and Marine Corps Operational Test and Evaluation Activity conducted testing on USNS *Spearhead* (JHSV-1), USNS *Choctaw County* (JHSV-2), and USNS *Millinocket* (JHSV-3) during the following test periods:
  - Post Delivery Test and Trials (PDT&T), February 2013 through July 2013
  - Dedicated IOT&E and live fire testing, July 2013 through August 2013
  - PDT&T, August 2013 through January 2014
  - Partial FOT&E, June and October 2014
- These tests were conducted at sea while transiting from the manufacturing facility in Mobile, Alabama, to their home port Joint Expeditionary Base Little Creek in Fort Story, Virginia; in the Virginia Capes area; and while in port at the Norfolk Naval Base, Virginia. The FOT&E events were conducted in Long Beach harbor, California, in June 2014, and at sea off Camp Pendleton, California, in October 2014.
- Personnel from the Combatant Craft Division of Naval Surface Warfare Center Carderock Division assisted in testing of the Rigid Hull Inflatable Boat (RHIB) launch and recovery with Sea State 3 in September 2013.
- Personnel from the Naval Surface Warfare Center (NSWC), Port Hueneme, California, conducted an underway replenishment (fuel receive only) ship qualification on USNS *Choctaw County* both in port at Norfolk Naval Base and underway in October 2013.
- Naval aviators from Norfolk Virginia Naval Air Station operated an MH-60S helicopter off the JHSV to complete the final operational test. Both the JHSV helicopter fueling and power systems, which Naval Air Systems Command testers had initially found to be deficient during tests in 2013, were retested after completion of required repairs and modifications.
- On May 19, 2014, DOT&E approved the JHSV FOT&E test plan. FOT&E consists of two test events: demonstration of the transfer capability of Marine Corps vehicles between JHSV and MLP (CCS) while at sea during day and night (interface tests), and the launch and recovery of the seal delivery vehicle from the JHSV while at sea.
  - The Navy attempted to conduct a day and night interface test, mooring of the JHSV to the MLP (CCS) vessel, during the week of June 23, 2014. USNS *Millinocket* (JHSV-3) moored skin-to-skin with USNS *Montford Point* (MLP-1) and Marine Corps vehicles transited back and forth during daylight. The vehicle transfer in daylight was completed successfully, but five mooring lines broke, prompting cancellation of the night test.
  - The Navy attempted a second interface test on October 29, 2014, at sea off Camp Pendleton, California. The mooring line issue was resolved, but the JHSV ramp suffered a casualty, prompting cancellation of further vehicles transfer after recovering the first vehicle and precluding completion of the test.
- All tests were conducted in accordance with a DOT&E-approved test plan.

Assessment

- The classified DOT&E combined IOT&E and LFT&E report states that the JHSV is effective and suitable with some limitations. The assessment is inclusive of activities from FY13 and FY14. Further details of the following assessment are identified in the classified report.
- JHSV is capable of fueling at sea.
- The JHSV ramp can accommodate all anticipated vehicles to a pier/quay wall and to a Roll On/Roll Off Discharge Facility (floating causeway) during Sea State 1 conditions, as normally found in protected harbors (the ramp was not designed for higher sea states).
- JHSV cannot achieve the required 23 knot, 4,700 nautical mile light-ship self-deployment transit. Calculations show it will be short by 682 nautical miles if it started with a 90 percent starting fuel load and was allowed to use all but the final 10,000 gallons in storage.
- JHSV cannot make the required 35 knot, 1,200 nautical mile fully loaded (600 short tons) transit. Calculations indicate it can make a 31 knot, 858 nautical mile transit. Longer and faster transits will require refueling from a tanker.
- There is an unexplained 47.7 short ton growth in the JHSV-1 ship weight that represents 13,700 gallons of fuel that cannot be loaded without exceeding maximum draft (maximum total ship and cargo weight).
- With an embarked security team, which includes both personnel and weapons, JHSV can engage a moving surface threat. However, testers identified the following safety problem: 0.50 caliber gun operators are vulnerable to falling overboard during high seas or radical ship maneuvers due to the lowering of lifelines during gun use.
- JHSV manning and facilities can accommodate handling of all required unarmed helicopters including providing fuel and power.
- The JHSV crew demonstrated day and night vertical replenishment with MH-60, MH-53, and MV-22.
- After completion of required repairs and modifications, the JHSV crew successfully retested the JHSV helicopter fueling and power systems, which Naval Air Systems Command testers had initially found to be deficient during tests in 2013.
- The JHSV crew demonstrated efficient loading, securing, and unloading of Marines and their equipment from II Marine Expeditionary Force, including their rolling stock.
- The JHSV crew demonstrated the 96-hour requirement for transporting and feeding 312 combat troops by supporting 354 people over that period.
- In August 2013, the crew only successfully demonstrated the capability to launch two 11-meter RHIBs within 40 minutes in Sea State 2 (wave heights up to 2 feet). The requirement is to conduct this operation in Sea States up to 3 (wave heights up to 4 feet). Looking for Sea State 3, the Navy conducted a second attempt in September 2013. However, the Ship's Master cancelled attempts to launch a RHIB in Sea State 3 due to safety concerns.

- The ship's crew demonstrated the underway requirement to move a 27,000-pound container from the mission bay to the flight deck and back in Sea State 3.
- The JHSV's organic Cargo Loading Trailer is not effective for loading 20-foot long metal storage containers. During the IOT&E, the test team took five hours to connect the Cargo Loading Trailer with a storage container and failed to load it aboard the ship. A 20-foot storage container was loaded at the ship home port where ramp access from the pier was less restrictive.
- The ship service diesel electric generators installed in JHSV demonstrated poor reliability during the test period. Their target Mean Time Between Failure was 2,496 hours, but was measured to be only 208 hours.
- Cybersecurity testing found numerous significant Information Assurance vulnerabilities and an absence of written instructions and procedures to guide shipboard network administrators.
- Initial observations and assessment indicate deficiencies exist with skin-to-skin mooring operations with MLP (CCS). Although mooring line issues that arose in early testing were resolved, the JHSV ramp does not seem to be able to handle the small but continual relative movement of the two ships when moored skin-to-skin.
- JHSV is survivable only if used in a non-hostile environment. The ship has no self-defense capabilities other than crew-served weapons; it requires augmentation with a Navy self-protection team; and is built to commercial, high-speed craft specifications that do not include hull and equipment hardening or personnel protection features necessary to survive weapons effects.
- Vulnerability modeling identified a significant risk of casualties if JHSV is used in Major Combat Operations and put in harm's way. Small civilian crews operate the ships and are trained and equipped to recover from small-scale casualties, not those likely in major combat operations.

Recommendations

- Status of Previous Recommendations. The Navy addressed two of the six FY13 recommendations. The Navy still needs to determine the best self-deployed transit speed to achieve the 4,700 nautical mile unrefueled range requirement, a transit speed that allows for a 600 short ton load delivery to 1,200 nautical miles, and an outfitted weight for each hull to enable mission planners to characterize fully loaded transit capability. The Navy also still needs to evaluate design improvements identified during the Total Ship Survivability Trials and implement those that will enhance the ship's survivability.
- FY14 Recommendations. The Navy should:
  1. Review and modify tactics, techniques, and procedures to safely launch RHIBs in Sea States greater than Sea State 2.
  2. Consider a replacement for the Cargo Loading Trailer if a JHSV is utilized routinely to transport 20-foot storage containers
  3. Implement a reliability growth program for the ship service diesel electric generators.
  4. Resolve and retest the significant Information Assurance vulnerabilities identified in the classified DOT&E combined IOT&E and LFT&E report.
  5. Address lack of written instructions and procedures to guide shipboard network administrators.
  6. Provide safety lanyards and harnesses for embarked security team members that man gun mounts. Additionally, provide hands-free communication devices to help coordinate firing engagements.
  7. Investigate casualty problem with JHSV's ramp that occurred during interface test with MLP (CCS) in October 2014. If necessary, reevaluate the need for at sea skin-to-skin operations between JHSV and MLP (CCS).
  8. Complete JHSV FOT&E with the launch and recovery of the seal delivery vehicle.

Joint Standoff Weapon (JSOW)

Executive Summary

- The Navy accomplished additional integrated testing of the AGM-154C-1 Joint Standoff Weapon (JSOW) variant during FY14. Problems identified during FY12-13 integrated testing resulted in follow-on integrated testing in late FY14 and pushed operational testing to FY15. The JSOW C-1 operational testing is scheduled to begin in mid-FY15.
- Preliminary results to date indicate:
  - Weapon impact accuracy for moving maritime targets is well within the accuracy requirement value, and accuracy performance against stationary land targets has been maintained.
  - The JSOW C-1 Mean Flight Hours Between Operational Mission Failure (MFHBOMF) remains below the requirement value, primarily the result of software-driven problems, but is showing progress towards meeting the requirement value.
  - The pilot-vehicle interface (PVI) has improved, but there remain some minor challenges the aircrew must work around for successful mission execution.
- Testing of the implemented updates to the JSOW software to address these problems validate the use of developmental and integrated test data for DOT&E's operational evaluation of JSOW C-1.

System

- The AGM-154 JSOW family uses a common and modular weapon body capable of carrying various payloads. The JSOW is a 1,000-pound class, air-to-surface glide bomb intended to provide low observable, standoff precision engagement with launch and leave capability. All variants employ a tightly coupled GPS/Inertial Navigation System.
- AGM-154A (JSOW A) payload consists of 145 BLU-97/B combined effects submunitions.
- AGM-154C (JSOW C) utilizes an imaging infrared seeker and its payload consists of an augmenting charge and follow-through bomb that can be set to detonate both warheads simultaneously or sequentially.
- AGM-154A and AGM-154C are fielded weapons and no longer under DOT&E oversight. AGM-154C-1 (JSOW C-1) adds moving maritime target capability and the two-way strike common weapon datalink to the baseline AGM-154C weapon.

Mission

- Combatant Commanders use JSOW A to conduct pre-planned attacks on soft point and area targets such as air defense sites, parked aircraft, airfield and port facilities, command and control antennas, stationary light vehicles, trucks, artillery, and refinery components.
- Combatant Commanders use JSOW C to conduct pre-planned attacks on point targets vulnerable to blast and fragmentation effects and point targets vulnerable to penetration such as industrial facilities, logistical systems, and hardened facilities.
- Units will use JSOW C-1 to conduct attacks against moving maritime targets and have the ability to retarget weapons post launch. JSOW C-1 will retain the JSOW C legacy capability against stationary land targets.

Major Contractor

Raytheon Company, Missile Systems – Tucson, Arizona

Activity

- The Navy conducted developmental and integrated testing in accordance with a DOT&E-approved Test and Evaluation Master Plan for the JSOW C-1.
- The Navy was scheduled to complete operational testing following the previous FY12-13 integrated testing, but it was delayed to 2QFY15 due to problems with the complicated PVI and integration with the F/A-18E/F H8 Operational Flight Program (OFP).
- The Navy implemented 79 software change requests, of which 34 addressed major PVI and integration problems. This activity required a change of approximately 4 percent of the

123,000 software lines of codes in the guidance electronics unit.
- The Navy conducted nine additional integrated captive-carry tests between 1QFY14 and 4QFY14 to verify the software fixes and integration with the F/A-18E/F H10 OFP. The Navy has one free-flight test against a moving maritime target planned for 2QFY15.
- Results from the developmental and integrated testing will support an Operational Test Readiness Review (OTRR) in 2QFY15. The Navy has rescheduled JSOW C-1 operational testing for FY15 following the OTRR.

Assessment
- The Navy accomplished additional integrated testing of JSOW C-1 in FY14. Preliminary results to date indicate:
  - Weapon impact accuracy for moving maritime targets continues to be well within the accuracy requirement value and accuracy performance against stationary land targets has been maintained.
  - JSOW C-1 MFHBOMF is below the requirement value. This is primarily the result of software-driven problems. With the migration from F/A-18 H8 OFP to H10, the MFHBOMF is showing progress towards meeting the requirement value. Achieving adequate assessment of MFHBOMF during operational testing is an area of moderate risk.
  - The Navy has reduced the complexity of the PVI in the F/A-18E/F H10 OFP. There remain minor PVI challenges that could prevent successful mission execution. These challenges can be effectively overcome with proper training prior to employment. This is an area of low risk during operational testing.
- Testing of the implemented updates to the JSOW software to address these problems validate the use of developmental and integrated test data for DOT&E's operational evaluation of JSOW C-1.

Recommendations
- Status of Previous Recommendations. The Navy has partially addressed the previous recommendations. The Navy has demonstrated a reduction in software-driven failures during the extended integrated testing phase. While they have significantly reduced the complex PVI, their plan will not fully address this issue until the F/A-18E/F H12 OFP release, scheduled for FY17.
- FY14 Recommendation.
  1. The Navy should continue to reduce the PVI complexity between the JSOW C-1 and the F/A-18 Super Hornet to permit successful mission execution.

LHA-6 New Amphibious Assault Ship

Executive Summary

- The Navy accepted delivery of LHA-6 in April 2014, seven months behind schedule.
- The Navy identified a budget shortfall that will likely prohibit the completion of IOT&E by the acquisition program threshold of October 2016 for reaching Initial Operational Capability. In addition, the late delivery of the ship reduces its availability for operational testing prior to its deployment in FY17.
- The Navy and Marine Corps Operational Test Agencies conducted the first phase of an Early Operational Assessment for LHA-8 in May 2014.

System

LHA-6 is a large-deck amphibious ship designed to support a notional mix of fixed- and rotary-wing aircraft consisting of 12 MV-22s, 6 F-35B Joint Strike Fighters (Short Take Off/Vertical Landing variant), 4 CH-53Es, 7 AH-1s/UH-1s, and 2 embarked H-60 Search and Rescue aircraft, or a load out of 20 F-35Bs and 2 embarked H-60 Search and Rescue aircraft. Key ship features and systems include:

- Greater aviation storage capacity and an increase in the size of the hangar bay, which is necessary to accommodate the increased maintenance requirements of the F-35B and the MV-22. Additionally, two maintenance areas with high-overhead clearance are incorporated into the design of the ship to accommodate wings-open MV-22 maintenance.
- Shipboard medical spaces reduced by approximately two thirds compared to contemporary LHDs to expand the hangar bay.
- A Ship Self-Defense System Mk 2-based combat system with the following seven major components.
  - The Ship-Self Defense System Mk 2 Mod 4B control and decision system supports the integration and control of most other combat system elements
  - The ship's AN/SPS-48E and AN/SPS-49A air search radars and the AN/SPQ-9B horizon search radar
  - USG-2 Cooperative Engagement Capability radar tracking systems
  - The Rolling Airframe Missile and the Evolved SeaSparrow Missile, with the NATO SeaSparrow Mk 9 Track Illuminators
  - The AN/SLQ-32B(V)2 electronic warfare system with the Nulka electronic decoy-equipped Mk 53 Decoy Launching System
  - The Phalanx Close-in Weapon System for air and small boat defense
  - The Mk 38 Mod 2 Gun Weapon System for small boat defense

- Propulsion is provided by two marine gas turbine engines, two electric auxiliary propulsion motors, and two controllable pitch propellers. Six diesel generators provide electric power.
- Command, Control, Communications, Computers, and Intelligence facilities and equipment to support Marine Corps Landing Force operations are part of the program of record.
- LHA-6 and LHA-7 do not have well decks, which are traditionally used to move large volumes of heavy equipment needed for amphibious operations. LHA-8 and later ships will have a well deck.

Mission

The Joint Maritime Component Commander will employ LHA-6 to:

- Be the primary aviation platform within an Amphibious Ready Group with space and accommodations for Marine Corps vehicles, cargo, ammunition, and more than 1,600 troops
- Serve as an afloat headquarters for a Marine Expeditionary Unit, Amphibious Squadron, or other Joint Force commands using its Command, Control, Communications, Computers, and Intelligence facilities and equipment
- Accommodate elements of a Marine Expeditionary Brigade when part of a larger amphibious task force
- Carry and discharge combat service support elements and cargo to sustain the landing force

Major Contractor

Huntington Ingalls Industries, Ingalls Shipbuilding Division – Pascagoula, Mississippi

Activity

- The Navy accepted delivery of LHA-6 in April 2014. This was seven months late and has the potential to affect the planned IOT&E schedule.
- In September 2014, the Navy identified a budget shortfall that will prevent the completion of IOT&E prior to the acquisition program threshold of October 2016. The Navy is investigating alternate courses of action to mitigate this problem.
- The Navy and Marine Corps Operational Test Agencies conducted the first phase of an Early Operational Assessment (EOA) design review for LHA-8 in May 2014.
  - The Navy desired to conduct this test to identify design risks prior to releasing the Request for Proposal.
  - The test was not conducted in accordance with the DOT&E-approved test plan because many of the specified subject matter experts were not available and the review was not conducted in a facility that permitted classified work. Hence, the ship's self-defense capability was not reviewed.
- A second phase of the EOA that was originally planned to examine the ship's amphibious attack and air assault mission capability in late 1QFY15 is currently under review due to the withdrawal of funding.

Assessment

- Because of a seven-month delay in the ship's delivery and resultant delays in the scheduling of the ship's self-defense weapon systems test, the LHA-6 program is unlikely to complete IOT&E by the acquisition program threshold of October 2016.
- If the $4.5 Million allocated in the Test and Evaluation Master Plan for the amphibious warfare IOT&E event in FY16 is not restored to permit the event to occur as planned, the operational testing that can be conducted prior to acquisition program threshold for reaching Initial Operating Capability will be inadequate to determine the ship's effectiveness and suitability. The Navy is investigating how to conduct the amphibious warfare portion of IOT&E prior to the ship's deployment in 2017.
- The Total Ship Survivability Trial, which contributes to the survivability assessment of the ship, was planned to occur during the amphibious warfare event to minimize the cost of the test program. If this now has to be scheduled to occur by itself, it may require a larger test budget.
- The first phase of the LHA-8 EOA was too limited to identify shortfalls, if any, in the ship's design.
- The LHA-6 Ship Self-Defense System (SSDS) has demonstrated capability against some classes of anti-ship cruise missile (ASCM) threats. However, based on combat systems testing on other platforms, it is unlikely that LHA-6's SSDS Mk 2-based combat system will meet the ship's Probability of Raid Annihilation requirement against all classes of ASCMs.
- The Fire Control Loop Improvement Program (FCLIP) was initiated to correct some combat system deficiencies related to self-defense against ASCMs discovered using the Self-Defense Test Ship and has the potential to mitigate some of the likely shortfalls in the ship's self-defense capability. However, FCLIP has been only partially implemented.
- Phase One of the FCLIP has been completed, but not operationally tested. Phases Two and Three of the proposed program have not been funded.

Recommendations

- Status of Previous Recommendations. The Navy has either addressed or established a process through which to address most of the previous recommendations. The Navy has not fully resolved the following four recommendations to:
  1. Correct systems engineering deficiencies related to SSDS Mk 2-based combat systems and other combat system deficiencies so that LHA-6 can satisfy its Probability of Raid Annihilation requirement.
  2. Evaluate the survivability improvement recommendations resulting from the analysis of the LHA-6 design for incorporation into the LHA-7 design.
  3. Implement improvements to the SSDS Mk 2-based combat system and test those changes during FOT&E.
  4. Make the Multi-Stage Supersonic Target available to support an assessment of the LHA-6 Probability of Raid Annihilation requirement.
- FY14 Recommendations. The Navy should:
  1. Allocate sufficient resources to permit the IOT&E and Total Ship Survivability Trial to be conducted as currently planned, or seek approval of a modified course of action that allows all operational testing objectives to be satisfied.
  2. Review and revise the ship's post-delivery schedule to assure that sufficient time is available for the completion of IOT&E prior to its first deployment.

Littoral Combat Ship (LCS)

Executive Summary

- During FY14, the Navy conducted both developmental testing and operational testing of the *Freedom* class Littoral Combat Ship (LCS) seaframe and Increment 2 Surface Warfare (SUW) Mission Package aboard USS *Fort Worth* (LCS 3). The 2014 operational testing identified shortcomings in air defense, reliability, and endurance, and significant vulnerabilities in cybersecurity. When equipped with the Increment 2 SUW Mission Package, LCS 3 was able to defeat a small number of Fast Inshore Attack Craft under the particular conditions specified by the Navy's reduced incremental requirement and after extensive crew training and tailoring of the tactics described in Navy doctrine; however, testing conducted to date has not been sufficient to demonstrate LCS capabilities in more stressing scenarios consistent with existing threats.
- The core combat capabilities of the *Independence* class variant seaframe remain largely untested. Developmental testing has focused on evaluating the performance of the seaframe and the Increment 1 Mine Countermeasures (MCM) Mission Package, with multiple deficiencies identified.
  - The MCM Mission Package has not yet demonstrated sufficient performance to achieve the Navy's minimal Increment 1 requirements. Although the ship's and its crew's ability to launch and recover Remote Multi-Mission Vehicles (RMMVs) has improved, LCS has had difficulty establishing and maintaining reliable communications with the RMMV, and the RMMV continues to exhibit reliability problems. The current communications systems also do not support bottom mine identification beyond the horizon.
  - Attempts to demonstrate the sequence of events necessary for an LCS to complete end-to-end mine clearance operations have been limited by low operator proficiency, software immaturity, system integration problems, and poor Remote Minehunting System (RMS)/RMMV reliability.
  - During a shore-based assessment, the Airborne Mine Neutralization System (AMNS) did not meet the Navy's requirement for mine neutralization success. Failures of the host MH-60 aircraft's systems and its associated Airborne MCM kit severely limited AMNS availability. Frequent loss of fiber-optic communications between the aircraft and the neutralizer was the primary cause of unsuccessful attack runs. Both problems increase the time needed to conduct LCS-based AMNS operations and reduce the ship's sustained area coverage rate.
- LCS is not expected to be survivable in high-intensity combat because its design requirements accept the risk that the ship must be abandoned under circumstances that would not require such an action on other surface combatants. Although the ship incorporates capabilities to reduce susceptibility to attack, previous testing of analogous capabilities demonstrates it cannot be assumed LCS will not be hit in high-intensity combat.
  - While both seaframe variants are fast and highly maneuverable, they are lightly armed and possess no significant offensive capability without the planned SUW Increment 4 Mission Package or Increment 2 Anti-Submarine Warfare (ASW) Mission Package.
- Equipment reliability problems have degraded the operational availability of both LCS classes. The Navy reports that recent reliability improvements made to the affected seaframe components have led to improved operational availability; however, that improvement has not been verified in operational testing.
- At the request of the Secretary of Defense, DOT&E prepared in October 2014 an independent assessment of the combat capabilities and survivability of the alternative concepts for a new small surface combatant (SSC) developed by the Navy's SSC Task Force. Using the Task Force's results, that assessment found that only major modifications to the existing LCS design, or a new ship design, could provide the multi-mission combat capabilities and survivability features found in a modern frigate.

***Freedom* Variant (LCS 1)**

***Independence* Variant (LCS 2)**

System

Seaframes

- The LCS is designed to operate in the shallow waters of the littorals that can constrain the ability of larger ships to maneuver.
- The Navy planned to acquire a total of 52 LCSs; however, in a February 24, 2014, memorandum, the Secretary of Defense announced that no new contract negotiations beyond 32 ships will go forward and directed the Navy to submit alternative proposals to procure a capable and lethal SSC, generally consistent with the capabilities of a frigate. In December, he approved the Navy's recommendation to modify the existing LCS designs for the remaining 20 ships.
- The Navy is currently procuring two variants of LCS seaframes:
  - The *Freedom* class (LCS 1, 3, 5, and follow-on odd-numbered ships) is a semi-planing monohull design constructed of steel (hull) and aluminum (deckhouse) with two steerable and two fixed-boost water jets driven by a combined diesel and gas turbine main propulsion system.
  - The *Independence* class (LCS 2, 4, 6, and follow-on even-numbered ships) is an aluminum trimaran design with two steerable water jets driven by diesel engines and two steerable water jets driven by gas turbine engines.
- Common design specifications include:
  - Sprint speed in excess of 40 knots, draft of less than 20 feet, and an unrefueled range in excess of 3,500 nautical miles at 14 knots
  - Accommodations for up to 98 personnel
  - A Common Mission Package Computing Environment for mission package control
  - Hangars sized to embark MH-60R/S and Vertical Take-Off Unmanned Aerial Vehicles (VTUAVs)
  - Mk 110 57 mm gun
- The designs have different core combat systems to provide command and control, situational awareness, and self-defense against anti-ship cruise missiles and surface craft.
  - *Freedom* Class Variant:
    - COMBATSS-21, an Aegis-based integrated combat weapons system with a TRS-3D (SPS-75) air/surface search radar
    - Ship Self-Defense System Rolling Airframe Missile (RAM) system (one 21-cell launcher)
    - Soft Kill Weapon System
    - DORNA gunfire control system with an electro-optical/infrared sensor to control the Mk 110 57 mm gun.
  - *Independence* Class Variant:
    - Integrated Combat Management System (derived from Dutch TACTICOS system) with a Sea Giraffe (SPS-77) air/surface search radar
    - One Mk 15 Mod 31 SeaRAM launcher (integrates the search, track, and engagement scheduler of the Close-in Weapon System with an 11-round RAM launcher assembly)
    - ALEX (Automatic Launch of Expendables) System (off-board decoy countermeasures)
    - Sea Star SAFIRE electro-optical/infrared systems for 57 mm gun fire control.

Mission Packages

- LCS is designed to host a variety of individual warfare systems (mission modules) assembled and integrated into interchangeable mission packages. The Navy currently plans to field MCM, SUW, and ASW Mission Packages. A mission package provides the seaframes with capability for a single or "focused" mission. Multiple individual programs of record involving sensor and weapon systems and off-board vehicles make up the individual mission modules.

  SUW Mission Package
  - Increment 1 includes:
    - Gun Mission Module (two Mk 46 30 mm guns)
    - Aviation Module (embarked MH-60R)
  - Increment 2 adds:
    - Maritime Security Module (small boats)
  - Increment 3 adds:
    - Surface-to-Surface Missile Module Increment I, employing the AGM 114L Longbow HELLFIRE missile
    - One MQ-8B Fire Scout VTUAV to the Aviation Module
  - Increment 4 adds:
    - Surface-to-Surface Missile Module Increment II to replace Increment I

  MCM Mission Package
  - Increment 1 includes:
    - Remote Minehunting Module, consisting of two RMMVs and three AN/AQS-20A/B sensors. The Navy is considering plans to incorporate an improved sensor (AN/AQS-20B) in the current increment; otherwise, the AN/AQS-20B will most likely be delivered in a future increment.
    - Near Surface Detection Module consisting of two Airborne Laser Mine Detection Systems (ALMDS). The Navy is also developing pre-planned product improvements that it expects to incorporate in a future increment.
    - Airborne Mine Neutralization Module consisting of two AMNS. In Increment 1, the AMNS does not include a near-surface mine neutralization capability; the Navy plans to develop this capability in a future increment.
    - Aviation Module consisting of an MH-60S Block 2B or subsequent Airborne Mine Countermeasures (AMCM) Helicopter outfitted with an AMCM system operator workstation and a tether system.

- Increment 2 adds:
  - Coastal Battlefield Reconnaissance and Analysis (COBRA) Block I system and one MQ-8B VTUAV for daytime unmanned aerial tactical reconnaissance to detect and localize mine lines and obstacles in the beach zone.
- Increment 3 adds:
  - Unmanned Influence Sweep System to activate acoustic-, magnetic-, and combined acoustic/magnetic-initiated volume and bottom mines in shallow water so they self-destruct.
- Increment 4 adds:
  - COBRA Block II system, which retains Block I capability and adds night-time minefield and obstacle detection capability and day/night detection capability in the surf zone.
  - Knifefish Unmanned Undersea Vehicle, an untethered, autonomous underwater vehicle, employing a low-frequency broadband sonar sensor to detect, classify, and identify volume and bottom mines in shallow water.

ASW Mission Package (only Increment 2)

- Torpedo Defense and Countermeasures Module (Lightweight Tow torpedo countermeasure)
- ASW Escort Module (Multi-Function Towed Array and Variable Depth Sonar)
- Aviation Module (embarked MH-60R and MQ-8B Fire Scout VTUAV) (Inclusion of Fire Scout has reportedly been deferred because of fiscal constraints.)

Mission

- The Maritime Component Commander will employ LCS to conduct MCM, ASW, or SUW tasks depending on the mission package fitted into the seaframe. Commanders can employ LCS in a maritime presence role in any configuration because of capabilities inherent to the seaframe. With the Maritime Security Module, installed as part of the SUW Mission Package, the ship can conduct Visit, Board, Search, and Seizure maritime interception operations.
- The Navy can employ LCS alone or in company with other ships. The Navy's Concept of Operations for LCS anticipates that the ship's primary operational role will involve preparing the operational environment for joint force assured access to critical littoral regions by conducting MCM, ASW, and SUW operations, possibly under an air defense umbrella as determined necessary by the operational commander.

Major Contractors

- *Freedom* Class Variant (LCS 1, 3, 5, and follow-on odd-numbered ships)
  - Prime: Lockheed Martin Maritime Systems and Sensors – Washington, District of Columbia
  - Shipbuilder: Marinette Marine – Marinette, Wisconsin
- *Independence* Class Variant (LCS 2, 4, 6, 8, and follow-on even-numbered ships)
  - Prime for LCS 2 and LCS 4: General Dynamics Corporation Marine Systems, Bath Iron Works – Bath, Maine
  - Prime for LCS 6, LCS 8, and follow-on even numbered ships: Austal USA – Mobile, Alabama
  - Shipbuilder: Austal USA – Mobile, Alabama
- Mission Packages
  - Future Mission Package Integration contract awarded to Northrop Grumman – Los Angeles, California

---

Activity

LCS Program

- DOT&E published an Early Fielding Report providing an assessment of the LCS seaframes and mission packages in December 2013.
- DOT&E forwarded a response to the reporting requirement in the FY14 Conference Report (113-66) accompanying H.R. 3304, the National Defense Authorization Act for FY14, to the Navy for inclusion with the Navy's response on April 4, 2014.
- DOT&E will publish an assessment of the results of operational testing of the *Freedom* class seaframe and SUW Mission Package (Increments 1 and 2) in 2QFY15.

Seaframes

- *Freedom* Class Variant:
  - USS *Freedom* (LCS 1) returned to San Diego, California, from operations in the Western Pacific in December 2013.
  - After receiving modifications needed to host the ASW Mission Package, USS *Freedom* (LCS 1) participated in engineering tests designed to test the integration of the ASW mission modules into the *Freedom* class seaframe.
  - The Navy conducted developmental testing of the *Freedom* class variant seaframe aboard USS *Fort Worth* (LCS 3) in 1Q-2QFY14.
  - The Navy conducted operational testing of the *Freedom* class variant seaframe aboard USS *Fort Worth* (LCS 3) in March and April 2014. The testing was conducted in accordance with a DOT&E-approved test plan.
- *Independence* Class Variant:
  - USS *Independence* (LCS 2) hosted a scheduled phase of developmental testing focused on the integrated seaframe and Increment 1 MCM Mission Package operations in October 2014.

- USS *Independence* (LCS 2) participated in a phase of developmental testing designed to evaluate RMMV launch and recovery operations using modified hardware and revised procedures and communications between the LCS and RMMVs using the Multi-Vehicle Communications System.
- The Navy conducted Heavy Weather developmental testing in early FY14. Subsequently, the Navy discovered cracks in the welds at the base of support stanchions located in the mission bay and imposed a weight limit on the launch and recovery system for USS *Independence* (LCS 2) and USS *Coronado* (LCS 4).
- The Navy placed USS *Coronad*o (LCS 4) in commission in April 2014.
- The Board of Inspection and Survey (INSURV) conducted Final Contract Trials aboard USS *Coronado* (LCS 4) in June 2014.
- USS *Coronado* (LCS 4) completed a series of basic seaframe developmental tests, including 57 mm gunnery events, before starting her post-shake-down availability in 1QFY15.

SUW Mission Package

- The Navy conducted developmental testing of the Increment 2 SUW Mission Package aboard USS *Fort Worth* (LCS 3) in 1Q-2QFY14.
- The Navy conducted an initial phase of operational testing of the Increment 2 SUW Mission Package aboard USS *Fort Worth* (LCS 3) in March and April 2014. This test examined the *Freedom* class variant's self-defense capability against small swarms of high-speed boats and its effectiveness in conducting simulated maritime interdiction operations that required the crew to intercept and board a vessel suspected of transporting contraband.
- The testing was conducted in accordance with a DOT&E-approved test plan.

MCM Mission Package

- In 1QFY14, the Navy completed two phases of developmental testing (DT-IIG) of the RMS consisting of a version 4.2 (v4.2) RMMV and an AN/AQS-20A sensor from a shore base at the contractor's facility in West Palm Beach, Florida. A third phase of testing described by the RMS Test and Evaluation Master Plan as an opportunity to assess risk of the interfaces with the LCS, including cybersecurity, was not conducted. The Navy cited lack of LCS availability as the rationale for cancellation of this phase, but incompatibility of the v4.2 RMMV with LCS was also a factor. In 3QFY14, the Navy conducted dockside and at-sea developmental testing to verify correction of the RMMV launch, handling, and recovery system and communications deficiencies observed in FY13 developmental testing. Finally, in 1QFY15, the Navy conducted the last scheduled phase of the Increment 1 MCM Mission Package developmental test DT-B2 aboard USS *Independence* (LCS 2). This phase was the first time that RMS and the airborne MCM Mission Package components had operated together off an LCS.
- The Navy conducted Phase A of an operational assessment of the AMNS in 3QFY14 with the MH-60S helicopter operating from Naval Air Station Oceana, Virginia. The test included the use of explosive neutralizers and inert training neutralizers against inert moored and bottom mine targets.
- The Navy conducted Phase B of the AMNS operational assessment to focus on shipboard integration and the system's suitability, but was also able to collect some limited effectiveness data. This phase of test was conducted aboard USS *Independence* (LCS 2) in 1QFY15 during Increment 1 MCM Mission Package developmental testing. Because some deficiencies in mission package performance discovered earlier had not been corrected, some deviations from the approved test plan occurred; those deficiencies are discussed in the assessment section below.
- The Navy completed Phase B (LCS-based phase) of the test in 1QFY15 aboard USS *Independence* (LCS 2) during Increment 1 MCM Mission Package developmental testing. The test examined system effectiveness and the shipboard suitability of the MH-60S helicopter equipped with ALMDS.
- The Navy postponed a scheduled operational assessment of COBRA Block I after an Antares rocket exploded just after lift-off from the Wallops Island launch pad on October 28, 2014. Although all test preparations had been completed, both MQ-8B Fire Scout VTUAVs that were to host the COBRA system during the test suffered shrapnel damage from the rocket explosion. The Navy has not yet established a new date for the operational assessment.

ASW Mission Package

- The Navy conducted Advanced Development Model (ADM) testing of the ASW Escort Module aboard LCS 1 in September 2014. Testing was focused on the integration of the Variable Depth Sonar and Multi-Function Towed Array with the LCS platform, to include pull stresses and stern door effectiveness with penetrating systems. Testing also included some long-range passive and active ASW search in deep water against a U.S. nuclear submarine. Testing was highly scripted, which is appropriate for early system integration efforts, but the results cannot be used to make any assessment of operational performance under realistic combat conditions. The test was conducted with full knowledge of the target submarine's position throughout the test, and the operators focused their search only in the region where the submarine was known to be.

LFT&E

- The Navy conducted a Total Ship Survivability Trial (TSST) on USS *Fort Worth* (LCS 3) in accordance with the DOT&E-approved trial plan.
- DOT&E provided an interim survivability assessment of both LCS designs in the Early Fielding Report issued on December 9, 2013.

- As part of the response to the reporting requirement in the FY14 Conference Report (113-66) accompanying H.R. 3304, the National Defense Authorization Act for FY14, DOT&E provided the Navy a review of the survivability testing, modeling, and simulation conducted to date on the two seaframes and an assessment of the expected survivability of LCS in the context of the planned employment of LCS as described in the concept of operations.

SSC Study

- At the request of the Secretary of Defense, DOT&E prepared in October 2014 an independent assessment of the combat capabilities and survivability of the alternative concepts for a new SSC developed by the Navy's SSC Task Force. The DOT&E assessment is a classified document.

Assessment

This assessment is based on information from DOT&E's observations of post-delivery testing and trial events, fleet operations, developmental test data, results provided by the Navy program offices, operational assessments of some mission systems, and operational testing of the *Freedom* class seaframe with the Increment 1 and 2 SUW Mission Packages.

LCS Program

- The Navy intends to field LCS capabilities incrementally as mission package systems mature and become ready for fleet use. Additionally, the Navy directed changes to the seaframe designs based on the results of early developmental testing and operations.
  - The Navy has indicated that the seaframe designs will be stabilized in the third ship of each variant (LCS 5 and LCS 6).
  - Since the Navy expects each increment to deliver significant increases in mission capability, the approved Test and Evaluation Master Plan anticipates an appropriately-designed phase of OT&E on all delivered mission package increments on each seaframe variant. The details of the testing to be accomplished for later Increments of mission package capability will be decided when the content of those later increments are defined by the Navy.
  - An initial phase of operational testing was completed in FY14 for the *Freedom* class variant seaframe and SUW Mission Package only, but the final phases will not be completed until the FY19 timeframe.

Seaframes

- While both seaframe variants are fast and highly maneuverable, they are lightly armed and possess no significant offensive capability without the planned Increment 4 SUW Mission Package or the Increment 2 ASW Mission Package.
  - In comparison to other Navy ships, the LCS seaframes have relatively modest air defense capabilities; however, their air defense capabilities cannot be characterized fully until tests on LCS 5 and LCS 6 (the production-representative seaframes) and the Navy's unmanned Self-Defense Test Ship provide data for the Navy Probability of Raid Annihilation high-fidelity modeling and simulation analyses in FY18. The Navy plans to test the *Independence* class variant's capability to defeat unmanned aerial vehicles and slow-flying aircraft in FY15.
  - The *Freedom* class seaframe's surface self-defense capability was operationally tested in FY14 (see below) and the *Independence* class seaframe's capability is scheduled to be tested in FY15 aboard USS *Coronado* (LCS 4).
  - The seaframes include no systems designed to detect torpedo attacks or mines without the appropriately configured mission packages installed.
- Crew size can limit the mission capabilities, combat endurance, and recoverability of the ships. The Navy continues to review manning to determine appropriate levels, and is adding 20 berths to all seaframes. The increased berthing supports small increases in the size of the core crew, mission package detachments, and the aviation detachment.
- *Freedom* Class Variant (LCS 1 and 3):
  - Although not all aspects of operational effectiveness and operational suitability could be examined during the 2014 operational testing, that testing identified shortcomings in air defense, reliability, and endurance, and significant vulnerabilities in cybersecurity.
  - Cybersecurity testing conducted during operational testing aboard LCS 3 uncovered significant vulnerabilities in the ship's capability to protect the security of information and prevent malicious intrusion. Limited cybersecurity testing conducted during a 2012 Quick Reaction Assessment aboard LCS 1 also found vulnerabilities.
  - Tracking events conducted during operational testing aboard LCS 3 demonstrated that in some scenarios the SPS-75 (TRS-3D) air search radar is unable to detect and track some types of air threats in operationally realistic environments. Tracking performance improved significantly when the LCS received tracking information via datalink from a nearby Aegis destroyer. The lack of an integrated electronic support measures system limits the ship's capability to make best use of its inventory of RAM surface-to-air missiles.
  - Critical equipment required to support ship operations, core mission functions, and mission package operations is unreliable. The ship's crew does not have adequate training and technical documentation to troubleshoot equipment failures; the Navy lacks repair parts for some critical systems; and the Navy's plan for distribution of the maintenance workload among the ship's crew,

shore-based Navy support organizations, and technical experts from other organizations is immature. The operational availability of shipboard systems in 10 of 12 categories examined met or exceeded Navy requirements, however, failures of critical propulsion and maneuvering and Total Ship Computing Environment systems forced the ship to return to port for repairs that, respectively, caused 42 and 36 days of downtime during the period of data collection during operational testing. Excluding scheduled maintenance periods, LCS 3 was fully mission capable less than 25 percent of the time during that period.

- During operational testing, LCS 3 did not demonstrate that it could achieve the Navy requirement for fuel endurance (operating range) at the prescribed transit speed or at sprint speed. Information provided by the Navy indicated that between 91 and 92 percent of the ship's total diesel fuel (F-76) tank capacity would actually be available for use since some room must be left for expansion when the tanks are filled, a portion of the tanks' volume is filled with piping and structural members, and a small amount of fuel remains inaccessible when the tanks are emptied. Based on fuel consumption data collected during the test, the ship's operating range at 14.4 knots is estimated to be approximately 1,961 nautical miles (Navy requirement: 3,500 nautical miles at 14 knots) and the operating range at 43.6 knots is approximately 855 nautical miles (Navy requirement: 1,000 nautical miles at 40 knots). In an emergency, the ship could use its aviation fuel (F-44) to extend the transit and sprint ranges by 360 and 157 nautical miles, respectively. The shortfall in endurance may limit the flexibility of the ship's operations in the Pacific and place a heavier than anticipated demand on fleet logistics.
- Operational testing confirmed earlier observations that, except for the ships' lack of endurance, the *Freedom* class variant is well-suited for Maritime Security Operations. LCS 3 readily demonstrated the capability to position, launch, and recover the 11-meter boats included in the SUW Mission Package when the launch, recovery, and handling system is operational.
- The ship's Mk 110 57 mm gun system performed reliably during operational testing, and the ship was able to demonstrate the core capability for self-defense against a small boat in two valid trials. The Navy attempted to collect additional data from swarm presentations, but the data were invalid. The 57 mm gun failed to achieve a mission kill during one swarm presentation, and the target killed by the 57 mm gun during a second swarm presentation had previously been engaged by 30 mm guns.
- The *Freedom* class LCS has sufficient aviation facilities and meets Navy requirements to safely launch, recover, and handle all appropriate aircraft while operating in Sea State 4 conditions. However, the ship frequently experienced difficulty with establishing and maintaining a Tactical Common Data Link with the aircraft during the FY14 operational test. The crew's efforts were hampered by an antenna failure and the total lack of technical documentation on the operation and maintenance of the datalink.
- The LCS 3 anchoring system could not securely anchor the ship in an area with a bottom composed of sand and shells. Despite repeated efforts, the ship was unable to set the anchor. It appears that the anchor and chain are too light and there are too many friction points along the anchor chain's internal path from the chain locker to the hawse pipe to allow the anchor and chain to pay out smoothly.
- The fenders designed to guide the 11-meter Rigid Hull Inflatable Boats included in the SUW Mission Package during launch and recovery are fragile and occasionally sheared off when impacted by the boats during operational testing. Although the fenders have undergone several redesigns, they are not yet strong enough to sustain such impacts.

• *Independence* Class Variant (LCS 2):
  - DOT&E still has no data to assess the core mission capabilities of the *Independence* class variant seaframe.
  - The USS *Independence* (LCS 2) crew encountered multiple problems with the twin-boom extensible crane (TBEC) and other mission package support systems during initial developmental testing of the MCM Mission Package. Since then, the vendor has improved the TBEC, and the Navy has made changes to the RMMV launch and recovery hardware. Developmental testing in August 2013, May 2014, and October 2014 demonstrated that the ship's capability to launch and recover the RMMV has improved because of crew training, but it is not yet clear that launch and recovery can be completed routinely without problems.
  - In the past, availability of the USS *Independence* (LCS 2) to support testing has been degraded by equipment failures, including problems with operator consoles, power generation equipment, components of the ship's computing and networking equipment, propulsion drive train components, and communications systems. DOT&E is unable to evaluate the success of Navy efforts to improve the reliability of these systems. In September and October 2014, the start of developmental testing of the MCM Mission Package was delayed by LCS air conditioning and propulsion system failures. During at-sea testing, observers noted that LCS sometimes experienced difficulties when communicating with a simulated Mine Warfare Commander operating from a shore-based command center.

SUW Mission Package

- LCS 3 equipped with the Increment 2 SUW Mission Package demonstrated the capability to defeat a small swarm of Fast Inshore Attack Craft under the conditions specified in the Navy requirement; however, the crew received extensive hands-on training that might not be available to crews on other ships. Testing conducted to date has not been sufficient to demonstrate LCS capabilities in more stressing scenarios consistent with existing threats.
- The SUW Mission Package has not yet been tested aboard an *Independence* class LCS.
- The 30 mm Gun Mission Modules (GMM) remain prone to jams caused by separation of ammunition links and accumulation of spent cartridges in the ejection path; however, LCS 3 experienced fewer jams during operational testing than had been observed in past developmental testing. While the Navy has made a concerted effort to improve ammunition belts, the problem was not entirely eliminated. Ammunition jams interrupt firing but can typically be cleared in a few minutes; however, they are still sufficiently disruptive to cause the ship to maneuver to bring the other 30 mm GMM to bear on the target.

MCM Mission Package

- During developmental testing, attempts to demonstrate the sequence of events necessary for an LCS to complete end-to-end mine clearance operations have been limited by low operator proficiency, software immaturity, system integration problems, and poor reliability of MCM components including RMS/RMMV. In the most recent period of developmental testing in 1QFY15, fleet operators using mission package tools such as the Organic Post Mission Analysis (OPMA) and the new Contact Management Tool (CMT) failed to convey some mine targets, correctly detected by the RMS in an initial search pass, to the AMNS for neutralization. As a result, fleet operators were unable to execute operationally-realistic, end-to-end mine reconnaissance and clearance without intervention by testers with knowledge of ground truth target positions. The Navy continues to investigate the root cause of target position errors and incorrectly dropped contacts; unless corrected, these problems will limit LCS MCM mission effectiveness.
- During developmental testing, the operational availability of MCM Mission Package systems has been degraded by low reliability, the LCS crew's limited capacity for corrective maintenance, and the ship's constrained inventory of repair parts. Testing has often been delayed to obtain the assistance of shore-based technicians and repair parts not available onboard LCS. Left uncorrected, these problems will severely limit LCS's operational capability for mine reconnaissance and clearance.
- Mission package minehunting systems (AN/AQS-20A and ALMDS) have not demonstrated the detection and localization capabilities needed for an LCS equipped with an Increment 1 MCM Mission Package to meet its required sustained area coverage rate. During developmental testing and a shore-based operational assessment, AN/AQS-20A contact depth (vertical localization) errors have exceeded Navy limits in all operating modes. A shore-based operational assessment of ALMDS showed that the system does not meet Navy detection requirements. Both systems generate a large number of false classifications (objects erroneously classified as mine-like). Unless eliminated from the contact list, these false classifications require identification and neutralization effort, result in the expenditure of limited neutralizer assets, and substantially reduce the LCS sustained area coverage rate. As an alternative, the Navy has implemented tactics that require multiple search passes over the same area to minimize the number of false classifications conveyed for identification/neutralization. Although multiple search passes also reduce the LCS sustained area coverage rate relative to single pass systems, Navy modeling suggests this approach is less detrimental to MCM timelines. Whether LCS can meet the already-reduced low area clearance requirement for the Increment 1 Mission Package remains in question. Furthermore, testing has not yet shown whether the goal of minimizing AN/AQS-20A false classifications can be accomplished without also eliminating correct classifications from the contact list and degrading minehunting performance.
  - The Navy expected to correct AN/AQS-20A deficiencies prior to the first phase of operational testing in FY15 by implementing pre-planned product improvements (the AN/AQS-20B version of the sonar) and integrating the improved sensor into the MCM Mission Package. Delays in the delivery of AN/AQS-20B prototypes and problems discovered in early characterization testing in FY14 leave little time to complete necessary developmental and operational testing of the AN/AQS-20B prior to the planned operational test of LCS equipped with the first increment of the MCM Mission Package in FY15.
  - The Navy is working on pre-planned product improvements to improve ALMDS detection performance and reduce the frequency of receiver failures, but does not expect to integrate these changes into the first increment of the MCM Mission Package. Frequent receiver failures continued to affect ALMDS performance during an experimental deployment to the Navy's 5th fleet and recent developmental testing aboard LCS 2. During LCS developmental testing, the MH-60S aircrew was also unable to assess ALMDS achieved search/clearance level during post-mission analysis. Observations from 5th fleet operators also indicate mission planning and evaluation tools do not adequately support ALMDS mission planning and post-mission clearance estimates.

- During a shore-based operational assessment of the AMNS in FY14, AMNS was unable to achieve the Navy's requirement for mine neutralization success except under limited conditions not generally expected during combat. Failures of the host MH-60S aircraft's systems and its associated AMCM Mission Kit limited AMNS mission availability. Frequent loss of fiber-optic communications between the aircraft and the neutralizer was the primary cause of unsuccessful attack runs. Although the Navy attributed the failures to the bottom composition (sand and shells), the root cause of these failures has not yet been determined, and the bottom compositions used in testing are representative of realistic operating areas. Both problems negatively affect the timeliness of LCS-based AMNS operations and will likely reduce the ship's sustained area coverage rate.
- As noted earlier, the *Independence* class LCS has had difficulty launching and recovering the RMMV because of the vehicle's erratic motion in the ship's wake. In past developmental testing, violent RMMV yaw and roll motions have overstressed and damaged the launch and recovery hardware and resulted in damage to the RMMV, causing the Navy to limit handling operations to when sea state is less than 3. Following changes to launch and recovery hardware, procedures, training, and RMMV hardware, the Navy demonstrated 16 RMMV launches and 14 RMMV recoveries during 23 days at sea in developmental testing during favorable sea state conditions in 1QFY15. Nonetheless, the most recent period of developmental testing witnessed several instances of equipment damage that delayed or prevented recovery of an off-board RMMV. Because of the cracks in the welds at the base of support stanchions located in the mission bay, during this phase of testing, launch and recovery operations could be conducted only when wave-induced loading on the recovery system (a function of wave height and period) did not exceed 32,000 pounds-force. For example, a wave height of 2 feet coupled with a wave period of 2 seconds, which could occur in a Sea State 2, would have precluded RMMV recovery until calmer sea conditions developed. The Navy revealed they are making design changes to LCS 6 and later seaframes to correct the problem and remove the weight limit. LCS 2 and LCS 4 will be corrected during the next shipyard availability. This problem must be corrected to ensure safe and sustained RMS operations.
  - No RMMV launch and recovery operations have been conducted aboard a *Freedom* class LCS at sea.
  - Although the RMMV can search autonomously while operating over the horizon from the LCS, it can currently only conduct operations to reacquire and identify bottom mines within the range of Ultra High Frequency communications. This limitation will complicate MCM operations in long shipping channels, and may make it necessary to clear a series of LCS operating areas to allow MCM operations to progress along the channel. The cleared operating areas will be needed to keep the LCS and its crew out of mined waters. The additional effort required to clear these LCS operating areas would increase the demand for mine clearance and delay attainment of strategic objectives. This issue is not new to RMS; however, it did not become operationally significant until the Navy decertified the MH-60S helicopter for towing MCM devices, including the AN/AQS-20A/B sensor. The RMS communication range limitation was not an operational concern when the option existed for the helicopter with towed sensor to conduct identification operations beyond the horizon. The Navy has not yet identified a solution.
  - RMS reliability problems persisted in the recent phase of developmental testing (1QFY15) evidenced in part by fewer vehicle recoveries than vehicle launches. Problems observed include the inability to align the system's inertial navigational unit, intermittent communications, a lube oil pump failure that caused a mission abort, capture latch impairment that precluded shipboard recovery of the RMMV, degraded electro-optic identification resulting in a mission abort to replace the AN/AQS-20A towed body, tow cable damage following an apparent snag that rendered the system inoperable in the assigned mission until a replacement tow cable could be installed with the assistance of shore-based support, and multiple incidents of AN/AQS-20A stuck fins or fin actuation faults. Although the Navy demonstrated more frequent RMMV launches during this period of testing, continued RMS reliability problems limited system minehunting to less than 50 hours during the 3 weeks of most intensive testing (approximately 16 hours per week).
    - LCS reliability problems also forced the ship to remain in port for repairs instead of conducting at-sea RMS testing as planned. Including an additional week spent in port for LCS repairs, RMS averaged approximately 12 hours of minehunting per week. This result is consistent with the assessment of RMS capability DOT&E provided to members of the Defense Acquisition Board following RMMV v4.2 and AN/AQS-20A testing to indicate that the Navy had not yet demonstrated that it could sustain operations of more than one 14-hour RMMV sortie per week (i.e., 10 to 12 hours of RMS minehunting per week). Unless greater minehunting operating tempo is achieved, the Navy will not meet its interim area clearance rate requirements.
    - The Navy reports that the RMS operated for approximately 140 hours during LCS developmental testing in 1QFY15. DOT&E's preliminary assessment of test data identified at least seven RMS failures that precluded vehicle recovery, required sensor replacement, or required assistance from shore-based support contractors to restore system availability. In

operational testing, these failures would be assessed as operational mission failures. Thus, by operational criteria, RMS demonstrated reliability was no more than 20 hours Mean Time Between Operational Mission Failure during this phase of testing. Because much of the operating time cited by the Navy was not devoted to minehunting activities, this estimate should be considered an upper bound for current RMS operational reliability Moreover, statistical analysis of all existing data does not yet support the Navy's assertions of improving RMS reliability.
- Since RMS is critical to achieving the Navy's sustained area coverage rate requirement, this Annual Report includes a separate article on the RMS that provides additional detail.

LFT&E
- LCS is not expected to be survivable in high-intensity combat because the design requirements accept the risk the ship must be abandoned under circumstances that would not require such an action on other surface combatants. Although the ship incorporates capabilities to reduce susceptibility to attack, previous testing of analogous capabilities demonstrates it cannot be assumed LCS will not be hit in high-intensity combat.
- During the TSST on LCS 3, the Machinery Plant Control and Monitoring System (MPCMS) appeared to be improperly controlling the ventilation system for the highest of three material conditions of damage control readiness known as "Condition ZEBRA." This could allow smoke to spread through fire boundaries. Pressure differentials were observed in several spaces that made hatches and doors difficult to operate.
- There is a problem with the MPCMS that caused every fire alarm on the ship to activate during shot 1 of the TSST on LCS 3, even though the fire was limited to the 01 Level. Based on discussions with system experts, this is a known problem with the MPCMS.

SSC Study
- In February 2014, the Secretary of Defense directed the Secretary of the Navy and the Chief of Naval Operations to "Submit to me, in time to inform the PB 2016 budget deliberations, alternative proposals to procure a capable and lethal small surface combatant, generally consistent with the capabilities of a frigate." In October 2014, the Secretary of Defense requested DOT&E provide an independent assessment of the work done by the SSC Task Force established by the Navy pursuant to the Secretary's direction. In response, DOT&E provided a written classified assessment report to the Secretary.
- In its report, DOT&E concluded that the Navy's SSC Task Force's results indicate, of the alternatives it considered, the multi-mission combat capabilities and survivability design features of a modern frigate could be provided only by a new ship design or a major modification to the LCS design – the so-called large plug insertion developed by the Task Force. While offering some improvements in combat capability and survivability (primarily via reduced susceptibility) relative to LCS, the minor modifications to LCS considered by the Task Force and recommended by the Navy Leadership do not satisfy significant elements of a capability concept developed by the Task Force for a modern frigate. (The Task Force developed a number of capability concepts incorporating various mixes of capabilities consistent with a frigate. After consulting with the Task Force's lead, DOT&E's assessment used one particular concept as representative of a modern frigate's capabilities. Also, "major modification to LCS" and "minor modification to LCS" are the characterizations used by the Task Force of its alternatives.) Notwithstanding potential reductions to its susceptibility relative to LCS, DOT&E's assessment is that minor modifications to LCS will not yield a ship that is significantly more survivable than LCS.
- DOT&E also noted in its report provided to the Secretary that DOT&E's assessment was based on results that might subsequently change, because the Task Force's report remained unfinished at the time of DOT&E's report.

Recommendations
- Status of Previous Recommendations.
  - The Navy partially addressed one FY09 recommendation to develop an LFT&E program with the approval of the LFT&E Management Plan; however, the details of the surrogate testing and the lethality testing still need to be developed.
  - The Navy partially addressed the FY10 recommendations to implement recommendations from DOT&E's Combined Operational and Live Fire Early Fielding Report. Significant remaining recommendations include enhancing seaframe sensors and improving capability of seaframe and SUW Mission Package gun systems.
  - With respect to FY11 recommendations regarding AN/AQS-20A and ALMDS, the Navy is adjusting tactics and, for the AN/AQS-20A, funding improvements to address deficiencies. The FY11 recommendation for the Navy to continue to report vulnerabilities during live fire tests remains valid.
  - For FY12 recommendations:
    - The Navy partially addressed the recommendations to complete the revised capabilities document defining the incremental approach to fielding mission packages.
    - The Navy has released requirements letters for Increments 1 and 2 SUW and Increment 1 MCM Mission Packages only; however, the requirements have not been codified in an approved Capabilities Production Document. The Navy published the LCS Platform Wholeness Concept of Operations Revision D in January 2013.
    - The Navy has not published the concept of employment for all the mission packages, but advises that initial manning level studies have been completed. The Navy has adjusted ship and mission package manning levels

and is continuing studies to determine the final manning levels.
  - The Navy has stated that gun reliability problems identified during the Quick Reaction Assessment have been resolved based on limited testing conducted in October 2012. Additional testing conducted aboard LCS 3 in 2013 and 2014, which was observed by DOT&E, indicates that the gun reliability has improved.
  - The Navy conducted LCS ship-based phases of the planned operational assessments of the MH-60S Block 2/3 and ALMDS and the MH-60S Block 2/3 and AMNS MCM systems in 1QFY15.
  - Throughout FY13/14, the Navy focused on correction of material deficiencies with seaframe launch and recovery systems, and manpower and training deficiencies that prevent safe shipboard launch and recovery of the RMS, and can now launch and recover the RMMV with less frequent damage to equipment in low to moderate sea states.
- The Navy should still address the FY13 recommendation to provide a Surface-to-Surface Missile LFT&E Management Plan for DOT&E approval.

- FY14 Recommendations. The Navy should:
  1. Continue to address material reliability issues for both ship classes.
  2. Address the cybersecurity vulnerabilities identified during operational testing of the *Freedom* class. Conduct in-depth cybersecurity testing of the *Independence* class as soon as practicable and address deficiencies.
  3. Emphasize live-fire swarm engagements for future testing of the SUW Mission Package to enhance confidence in the probability of successful engagement. As the SUW Mission Package matures to Increments 3 and 4, focus testing on more challenging threats.
  4. Investigate the use of communications relays and other solutions that might improve the standoff distance between an RMMV and its host ship to improve the efficiency of LCS MCM operations.
  5. Improve mission system (RMMV, ALMDS, AMNS, AMCM mission kit, AN/AQS-20A/B) reliability to facilitate timely and sustained MCM operations without excessive reliance on shore-based support.
  6. Continue to investigate the root cause of contact management and communications problems observed during recent MCM developmental testing; develop corrective actions.
  7. Develop corrective actions to eliminate early termination fiber optic communications losses observed in the AMNS operational assessment; fund and develop LCS near-surface mine neutralization capability.
  8. Review the ventilation lineup during condition ZEBRA to determine if the system is operating as intended.
  9. Correct problems with the MPCMS fire alarm system.

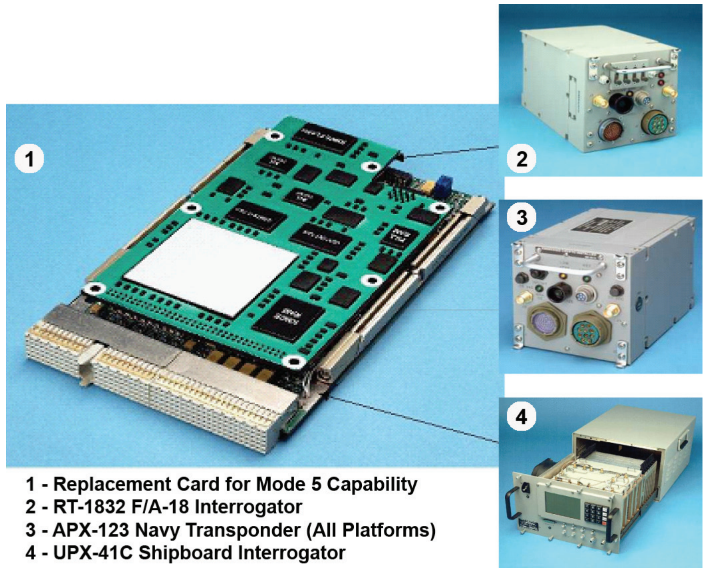
Mark XIIA Mode 5 Identification Friend or Foe (IFF)

Executive Summary

- Independent Mark XIIA Mode 5 Identification Friend or Foe (IFF) (referred to as "Mode 5") development efforts exist in each U.S. Military Service as well as some NATO countries. Since Mode 5 is not a joint program, the Services are separately developing IFF equipment for use on various land, sea, and air platforms.
  - Of these separate Service efforts, only the Navy has an established Acquisition Category II program.
  - The Army and Marine Corps are procuring Mode 5 transponders developed in the Navy program.
  - Separately, the Army developed and is fielding its own Mode 5 Air Defense Interrogator.
  - The Air Force is developing its own Mode 5 transponders and interrogators.
- The Services are designing and building Mode 5 systems to comply with NATO and DOD IFF standards. DOT&E, in coordination with the Joint Staff and USD(AT&L), initiated oversight in 2006 because of the concern that the multiple programs and vendors required oversight to reduce risks in achieving joint IFF interoperability.
- DOT&E published the Mark XXIIA Mode 5 Joint Operational Test Approach (JOTA) 2 Interoperability Assessment in July 2014 based on the June 2013 major joint operational test off the U.S. East Coast that focused on Mode 5 interoperability and identification in a system-of-systems (SoS) context. This two week event included extensive participation by joint Service and allied systems equipped with a wide variety of Mode 5 equipment produced by different U.S. and European manufacturers.
  - Test results showed that the following Mode 5 transponders and interrogators were interoperable in a joint SoS environment:
    - Army: Sentinel; Air Traffic Navigational, Integration, and Coordination System; A/MH-6; C-12R; CH-47F; UH-60M
    - Air Force: F-15C/D/E, F-16 Block 40/50
    - Marine Corps: US-1Y
    - Navy: E-2C, MH-60R, P-3C
  - DOT&E observed some deficiencies during interrogation with the Patriot and Aegis systems, which were documented in the classified assessment.
  - Patriot and Aegis will be required to participate in additional joint interoperability tests.
  - Similar future events will evaluate Mode 5 interoperability and identification as other IFF systems in development are integrated into various Service platforms.

System

- The Mark XIIA Mode 5 IFF is a cooperative identification system that uses interrogators and transponders on host platforms to send, receive, and process friendly identification data.
- Mode 5 is a military-only identification mode, which modifies the existing Mark XII Mode 4 IFF (referred to as "Mode 4") system and addresses known shortcomings of the legacy Mode 4 identification mode. Mode 5 will eventually replace Mode 4 and allows National Security Agency-certified secure encryption of interrogations and replies. Primary Mode 5 system features include:
  - A Lethal Interrogation format, which is used by a weapons-capable platform prior to weapons release as a final attempt to get a valid Mode 5 reply from the target, even with the target's interrogated Mode 5 transponder system in standby; this is intended to reduce the possibility of fratricide.
  - A random-reply-delay, which prevents overlapping replies and provides better display discrimination for closely-spaced platforms.
- Mode 5 offers more modern signal processing, compatibility with legacy Mode 4 systems and civilian air traffic control, and secure and encrypted data exchange through the use of a new waveform.
- Mode 5 serves as a component of the combat identification process used on ground-based systems such as the Army's Patriot and Sentinel missile systems, sea-based systems such as Aegis-equipped warships, and military aircraft to include the E-3 Sentry Airborne Warning and Control System (AWACS) and E-2 Hawkeye command and control platforms.
- Independent Mode 5 development efforts exist in each U.S. Military Service as well as some NATO countries. Although not a joint program, the Services are developing



1 - Replacement Card for Mode 5 Capability
2 - RT-1832 F/A-18 Interrogator
3 - APX-123 Navy Transponder (All Platforms)
4 - UPX-41C Shipboard Interrogator

equipment capable of employment on multiple Service platforms.
- Of the four separate Service efforts, only the Navy had an established Acquisition Category II Program of Record, with incorporation of Mode 5 capability through platform-specific Engineering Change Proposals.
- The Army and Marine Corps are leveraging the Navy program, and the Air Force is executing individual Engineering Change Proposals to introduce Mode 5 capabilities into its various platforms.

Mission

The Combatant Commander employs the Mode 5 system to provide positive, secure, line-of-sight identification of friendly platforms equipped with an IFF transponder. In the future, this system's information will be combined with other cooperative and non-cooperative combat identification techniques in order to provide identification of all platforms—enemy, neutral, and friendly.

Major Contractors

- Navy Transponder and Interrogator: BAE Systems – Arlington, Virginia
- Air Force Transponder and Interrogator and Army Air Defense Interrogator: Raytheon Systems – Waltham, Massachusetts
- Air Force E-3 Interrogator: Telephonics Corporation – Farmingdale, New York

---

Activity

- The Navy conducted a JOTA event in 3QFY13 off the U.S. East Coast during the Joint Staff J-6-led Bold Quest Coalition Capability Demonstration and Assessment event, which involved a mixture of blue and red forces consisting of a variety of joint Service and allied aircraft equipped with interrogators and transponders produced by different U.S. and allied manufacturers.
  - Air warfare scenarios were conducted under Navy Aegis warship, AWACS, or ground controlled intercept control.
  - During the JOTA event, U.S. and allied aircraft flew 272 of 294 planned aircraft sorties. Representative operational flight profiles and tactics were used during the event.
- Future JOTA events are intended to support the planned FY20 Full Operational Capability declaration.
- The next JOTA event is expected in the FY17/18 timeframe and is driven by systems ready to test as well as test venue availability.
- DOT&E published the Mark XIIA Mode 5 JOTA 2 Interoperability Assessment in July 2014.

Assessment

- The Navy Aegis Weapon System was initially unable to come online at the start of its scheduled participation in the joint interoperability exercise due to the fact that the published procedures for the initialization of the Mode 5 interrogator as installed in the Aegis system were incorrect. Subsequent to the JOTA 2 Interoperability Assessment, the Navy developed and disseminated a procedural change to the Aegis operator manuals to correct this issue.
- The 3QFY13 JOTA test event addressed DOD concerns about joint interoperability and identification in an SoS context for those systems under test.
  - Results revealed no new Mode 5-associated deficiencies and the following Mode 5 transponders and interrogators were interoperable in a joint SoS environment:
    - Army – Sentinel; Air Traffic Navigational, Integration, and Coordination System; A/MH-6; C-12R; CH-47F; UH-60M
    - Air Force – F-15C/D/E, F-16 Block 40/50
    - Marine Corps – US-1Y
    - Navy – E-2C, MH-60R, P-3C
  - Both Patriot and Aegis need to improve their ability to fully employ the new Lethal Interrogation capability inherent in the Mode 5 system.
  - Identification information from some Mode 5-equipped command and control systems could not be directly passed via Link 16 datalinks due to inconsistent implementation of the latest version of the Military Standard for dissemination of Mode 5 messages over Link 16.
    - Prior to the JOTA 2 interoperability exercise, some systems had implemented Military Standard-6016E with others scheduled to receive it later. For those systems that did not feature 6016E at the time of the JOTA 2 exercise, a complex and time-consuming methodology was developed and utilized post-exercise to allow Mode 5 track data to be reconstructed and used in the interoperability and effectiveness assessment.
- The Services are implementing new software builds to enable Link 16-equipped systems to disseminate Mode 5 identification information. Specifically, Lethal Interrogation capability with Patriot and Aegis is planned to be improved.
  - The installed performance of new software builds, as well as Mode 5 interoperability with both existing and planned IFF systems, is being validated in combined developmental/integration testing. These upgrades will be incorporated into Mode 5-equipped systems over the next several years.

Recommendations

- Status of Previous Recommendations. The Services have adequately addressed previous recommendations for some platforms; however, response to these FY13 recommendations is ongoing as Mode 5 integration occurs on additional platforms.
- FY14 Recommendations.
  1. In order to ensure interoperability between interrogators, transponders, and combined interrogator-transponders, Service program managers must ensure that developmental and operational testing of Mode 5 capabilities and systems address compatibility with both joint Service and allied IFF systems as well as interoperability with Link 16.
  2. All platforms that did not participate in JOTA 2 and are equipped with Mode 5 capability must participate in a future JOTA equivalent SoS interoperability event.
  3. Patriot and Aegis must return for a subsequent JOTA equivalent SoS event to assess correction of deficiencies during JOTA 2.

MH-60R Multi-Mission Helicopter

Executive Summary

- Commander, Operational Test and Evaluation Force (COTF) completed testing in FY13 on corrections made to resolve previously identified deficiencies with AGM-114 HELLFIRE missiles and the Multi-spectral Targeting System (MTS). DOT&E issued a classified report in April 2014 and noted that while some deficiencies with MTS were resolved, it still does not adequately meet its tracking requirement.
- COTF completed IOT&E of MH-60R with the Automatic Radar Periscope Detection and Discrimination (ARPDD) upgrade in 1QFY14. In April 2014, DOT&E issued a classified IOT&E report and concluded that ARPDD was operationally effective but performance was significantly affected by environmental conditions. DOT&E did not resolve ARPDD suitability due to uncertainty in system reliability that requires further monitoring.
- The January 2014 FOT&E for the Mk 54 lightweight torpedo with Block Upgrade (BUG) tactical software identified shortfalls with the MH-60R tactics and tactical documentation, and interoperability problems with the helicopter's fire control systems.

System

- The MH-60R is a ship-based helicopter designed to operate from cruisers, destroyers, frigates, littoral combat ships, and aircraft carriers.
- It incorporates dipping sonar and sonobuoy acoustic sensors, multi-mode radar, electronic warfare sensors, a forward-looking infrared sensor with laser designator, and an advanced mission data processing system.
- It employs Mk 46 and Mk 54 torpedoes, HELLFIRE air-to-ground missiles, 2.75-inch family of rockets, and crew-served mounted machine guns.
- It has a three-man crew: two pilots and one sensor operator.

Mission

The Maritime Component Commander employs the MH-60R from ships or shore stations to accomplish the following:

- Surface Warfare, Under Sea Warfare, Area Surveillance, Combat Identification, and Naval Surface Fire Support missions previously provided by two different helicopters (SH-60B and SH-60F)
- Support missions such as Search and Rescue at-sea and, when outfitted with necessary armament, maritime force protection duties

Major Contractors

- Sikorsky Aircraft Corporation – Stratford, Connecticut
- Lockheed Martin Mission System and Sensors – Owego, New York

Activity

- COTF executed FOT&E on the MH-60R helicopter employing AGM-114 HELLFIRE missiles with the MTS from 4QFY12 to 2QFY13. This testing focused on corrections made to resolve previously identified MTS deficiencies. DOT&E issued a classified report on the completed FOT&E on April 28, 2014.
- COTF conducted ARPDD testing between August 2012 and September 2013 that included three different locations: the Narragansett Bay Operating Area near Cape Cod, Massachusetts; the Patuxent River Operating Area off the Maryland coast; and the Southern California Offshore Range off the coast of San Diego, California. This testing focused on determining ARPDD capability to detect and classify threat-representative scope exposures across a range of distance, environmental, and exposure duration conditions. DOT&E issued a classified report on completed IOT&E of MH-60R with the ARPDD upgrade on April 3, 2014.
- The Navy completed FOT&E for the Mk 54 lightweight torpedo with BUG tactical software in January 2014. The MH-60R served as the launch platform for 14 weapon drops.
- COTF conducted all testing in accordance with a DOT&E-approved test plan.

Assessment

- The upgraded MTS software showed some improved performance compared to prior operational testing, but the MTS still did not adequately meet its requirement for tracking. The Navy conducted a demonstration of the Surface Warfare mission capability of the MH-60R helicopter equipped with the HELLFIRE missile and MTS; however, testing throughout the operational mission environment is not complete.
- IOT&E demonstrated that ARPDD was operationally effective, but environmental conditions significantly affected performance. Periscope detection and classification performance were demonstrated at ranges that should support effective Anti-Submarine Warfare in low, sea-clutter conditions that are routinely experienced in the defense of a battlegroup in open-ocean. Periscope detection and classification were degraded by significant numbers of non-periscope detections in high-clutter environments that may be observed in littoral waters, an area of interest due to the prevalence of threat submarines in these regions. Overall, ARPDD provided MH-60R helicopters with a submarine identification capability that exceeds radar systems used on other Anti-Submarine Warfare air platforms. As with all radar systems, ARPDD requires a periscope exposure and has no detection capability against submarines that remain submerged below periscope depth.
- During dedicated operational testing, the AN/APS-153 radar system with ARPDD demonstrated a Mean Time Between Failure of 60 hours, well below the fleet operational reported Mean Time Between Failure of nearly 1,000 hours. The cause of the significant discrepancy is unknown and did not support resolution of ARPDD suitability. However, the much more extensive set of fleet data is likely a better indicator of the radar's reliability than the more limited set of data from ARPDD test events.
- Operational testing of the Mk 54 BUG torpedo identified shortfalls with MH-60R tactics and tactical documentation and interoperability problems with the helicopter's fire control systems. Navy testers discovered that MH-60R crews could not access some weapon presets. These problems could prevent fleet operators from effectively employing the Mk 54 BUG torpedo. The Navy initiated immediate actions to address this shortfall.

Recommendations

- Status of Previous Recommendations. The Navy has partially addressed the FY12 recommendation to assess corrections made to resolve previously identified MTS deficiencies by conducting FOT&E. The Navy has not acted on the FY13 recommendations to conduct comprehensive live fire lethality testing of the HELLFIRE missile against a complete set of threat-representative small boat targets and to test the Surface Warfare mission capability of MH-60R equipped with HELLFIRE missiles.
- FY14 Recommendations. The Navy should:
  1. Continue to correct the remaining deficiencies with the MTS tracker.
  2. Demonstrate the Surface Warfare mission capability of the MH-60R helicopter equipped with the HELLFIRE missile and MTS throughout the operational mission environment in FOT&E and LFT&E.
  3. Conduct further evaluation of ARPDD employment in high-clutter, high-contact density littoral environments.
  4. Collect additional radar reliability data, particularly during periods of operations that employ the ARPDD mode.
  5. Address the additional six recommendations in the classified IOT&E report on MH-60R with the ARPDD system.
  6. Investigate and correct interoperability deficiencies of the Mk 54 with MH-60R weapons control systems.

MH-60S Multi-Mission Combat Support Helicopter

Executive Summary

- Commander, Operational Test and Evaluation Force (COTF) completed testing in FY13 on corrections made to resolve previously identified deficiencies with AGM-114 HELLFIRE missiles and the Multi-spectral Targeting System (MTS). DOT&E issued a classified report in April 2014 and noted that while some deficiencies with MTS were resolved, it still does not adequately meet its tracking requirement.
- DOT&E provided an analysis of the results of the Quick Reaction Assessment (QRA) of the LAU-61G/A Digital Rocket Launcher using Advanced Precision Kill Weapon System II (APKWS) rockets in June 2014. The analysis showed that the Digital Rocket Launcher with APKWS rockets provides additional Surface Warfare capability to the MH-60S, but noted technical and operational risks that should be addressed for improved performance.
- COTF completed Phase A (shore-based and training phase) of the planned operational assessment of the MH-60S Block 2 Airborne Mine Neutralization System (AMNS) in 3QFY14. Failures of the host MH-60 aircraft's systems and its associated Airborne Mine Countermeasures (AMCM) kit severely limited AMNS availability. Frequent loss of fiber-optic communications between the aircraft and the neutralizer was the primary cause of unsuccessful attack runs. Both problems increase the time needed to conduct Littoral Combat Ship (LCS)-based AMNS operations and reduce the ship's sustained area coverage rate. COTF completed an operational assessment of the Airborne Lase Mine Detection System (ALMDS) and AMNS by conducting Phase B (LCS)-based phase) of the test in 1QFY15 aboard LCS 2 during Increment 1 MCM mission package developmental testing. DOT&E assessed the detection and localization capabilities provided by ALMDS and the identification and neutralization capabilities provided by AMNS to be consistent with the findings from earlier shore-based operational assessments of the systems. Neither system demonstrated the performance necessary for an LCS equipped with an Increment 1 MCM mission package to meet its required sustained area coverage rate.

System

- The MH-60S is a helicopter modified into three variants (blocks) from the Army UH-60L Blackhawk for operation in the shipboard/maritime environment.
- The blocks share common cockpit avionics and flight instrumentation with the MH-60R.
- Installed systems differ by block based on mission:
  - Block 1, Fleet Logistics – precision navigation and communications, maximum cargo or passenger capacity.
  - Block 2A/B, AMCM System – AMCM system operator workstation; a tether/towing system and the two MCM systems currently under development; ALMDS for detection and classification of near-surface mines; and the AMNS for neutralization of in-volume and bottom mines. In FY12, the Chief of Naval Operations concluded that the MH-60S helicopter is significantly underpowered for the safe performance of the AMCM tow mission and provides limited tactical utility relative to the risk to aircrew, and cancelled that MH-60S mission. The decision to cancel the AMCM tow mission affects employment of both the AQS-20A sonar and Organic Airborne and Surface Influence Sweep. Both systems are no longer being developed for use in the AMCM system. Any Block 2 or subsequent aircraft (e.g., Block 3 A/B aircraft) can be an AMCM aircraft.
  - Block 3A, Armed Helicopter – 20 mm Gun System, forward-looking infrared with laser designator, crew-served side machine guns, dual-sided HELLFIRE air-to-ground missiles, and defensive electronic countermeasures.
  - Block 3B, Armed Helicopter – Block 3A with addition of tactical datalink (Link 16) and tie-beam to the External Weapon System Pylon to support the required weight of the loaded LAU-61s.

Mission

The Maritime Component Commander can employ variants of MH-60S from ships or shore stations to accomplish the following missions:

- Block 1 – Vertical replenishment, internal cargo and personnel transport, medical evacuation, Search and Rescue, and Aircraft Carrier Plane Guard
- Block 2 – Detection, classification, identification and/or neutralization of sea mines, depending on which AMCM systems are employed on the aircraft

- Block 3 – Combat Search and Rescue, Surface Warfare, Aircraft Carrier Plane Guard, Maritime Interdiction Operations, and Special Warfare Support

Major Contractors
- Sikorsky Aircraft Corporation – Stratford, Connecticut
- Lockheed Martin Mission System and Sensors – Owego, New York
- Raytheon Company, Integrated Defense Systems – Tewksbury, Massachusetts
- Northrop Grumman – Melbourne, Florida

Activity
- COTF executed FOT&E on the MH-60S helicopter equipped with AGM-114 HELLFIRE missiles and the MTS from 4QFY12 to 2QFY13. This testing focused on corrections made to resolve previously identified MTS deficiencies.
- DOT&E issued a classified report on completed FOT&E of MH-60R/S helicopters equipped with AGM-114 HELLFIRE missiles and the MTS on April 28, 2014.
- COTF conducted a QRA of MH-60S with the LAU-61G/A Digital Rocket Launcher armed with APKWS II rockets in 1QFY14. DOT&E issued the QRA report in June 2014.
- COTF completed Phase A (shore-based and training phase) of the planned operational assessment of the MH-60S Block 2 AMNS in 3QFY14. The test included the use of explosive neutralizers and inert training neutralizers against inert moored and bottom mine targets, in the lower current environment only.
- COTF completed an operational assessment of the ALMDS and AMNS by conducting Phase B (LCS-based phase) of the test in 1QFY15 aboard USS *Independence* (LCS 2) during Increment 1 MCM mission package developmental testing. The test examined the shipboard compatibility of the MH-60S helicopter and the ALMDS and the AMNS, and other aspects of operational suitability necessary to support and sustain LCS MCM effectiveness.
- COTF conducted all testing in accordance with a DOT&E-approved test plan.

Assessment
- The upgraded MTS software showed some improved performance compared to prior operational testing, but the MTS still did not adequately meet its requirement for tracking. Additionally, the Surface Warfare mission capability of the MH-60S helicopter equipped with MTS and the HELLFIRE missile was not tested throughout the operational mission environment. MTS tracking risks should be addressed as soon as possible.
- The QRA of the MH-60S equipped with the Digital Rocket Launcher and APKWS rockets demonstrated additional Surface Warfare capability for the MH-60S, but identified technical and operational risks that should be addressed for improved mission performance.
- During the shore-based operational assessment of the AMNS in FY14, AMNS was unable to achieve the Navy's requirement for mine neutralization success except under limited conditions not generally expected during combat. Failures of the host MH-60S aircraft's systems and its associated AMCM Mission Kit limited AMNS mission availability. Frequent loss of fiber-optic communications between the aircraft and the neutralizer was the primary cause of unsuccessful attack runs. Although the Navy attributed the failures to the bottom composition (sand and shells), the root cause of these failures has not yet been determined, and the bottom compositions used in testing are representative of realistic operating areas. Both problems negatively affect the timeliness of LCS-based AMNS operations and will likely reduce the ship's sustained area coverage rate.
- The results of the Navy's 1QFY15 operational assessment of the ALMDS and AMNS were consistent with the findings from earlier shore-based operational assessments of the systems:
  - DOT&E assessed the MH-60S helicopter equipped with the AMNS and determined the identification and neutralization capabilities were not demonstrated for an LCS equipped with an Increment 1 MCM mission package to meet its required sustained area coverage rate. No data were collected to assess AMNS performance in the medium or higher current regimes.
  - DOT&E assessed the MH-60S helicopter equipped with the ALMDS and determined the detection and localization capabilities were not demonstrated for an LCS equipped with an Increment 1 MCM mission package to meet its required sustained area coverage rate. Shore-based testing of the ALMDS completed in 4QFY12 showed that the system does not meet Navy detection requirements. ALMDS generates a large number of false classifications (objects erroneously classified as mine-like). Unless eliminated from the contact list, these false classifications require identification and neutralization effort, result in the expenditure of limited neutralizer assets, and drastically reduce the LCS sustained area coverage rate. As an alternative, the Navy has implemented tactics that require multiple search passes over the same area to minimize the number of false classifications passed on for identification/neutralization. Although multiple passes also reduce the LCS sustained area coverage rate relative to single pass systems, Navy modeling suggests this approach is less detrimental to MCM timelines. Whether LCS can

meet the already-reduced low area clearance requirement for the Increment 1 mission package remains in question.

Recommendations

- Status of Previous Recommendations. The Navy still needs to address the FY11 recommendation to investigate solutions and correct the ALMDS False Classification Density and reliability deficiencies prior to IOT&E. The Navy has partially addressed the FY12 recommendation to assess corrections made to resolve previously identified MTS deficiencies by conducting FOT&E. The Navy has not acted on the FY13 recommendations to:
  1. Complete comprehensive survivability studies for MH-60S employing the 20 mm Gun System and the Unguided Rocket Launcher.
  2. Conduct comprehensive live fire lethality testing of the HELLFIRE missile against a complete set of threat-representative small boat targets.
  3. Correct the tracking deficiencies in the MTS and conduct appropriate FOT&E in order to satisfactorily resolve the Surface Warfare Critical Operational Issue.
  4. Complete comprehensive IOT&E on the 2.75" Unguided Rocket and APKWS II to resolve the Surface Warfare Critical Operational Issue not resolved in limited assessments of system performance provided in QRAs against small boat threats.
- FY14 Recommendations. The Navy should:
  1. Continue to correct the deficiencies with the MTS tracker identified in testing.
  2. Test the Surface Warfare mission capability of MH-60S Helicopter equipped with MTS and the HELLFIRE missile throughout the operational mission environment in FOT&E and LFT&E.
  3. Complete vulnerability studies for MH-60S employing the LAU-61G/A Digital Rocket Launcher armed with APKWS II rockets.
  4. Conduct comprehensive lethality testing of the LAU-61G/A Digital Rocket Launcher armed with APKWS II rockets against a complete set of threat-representative small boat targets.
  5. Correct AMCM mission kit reliability issues that limit AMNS mission availability identified during the operational assessment.
  6. Develop corrective actions to eliminate early termination fiber-optic communications losses observed in the AMNS operational assessment.
  7. Conduct AMNS medium current testing from MH-60S. This testing must be completed prior to the completion of IOT&E.

Mine Resistant Ambush Protected (MRAP) Family of Vehicles (FoV) – Marine Corps

Executive Summary

- The U.S. Marine Corps (USMC) will retain 2,467 Mine Resistant Ambush Protected (MRAP) vehicles in its enduring fleet that includes Cougar Category (CAT) I, Cougar CAT II, Buffalo CAT III, and MRAP All-Terrain Vehicle (M-ATV) variants.
- Early live fire testing conducted in 4QFY14 suggests that the Cougar CAT II A1 variant with seat survivability upgrades will meet its required level of performance; however, additional planned live fire testing remains to be executed in FY15.
- The Cougar retrofitted with a remote weapons station for use by the Air Force provides protection from underbody blasts.

Cougar Category (CAT) II A1

System

- The MRAP Family of Vehicles (FoV) is designed to provide increased crew protection and vehicle survivability against current battlefield threats, such as IEDs, mines, small arms fire (SAF), rocket-propelled grenades (RPGs), and Explosively Formed Penetrators (EFPs). The MRAPs are employed by units in current combat operations in the execution of missions previously accomplished with the High Mobility Multi-purpose Wheeled Vehicle.
- In FY14, the MRAP Joint Program Office (JPO) dissolved and the Army and the Marine Corps became the lead Services responsible for their respective MRAP variants. In 2013, the Marine Corps defined its enduring MRAP fleet, which it will retain after transitioning from a JPO to a USMC-led program manager. Currently, 2,467 MRAP vehicles will be retained in the USMC enduring fleet: CAT I A1 (1,337 vehicles); CAT I A1 tube-launched, optically-tracked, wireless-guided (TOW®) weapons system (59); CAT II A1 (300); Cougar A2 Ambulance (19); M-ATV with Underbelly Improvement Kit (704); Cougar CAT II Mounted Communications Emitter Sensing Attack System (10), and Buffalo CAT III (38). In addition, the USMC will remain the Primary Inventory Control Activity for all Cougar platforms, including those vehicles divested to the Navy and Air Force.
- This report covers testing of two USMC Cougar CAT II A1 variants: one with seat survivability upgrades (SSU) and one with a remote weapons station (RWS) that is intended for use by the Air Force.
  - The SSU is primarily a redesign of the rear crew compartment of the Cougar, focusing on improved seating for survivability, safety, and human factors integration, and can carry 10 Marines and 1 gunner.
  - The Air Force RWS Cougar has a Common Remotely-Operated Weapons Station II mounted to its roof, and will carry a crew of three (driver, assistant driver, and RWS gunner).

Mission

Marines will operate the MRAP Cougar CAT II A1 vehicle to conduct mounted patrols, reconnaissance, communications, and command and control missions in a threat environment. Explosive Ordnance teams will rely on the Air Force RWS Cougar for support in a wide range of missions and environments both in the U.S. and while deployed.

Major Contractor

General Dynamics Land Systems – Ladson, South Carolina

Activity

Cougar CAT II A1 with SSU

- The Marine Corps plans to retrofit a total of 303 USMC, 41 Air Force, and 14 Navy CAT II A1 vehicles with the SSU upgrades that are designed to achieve Capabilities Production Document 1.1 objective-level protection against underbody and under-wheel blast mines.
- Live fire testing of the CAT II A1 Cougar with SSU commenced in FY14 with an underbody blast event, crew Automatic Fire Extinguishing System testing, and ballistic exploitation testing. Additional planned blast testing will continue into FY15. This seat upgrade program is a result of the 2010 DOT&E report on the original MRAP Cougar

vehicles and a 2011 DOT&E report on the Cougar vehicles retrofitted with an Independent Suspension System. Both reports emphasized the need for the then JPO to install improved energy-attenuating seats across the Cougar fleet.

Air Force RWS Cougar

- The Air Force will integrate the RWS upgrade into the following Cougar four variants: CAT I A1 (9 vehicles), CAT II A1 (39 vehicles), CAT I A2 (15 vehicles), and CAT II A2 (19 vehicles).
- The Marines executed a single underbody blast test of a CAT II A1 Cougar in the RWS configuration. The CAT II AI Cougar comprises 39 of the 82 total vehicles to be retrofitted, and configuration of the RWS integration across all four variants is sufficiently similar for the results of that test to apply to all four variants. This test focused on the area of significant modification for this platform, which was under the new RWS gunner seat.
- All testing was conducted in accordance with a DOT&E-approved test plan.

Assessment

Cougar CAT II A1 with SSU

- Early live fire testing indicates that the Cougar CAT II A1 with SSU meets its contract specifications. However, additional planned live fire testing remains to determine the level of protection provided to occupants of the vehicle. The results from the legacy Cougar live fire test program (as found in the 2010 DOT&E report on the original MRAP Cougar vehicles) relative to other tested threats such as IEDs, indirect fire, SAF, RPGs, and EFPs are applicable to the Cougar CAT II A1 with SSU.

Air Force RWS Cougar

- The Air Force RWS Cougar provides protection to its occupants from underbody blasts at the location tested. The results from the legacy Cougar live fire test program (as found in the 2010 DOT&E report on the original MRAP Cougar vehicles) relative to other tested threats such as IEDs, indirect fire, SAF, RPGs, and EFPs are applicable to the Air Force Cougar with RWS.

Recommendations

- Status of Previous Recommendations. The program is making progress implementing the previous recommendations regarding upgrading the seats in the Cougar CAT II A1 vehicles. There was no live fire or operational testing conducted on the M-ATV in FY14; therefore, none of the FY13 recommendations apply to the vehicles tested in FY14.
- FY14 Recommendations. None.

Mk 54 Lightweight Torpedo

Executive Summary

- The Navy and DOT&E completed OT&E for the Mk 54 lightweight torpedo with Block Upgrade (BUG) tactical software in January 2014.
  - OT&E started after the Navy fielded the Mk 54 (BUG) in January 2012 in response to an urgent operational need. During operational testing that included fleet training, the Navy shot weapons from surface ships, fixed-wing aircraft, and helicopters against U.S. attack submarine and static submarine surrogate targets.
  - DOT&E issued a classified OT&E report on the Mk 54 (BUG) torpedo in September 2014. DOT&E assessed the Mk 54 (BUG) torpedo as not operationally effective. During operationally challenging and realistic scenarios, the Mk 54 (BUG) demonstrated below threshold performance and exhibited many of the same failure mechanisms observed during the FY04 IOT&E.
- The Mk 54 torpedo is operationally suitable and meets the same reliability and availability requirements as the baseline torpedo. However, operational testing identified shortfalls with the employing platforms' tactics and tactical documentation, and interoperability problems with some platform fire control systems.
- The Navy continued development of hardware and software updates to the Mk 54. The new version is designated the Mk 54 Mod 1 torpedo and is scheduled to begin OT&E in FY17.
- DOT&E is participating in the Navy's Torpedo Target Strategy Working Group to identify and develop test target surrogates for the Mk 54. The Navy proposed a short-term strategy that utilizes three separate targets, each appropriate for specific limited scenarios. The Navy does not have an adequate long-term strategy. Currently, the strategy is not fully funded.

System

- The Mk 54 lightweight torpedo is the primary Anti-Submarine Warfare (ASW) weapon used by U.S. surface ships, fixed-wing aircraft, and helicopters.
- The Mk 54 combines the advanced sonar transceiver of the Mk 50 torpedo with the legacy warhead and propulsion system of the older Mk 46. Mk 46 and Mk 50 torpedoes can be converted to an Mk 54 via an upgrade kit.
- The Mk 54 sonar processing uses an expandable, open architecture system. It combines algorithms from the Mk 50 and Mk 48 torpedo programs with the latest commercial off-the-shelf technology.
- The Navy designed the Mk 54 to operate in shallow-water environments and in the presence of countermeasures.
- The Navy has designated the Mk 54 torpedo to replace the Mk 46 torpedo as the payload section for the Vertical Launched Anti-Submarine Rocket for rapid employment by surface ships.

- The High-Altitude Anti-Submarine Warfare Weapons Capability (HAAWC) program will provide an adapter kit to permit long-range, high-altitude, GPS-guided deployment of the Mk 54 by a P-8A Multi-mission Maritime Aircraft.
- The Mk 54 BUG is a software upgrade to the Mk 54 baseline torpedo designed to correct deficiencies identified during the 2004 Mk 54 IOT&E.
- The Mk 54 must be interoperable and compatible with the analog or digital combat control systems and software variants installed on all ASW fixed-wing and helicopter aircraft, and on the surface ship combat control system variants used for torpedo tube or ASW rocket-launched torpedoes.

Mission

Navy surface ships and aircraft employ the Mk 54 torpedo as their primary anti-submarine weapon:

- For offensive purposes, when deployed by ASW aircraft and helicopters
- For defensive purposes, when deployed by surface ships
- In both deep-water open ocean and shallow-water littoral environments
- Against fast, deep-diving nuclear submarines and slow moving, quiet, diesel-electric submarines

Major Contractors

- Raytheon Integrated Defense Systems – Tewksbury, Massachusetts
- Progeny Systems Corporation – Manassas, Virginia
- Boeing Company – St. Charles, Missouri
- Northrop Grumman – Annapolis, Maryland

Activity

- Operational testing of the Mk 54 (BUG) torpedo commenced in FY12, following the early fielding of the software upgrade in January 2012 to address a Fifth Fleet Urgent Operational Need threat. During operational testing, the Navy shot 77 weapons from surface ships, fixed-wing aircraft, and helicopters against U.S. attack submarine and static submarine surrogate targets. The Navy and DOT&E completed OT&E for the Mk 54 lightweight torpedo with BUG tactical software in January 2014 in accordance with a DOT&E-approved test plan.
- DOT&E issued a classified OT&E report on the Mk 54 (BUG) torpedo in September 2014.
- The Program Executive Officer (Submarines) recommended the unrestricted fielding of the Mk 54 (BUG) in June 2014.
- During FY14, the Navy continued development of hardware and software updates to the Mk 54. The new version is designated the Mk 54 Mod 1 torpedo and is scheduled to begin OT&E in FY17. The Navy is developing new Mk 54 Mod 1 torpedo front end processors and transducers and new tactical software to address the performance shortfalls identified with the Mk 54 (BUG). The Navy plans to approve a new set of Mk 54 Mod 1 requirements documents and the Test and Evaluation Master Plan (TEMP) in FY15.
- DOT&E is participating in the Navy's Torpedo Target Strategy Working Group to identify and develop test target surrogates for the Mk 54. The Navy proposed a short-term strategy that utilizes three separate targets, each appropriate for specific limited scenarios. The Navy does not have an adequate long-term strategy. Currently, the strategy is not fully funded.
- DOT&E is participating in working groups and funding (as a short-term resource enhancement project) an update to the Weapons Assessment Facility (WAF) Hardware-in-the-Loop model and simulation located at the Naval Undersea Warfare Center in Newport, Rhode Island. The project is intended to improve the WAF for developing and testing torpedoes by improving the modeling of the ocean environment and improving target models.

Assessment

- DOT&E assessed that the Mk 54 torpedo is not operationally effective as an offensive ASW weapon. During operationally challenging and realistic scenarios, the Mk 54 (BUG) demonstrated below threshold performance and exhibited many of the same failure mechanisms observed during the IOT&E. Torpedo mission kill performance against targets employing the operationally realistic evasion tactics was below requirement thresholds. Performance is further degraded when considering crew performance for targeting and employing the Mk 54 and the Navy's assessment of warhead performance in operationally realistic scenarios.
- The Mk 54 torpedo is operationally suitable and meets the same reliability and availability requirements as the baseline torpedo. However, operational testing identified shortfalls with the employing platforms' tactics and tactical documentation, and interoperability problems with some platform fire control systems. During operational testing of the Mk 54 BUG torpedo, Navy testers discovered that crews could not access some weapon presets on some of the intended launch platforms. These problems could prevent fleet operators from effectively employing the Mk 54 BUG torpedo. The Navy initiated immediate actions to address this shortfall.
- Some operational realistic scenarios have not been assessed due to the unavailability of target surrogates and the Navy's safety regulations for shooting against manned submarine targets. Limited testing of these regions of the torpedo's operational profile confirmed previous assumptions were not valid and that future dedicated testing is required with target surrogates that are capable of being hit by the Mk 54 (set-to-hit testing).
- Additional information and a detailed assessment are available in DOT&E's OT&E classified report on the Mk 54 (BUG) lightweight torpedo dated September 2014.
- The Navy proposed some unmanned target surrogates that could be used to assess the performance of the Mk 54 during the end of the torpedo's run. The proposals include an unmanned static target, a mobile device towing electronic target signal repeater (unfunded), and a mobile small submarine surrogate intended for training (developed and built but unfunded for validation or operations). However, the Navy has not provided sufficient evidence to indicate these will permit realistic engagements.

Recommendations

- Status of Previous Recommendations. The following previous recommendations remain outstanding. The Navy still needs to:
  1. Conduct mobile target set-to-hit testing. The Navy completed an initial terminal homing assessment against the set-to-hit Steel SSK static target surrogate; however, the Navy deferred the mobile testing due to the lack of a suitable target surrogate.
  2. Continue to develop an LFT&E strategy that includes the firing of the Mk 54 against appropriate targets. The Navy plans to conduct this testing with the Mk 54 Mod 1 torpedo upgrade.
  3. Fund an operationally realistic mobile set-to-hit target to complete the terminal homing testing of the Mk 54 torpedo. The Navy continues to investigate possible surrogates; however, the proposals are unfunded.
  4. Propose alternatives to minimize or eliminate the test and safety limitations that minimize operational realism in Mk 54 testing.
  5. Complete development of the Mk 54 Mod 1 requirements and TEMP. This TEMP should include all the necessary resources or plans to develop the necessary resources, including target and range needs, to complete the remaining testing.
  6. Pursue development of an evasive mobile set-to-hit target and threat representative countermeasures to support operationally realistic development and testing of the

Mk 54 Mod 1 torpedo. The targets identified by the Navy's Torpedo Target Strategy Working Group will support a limited portion of the required Mk 54 development and testing.

7. Institute processes to verify the incremental upgrades to the Mk 54 are interoperable with the variety of combat systems on surface ship, aircraft, and helicopter platforms and that tactics and documentation are updated.

- FY14 Recommendations. The Navy should evaluate and incorporate the 11 recommendations in DOT&E's Mk 54 (BUG) OT&E report to improve the effectiveness of the Mk 54. Significant unclassified recommendations include:

1. Improve the target detection localization and track performance of ship and aircraft crews that employ the Mk 54. While improving the sensor system capability on ships and aircraft is a longer range goal, updating the Mk 54 employment tactics, training, and documentation could immediately improve overall crew proficiency and ASW effectiveness.
2. Improve the Mk 54's effective target search and detection capability. The Mk 54 should be able to effectively search the area defined by typical fire control solution accuracy and crew employment and placement errors.
3. Simplify the variability of Mk 54 employment options and required water entry points in existing tactical documentation.

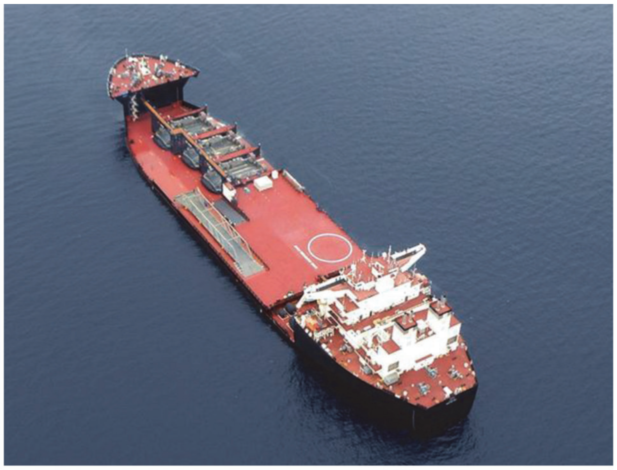
Mobile Landing Platform (MLP) Core Capability Set (CCS) and Afloat Forward Staging Base (AFSB)

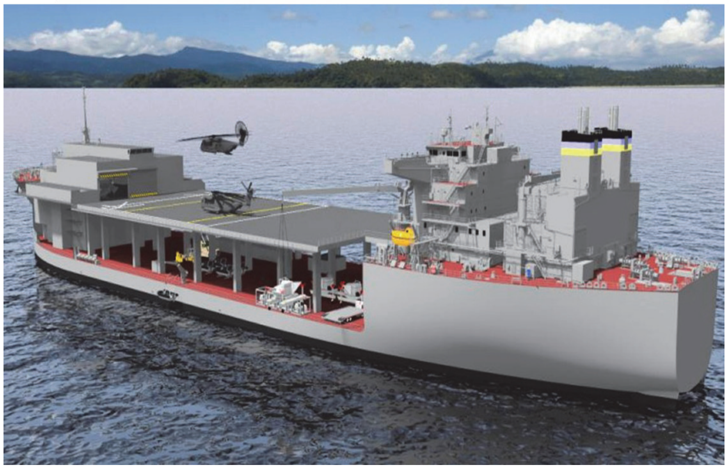
Executive Summary

- In June 2014, the Navy commenced Post Delivery Test and Trials (PDT&T) on USNS *Montford Point* (MLP-1) Mobile Landing Platform (MLP) Core Capability Set (CCS). IOT&E took place August 25 through November 4, 2014. Initial results indicate the following:
  - MLP (CCS) is capable of transiting the required 9,500 nautical miles at 15 knots unrefueled.
  - MLP (CCS) can land and launch Landing Craft Air Cushion (LCAC) vehicles through Sea State 3.
  - MLP (CCS) can operate skin-to-skin, to include vehicle transfer through Sea State 3, with both the USNS *Bob Hope* (*Bob Hope* class) and USNS *Dahl* (*Watson* class) Large Medium Speed Roll-on roll-off (LMSR) ships.
  - Initial observations and assessment indicate deficiencies exist with MLP (CCS) skin-to-skin mooring operations with Joint High Speed Vessel (JHSV). During the first test, several mooring lines parted, precluding completion of the test event. During the second test, the mooring line issue was resolved but the JHSV ramp suffered a casualty, precluding completion of the test.
  - The Navy's Commander, Operational Test and Evaluation Force (COTF) conducted cybersecurity testing of MLP (CCS) and no significant vulnerabilities were noted. Initial evaluation suggests that even if a cyber-adversary gained access, overall ship's mission disruption would be minimal.
- The MLP program did not conduct any major live fire test events during FY14. The Navy plans to conduct the Total Ship Survivability Trial on the MLP Afloat Forward Staging Base (AFSB) variant in FY16, which will provide data for recoverability analysis. The Navy issued the Detailed Design Survivability Assessment Report in December 2013. The final Survivability Assessment Report is planned for FY17.

System

- MLP is a modified heavy-lift ship the Navy procured that uses float-on/float-off technology. It is based on the British Petroleum *Alaska* class oil tanker.
- Thirty-four Military Sealift Command (MSC) contracted mariners will operate and maintain the MLP (CCS) vessels. Thirty-four MSC civilian mariners will operate and maintain the MLP (AFSB) vessels. MSC will serve as MLP Life Cycle Managers.
- The Navy plans to deliver the MLP with two different mission capabilities: a CCS on hulls 1 and 2, and an AFSB on hulls 3 and 4.





- The Navy intends for CCS to:
  - Support Mobile Prepositioning Force operations by facilitating at-sea transfer and delivery of pre-positioned assets to units ashore
  - Consist of a vehicle staging area (raised vehicle deck), vehicle transfer ramp, large mooring fenders, an emergency-only commercial helicopter operating spot, and three LCAC lanes/operating spots (barriers, catwalk, lighting, wash down, and fueling services)
  - Be equipped with a crane for placing of fenders used for skin-to-skin operations with an LMSR or JHSV
  - Interface with the LMSR ships and LCACs or the follow-on Ship-to-Shore Connectors to permit off-loading military vehicles ranging from High Mobility Multi-purpose Wheeled Vehicles to battle tanks (M1A2)
  - Be classified as a non-combatant with a limited self-protection capability

- The Navy intends for AFSB to:
  - Support Airborne Mine Countermeasure (AMCM) operations
  - Host a squadron of four MH-53E helicopters
  - Include a two-spot flight deck, hangar facility, helicopter-fueling capability, ordnance storage, operation planning and work spaces, and berthing for 250 Navy personnel
  - Have a mission deck below the flight deck with a crane for storing and deploying the various mine-hunting and clearing equipment used with the MH-53E helicopters; explosive ordnance demolition boats and equipment may also be stored and handled on the mission deck
  - Support Special Forces in the future when funding is available to provide that capability
  - Be classified as a non-combatant with a limited self-protection capability

Mission

- The Navy developed MLP to host multiple mission sets, operate from international waters, and persist for extended periods providing a capability unencumbered by geo-political constraints in order to meet strategic goals.
- Combatant Commanders will use MLP (CCS) as a surface interface between other Mobile Prepositioning Force (future) squadron ships and connectors and the sea base. They will also use it to transfer personnel and equipment from LMSR and JHSVs to the MLP (CCS), and then onto LCACs or Ship-to-Shore Connectors to facilitate delivery ashore of forces from the sea.
- Combatant Commanders will use MLP (AFSB) to provide AMCM capabilities during the AMCM mission to support the legacy MH-53E helicopters and host the various mine-detecting and clearing equipment used with the helicopters, along with explosive ordnance demolition boats and equipment.

Major Contractors

- MLP base ship and MLP AFSB: General Dynamic's National Steel and Shipbuilding Company (NASSCO) – San Diego, California
- CCS arrangement : Vigor Marine (Limited Liability Company) Shipbuilding – Portland, Oregon

---

Activity

- On June 13, 2014, DOT&E approved the MLP (CCS) IOT&E test plan. The test plan adopts an integrated test approach where the Navy conducts developmental and operational testing concurrently, with each having its own set of metrics and data collection. All tests were conducted in accordance with the DOT&E-approved test plan.
- USNS *Montford Point* (MLP-1) launched November 2012, completed builders and acceptance trials, delivered in May 2013, and completed final contract trials in September 2013. The Navy and Vigor Marine completed installation of the CCS in April 2014, and PDT&T commenced in June 2014. USNS *Lewis B. Puller* (MLP-3 AFSB) is expected to deliver in 4QFY15. The following test events were conducted at sea off Camp Pendleton, in Long Beach Harbor, and in harbor in San Diego, California:
  - The Navy and Marine Corps attempted to conduct a day and night interface test mooring of the JHSV to the MLP (CCS) vessel during the week of June 23, 2014. USNS *Millinocket* (JHSV-3) moored skin-to-skin with USNS *Montford Point* (MLP-1 CCS) and Marine Corps vehicles transited back and forth during daylight. The vehicle transfer in daylight was completed successfully, but five mooring lines broke prompting cancellation of the night test.
  - The Navy and Marine Corps attempted the same evolution a second time on October 29, 2014. Although the mooring line problem was resolved, and both day and night moorings were completed, the JHSV ramp suffered a casualty, prompting cancellation of further vehicle transfers after recovering the first vehicle.
  - The Navy and Marine Corps conducted a portion of the primary timed vehicle transfer requirement during a fleet exercise the week of July 7, 2014. The primary timed requirement for MLP (CCS) is to enable the transfer ashore of all the vehicles for a Marine Corps reinforced rifle company in a 12-hour period from 25 nautical miles at sea with the exception of Amphibious Assault Vehicles (AAVs). AAVs are slower than LCACs in the water, and are best launched within five nautical miles from the beach. During this exercise, MLP-1 was positioned just inside 3 nautical miles from shore, and the United States Marine Corps transferred 15 AAVs ashore in 1 hour and 4 minutes.
  - The Navy and Marine Corps successfully completed the rest of the reinforced rifle company vehicle transfers via LCAC in a timed event on October 14, 2014. Although MLP-1 was not positioned 25 nautical miles from shore, the LCACs transited a route of 25 nautical miles both to shore and then back to MLP-1 for the next load.
  - The Navy conducted a 24-hour, 15-knot fuel economy trial as MLP-1 transited from the Seattle Washington area to Southern California waters. Preliminary analysis indicates the ship can easily achieve the 9,500 nautical miles, unrefueled, 15-knot transit requirement.
  - The Navy and Marine Corps successfully conducted skin-to-skin operations through Sea State 3 with both the USNS *Bob Hope* (*Bob Hope* class) and the USNS *Dahl*

(*Watson* class) LMSRs, to include vehicle transfer and LCAC operations, in various tests during September and October 2014.
  - The Navy and Marine Corps conducted a Critical System Maintenance Review with the ship's company to assist in evaluating suitability of both maintenance and logistics for the ship class.
  - The Navy conducted a limited self-defense drill (no targets engaged) and a Structural Test Fire Event that verified fields of fire and 0.50 caliber machine gun mount structure suitability on November 3, 2014.
- COTF conducted a local cybersecurity evaluation of MLP-1 during the week of July 28, 2014. COTF conducted this evaluation to assess the ship's hosts and servers on the unclassified and classified networks.
- COTF conducted the remote reconnaissance and cyber-attack evaluation on MLP-1 on August 25 – 26, 2014. This evaluation focused on how initial footholds can be gained by an external attacker and how well they can be leveraged.
- The MLP program did not conduct any major live fire test events during FY14. The Navy plans to conduct the Total Ship Survivability Trial on the MLP AFSB variant in FY16, which will provide data for recoverability analysis. The Navy issued the Detailed Design Survivability Assessment Report in December 2013. The final Survivability Assessment Report is planned for FY17.

Assessment
- This report provides only a preliminary assessment of the MLP (CCS) based on observations on USNS *Montford Point* (MLP-1). DOT&E will provide the final assessment in the 3QFY15 IOT&E report.
- Vehicle transfer at sea with JHSV moored skin-to-skin with MLP (CCS) is not advised (mooring with JHSV is a secondary mission for MLP.) Initial observations and assessment indicate deficiencies exist with MLP (CCS) skin-to-skin mooring operations with JHSV. During the first test event, several mooring lines parted, precluding completion of the test event. During the second test event, the mooring line issue was resolved but the JHSV ramp suffered a casualty, precluding completion of the test. Analysis is in progress and final assessment will be provided in the IOT&E report.
- The primary timed vehicle transfer requirement is satisfied. The unrefueled range requirement is satisfied
- The Navy demonstrated skin-to-skin operations and vehicle transfer through Sea State 3 with both the USNS *Bob Hope* (*Bob Hope* class) and USNS *Dahl* (*Watson* class) LMSRs.
- The local cybersecurity test demonstrated that the network's Host-Based Security System stopped most of COTF's cyber-attacks against unclassified and classified networks. As the ship's networks are not connected to the ship's critical systems, the loss of either unclassified or classified networks during operations would be an inconvenience, but would not hinder the ship's ability to conduct its mission since it has communication backups, including radios and standalone satellite phones.
- During the remote reconnaissance and cyber-attack evaluation, COTF was unable to gain a foothold on the MLP-1 networks with the toolset used for these assessments. However, the test did not explore the vulnerability of the ship to very advanced cyber threats due to security restrictions in place during the time of the test.

Recommendations
- Status of Previous Recommendations. This is the first annual report for this program.
- FY14 Recommendation. IOT&E analysis is ongoing and DOT&E expects to issue a full assessment and recommendations in 3QFY15.
  1. The Navy should reevaluate the need for at sea skin-to-skin operations between MLP (CCS) and JHSV.

MQ-4C Triton Unmanned Aircraft System

Executive Summary

- In 1QFY14, USD(AT&L) approved a revised Triton program plan, which projects an operational assessment (OA) occurring in 3QFY15 and a Milestone C in 1QFY15. An updated Acquisition Program Baseline was subsequently approved on July 7, 2014. The revised program schedule has allowed the program to execute additional risk reduction testing prior to conducting the OA.
- The Navy continued several development efforts in FY14, including ground and lab testing of system communications and datalink architectures, and the Multi-Function Active Sensor (MFAS) radar risk reduction flight testing on a Northrop Grumman surrogate test bed aircraft.
- On September 18, 2014, Triton aircraft B-1 was ferried from Edwards AFB, California, to Patuxent River Naval Air Station (NAS), Maryland. Basing of Triton at Patuxent River NAS is a prerequisite for integration of mission systems on the air vehicle, development of the Integrated Functional Capability 2.2 system software, and operational test flights. The movement of the Triton Aircraft from Edwards AFB to Patuxent River NAS was an important milestone for the program.

System

- The MQ-4C Triton Unmanned Aircraft System (UAS) is an Intelligence, Surveillance, and Reconnaissance system-of-systems consisting of the high-altitude, long-endurance MQ-4C air vehicle, sensor payloads, and supporting ground control stations. The MQ-4C system is a part of the Navy Maritime Patrol and Reconnaissance family-of-systems, with capabilities designed to complement the P-8A Poseidon Multi-mission Maritime aircraft.
- The MQ-4C air vehicle design is based on the Air Force RQ-4B Global Hawk air vehicle with significant modifications that include strengthened wing structures and an anti-ice and de-icing system. An air traffic de-confliction and collision avoidance radar system is also planned, but the Navy is no longer pursuing the Air-to-Air Radar Subsystem (AARSS).
- The MQ-4C is equipped with the MFAS maritime surveillance radar to detect, identify, and track surface targets and produce high-resolution imagery. The MQ-4C electro optical/infrared sensor provides full motion video and still imagery of surface targets. An Electronic Support Measures system detects, identifies, and geolocates radar threat signals. An Automatic Identification System receiver permits the detection, identification, geolocation, and tracking of cooperative vessels equipped with Automatic Identification System transponders.

- Onboard line-of-sight and beyond line-of-sight datalink systems transmit sensor data from the air vehicle to ground control stations for dissemination to fleet tactical operation centers and intelligence exploitation sites.

Mission

- Commanders use units equipped with MQ-4C to conduct maritime surveillance operations and provide high- and medium-altitude, long-endurance intelligence collection.
- MQ-4C operators detect, identify, track, and assess maritime and littoral targets of interest and collect imagery and signals intelligence information. Operators disseminate sensor data to fleet units to support a wide range of maritime missions to include surface warfare, intelligence operations, strike warfare, maritime interdiction, amphibious warfare, homeland defense, and search and rescue.

Major Contractor

Northrop Grumman Aerospace Systems, Battle Management and Engagement Systems Division – Rancho Bernardo, California

Activity

- Technical problems and budget impacts caused delays in the flight test schedule throughout FY12 and FY13. In 1QFY14, the USD(AT&L) approved the Triton program to re-baseline the schedule and budget. The current schedule reflects a goal to conduct an OA in 3QFY15 and to reach Milestone C in 1QFY16.

- Since May 2013, the Navy has completed a total of 16 flights, including the ferry flights from Edwards AFB, with 9 of those flights completed in FY14.
- During the developmental testing and envelope expansion of the Air Vehicle, the Navy continued several development efforts including:
  - Ground and lab testing of system communications and datalink architectures, which are intended to provide risk reduction for mission systems and end-to-end mission flight testing.
  - MFAS radar risk reduction flight testing on a Northrop Grumman surrogate test bed aircraft to identify and resolve potential radar performance problems prior to integration on the MQ-4C air vehicle. The contractor has completed a total of 39 total flights (8 in CY14) and implemented radar software changes to improve sensor stability, maritime target surveillance, tracking performance, and synthetic aperture radar image quality.
- Due to technical difficulties with the AARSS, the Navy is no longer pursuing AARSS as a technical solution to the due regard or "sense and avoid" capability for Triton. The Navy continues to pursue procedural and/or technical solutions to compensate for the loss of the AARSS.
- The Navy has developed a network environment that can be used for operational training and employment. In addition, the Navy has completed construction of the hangar and training spaces required to execute the Triton test program.
- On September 18, 2014, Triton B-1 aircraft was ferried from Edwards AFB, California, to Patuxent River NAS, Maryland.

Assessment

- The re-baseline of the program has provided stability to the Triton program and enabled the Navy to execute acquisition and evaluation strategies in FY14, and to execute additional risk reduction testing prior to conducting the OA.
- Developmental testing of the Air Vehicle revealed the following:
  - Ground and lab testing of system communications and datalink architectures are producing early deficiency reports in support of efforts to improve system maturity before mission system flight testing begins.
  - The Northrop Grumman MFAS risk reduction flight test program identified several system performance problems for resolution prior to MFAS integration on to the MQ-4C platform. The program has implemented radar software changes to improve sensor stability, maritime target surveillance and tracking performance, and synthetic aperture radar image quality. Other UAS platforms have experienced degradation in performance when sensors move from surrogate platforms to the developmental aircraft. It is likely that some degradation is possible with Triton as well, but the continuing MFAS test flights on the surrogate have reduced the risk of initial integration.
- Traffic de-confliction and collision avoidance provide critical mission capability for operation of the MQ-4C in civil and international airspace in support of global naval operations
- Prior to beginning developmental testing of mission systems, the Navy must also integrate sensors onto the air vehicle at Patuxent River NAS, complete development of the Integrated Functional Capability 2.2 system software, and load it on the Triton system.
- The movement of the Triton air vehicle from Edwards AFB to Patuxent River NAS was an important milestone for the program.

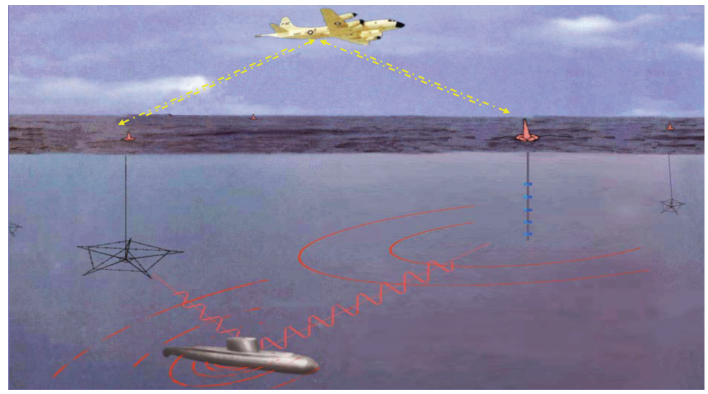
Recommendations

- Status of Previous Recommendations. The program was re-baselined in December 2013, which affected program scheduling and delayed Milestone C and completion of the Test and Evaluation Master Plan (TEMP) update, as recommended in FY13. The Navy still needs to develop a revised test schedule and TEMP that reflect test delays.
- FY14 Recommendations. The Navy should:
  1. Prepare and submit a TEMP update to DOT&E by the Milestone C decision.
  2. The Navy should complete the planned OA in FY15 in preparation for Milestone C.
  3. During the planned FY15 OA, the Navy should demonstrate tactics and procedures that will enable Triton to descend and operate in medium- and low-altitude environments, in accordance with the MQ-4C Triton Warfighting Concept of Operations.

Multi-Static Active Coherent (MAC) System

Executive Summary

- The Navy completed the initial operational testing of the Multi-Static Active Coherent (MAC) system on P-3C aircraft in October 2013.
- Operational test results indicate that the MAC system provides P-3C aircraft with a wide-area Anti-Submarine Warfare (ASW) search capability in select scenarios in some environments but it does not meet the program's requirements in other operational environments or scenarios.
- The IOT&E did not fully examine the capability of MAC across all operational conditions, representative operational environments, and target types. DOT&E agreed to limit testing during the initial phase because sufficient active source buoys were not available and because the MAC system would be installed and further tested on P-8A aircraft in several increments through FY19.
- In FY14, the Navy installed the MAC system on the P-8A Poseidon Multi-mission Maritime aircraft. Due to integration problems, the Navy delayed the initial MAC operational testing on the P-8A from March 2014 to November 2014.



- The Navy initially intends to employ MAC on P-3C aircraft in a limited set of acoustic environments. Future increments of MAC will be employed on P-8A aircraft and in a wider variety of acoustic ocean environments in order to span the operational envelope of threat submarine operations. MAC will be the primary wide-area acoustic search system for the P-8A.
- MAC is expected to have fewer effects on marine mammals and the environment than the legacy IEER system.

System

- The MAC system is an active sonar system composed of two types of sonobuoys (source and receiver) and an acoustic processing and aircraft mission computer software suite. It is employed by the Navy's maritime patrol aircraft (P-3Cs and eventually P-8As) to search for and locate threat submarines in a variety of ocean conditions. To plan MAC missions, the Navy has updated the Active System Performance Estimate Computer Tool (ASPECT)/Multi-static Planning Acoustics Toolkit (MPACT) previously used to plan Improved Extended Echo Ranging (IEER) system missions.
- MAC replaces the Navy's current IEER system, which employs non-coherent sources to produce loud sounds that reflect off submarine targets. MAC employs new coherent source buoys that enable multiple pings, optimized waveforms, and various ping durations, none of which the legacy IEER system provided.

Mission

The Navy intends for P-3C and P-8A crews equipped with MAC to support the search, detect, and localization phases of the ASW mission. MAC is particularly focused on large-area active acoustic searches for threat submarines.

Major Contractors

- Lockheed Martin – Manassas, Virginia
- Sparton Electronics Florida, Inc. – De Leon Springs, Florida
- Ultra Electronics, Undersea Sensor Systems Incorporated (USSI) – Columbia City, Indiana
- Boeing Defense, Space, and Security – St. Louis, Missouri

Activity

- The Navy completed operational testing of the MAC Phase 1 system on P-3C Multi-mission Aircraft in October 2013. Operational testing consisted of 3 developmental test events conducted off the coast of Jacksonville, Florida; 7 dedicated operational test events conducted in the Southern California Fleet Operating Areas (SOCAL); and 14 events in the Narragansett Bay Operating Areas (NBOA). Testing did not include the ASPECT/MPACT because its bottom environment database was poorly populated causing it to inaccurately predict the probability of detection. The Navy conducted the operational testing in accordance with a DOT&E-approved test plan.
- Following the first five NBOA test events, the Navy paused operational testing to investigate observed performance problems. The Navy identified operator training and material problems on the P-3C aircraft as probable causes of the

degraded performance. The Navy required these events to be repeated.
- DOT&E issued an IOT&E report in July 2014.
- In FY14, the Navy installed the MAC system on the P-8A Poseidon aircraft. Due to integration problems, the Navy delayed the initial MAC operational testing on the P-8A from March 2014 to November 2014.
- The Navy and DOT&E commenced developing a Test and Evaluation Master Plan to identify deferred MAC testing and to plan for the Phase 2 MAC improvements. To efficiently utilize test resources, DOT&E is requiring the test program be consistent with and utilize MAC events programmed in the recently approved P-8A Increment 2 Test and Evaluation Master Plan.
- The Navy started operational testing of the MAC installed on the P-8A aircraft off the coast of Florida in November 2014.

Assessment
- Operational test results indicate that the MAC system provides P-3C aircraft with a wide-area ASW search capability in some environments and for select target scenarios, but MAC falls short of what the fleet identified as the capability needed to protect high-value units. Initial testing identified that detection performance strongly relies on the characteristics of the ocean environment and the tactics employed by the target to evade detection. Testing to understand the effects different threat types and environments have on performance will continue through FY19 in conjunction with the P-8 program.
- The IOT&E did not fully examine the capability of MAC across all operational conditions, representative operational environments, and target types. DOT&E agreed to limit testing of the initial phase of MAC because sufficient active source buoys were not available and because the MAC system would be installed and tested on P-8A aircraft beginning in FY14 and continuing through FY19.
- Although the MAC system demonstrated detection capability against evasive undersea targets, acoustic operators were expected to quickly distinguish system submarine detections from a variety of non-submarine clutter detections, some of which appeared target-like. Complicating this task, completed test analysis identified that the MAC system detections of target and non-target clutter varies with environmental conditions and likely target types. The data also show operators are only able to recognize a small fraction of valid system submarine detections as a possible target and spent time assessing and prosecuting false targets.
- The Navy uses ASPECT/MPACT to develop MAC search plans and to estimate theoretical system performance. In addition to the known shortfalls with the environmental databases used by ASPECT that the Navy deferred, the planning tool performance estimates are highly dependent on the wide-range of potential mission planning input parameters estimated by the mission planner. As a result, ASPECT performance estimates can widely vary when compared to test results. Since ASPECT does not have a good estimate for the operator recognition of the submarine target, it overestimates ASW detection performance.
- For additional information, see DOT&E's classified IOT&E report on the MAC System on P-3C Aircraft dated July 2014.

Recommendations
- Status of Previous Recommendations. The Navy has partially addressed the FY13 recommendations.
  1. The Navy Program Office is investigating fleet exercise data to assess detection performance and to gather data for developing future algorithm and software improvements. Although fleet exercise data includes new environments where the fleet operates in peacetime, the Navy has not investigated MAC performance variability with a variety of submarine target types.
  2. The Navy has not completed development of a sustainable MAC training program or completed the formal updates to tactics guidelines and documentation.
- FY14 Recommendations. The Navy should:
  1. Plan and complete the outstanding MAC operational testing and investigate MAC system and operator performance against different target types. This testing should be in conjunction with P-8A MAC introduction and improvements.
  2. Implement the recommendations in DOT&E's IOT&E report. DOT&E provided 15 recommendations to improve the MAC system performance and 5 recommendations to improve test realism, minimize test limitations, and improve data collection. Significant unclassified recommendations include—
     - Investigate and develop improved methods for aircrews to sample and characterize the time and space variability of the search area environment.
     - Investigate and develop tactics to improve the operator's ability to transition system detections to high confidence target detection. Consider measures to balance operator workload and update search plans based on the actual conditions experienced in the search area.
     - Investigate the system's capability for longer range detections based on the environmental conditions in the search area.
     - Investigate and develop improvements to the ASPECT planning system and the supporting databases.
     - Complete the MAC upgrades to aircrew trainers and training documentation.
     - Improve the operator's capability to utilize the passive detection capability of the MAC receiver buoys.
     - Conduct future testing and exercises using a variety of target surrogates that execute tactics appropriate for their assigned mission. The targets and tactics should be validated as representative of the threats.

MV-22 Osprey

Executive Summary

- The Navy conducted cyber testing of the MV-22B Joint Mission Planning System – Maritime (JMPS-M) in August 2013 and FOT&E OT-IIIJ from September through October 2013.
- The Navy should implement stronger role-based access controls for JMPS-M to strengthen cybersecurity.
- OT-IIIJ demonstrated the utility of most system hardware and flight software improvements.
- Additional testing is needed to demonstrate the utility of the APX-123 Mode 5 Identification Friend or Foe (IFF) Transponder and the Integrated Waveform Satellite Communications performance, and the reliability of the GAU-21 Defensive Weapon System.
- The Navy should continue to execute the reliability growth program for the MV-22 fleet

System

- There are two variants of the V-22: the Marine Corps MV-22 and the Air Force/U.S. Special Operations Command CV-22. The air vehicles for Air Force and Marine Corps missions are nearly identical, with common subsystems and military components sustainable by each Service's logistics system.
- The Marine Corps is replacing the aging CH-46 and CH-53D helicopters with MV-22s. The MV-22 is a tilt rotor aircraft capable of conventional wing-borne flight and vertical take-off and landing.
- The MV-22 can carry 24 combat-equipped Marines and operate from ship or shore. It can carry an external load up to 10,000 pounds over 50 nautical miles, and can self-deploy 2,363 nautical miles with a single aerial refueling.
- Recent system upgrades include the following:
  - Enhanced Rapid Ground Refueling system
  - APX-123 IFF transponder (replaced the APX-118 IFF transponder to support Mode 5)
  - Generation 5 radios (replaced Generation 3 radios to support Integrated Waveform Satellite Communications (SATCOM))
  - GAU-17 Defensive Weapon System improvements (upgraded with a sensor-only mode that allows the gunner to use the electro-optical sensor when the gun turret is not being used)
  - Modified aircraft flight control laws (granted pilots greater lateral control authority and increased thrust sensitivity)
  - Increased Forward-Looking Infrared Sensor look down angle (expanded by a factor of six)
  - Blue Force Tracker (BFT-1) mount and circuitry improvements

Mission

- Squadrons equipped with MV-22s will provide medium-lift assault support in the following operations:
  - Ship-to-Objective Maneuver
  - Sustained operations ashore
  - Tactical recovery of aircraft and personnel
  - Self-deployment
  - Amphibious evacuation
- Currently deployed squadrons are providing high-tempo battlefield transportation in the U.S. Central Command Area of Responsibility.

Major Contractors

Bell-Boeing Joint Venture:
- Bell Helicopter – Amarillo, Texas
- The Boeing Company – Ridley Township, Pennsylvania

Activity

- The Navy, with assistance from the Marine Corp Information Assurance Red Team, conducted cyber testing of the MV-22B JMPS-M in August 2013. The JMPS-M provides a network-based mission-planning environment for the MV-22 aircraft, and is a potential cyber vulnerability for the MV-22B.
- The Marine Corps Operational Test and Evaluation Squadron 22 (VMX-22) conducted FOT&E OT-IIIJ from September through October 2013. This 89-flight hour dedicated operational test was preceded by 14 months and 627 flight hours of integrated testing (IT-IIID).

- Operational pilots evaluated capabilities of the latest MV-22B enhancements: the enhanced Rapid Ground Refueling system, APX-123 IFF transponder, Generation 5 radios, GAU-17 Defensive Weapon System improvements, increased Forward-Looking Infrared Sensor look down angle, BFT-1 mount and circuitry improvements, and modified aircraft flight control software.
- VMX-22 conducted the OT-IIIJ missions using four production-representative aircraft (two Block C and two Block B) at Marine Corps Air Station New River, North Carolina, and Petersen AFB, Colorado. DOT&E observed all of the OT-IIIJ missions.
- OT-IIIJ was conducted in accordance with a DOT&E-approved Test and Evaluation Master Plan and Operational Test Plan.

Assessment

- Units equipped with the MV-22B remain operationally effective, suitable, and survivable as previously reported.
- OT-IIIJ demonstrated the utility of most software version B5.01/C2.01 and hardware enhancements.
  - As a mobile-refueling platform, the MV-22 can now deliver twice as much fuel at twice the previous refueling rate during ground refueling operations.
  - The software version B5.01/C2.01 improvements aided mission management as intended, but created minor increases in pilot workload with nuisance warnings and uncommanded resets.
- Improvements to the GAU-17 Defensive Weapon System, the APX-123 Mode 5 IFF, and the Integrated Waveform SATCOM were not adequately demonstrated during OT-IIIJ; following successful developmental testing, these will be tested in OT-IIIK in 2015.
  - Only 1,500 rounds were fired with the GAU-17 Defensive Weapon System; too few rounds to observe the effects of the improvements.
  - Mode 5 IFF interrogators were not employed during operational testing.
  - The new capability of the Generation 5 radio was the Integrated Waveform SATCOM, but this waveform did not work at all in developmental or operational testing of the radio on MV-22 aircraft.
- Reliability improvements were evident in the OT-IIIJ test aircraft and MV-22B fleet, but recurring problems continue to degrade non-deployed fleet and test aircraft availability.
  - Overheating prop-rotor gearboxes and flight control actuator failures were noteworthy sources of OT-IIIJ aircraft downtime and maintenance effort.
  - Reliability improvements to the Icing Protection System (IPS) have been demonstrated on CV-22 aircraft, but the full set of IPS upgrades has not been implemented on the MV-22B test aircraft. The reliability of MV-22B IPS could not be accurately measured because of unresolved IPS reliability failures on the OT-IIIJ test aircraft.
- Information generated by the JMPS-M is vulnerable to alteration by malicious or unwitting users who gain access to administrative functions. Otherwise, JMPS-M information protections successfully prevented unauthorized access by internal and external cyber threats.

Recommendations

- Status of Previous Recommendations. The Navy has made progress on the FY11 recommendation to improve reliability of the IPS. While the Navy has not implemented the full set of IPS upgrades on all the MV-22 aircraft, it has demonstrated reliability improvements to the IPS on CV-22 aircraft, which is identical to the system used on MV-22. The Navy should continue to make reliability improvements through execution of its reliability growth program. The Navy did not field the Traffic and Collision Avoidance System as DOT&E recommended in FY12.
- FY14 Recommendations. The Navy should:
  1. Maintain the V-22 program's focus on reliability growth, parts provisioning, and reduction of repair time for gearboxes and flight control components.
  2. Implement role-based access controls for authorized JMPS-M users and investigate the operational effects of cyber penetration of this and other interfacing systems on the MV-22B.
  3. Conduct additional operational testing of the GAU-17 Defensive Weapon System and Integrated Waveform SATCOM.
  4. Include MV-22 in the next Joint Operational Test Approach testing of Mode 5 IFF, currently scheduled for FY16.
  5. Provide appropriate warnings when fielding MV-22B software versions B5.01 and C2.01. In future software development, address nuisance warnings and uncommanded resets.

P-8A Poseidon Multi-Mission Maritime Aircraft (MMA)

Executive Summary

- The Navy conducted the P-8A Increment 1 FOT&E from October 2013 through March 2014 to evaluate the operational effectiveness and suitability of the integration and employment of the AGM-84D Block 1C Harpoon anti-ship missile system. FOT&E also included evaluation of software improvements intended to correct 17 operationally significant system deficiencies that degraded Anti-Surface Warfare (ASuW); Intelligence, Surveillance, and Reconnaissance (ISR); and Command, Control, and Communication (C3) mission capabilities during IOT&E. Based on FOT&E results, DOT&E concluded that:
  - The P-8A Increment 1 system provides an operationally effective armed ASuW mission capability to detect, classify, and track maritime surface targets and engage them using the AGM-84D Block 1C Harpoon anti-ship missile. System software changes improved overall surface target search, classification, and tracking capabilities as compared to observed IOT&E performance.
  - Based on FOT&E results, the P-8A Increment 1 system does not yet provide an operationally effective ISR mission capability. System software improvements corrected several high-priority sensor integration problems and improved imagery dissemination capabilities. However, persistent synthetic aperture radar (SAR) image quality problems, unresolved electronic intelligence collection deficiencies, and data dissemination limitations continue to degrade P-8A ISR mission capabilities. Additional SAR, electronic intelligence collection, and data dissemination upgrades are scheduled for inclusion in upcoming pre-planned software updates and will be assessed during future FOT&E periods.
  - The P-8A Increment 1 system provides a C3 mission capability to collect and disseminate key elements of a common operational picture (COP) to maritime forces and on-scene commanders via Link 16 and Link 11 datalink systems and through other voice communication and data transfer systems. However, unresolved tactical display, communication system, and data transfer system deficiencies reduce P-8A COP data collection and dissemination capabilities in some operational scenarios. Corrections for these deficiencies will be evaluated in future operational test events.
  - The P-8A is operationally suitable for Anti-Submarine Warfare (ASW), ASuW, ISR, C3, and related maritime patrol missions. During FOT&E, P-8A mission capable rates exceeded those measured during IOT&E. Hardware components continued to demonstrate high reliability during operational testing and system software reliability improved compared to previous IOT&E results. P-8A aircraft flight performance (range, speed, payload, etc.) meet or exceed specified operational requirements for ASW, ASuW, and ISR missions. The P-8A meets all ASuW mission endurance, weapons carriage, and mission turnaround requirements while carrying the AGM-84D Block 1C anti-ship missile system.
  - The P-8A is partially compliant with joint interoperability standards and Net Ready Key Performance Parameter requirements. System improvements corrected several high-priority communication system interoperability and net ready compliance problems identified during IOT&E. The Joint Interoperability Test Command (JITC) follow-up assessments verified compliance with all 39 specified mission critical information exchange requirements, leading to joint use certification in October 2013. The JITC assessment also identified remaining net ready and interoperability shortfalls that require future improvement. The Navy has identified additional system enhancements necessary to deliver a fully net-enabled architecture as principle requirements of the P-8A Increment 3 upgrade program.
- As part of the P-8A Increment 2 program, the Navy is integrating the Multi-static Active Coherent (MAC) system into the P-8A to provide the initial broad-area ASW search capabilities originally included in the P-8A Increment 1 baseline acquisition program and supporting operational requirement documents. DOT&E previously issued a MAC IOT&E report based on testing conducted on the P-3C aircraft. This report concluded that the MAC system provides the P-3C with a broad-area ASW search capability in some operational environments and for select target scenarios, but falls short of fleet-defined capabilities needed to protect high value units. Initial test results indicate that MAC performance varies strongly by ocean environmental characteristics and

target tactics. Further information can be found in DOT&E's July 2014 IOT&E report on the MAC System on P-3C Aircraft. Until a fully-capable broad-area ASW search sensor is successfully integrated, the P-8A will be unable to execute the full range of ASW mission tasks defined by the original P-8A Increment 1 ASW concept of operations.

- The Navy conducted developmental flight testing of the MAC Phase I System broad-area ASW search capability on the P-8A in February through March 2014 and intended to commence operational testing in May 2014. Following the March 2014 developmental test flights, the Navy delayed the start of operational testing to correct integration and performance deficiencies. The contractor delivered a final MAC software update in August 2014. Completion of developmental testing and start of operational testing is scheduled for November 2014.
- The Navy completed the first lifetime of the P-8A full-scale structural fatigue testing in July 2014. This phase of testing identified localized fatigue cracking in non-critical structural components, including replaceable pressure web and aircraft tail section components. The program is currently reviewing these results to identify fleet airframe inspection requirements and depot repair procedures to ensure the airframe meets the intended 25-year design life. The program is planning a second full lifetime of structural fatigue testing in FY15 to complete the airframe durability assessment and to further refine inspection and repair procedures.

System

- The P-8A Poseidon Multi-mission Maritime Aircraft design is based on the Boeing 737-800 aircraft with significant modifications to support Navy maritime patrol mission requirements. It will replace the P-3C Orion.
- The P-8A incorporates an integrated sensor suite that includes radar, electro-optical, and electronic signal detection sensors to detect, identify, locate, and track surface targets. An integrated acoustic sonobuoy launch and monitoring system detects, identifies, locates, and tracks submarine targets. The P-8A carries Mk 54 torpedoes and the AGM-84D Block 1C Harpoon anti-ship missile system to engage submarine and maritime surface targets. Sensor systems also provide tactical situational awareness information for dissemination to fleet forces and ISR information for exploitation by the joint intelligence community.
- The P-8A aircraft incorporates aircraft survivability enhancement and vulnerability reduction systems. An integrated infrared (IR) missile detection system, flare dispenser, and directed IR countermeasure system is designed to improve survivability against IR missile threats. On and off-board sensors and datalink systems are used to improve tactical situational awareness of expected threat systems. Fuel tank inerting and fire protection systems reduce aircraft vulnerability.
- The Navy is integrating the MAC system into the P-8A to provide a broad-area active ASW search capability.

Mission

- Theater Commanders primarily use units equipped with the P-8A Multi-mission Maritime Aircraft to conduct ASW operations including the detection, identification, tracking, and destruction of submarine targets.
- Additional P-8A maritime patrol missions include:
  - ASuW operations to detect, identify, track, and destroy enemy surface combatants or other maritime targets
  - ISR operations to collect and disseminate imagery and signals information for exploitation by the joint intelligence community
  - C3 operations to collect and disseminate tactical situation information to fleet forces
  - Identification and precise geolocation of targets ashore to support fleet strike warfare missions

Major Contractor

Boeing Defense, Space, and Security – St. Louis, Missouri

Activity

- The Navy conducted the P-8A Increment 1 FOT&E from October 2013 through March 2014 to evaluate the operational effectiveness and suitability of the integration and employment of the AGM-84D Block 1C Harpoon anti-ship missile system. FOT&E also included evaluation of software improvements intended to correct 17 operationally significant system deficiencies that degraded ASuW, ISR, and C3 mission capabilities or system survivability during IOT&E. This FOT&E did not re-evaluate ASW mission capabilities since no ASW-related system improvements were included in the flight software version assessed during this test.
  - FOT&E included 15 flight missions totaling 76.2 hours to evaluate AGM-84D operational employment effectiveness and verify correction of some previously identified system deficiencies.
  - DOT&E evaluated system operational suitability during the course of 42 test and training missions totaling 234.9 flight hours using both test and fleet aircraft.
  - The Navy conducted integrated test and dedicated FOT&E events at Naval Air Station (NAS) Patuxent River, Maryland; Naval Base Ventura County, California; and NAS Jacksonville, Florida.
  - The Navy completed all testing in accordance with the DOT&E-approved FOT&E plan.
- The Navy completed the first lifetime of the P-8A full-scale fatigue and durability testing in FY14 using the fifth P-8A

production aircraft (YP-005). Concurrent “off-aircraft” fatigue testing of selected landing gear components completed the equivalent of two design lifetimes of testing. Fatigue test execution and data analysis activities will continue into FY15.

- The Navy continued P-8A Increment 2 software development testing in FY14. The P-8A Increment 2 program integrates the MAC system to provide a limited broad-area ASW search capability for some environments.
  - The Navy conducted developmental flight testing of the MAC Phase I System broad-area ASW search capability on the P-8A from February through March 2014 to support the start of operational testing in May 2014. Following the March 2014 test flight, the Navy delayed the start of operational testing to correct MAC integration and performance deficiencies.
  - The contractor delivered a final P-8A MAC software update in August 2014. Completion of developmental testing and start of operational testing is now scheduled for November 2014. Future Increment 2 program upgrades include new high-altitude ASW capabilities and correction of some P-8A deficiencies identified during previous developmental and operational test events.

Assessment

- The P-8A Increment 1 FOT&E re-evaluated armed ASuW, ISR, and C3 mission operational effectiveness and operational suitability. Based on FOT&E results, DOT&E concluded that:
  - The P-8A Increment 1 system provides an operationally effective armed ASuW mission capability to detect, classify, and track maritime surface targets and engage them using the AGM-84D Block 1C Harpoon anti-ship missile. During FOT&E, operational crews demonstrated the capability to carry and employ up to four AGM-84D missiles in operationally realistic ASuW mission scenarios. System software changes improved surface target search, classification, and tracking capabilities as compared to observed IOT&E performance. However, FOT&E also revealed additional sensor integration and display deficiencies that increase operator workload and/or preclude use of some ASuW mission system capabilities.
  - Based on FOT&E results, the P-8A Increment 1 system does not yet provide an operationally effective ISR mission capability. System software improvements corrected several high-priority sensor integration problems and improved imagery dissemination capabilities. However, persistent SAR image quality problems, unresolved electronic intelligence collection deficiencies, and data dissemination limitations continue to degrade P-8A ISR mission capabilities. Additional SAR, electronic intelligence collection, and data dissemination upgrades are scheduled for inclusion in upcoming pre-planned software updates and will be assessed during future FOT&E periods.
  - The P-8A Increment 1 system provides a C3 mission capability to collect and disseminate key elements of a common operational picture (COP) to maritime forces and on-scene commanders. Operational crews can develop, maintain, and disseminate tactical COP information via Link 16 and Link 11 datalink systems and through voice communication and other data transfer systems. However, P-8A C3 capabilities are reduced by radar and threat display deficiencies that complicate COP data collection in high traffic operating areas. COP data dissemination capabilities are reduced by unreliable voice satellite communications, Link 11 and Link 16 integration problems, Common Data Link interoperability shortfalls, and a limited capability to exchange intelligence information via satellite communication links. Corrections for these deficiencies will be evaluated in future operational test events.
  - The P-8A is operationally suitable for ASW, ASuW, ISR, and related maritime patrol missions. During FOT&E, P-8A mission capable rates exceeded those measured during IOT&E. Hardware components continued to demonstrate high reliability during operational testing and system software reliability improved compared to previous IOT&E results. P-8A aircraft flight performance (range, speed, payload, etc.) meets or exceeds specified operational requirements for ASW, ASuW, and ISR missions. The P-8A meets all armed ASuW mission endurance, weapons carriage, and mission turnaround requirements while carrying the AGM-84D Block 1C anti-ship missile system.
  - The P-8A is partially compliant with joint interoperability standards and Net Ready Key Performance Parameter requirements. System improvements corrected several high-priority communication system interoperability and net ready compliance problems identified during IOT&E. The JITC follow-up assessments verified compliance with all 39 specified mission critical information exchange requirements, leading to joint use certification in October 2013. The JITC assessment also identified remaining net ready and interoperability shortfalls that require future improvement. The Navy has identified additional system enhancements necessary to deliver a fully net-enabled architecture as principle requirements of the P-8A Increment 3 upgrade program.
- As part of the P-8A Increment 2 program, the Navy is integrating the MAC system into the P-8A to provide the broad-area ASW search capabilities originally included in the P-8A Increment 1 baseline acquisition program and supporting operational requirement documents. DOT&E previously issued a MAC IOT&E report based on testing conducted on the P-3C aircraft. This report concluded that the MAC system provides the P-3C with a broad-area ASW search capability in some operational environments and for select target scenarios, but falls short of fleet-defined capabilities needed to protect high value units. Initial test results indicate that MAC performance varies strongly by ocean environmental characteristics and target tactics. Further information can be found in DOT&E’s July 2014 IOT&E report on the MAC System on P-3C Aircraft. Until a fully-capable broad-area ASW search sensor is successfully integrated, the P-8A will be

unable to execute the full range of ASW mission tasks defined by the original P-8A Increment 1 ASW concept of operations.

- The Navy delayed the start of P-8A MAC OT&E to fix integration and performance deficiencies that were expected to reduce ASW mission performance and system reliability. The Navy's contractor delivered the final software with fixes in August 2014. Integration laboratory testing and flight testing is progressing to support the scheduled start of operational testing in November 2014.
- The Navy completed the first lifetime of the P-8A full-scale structural fatigue testing in July 2014. This phase of testing identified localized fatigue cracking in non-critical structural components, including replaceable pressure web and aircraft tail section components. The program is currently reviewing these results to identify initial fleet airframe inspection requirements and depot repair procedures to ensure the airframe meets the intended 25-year design life. The program is planning a second full lifetime of structural fatigue testing in FY15 to complete the airframe durability assessment and to finalize inspection and repair procedures.

Recommendations

- Status of Previous Recommendations. The Navy made progress on all four FY13 recommendations. The Navy implemented corrective actions and conducted FOT&E for 17 operationally significant system deficiencies related to prioritized ASuW, ISR, and C3 mission capabilities. Future program plans include additional deficiency correction activities in conjunction with P-8A Increment 2 development and testing. DOT&E approved the operational test plans for the P-8A Increment 2 program designed to evaluate previously deferred ASW broad-area search capabilities. The Navy is also reviewing and prioritizing potential future system upgrades, including consideration of options to integrate RF threat warning systems and improve the Dry Bay Fire Protection System, as previously recommended by DOT&E.
- FY14 Recommendations. The Navy should:
  1. Continue to implement corrective actions for significant system deficiencies identified in previous P-8A developmental and operational test reports and conduct additional follow-on operational tests to verify improved mission capabilities.
  2. Complete adequate operational testing of deferred ASW broad-area search capabilities in conjunction with the P-8A Increment 2 program.
  3. Plan and conduct operational testing of new P-8A system improvements intended to provide high-altitude ASW search and attack capabilities in conjunction with the P-8A Increment 2 and Increment 3 programs.

Remote Minehunting System (RMS)

Executive Summary

- In June 2014, DOT&E reported the Remote Minehunting System (RMS) (consisting of a version 4.2 (v4.2) Remote Multi-Mission Vehicle (RMMV) and AN/AQS-20A sonar) had not demonstrated sufficient performance or successful integration with interfacing Littoral Combat Ship (LCS) systems to demonstrate the Navy's minimum Increment 1 warfighting capability. Although the Navy is working on upgrades to improve system performance and LCS capability in the v6.0 RMMV and the AN/AQS-20A/B sonar, developmental testing completed in 1QFY15 demonstrated continued performance issues and RMS mission package integration challenges.
- In 4QFY14, USD(AT&L) delayed a review to consider approval of RMS low-rate initial production (LRIP) until 3QFY15.
- Combined developmental and integrated testing completed in FY14 provides a point estimate for v4.2 vehicle reliability of 31.3 hours Mean Time Between Operational Mission Failure (MTBOMF). Developmental testing completed in 1QFY15 provides a point estimate for v6.0 vehicle reliability of 34.6 hours MTBOMF. Statistical analysis of all test data indicates the result is not sufficient to conclude that reliability has actually improved since a Nunn-McCurdy review of the program in 2010. Therefore, test data currently available (including early testing of the v6.0 vehicle) do not support the Navy's assertion that vehicle reliability has improved. Moreover, the current estimate of RMS reliability, once all of the other components of the system are considered, is no more than 20 hours MTBOMF, which is well-short of what is needed to complete MCM missions in a timely fashion and meet the Navy's desired mission timelines.
- Developmental testing conducted in FY14 and 1QFY15 continued to show that the AN/AQS-20A sonar does not meet all Navy requirements. The Navy expected to correct these deficiencies prior to operational testing in FY15 by implementing pre-planned product improvements (the AN/ AQS-20B version of the sonar) and integrating the improved sensor into the Mine Countermeasures (MCM) mission package. Delays in the delivery of AN/AQS-20B prototypes and problems discovered in early characterization testing in FY14 leave little time to complete necessary developmental and operational testing of the AN/AQS-20B prior to the planned operational testing of LCS equipped with the MCM mission package in FY15.
- Communications ranges afforded by current RMS radios will require operational commanders to clear a series of LCS operating boxes to support minehunting and clearance operations. These operating boxes will be necessary to keep an LCS and its crew out of the minefield while operating the RMS in searches for mine-like objects or identifying bottom objects located within shipping lanes that are longer than demonstrated communications ranges. Additional effort to clear operating boxes will increase the demand for mine clearance and delay attainment of strategic objectives. The analysis of communications data collected during the most recent period of LCS developmental testing is still in progress, but test observers reported continued communication problems.

System

- The RMS is designed to provide an organic, off-board mine reconnaissance capability to detect, classify, and localize non-buried bottom and moored mines, as well as to identify shallow-water bottom mines only.
- The RMS will be launched, operated, and recovered from the LCS as part of the MCM mission package (when embarked).
- The RMS is comprised of four major components:
  - RMMV
    - The RMMV is an unmanned, semi-submersible, untethered vehicle designed to conduct autonomous or semi-autonomous mine reconnaissance missions.
    - The RMMV physically transports AN/AQS-20A/B sensors, processors, and datalink equipment to the operations area where mine reconnaissance data are collected, recorded, and transmitted to the host LCS platform.
    - RMS sensor data are recorded to a removable hard drive during minehunting operations. Following vehicle recovery, operators transfer data to an Organic Post Mission Analysis station and review sonar data to mark contacts as suspected mine-like objects.

  - The Navy has not yet presented its plans to incorporate reliability growth improvements in a future system increment (LRIP 2).
- AN/AQS-20A sensor
  - The AN/AQS-20A is a variable depth forward-looking and side-scanning sonar that is deployed and retrieved by the RMMV.
  - The sensor tow body automatically controls depth based on specific mission planning parameters, providing a stable platform for integral mine reconnaissance sensors.
  - The AN/AQS-20A provides detection, classification, and localization of non-buried bottom (on the ocean floor) and volume (in the water column) mine-like-contacts. The sensor utilizes port and starboard Side-Looking Sonars and a Gap Filler Sonar for detection of bottom and closely tethered moored mines in shallow waters. A Volume Search Sonar (VSS) and a Forward-Looking Sonar are utilized for all other moored mine detection. An Electro-Optic Identification Device can replace the VSS for missions requiring identification (mine versus non-mine) of shallow-water bottom mine-like contacts via high-resolution imaging.
  - The Navy plans to incorporate an improved forward-looking sonar and new synthetic aperture side-looking sonars (AN/AQS-20B) in FY15.
- Remote Minehunting Functional Segment (RMFS)
  - The RMFS is the control system hosted in the mission package computing environment on the LCS.
  - RMFS is a two-operator system that enables the Remote Vehicle Operator and Remote Sensor Operator to command and monitor RMS operations.
  - Specific RMFS functionality enables the operator to (1) command and monitor the RMMV; (2) receive, process, and display real-time mission data; (3) conduct performance monitoring/fault detection/fault localization; and (4) perform network communication to the Data Link System (DLS).
  - RMFS also exchanges data with the Global Command and Control System – Maritime/Mine Warfare Environmental Decision Aids Library for mission planning and interface to the Department of Defense Information Network.
- DLS
  - The DLS enables the RMMV to communicate with the LCS MCM mission package via one of two radio frequency datalink subsystems.
  - The Multi-Vehicle Communications System (MVCS) consists of two radios – an Ultra High Frequency line-of-sight datalink that is used for vehicle launch and recovery and near-ship operations and a low-band Very High Frequency datalink that is used for over-the-horizon mission operations. Both datalinks provide encrypted communications between the LCS MCM mission package and the RMMV for real-time command and control and transmission of some sensor data.

Mission

MCM Commanders will employ the RMS from an MCM mission package-equipped LCS, to detect, classify, and localize non-buried bottom and moored mines, as well as to identify shallow-water bottom mines in support of theater minehunting operations in shallow-water and deep-water minefields.

Major Contractors

- RMMV: Lockheed Martin – West Palm Beach, Florida
- AN/AQS-20A: Raytheon Corporation – Portsmouth, Rhode Island

---

Activity

- In 1QFY14, the Navy completed two phases of developmental testing (DT-IIG) of the RMS consisting of a v4.2 RMMV and an AN/AQS-20A sensor from a shore base at the contractor's facility in West Palm Beach, Florida. A third phase of testing described by the RMS Test and Evaluation Master Plan (TEMP) as an opportunity to assess risk of the interfaces with the LCS, including cybersecurity, was not conducted. The Navy cited lack of LCS availability as the rationale for cancellation of this phase, but incompatibility of the v4.2 RMMV with LCS was also a factor. The v4.2 vehicles did not have the needed structural improvements or communications upgrades to make them compatible with LCS systems.
- DOT&E disapproved the Navy's plan to conduct an operational assessment (OA) of the RMS in 2QFY14 because the OA would have been a wasted effort for the following reasons:
  - The proposed test article was not representative of the system the Navy plans to employ in the first increment of the LCS MCM mission package and therefore would not provide data necessary to augment the operational testing of an LCS equipped with that mission package.
  - Test limitations would have precluded an operational evaluation of key phases of the end-to-end mission.
  - Conduct of the test would have delayed vehicle upgrades necessary to support testing of the system the Navy expects to field.
- DOT&E advised the Navy that this testing may be conducted as combined developmental and integrated testing if the standards of operational realism are met. The Navy expects to conduct testing from December 2014 to January 2015 to satisfy objectives of the planned OA.
- The Navy initiated updates to the RMS and AN/AQS-20A TEMPs that merged the TEMPs into a single document in 2QFY14. To avoid confusion and promote efficiency, DOT&E advised the Navy that both TEMPs should be further

combined in the LCS TEMP, which is also being updated. It is unclear when updates to either the RMS or LCS TEMPs will be completed.

- The Navy continued to develop pre-planned product improvements for the AN/AQS-20A and is investigating improved tactics, techniques, and procedures for its employment. Both efforts are intended to mitigate deficiencies observed during previous OAs and developmental testing of the RMS and AN/AQS-20A. The Navy plans to conduct developmental testing of the RMS configured with the newly integrated v6.0 RMMV and the improved AN/AQS-20B sensor in late 1Q/early 2QFY15.
- The Navy imposed a weight limit on LCS 2 and LCS 4 launch and recovery systems as a result of finding cracks in the welds at the base of support stanchions located in the mission bay that the Navy attributes to LCS 2's heavy weather testing. As a result, subsequent testing of the launch and recovery operations could be conducted only when wave-induced loading on the recovery system (a function of wave height and period) did not exceed 32,000 pounds-force. (For example, a significant wave height of 2 feet coupled with a wave period of 2 seconds, which could be encountered in a Sea State 2, would preclude RMMV recovery until calmer sea conditions developed.) The Navy reported they are making design changes to LCS 6 and later seaframes to correct the stress cracking problem and remove the launch and recovery system weight limit. LCS 2 and LCS 4 will be corrected during their next shipyard availabilities. Prior to discovering the damaged support stanchions, the Navy had already imposed a sea state limit of less than Sea State 3 because of the erratic motion of the RMMV in the ship's wake, which had caused damage to capture spines and RMMVs.
- In 3QFY14, the Navy conducted dockside and at-sea developmental testing to verify correction of RMMV launch, handling, and recovery system and communications deficiencies observed in FY13 developmental testing.
- DOT&E provided an assessment of RMS performance in testing to members of the Defense Acquisition Board in June 2014 after the program was recertified following an FY10 Nunn-McCurdy breach. In 4QFY14, USD(AT&L) delayed a review to consider approval of RMS LRIP until FY15.
- The Navy commenced additional dockside and at-sea developmental testing of the RMMV launch, handling, and recovery system and the multi-vehicle communications system in 4QFY14. In 1QFY15, the Navy conducted the last scheduled phase of the Increment 1 MCM mission package developmental test DT-B2 aboard USS *Independence* (LCS 2). This phase was the first time that RMS (configured with a v6.0 RMMV) and the airborne MCM mission package components had operated together off an LCS. However, because the Navy now expects to make additional RMMV software changes and deferred a decision on which variant of the AN/AQS-20 to field until December 2014, LCS Technical Evaluation is expected to be the first time the fielded system will be tested in realistic end-to-end missions.
- The Joint Requirements Oversight Council (JROC) and the Navy approved the RMS Capability Production Document in March 2014.

Assessment

- As DOT&E reported to members of the Defense Acquisition Board in June 2014, the combined results of shore-based and LCS-based testing conducted since the program was recertified following a Nunn-McCurdy in 2010 have not demonstrated that an LCS equipped with an MCM mission package that includes two RMMVs and three AN/AQS-20A sonars will be able to support the sustained area coverage rate that the Navy has established for the Increment 1 MCM mission package. Few test data are available to indicate whether planned RMS improvements would support meeting the Increment 1 LCS requirements, let alone provide the more robust capability the Navy expects to achieve with Increment 4 of the MCM mission package.
- The requirements, in the approved RMS Capability Development Document and Capability Production Document, are not consistent with the approved requirements for minehunting conducted by the LCS.
  - The RMS could meet all threshold requirements designated as Key Performance Parameters and Key System Attributes and still not support the LCS MCM mission because the RMS requirements lack the appropriate mission focus.
  - The RMS search rate requirement, for example, has no limit on false alarms and excludes time required for planning, transit to and from the search area, operator assessment, follow-on actions to reduce false classifications, and efforts to recover from failures. All of these factors directly affect the achievement of the required performance and timeliness of LCS MCM missions.
  - The reliability of the v4.2 RMMV during combined developmental and integrated testing completed in FY14 was 31.3 hours MTBOMF, which is well below the required reliability of 75 hours MTBOMF. Although the Program Office maintains that the RMMV reliability is substantially above that value and that a reliability growth program completed in FY13 was highly successful, the Navy's reliability analysis is fundamentally flawed because it overstates RMMV operating time and undercounts the number of operational mission failures. The RMMV reliability issue has been the principal reason that the program has not attempted to reenter operational test.
  - The vendor completed an RMMV growth program and has subsequently incorporated additional fixes to correct deficiencies observed during developmental testing and combined developmental/integrated testing in 2013.
  - The restoration from RMS failures/faults when operating from an LCS is reliant on intermediate- and depot-level (off-board) maintenance support. Organizational-level (shipboard) maintenance support to restore system availability necessary to complete timely and realistic operational scenarios is limited.

- The system's AN/AQS-20A sensor also has reliability problems.

- The results of combined developmental and integrated testing completed in FY14 continued to show that the AN/AQS-20A sensor does not meet Navy requirements for contact depth localization accuracy or false classification density (number of contacts erroneously classified as mine-like objects per unit of area searched).
  - Contact depth (vertical localization) errors and false classification density exceeded Navy limits in all AQS-20A operating modes.
  - The sensor also has trouble meeting the probability of detection and classification requirement in shallow waters and RMS has difficulty guiding the sensor over bottom contacts for identification in deep water.
  - Although the Navy is working on pre-planned product improvements in the AN/AQS-20B version of the system, no test data are available to indicate that problems with false classifications and vertical localization errors have been mitigated. Delays in the delivery of AN/ AQS-20B prototypes and problems discovered in early characterization testing in FY14 leave little time to complete necessary developmental and operational testing of the AN/AQS-20B prior to the planned operational testing of LCS equipped with the MCM mission package in FY15. If left uncorrected, AN/AQS-20A/B problems will reduce the minehunting and clearing capability of the MCM mission package and the LCS will not meet interim area clearance requirements in ideal conditions let alone more realistic area clearance needs for the threat scenarios the mission package was developed to counter in theater.
- The RMS program has not yet demonstrated that the system can meet its detection and classification requirements against moored and bottom mines spanning the portion of the shallow water regime not covered by the Airborne Laser Mine Detection System; the program anticipates that the AN/ AQS-20B sensor will permit this capability. If this cannot be accomplished, the Navy will need to conduct additional search passes to achieve adequate coverage of the water column, resulting in increased detection and classification timelines and the LCS not meeting area clearance rate requirements.
- Testing completed in 1QFY14 indicates that fleet operators frequently misclassify moored mine targets as bottom objects during shallow water minehunting. These errors can increase the difficulty of reacquiring mines during the neutralization phase of MCM operations. The Navy is weighing the need for additional search passes to resolve mine position uncertainty before proceeding to mine clearance operations. Such tactics would require more time to accomplish, resulting in increased mine clearance timelines and the LCS not meeting area clearance rate requirements.
- RMS radios have had difficulty establishing reliable communications with the LCS during developmental testing, and once communications are established, the current communications systems do not support RMMV mine identification operations beyond the horizon. Although the RMMV can search autonomously while operating over the horizon from the LCS, it currently only can conduct operations to reacquire and identify bottom mines within the range of Ultra High Frequency communications. This limitation will complicate MCM operations in long shipping channels, and may make it necessary to clear a series of LCS operating areas to allow MCM operations to progress along the channel. The cleared operating areas will be needed to keep the LCS and its crew out of mined waters. The additional effort required to clear these LCS operating areas would increase the demand for mine clearance and delay attainment of strategic objectives. This issue is not new to RMS; however, it did not become operationally significant until the Navy decertified the MH-60S helicopter for towing MCM devices, including the AN/AQS-20A/B sensor. The RMS communication range limitation was not an operational concern when the option existed for the helicopter with towed sensor to conduct identification operations beyond the horizon. The Navy has not yet identified a solution. The analysis of communications data collected during the most recent period of LCS developmental testing is still in progress, but test observers reported continued communications problems.
- The *Independence* class LCS has had difficulty launching and recovering the RMMV because of the vehicle's erratic motion in the ship's wake. In past developmental testing, violent RMMV yaw and roll motions have overstressed and damaged the launch and recovery hardware and resulted in damage to the RMMV, which led to the Navy imposing a Sea State 3 limit on handling operations. Following changes to launch and recovery hardware, procedures, training, and RMMV hardware, the Navy demonstrated 16 RMMV launches and 14 RMMV recoveries during 23 days at sea in developmental testing during favorable sea state conditions and within the imposed weight loading restrictions in 1QFY15. Nonetheless, the most recent period of developmental testing witnessed several instances of equipment damage that delayed or prevented recovery of an off-board RMMV.
- Following the October 2014 phase of developmental testing, the Navy identified a new problem with the redesigned lifting structure used in the vehicle's launch and recovery. Deformation in the capture probe and corresponding latching mechanism in the vehicle (capture pawls) was observed following several failed attempts to recover the RMMV. This is significant because the entire weight of the vehicle is supported by these components during vehicle launch and recovery, and the defects pose a safety concern for mission package personnel who must work in close proximity to the suspended RMMV to secure it to the cradle pallet in the mission bay. The Navy identified substandard metallurgical strengthening as the root cause of observed deformation. In addition, non-load bearing components of the redesigned RMMV capture spine assemblies experienced multiple failures including several the test team attributed to substandard welds. In some cases, the team test was unable to continue RMS operations without replacement parts from shore, which

in theater would preclude sustained RMS operations without excessive reliance on shore-based support. The Navy must correct capture spine deficiencies to ensure safe and sustained RMMV launch and recovery in support of LCS MCM operations.

- Developmental testing conducted aboard LCS 2 in 1QFY15 also indicates that many RMS performance problems identified in earlier test phases have not been corrected and, in some cases, new problems have been introduced following changes to system configurations or tactics.
  - RMS reliability problems persisted in the recent phase of developmental testing (1QFY15) evidenced in part by fewer vehicle recoveries than vehicle launches. Problems observed include the inability to align the system's inertial navigational unit, intermittent communications, a lube oil pump failure that caused a mission abort, capture latch impairment that precluded shipboard recovery of the RMMV, degraded electro-optic identification resulting in a mission abort to replace the AN/AQS-20A towed body, tow cable damage following an apparent snag that rendered the system inoperable in the assigned mission until a replacement tow cable could be installed with the assistance of shore-based support, and multiple incidents of AN/AQS-20A stuck fins or fin actuation faults. Although the Navy demonstrated more frequent RMMV launches during this period of testing, continued RMS reliability problems limited system minehunting to less than 50 hours during the three weeks of most intensive testing (approximately 16 hours per week). LCS reliability problems also forced the ship to remain in port for repairs instead of conducting at-sea RMS testing as planned. Including an additional week spent in port for LCS repairs, RMS averaged approximately 12 hours of minehunting per week. This result is consistent with the assessment of RMS capability DOT&E provided to members of the DAB following RMMV v4.2 and AN/AQS-20A testing to indicate that the Navy had not yet demonstrated that it could sustain operations of more than one 14-hour RMMV sortie per week (i.e., 10 to 12 hours of RMS minehunting per week). Unless greater minehunting operating tempo is achieved the Navy will not meet its interim area clearance rate requirements.
  - The Navy reported that the RMS operated for approximately 140 hours during LCS developmental testing in 1QFY15. DOT&E's preliminary assessment of test data identified at least seven RMS failures that precluded vehicle recovery, required sensor replacement, or required assistance from shore-based support contractors to restore system availability. In operational testing, these failures would be assessed as operational mission failures. Thus, by operational criteria, RMS demonstrated reliability was no more than 20 hours MTBOMF during this phase of testing. Because much of the operating time cited by the Navy was not devoted to minehunting activities, this estimate should be considered an upper bound for current RMS operational reliability. Moreover, statistical analysis of all existing data do not yet support the Navy's assertions of improving RMS reliability.
  - As in previous testing, fleet operators were unable to execute operationally-realistic, end-to-end mine reconnaissance and clearance without the assistance of testers with knowledge of ground truth target positions. Using mission package tools such as Organic Post Mission Analysis and the new Contact Management Tool (CMT) fleet operators failed to convey some mine targets correctly detected by the RMS in an initial search pass to the Airborne Mine Neutralization System (AMNS) for neutralization. The Navy continues to investigate the root cause of incorrectly dropped contacts, which will severely limit LCS MCM mission effectiveness unless corrected.
  - Multiple-pass tactics and the CMT were introduced to minimize the number of false classifications passed on for identification/neutralization. However, during the recent phase of testing, the number of in-volume RMS false classifications remaining in the contact list after multiple RMS search passes and contact correlation far exceeded Navy pre-test predictions indicating these tactics and tools have not yet achieved the desired result. The CMT also failed during the later stages of testing requiring operators to attempt the cumbersome task of manually tracking contacts between stages of the RMS mission before determining which contacts merited further investigation. If large numbers of RMS in-volume false classifications are passed to the AMNS for follow-on action, LCS mine clearance requirements will not be met. Large quantities of contacts generated by the RMS make manual correlation time consuming and increase the potential to drop correct classifications; both of these problems will limit LCS MCM effectiveness unless corrected.
- The Navy has not assessed radiated noise following recent vehicle configuration changes. Radiated noise measurements were last collected during developmental testing in 2007/2008, and indicated that existing RMMVs may be vulnerable to some mines.
- The RMS program has not conducted operational testing of cybersecurity of the RMS hardware and software configurations intended for Initial Operational Capability in the LCS MCM mission package in FY15/16.
- No RMMV launch and recovery operations have been conducted aboard a *Freedom* class LCS at sea.

Recommendations

- Status of Previous Recommendations. The Navy made progress on all four FY13 recommendations. Shore-based testing completed in 1QFY14 and shipboard testing completed in 1QFY15 provided additional information regarding RMS, RMMV, and AN/AQS-20A reliability; RMS operational availability; and RMMV launch, handling, and recovery system performance. Although the Navy continues to develop and test AN/AQS-20 upgrades, it has not demonstrated in developmental or operational testing that it has corrected problems with false classifications and contact localization errors that will otherwise limit performance in the planned FY15 operational testing. The Navy expects to complete its update to the RMS TEMP, which now includes the AN/AQS-20 sonar, by 2QFY15.

- FY14 Recommendations. The Navy should:
  1. Identify the RMS configuration for operational testing of LCS equipped with the first increment of MCM capability and complete the required operationally realistic testing of that system prior to LCS MCM mission package Technical Evaluation.
  2. Conduct testing of the RMS consisting of the v6.0 RMMV and AN/AQS-20B in operationally realistic end-to-end minehunting missions to characterize AN/AQS-20B minehunting performance and accurately assess availability of the RMS and reliability of the RMMV and AN/AQS-20B.
  3. Investigate the use of communications relays and other solutions that might improve the standoff distance between an RMMV and its host ship to improve the efficiency of LCS MCM operations.
  4. Conduct cybersecurity testing of the RMS to identify risks associated with deploying the system planned for Initial Operational Capability in FY15/16.
  5. Document a robust reliability monitoring and growth strategy for any new LRIP vehicles procured following a planned FY15 Milestone C decision.
  6. Reassess RMMV v6.0 radiated noise following vehicle upgrades.
  7. Reexamine minimum vehicle and sensor reliability and LCS organizational-level maintenance support needed to complete timely and realistic operational scenarios without excessive reliance on intermediate- and depot-level support.
  8. Reconsider RMS minehunting requirements in the context of expected LCS tactics and operations.
  9. Recognizing schedule constraints, continue to conduct ship-based testing of the RMS that includes end-to-end minehunting missions from an LCS as part of the MCM mission package to:
     - Assess fixes to resolve RMMV launch, handling, and recovery problems observed in FY14/15 testing and verify it can be handled safely in higher sea states once the ship's structure is repaired, the weight restrictions are lifted and the capture probe and latching mechanism (capture pawls) are corrected.
     - Assess fixes to resolve communications problems observed in FY13/14/15 testing.
     - Assess improvements to post mission analysis and contact management software and training to resolve problems observed in 1QFY15 testing when attempting to pass RMS contacts to another mission system for follow-on action.
     - Verify the RMS mission module is ready to support conduct of operational testing of the LCS MCM mission package in FY15.

RQ-21A Blackjack
(formerly Small Tactical Unmanned Aerial System (STUAS))

Executive Summary

- The Navy started the RQ-21A Blackjack (formerly Small Tactical Unmanned Aerial System (STUAS)) IOT&E in accordance with a DOT&E-approved Test and Evaluation Master Plan and test plan in January 2014. The planned IOT&E consisted of a land-based phase of testing at Marine Corps Air Ground Combat Center, Twentynine Palms, California, and a ship-based phase of testing aboard an LPD-17 class ship. Originally scheduled for completion in March 2014, technical difficulties, including system deficiencies, extended the test into December 2014.
- Concurrent with the land-based phase of IOT&E, the Navy conducted RQ-21A Blackjack ship-based developmental testing. This ship testing identified interference between the ships degaussing system and the air vehicle's magnetometer. This deficiency necessitated software upgrades and regression testing, which delayed the scheduled ship-based phase of IOT&E.
- The RQ-21A Blackjack system provides commanders with a long-endurance Intelligence, Surveillance, and Reconnaissance (ISR) asset. The RQ-21A air vehicle has a demonstrated endurance of more than 12 hours to provide extended dwell times in support of ground units.
- During the land-based phase of IOT&E, the system demonstrated a Mean Flight Hours Between Abort (MFHBA) of 15.8 hours versus the threshold criterion of 50 hours. Low reliability adversely affected the ability of operators to support ground units in a timely manner. In particular, air vehicle engines fail often, and the system software is immature.
- The Navy should conduct an in-depth root cause analysis of the propulsion module to improve engine life so that a greater percentage of modules reach the advertised high time limits, and should review quality control procedures to reduce the number of failed parts delivered to fielded systems.

System

- Each system consists of five RQ-21A unmanned air vehicles, surface components, and assorted government-provided equipment. The surface components consist of ground control stations, launch and recovery equipment, datalinks, multi mission payloads, and support systems. Government-provided equipment includes vehicles and generators to transport and power ground components as well as intelligence workstations.
- The Marine Corps intends the RQ-21A system to have the following capabilities:
  - Reliability to support an operating tempo of 12 hours on station per day at a sustained rate for 30 days, and the capability for one surge of 24 hours on station per day for a 10-day period during any 30-day cycle
  - Air vehicle with 10 hours endurance, airspeed up to 80 nautical miles per hour, and a service ceiling of 15,000 feet density altitude
  - Operating radius of 50 nautical miles
  - Electro-optical sensor capable of identifying a 1-meter sized object from 3,000 feet altitude; infrared sensor capable of identifying a 3-meter sized object from 3,000 feet altitude
  - Entire system transportable by CH-53E helicopter
- The RQ-21A Blackjack will replace the Shadow RQ-7 unmanned aerial vehicles (UAVs) currently operated by Marine UAV Squadrons.

Mission

- Marine Corps commanders will use the RQ-21A Blackjack to provide units ashore with a dedicated persistent battlefield ISR capability that will reduce their dependence on higher headquarters for ISR support.
- The persistence of the system allows commanders greater coverage of their areas of interest, while providing the capability to concentrate for longer periods of time on a specified target of interest.
- In addition to operating from land bases, detachments from Marine Corps UAV Squadrons will embark the requisite personnel and equipment aboard L-class ships and conduct operations in the maritime domain.

Major Contractor

Insitu, Inc. – Bingen, Washington

Activity

- The Navy started the RQ-21A Blackjack IOT&E in accordance with a DOT&E-approved Test and Evaluation Master Plan and test plan in January 2014. Testing consisted of a land-based IOT&E phase (with concurrent ship-based developmental testing) intended to be followed by a ship-based IOT&E phase aboard an LPD-17 class ship.
  - During the land-based phase of IOT&E at Marine Corps Air Ground Combat Center, Twentynine Palms, operators flew 188 flight hours during 31 flights. The first flight ended in a mishap and loss of the air vehicle. Post-mishap investigation suspended operational test flights for 10 days.
  - Concurrent with the land-based phase of IOT&E, the Navy conducted ship-based developmental testing aboard an LPD-17 class ship. This ship testing identified interference between the ship's degaussing system and the air vehicle's magnetometer. This deficiency necessitated software upgrades and regression testing, which delayed the scheduled ship-based phase of IOT&E.
  - Based on poor system performance during the land-based phase of IOT&E and a software update to correct a GPS deficiency associated with shipboard operations, the Navy conducted a second land-based phase of IOT&E in June at Marine Corps Base Camp Lejeune, North Carolina. Operators flew 20.9 hours during 8 flights.
- In May 2014, the Marine Corps deployed an Early Operational Capability (EOC) system (the equivalent of two RQ-21A systems) to support combat operations in Afghanistan. The Marine Corps planned for this detachment to conduct operations until the end of September 2014. The EOC systems flew 995 hours in 115 flights before termination 3 weeks early.

Assessment

- The RQ-21A Blackjack provides the Marine Corps with a cost-effective alternative to the current contractor-owned and operated services providing ISR services overseas. A Marine Corps-owned and operated system provides for greater flexibility in the deployment and location of a commander's organic ISR asset.
- The system provides the Marine Corps with a tactical unmanned aircraft system capable of launching and recovering from aviation capable ships. This capability provides the commander with an organic pre-amphibious assault ISR asset that is able to seamlessly transition ashore.
  - For tactical movement ashore, the Marine Corps certified all RQ-21A Blackjack components for transport by CH-53E. Once ashore, a 4 air vehicle, 10-person detachment is transportable by 4 HMMWVs and 2 trailers. While this provides for a robust ISR capability, such a detachment is dependent upon other units for electrical power, shelter, and logistical support (i.e., fuel, food, water).
  - The RQ-21A Blackjack is capable of operating from austere launch and recovery sites. Because the system does not require a runway for launch and recovery, commanders have greater flexibility in terms of where to base the system.
- The modular nature of the RQ-21A air vehicle makes it an easy to maintain system at the unit level. Unit-level maintainers easily correct faults by removing and replacing the affected module in a minimum amount of time.
- During the land-based phase of IOT&E, the system demonstrated an MFHBA of 15.8 hours, well below the MFHBA threshold criterion of 50 hours. Low reliability adversely affected the ability of operators to support ground units in a timely manner.
- Land-based IOT&E identified production quality control deficiencies, such as an incorrectly assembled air vehicle fueler, a mis-wired operator workstation, and loose and broken servo connectors in several wings. Some spare parts received during the test arrived with either no software loaded, or the wrong software version installed.
- Propulsion Module Units (air vehicle engines) are not reliable. Each engine has a design high time limit of 100 hours, which means it is designed to fly 100 hours and then be replaced. Each propulsion unit accumulates 16 operating hours during production and operational checks before delivery, resulting in 84 hours of useful life after delivery. During the land-based phase of IOT&E, the test unit used all three spare engines during the course of 188 flight hours. Due to the subsequent lack of spare engines, one air vehicle remained down for a week when its engine reached the high time limit.
- The May 2014 EOC deployment also revealed problems with propulsion modules:
  - Two propulsion modules with the deployed EOC system failed during flight, resulting in air vehicle loss. Shortly thereafter, maintainers discovered cracks in the generator drive pulley on one propulsion module as they prepared an air vehicle for flight. Subsequent inspections revealed similar cracks on other propulsion modules. As a result, the Marine Corps reduced propulsion module operating life to 50 hours. Because of propulsion module concerns and lack of spares, the Marine Corps terminated EOC flight operations three weeks early.
  - The deployed EOC system replaced 28 propulsion modules during the course of 995 flight hours. This resulted in an average useful life of 35 hours per replaced propulsion module. The EOC unit replaced three of the 28 propulsion modules because of the 100-hour high time limit. The unit replaced nine propulsion modules because of fuel leaks.
- The current communications relay payload does not allow in-flight frequency changes. Before flight, operators load a single frequency into each relay radio. Any units that require the communications relay payload to support their operations must operate on these frequencies. This design precludes the system from supporting unplanned communications relay missions because supported units would have to switch their communications nets to the two pre-programmed payload

frequencies. Tactically, this is something that ground units would not do.

Recommendations

- Status of Previous Recommendations. The Navy has made progress in the FY13 recommendation that the program accelerate annual operating hours in order to reach the projected 3,300 flight hours sooner than 2017, which would allow the Navy to identify and correct failure modes before committing to buy a significant number of systems. In May 2014, the Marine Corps had deployed the equivalent of two RQ-21A systems to Afghanistan. This deployed system has identified numerous failure modes not previously encountered. The remaining FY13 recommendation to conduct a comprehensive review of RQ-21A reliability versus requirements remains open.
- FY14 Recommendations. The Navy should:
  1. Review quality control procedures to reduce the number of failed parts delivered to fielded systems.
  2. Conduct an in-depth root cause analysis of the propulsion module to improve engine life so that a greater percentage of modules reach the advertised high time limits.
  3. Upgrade the communications relay payload to allow for in-flight frequency changes.
  4. Delay the programs Full-Rate Production decision until additional land-based operational testing verifies correction of those deficiencies identified during OT&E.

Standard Missile-6 (SM-6)

Executive Summary

- The performance deficiency discovered during IOT&E and outlined in the classified Standard Missile-6 (SM-6) IOT&E report remains unresolved and continues to affect DOT&E's final assessment of effectiveness.
  - The Navy is assessing several options for a solution, each with varying degrees of complexity. A primary concern is to ensure the solution causes no degradation to the existing SM-6 performance envelope. The Navy plans to incorporate these changes in Block I (BLK I) and Block IA (BLK IA) production variants in FY16.
- The Navy will not demonstrate the SM-6 Capability Production Document performance requirement for interoperability until the fielding of the Navy Integrated Fire Control – Counter Air (NIFC-CA) From-the-Sea (FTS) Increment I capability in FY15. The Navy expects to demonstrate the maximum range Key Performance Parameters during SM-6 FOT&E and Aegis Baseline 9 operational testing in FY15, and the launch availability Key Performance Parameter in the FY15-16 timeframe.
- The Navy commenced developmental testing of pre-planned product improvements to the SM-6 BLK I missile; these improvements are the SM-6 BLK IA configuration. A successful, pre-production developmental flight test (Guidance Test Vehicle-1 (GTV-1)) occurred in FY14. The Navy will conduct an additional two GTV missions, one each in FY15 and FY16, with operational testing of the SM-6 BLK IA planned for FY16.
- The Navy conducted seven SM-6 missiles tests during FY14; all missions were successful. Four of the launches supported FOT&E with Aegis Baseline 9, and three supported NIFC-CA FTS Increment I capability.
- NIFC-CA FTS Increment I test events have demonstrated a basic capability, but its effectiveness under operationally realistic conditions is undetermined.
- DOT&E continues to monitor the uplink/downlink antenna shroud reliability during FOT&E. There are no recorded failures in testing since IOT&E in 2011.

System

- SM-6 is the latest evolution of the Standard Missile family of fleet air defense missiles.
- The SM-6 is employed from cruisers and destroyers equipped with Aegis combat systems.

- The SM-6 seeker and terminal guidance electronics derive from technology developed in the Advanced Medium-Range Air-to-Air Missile program. SM-6 retains the legacy Standard Missile semi-active radar homing capability.
- SM-6 receives midcourse flight control from the Aegis Combat System via ship's radar; terminal flight control is autonomous via the missile's active seeker or supported by the Aegis Combat System via the ship's illuminator.
- SM-6 is being upgraded to the BLK IA configuration to address hardware and software improvements and to address advanced threats

Mission

- The Joint Force Commander/Strike Group Commander will use SM-6 for air defense against fixed-/rotary-winged targets and anti-ship missiles operating at altitudes ranging from very high to sea-skimming.
- The Joint Force Commander will use SM-6 as part of the NIFC-CA FTS operational concept to provide extended range, over-the-horizon capability against at-sea and overland threats.

Major Contractor

Raytheon Missile Systems – Tucson, Arizona

Activity

- The Navy conducted seven SM-6 BLK I missiles tests during FY14 in accordance with a DOT&E-approved test plan; all missions were successful. Four of the launches supported FOT&E with Aegis Baseline 9, and three supported NIFC-CA FTS Increment I capability. While the SM-6 BLK IA test flight was a developmental test not covered under a DOT&E

operational test plan, suitability data on common components were collected.

SM-6 BLK I FOT&E

- In June 2014, an SM-6 successfully engaged a high-altitude supersonic target at Point Mugu, California.
- In August 2014, an SM-6 successfully engaged a subsonic target flying at the minimum altitude overland at White Sands Missile Range, New Mexico.
- In September 2014, an SM-6 successfully engaged a low-altitude supersonic target in a crossing engagement at Point Mugu, California.
- In September 2014, an SM-6 successfully engaged a low-altitude subsonic target in a crossing engagement at Point Mugu, California.

NIFC-CA Increment I Flights

- In June 2014, an SM-6 BLK I successfully engaged a subsonic low radar cross section target at medium-range and low-altitude at Point Mugu, California.
- In June 2014, an SM-6 BLK I successfully engaged a subsonic large radar cross section target at medium-range and medium-altitude at Point Mugu, California, .
- In June 2014, an SM-6 BLK I successfully engaged a subsonic large radar cross section target at long-range and medium-altitude at Point Mugu, California. This was the longest-range engagement by SM-6 to-date.

SM-6 BLK IA

- In August 2014, the Navy successfully conducted a land-based test launch of the pre-production SM-6 BLK IA at White Sands Missile Range, New Mexico. The missile successfully engaged a high-altitude subsonic target overland. The Navy will conduct two additional GTV missions, one each in FY15 and FY16, the last of which will be the production configuration.

Assessment

- The FY14 SM-6 BLK I flight tests were successful with no occurrences of the uplink/downlink antenna shroud reliability deficiency. DOT&E and the Navy will continue to collect data on this deficiency throughout FOT&E flight-testing. In addition, there were no observations of additional anomalies during these tests.
- In the May 2013 SM-6 IOT&E report, DOT&E assessed SM-6 BLK I as suitable. This assessment considered combined data from the IOT&E and developmental/operational flight tests. During FY14 testing, DOT&E collected additional reliability data and assessed the SM-6 BLK I continues to remain suitable. DOT&E will continue to collect suitability and effectiveness data throughout SM-6 BLK I FOT&E testing in FY14/15.
- The performance deficiency discovered during IOT&E and outlined in the classified SM-6 BLK I IOT&E report remains unresolved and continues to affect DOT&E's final assessment of effectiveness. The Navy is assessing several options for a solution, each with varying degrees of complexity. A primary concern is to ensure the solution causes no degradation to the existing SM-6 performance envelope. The corrective actions will be incorporated into production of the SM-6 BLK I and BLK IA configurations and tested during FOT&E in FY16.
- The Navy expects to demonstrate the maximum range Key Performance Parameter during SM-6 FOT&E and Aegis Baseline 9 operational testing in FY15 and the launch availability Key Performance Parameter in the FY15-16 timeframe.
- The Navy will not demonstrate the SM-6 Capability Production Document performance requirement for interoperability until the fielding of the NIFC-CA FTS Increment I capability in FY15.
- The NIFC-CA FTS Increment I demonstrations conducted during FY14 were basic developmental tests not conducted in an operationally realistic manner. The Navy plans to continue testing the Increment I configuration with increasingly-challenging scenarios; however, no operational test concept or test plans for NIFC-CA FTS increments have been provided to DOT&E.

Recommendations

- Status of Previous Recommendations. The Navy has not addressed the previous recommendation to complete corrective actions of the classified performance deficiency discovered during IOT&E and develop a flight test program to test those corrective actions.
- FY14 Recommendations. None.

Surface Electronic Warfare Improvement Program (SEWIP) Block 2

Executive Summary

- The Commander, Operational Test and Evaluation Force (COTF) conducted the IOT&E of the AN/SLQ-32 Electronic Warfare System (EWS), equipped with the Surface Electronic Warfare Improvement Program (SEWIP) Block 2 upgrade, from August 22 through November 7, 2014, on USS *Bainbridge* (DDG 96) in the Virginia Capes operating area.
- Analysis of the IOT&E data is ongoing. While preliminary results indicate that the AN/SLQ-32 EWS equipped with the SEWIP Block 2 upgrade appears to provide more capability than the legacy AN/SLQ-32 EWS, the at-sea portion of the IOT&E on USS *Bainbridge* from August 22 – 29 was inadequate to allow a determination of operational effectiveness.
- Inadequate crew training and proficiency caused the COTF test team to provide operationally unrealistic assistance to the crew, which adversely influenced some test results. An operational test of those affected portions of the test must be conducted before operational effectiveness can be fully assessed.
- In addition, several operational suitability deficiencies have been identified that must be corrected and demonstrated in a follow-on operational test.

System

- SEWIP is an incremental development program that is intended to improve the electronic warfare capability on all Navy surface combatants.
- The SEWIP Block 1 upgrade focused on the replacement of obsolete parts in the AN/SLQ-32 in addition to incorporation of a new operator console, a specific emitter identification capability, and an embedded trainer.
- The SEWIP Block 2 upgrade incorporates a new antenna system and enhanced processing capabilities, which are intended to improve the AN/SLQ-32's passive electronic support capabilities.
- The SEWIP Block 3 upgrade, which is in early development, will incorporate improvements to the AN/SLQ-32's active electronic attack to improve the ships' self-defense capabilities.

Mission

Navy surface ships will use SEWIP to enhance their AN/SLQ-32 Electronic Warfare System anti-ship missile defense, counter-targeting, and counter-surveillance capabilities, as well as to improve the system's ability to collect electronic data.

Major Contractor

Lockheed-Martin – Syracuse, New York

Activity

- COTF conducted operational testing of the AN/SLQ-32 EWS with the SEWIP Block 2 upgrade from August 22 through November 7, 2014. COTF conducted the IOT&E onboard USS *Bainbridge* (DDG 96) in the Virginia Capes operating area and it included operationally representative activities and scenarios using Navy operators.
- A DOT&E operational test report is anticipated in 2QFY15.

Assessment

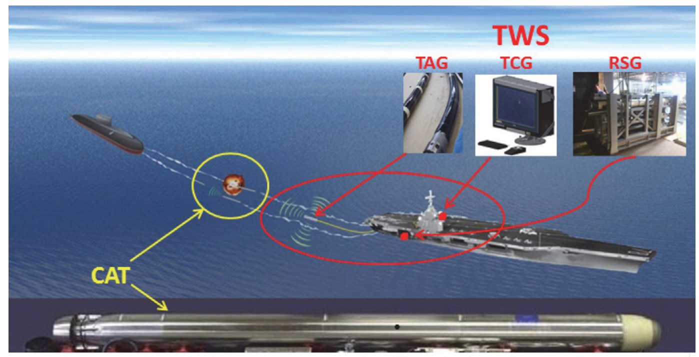
- Analysis of the IOT&E data is ongoing. While preliminary results indicate that the AN/SLQ-32 EWS equipped with the SEWIP Block 2 upgrade appears to provide more capability than the legacy AN/SLQ-32 EWS, the at-sea portion of the IOT&E on USS *Bainbridge* from August 22 – 29 was inadequate to allow a determination of operational effectiveness.
- Inadequate crew training and proficiency caused the COTF test team to provide operationally unrealistic assistance to the crew, which adversely influenced some test results.
  - These included providing assistance in setting up displays to make threat detection easier to recognize, showing operators which threats needed identification, helping operators identify extraneous emitter contacts, calibrating the system when the operators did not

perform the calibration when the system called for it, and resetting the system in the form of unscheduled warm and cold starts.
  - An operational test of those affected portions of the test must be conducted before operational effectiveness can be fully assessed.
- Several operational suitability deficiencies that included several display freezes, system crashes, and unscheduled warm and cold starts have been identified that must be corrected and demonstrated in a follow-on operational test.

Recommendations

- Status of Previous Recommendations. The Navy has not resolved the following FY06 and FY08 SEWIP recommendations:
  1. Review and modify the SEWIP detection and classification algorithms to correct deficiencies discovered while operating in dense pulse and emitter environments. Verify the correction of these deficiencies during future SEWIP operational test and evaluation.
  2. Continue to collect in-service SEWIP hardware reliability data to gain a higher degree of confidence regarding achievement of this requirement.
  3. Continue to review and modify the SEWIP software to improve its reliability.
  4. Develop threat representative aerial target/threat seeker combinations and/or procure actual threat anti-ship cruise missiles for more realistic testing of future SEWIP block upgrades and other electronic warfare systems.
- FY14 Recommendations. The Navy should:
  1. Identify the portions of the operational effectiveness testing that were adversely affected by the operationally unrealistic assistance and schedule an additional operational test of those affected portions.
  2. Correct the identified operational suitability deficiencies and schedule a follow-on operational test period to demonstrate the corrections.

Surface Ship Torpedo Defense (SSTD) System: Torpedo Warning System (TWS) and Countermeasure Anti-Torpedo (CAT)



CAT - Countermeasure Anti-Torpedo Torpedo
RSG - Ready Stow Group
TAG - Target Acquisition Group
TCG - Tactical Control Group
TWS - Torpedo Warning System

Executive Summary

- The Navy fielded the Torpedo Warning System (TWS) and the Countermeasure Anti-Torpedo (CAT) Engineering Development Model (EDM)-2 with the Stored Chemical Energy Propulsion System (SCEPS) aboard USS *George H. W. Bush* when she deployed in February 2014 to Fifth Fleet Operating Areas. USS *George H. W. Bush* returned home in November 2014. Analysis of the data collected during her deployment remains in progress.
- DOT&E issued a classified Early Fielding Report on TWS and CAT in April 2014. DOT&E determined the system demonstrated some capability to detect certain types of threat torpedoes. However, the system has not been fully tested and most TWS and CAT testing to date have been conducted in areas with benign acoustic conditions when compared to the expected threat operating areas, which may have biased the results.
- The Navy discovered an anomaly in the CAT's Safety and Arming device in March 2014, which would significantly reduce the effectiveness of the CAT. DOT&E issued a classified update to the Early Fielding Report on TWS and CAT in August 2014.
- In November 2014, the Navy conducted a new Quick Reaction Assessment (QRA) event of a temporary-installation version of TWS and CAT (designated as a roll-on/roll-off system) aboard USS *Theodore Roosevelt*.
  - The QRA event was held in conjunction with a contractor test event designated CT-2. Only two of the four planned QRA events and one of the five planned CT-2 events were accomplished due to several factors, including poor weather. This TWS installation included the new TWS active sonar.
  - During each completed event, a surrogate threat torpedo was fired at USS *Theodore Roosevelt* for the TWS system to detect and target. USS *Theodore Roosevelt*'s crew, with the contractor support that will accompany the ship on their deployment, engaged the threat torpedo surrogate with a CAT during some of the events. All CATs that were fired used electric propulsion. Analysis of the three completed events is in progress.
- The Navy plans to field the temporary-installation version of TWS and CAT installed aboard USS *Theodore Roosevelt* when she deploys in FY15.

System

- The Surface Ship Torpedo Defense is a system-of-systems that includes two new sub-programs: the TWS program (an Acquisition Category III program) and CAT (will not become an acquisition program until FY16).
- TWS is being built as an early warning system to alert on and localize incoming threat torpedoes and consists of three major subsystems:
  - The Target Acquisition Group consists of a towed acoustic array, tow cable, winch, power supply, and signal-processing equipment. Data from the array and the ship's radar system are processed into contact tracks and alerts to be forwarded to the Tactical Control Group. The array will be capable of both passive and active sonar operations.
  - The Tactical Control Group consists of duplicate consoles on the bridge and Combat Direction Center (on CVNs) that displays contacts, issues torpedo alerts to the crew, and automatically develops CAT placement presets using information sent from the Target Acquisition Group. The operator will use this console to manage the threat engagement sequence and command CAT launches.
  - The Ready Stow Group will consist of the steel cradles housing the CATs.
- CAT is a hard-kill countermeasure intended to neutralize threat torpedoes and consists of the following:
  - The Anti-torpedo Torpedo (ATT) is a 6.75-inch diameter interceptor designed for high-speed and maneuverability to support rapid engagement of the threat torpedo.
  - The All-Up Round Equipment consists of a nose sabot, ram plate, launch tube, muzzle cover, breech mechanism, and energetics to encapsulate and launch the ATT.
  - The tactical CAT is powered by a SCEPS. The battery powered electric motor CAT is for test purposes only.

- The Navy developed a temporary version of TWS and CAT (designated a roll-on/roll-off system) in addition to the permanent-installation version. The first temporary-installation version is also the first TWS system to incorporate active sonar operations. The Navy intends for this version to provide the same function as the permanent one.
  - The Ready Stow Group is eliminated by mounting the CAT All-Up Round Equipment directly to the carrier's deck.
  - The Tactical Control Group consists of two consoles contained in a container express box located on the carrier's hangar deck.
  - The towed acoustic array, tow cable, and winch are permanently installed on the carrier's fantail.

Mission

Commanders of nuclear-powered aircraft carriers and Combat Logistic Force ships will use Surface Ship Torpedo Defense to defend against incoming threat torpedoes.

Major Contractors

TWS

- 3Phoenix – Wake Forest, North Carolina
- In-Depth Engineering – Fairfax, Virginia
- Pacific Engineering Inc. (PEI) – Lincoln, Nebraska

CAT

- Pennsylvania State University Applied Research Laboratory – State College, Pennsylvania
- PEI – Lincoln, Nebraska

Activity

- The Navy has been working on a hard-kill torpedo defense system for surface ships for over 10 years, but accelerated the development and fielding of TWS and CAT as a result of the March 2010 sinking of the South Korean ship, ROKS *Cheonan*, and a Navy Fifth Fleet Urgent Operational Needs Statement. The Navy also decided to have the systems protect high-value ships (aircraft carriers and combat logistic ships) rather than destroyers as originally planned.
- In November 2013, the Navy conducted a QRA aboard USS *George H. W. Bush* in the Virginia Capes Operating Areas. During each event, a surrogate threat torpedo was fired at USS *George H. W. Bush* for the TWS system to detect and target. USS *George H. W. Bush*'s crew, with the contractor support that accompanied the ship on their deployment, engaged the threat torpedo surrogate with a CAT. During the QRA, two representative tactical CATs with SCEPS were fired; the remaining three CATs used electric propulsion.
- The Navy fielded the TWS system and the CAT EDM-2 with the SCEPS system aboard USS *George H. W. Bush* when she deployed in February 2014 to Fifth Fleet Operating Areas. USS *George H. W. Bush* returned home in November 2014, and the analysis of the data collected during her deployment is in progress.
- DOT&E issued a classified Early Fielding Report on TWS and CAT in April 2014.
- The Navy discovered an anomaly in the CAT's Safety and Arming device in March 2014. After being briefed on the anomaly, DOT&E issued a classified update to the Early Fielding Report on TWS and CAT in August 2014. The Navy developed a correction for the anomaly in the CAT Safety and Arming device but could not install the correction in the fielded CATs due to safety concerns and USS *George H.W. Bush's* operational schedule.
- During FY14, the Navy and DOT&E started development of an enterprise Test and Evaluation Master Plan (TEMP) for the TWS and CAT systems. The Navy made their TWS Milestone B decision without a TEMP and is not planning to make the CAT system an acquisition program until FY16.
- In June 2014, the Navy and Pennsylvania State University Applied Research Laboratory conducted contractor and developmental testing of CAT at the Dabob Bay, Washington, and the Nanoose Bay, British Columbia, Canada, acoustic tracking ranges. The Dabob Bay test consisted of six structured events to develop the CAT EDM-2s ability to intercept noisy and quiet, straight-running and maneuvering targets, to collect CAT self-noise data, and to collect data where two CATs tracked a single target. The Nanoose Bay testing included four structured events to develop the CAT EDM-2's ability to detect, track, and intercept surrogate threat torpedoes in the presence of a CVN, and one event to characterize the CVN's radiated noise signature and CAT's active returns in the vicinity of the CVN's hull. Four Dabob Bay events used electrically-propelled CATs (ECATs) and two used CAT EDM-2s with the SCEPS. Three Nanoose Bay events used ECATs and two events used CAT EDM-2s with the SCEPS.
- In October 2014, the Navy and 3Phoenix conducted contractor and developmental testing of TWS's active source at Lake Pend Oreille, Idaho. TWS's active source was redesigned following the failure of an earlier demonstration model in 2011. This was the first in-water test of the redesigned active source and included data collection against static and dynamic targets to support further development.
- In November 2014, the Navy conducted a new QRA event of a temporary-installation version of TWS and CAT (designated as a roll-on/roll-off system) aboard USS *Theodore Roosevelt*.
  - The QRA event was held in conjunction with a contractor test event designated CT-2. Only two of the four planned QRA events and one of the five planned CT-2 events were accomplished due to several factors, including poor weather. This TWS installation included the new TWS active sonar.

- During each completed event, a surrogate threat torpedo was fired at USS *Theodore Roosevelt* for the TWS system to detect and target. USS *Theodore Roosevelt*'s crew, with the contractor support that will accompany the ship on their deployment, engaged the threat torpedo surrogate with a CAT during some of the events. All CATs that were fired used electric propulsion. Analysis of the three completed events is in progress.
- The Navy plans to field the temporary-installation version of TWS and CAT installed aboard USS *Theodore Roosevelt* when she deploys in FY15.

Assessment

- The prototype TWS and early engineering developmental model CAT installed on USS *George H. W. Bush* and USS *Theodore Roosevelt* demonstrated some capability to detect certain types of threats. However, the system has not been fully tested and the Navy conducted most TWS and CAT testing to date in areas with benign acoustic conditions when compared to the expected threat operating areas, which may have biased the results high. Additionally, most threat surrogates were not executing operationally realistic threat torpedo profiles due to safety constraints.
- The Navy's decision to add a highly-trained contractor as the acoustic operator to supplement the automated detection and alerting functions of TWS improved threat detection performance during the 2013 QRA. However, the test areas did not offer the same number of opportunities for false alerts as expected in the threat area; thus, it is not known if the presence of the operator could also reduce the false alert rate. For safety reasons, the QRA testing was highly structured and allowed the operators to focus on torpedo detections and firing the CAT. Therefore, QRA testing was inadequate to resolve the rate of false alerts or their impact on mission accomplishment.
- USS *George H. W. Bush*'s deployment was useful in identifying TWS false alert sources, but system development done using these data needs to be assessed in testing that includes the presence of both threat torpedo surrogates and assets that may cause false alerts simultaneously.
- During developmental testing and the 2013 QRAs, a properly targeted CAT EDM-2 demonstrated a capability to detect and home on some surrogates torpedoes. However, all of the surrogate threat torpedoes and CATs were operating deeper than most expected threat torpedoes due to safety reasons. Shallower scenarios that force the CAT to track and attack the surrogate threat torpedo in the challenging areas of the water column were only investigated during limited contractor test events at Dabob Bay and during a single event in Nanoose Bay in June 2014; the Navy has not collected adequate data to assess CAT's overall ability to neutralize these threats.
- The Navy developed a correction for the anomaly in the CAT Safety and Arming device, but has not yet implemented a way to verify the device's correct operation in sea tests.
- Completed testing indicates the new active source has both hardware and software reliability deficiencies, which the Navy is investigating. The temporary-installation system exhibited other reliability deficiencies with interfaces to ship's power, operator display consoles, and the array-handling equipment. Should the Navy field the temporary-installation prototype TWS and EDM-2 model of the CAT aboard USS *Theodore Roosevelt* in FY15, this will be the first fielding of a TWS that incorporates active sonar operations. Additional information on the testing of TWS and CAT performance will be included in DOT&E's classified Early Fielding Report in 2QFY15.
- The ATT warhead tests indicate that the ATT should be lethal against select representative torpedo threats provided that both the CAT's closest point of approach to the threat torpedo and the CAT's fuzing occurs within the explosive kill zone. Further test and analysis is required to determine the comprehensive lethal capability of the ATT.

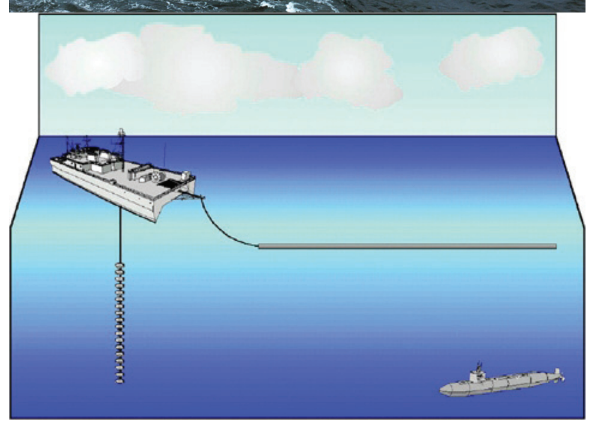
Recommendations

- Status of Previous Recommendations. The Navy has made limited progress on the FY13 recommendations. The Navy should still:
  1. Develop TEMPs for the TWS and CAT system and an LFT&E strategy for the ATT lethality as soon as possible.
  2. Conduct additional testing in challenging, threat-representative environments.
  3. Conduct additional CAT testing using operationally realistic threat target profiles closer to the surface to assess the CAT's terminal homing, attack, and fuzing within the lethality range of the warhead.
- FY14 Recommendations. The Navy should:
  1. Implement a way to verify the correct operation of the CAT's Safety and Arming device in all future sea tests.
  2. Investigate test methods designed to reduce or eliminate the safety limitations that have previously prevented testing against operationally realistic target scenarios. The Navy should consider using geographic separation, range boundaries, and shallower draft ships for future TWS and CAT testing.
  3. Investigate, correct, and retest deficiencies identified with the active source and other components of the temporary-installation system before fielding these aboard USS *Theodore Roosevelt*.

Surveillance Towed Array Sensor System (SURTASS) and Compact Low Frequency Active (CLFA) Sonar

Executive Summary

- DOT&E issued a classified Early Fielding Report on Surveillance Towed Array Sensor System (SURTASS) and Compact Low Frequency Active (CLFA) Sonar on February 24, 2014. This report was submitted due to significant and uncertain delays in the completion of IOT&E. It concluded that SURTASS/CLFA was not operationally effective during the limited testing conducted in FY12.
- The Commander, Operational Test and Evaluation Force (COTF) continued IOT&E in September 2014 in conjunction with the fleet exercise Valiant Shield 14 and a follow-on dedicated test phase. Completion of IOT&E is expected in FY15.



System

- SURTASS/CLFA is a low-frequency, passive and active, acoustic surveillance system installed on tactical auxiliary general ocean surveillance (T-AGOS) ships as a component of the Integrated Undersea Surveillance System.
- SURTASS provides passive detection of nuclear and diesel submarines and enables real-time reporting of surveillance information to Anti-Submarine Warfare (ASW) commanders.
- CLFA is a low-frequency, active sonar system developed to provide an active detection capability of quiet submarines operating in environments that support active sonar propagation.
- The system consists of:
  - A T-AGOS host ship with array-handling equipment
  - A towed vertical string of active acoustic projectors (CLFA)
  - A towed horizontal twin line (TL-29A) passive sonar array
  - An Integrated Common Processor (ICP) for processing active and passive acoustic data
  - A High-Frequency Marine-Mammal Monitoring (HFM3) active sonar used to ensure local water space is free of marine mammals prior to low-frequency active transmission
  - A communications segment to provide connectivity to shore-based Integrated Undersea Surveillance System-processing facilities and to fleet ASW commanders

Mission

Maritime Component Commanders:

- Employ T-AGOS ships equipped with SURTASS/CLFA systems to provide long-range active and passive ASW detection, classification, and tracking of submarines in support of Carrier Strike Group and theater ASW operations
- Use SURTASS/CLFA to provide blue force ASW screening and threat submarine localization information to theater ASW commanders to support coordinated prosecution of detected threat submarines

Major Contractors

- Overall Integrator: Maritime Surveillance Systems Program Office (PMS 485)
- Integrated Common Processor: Lockheed Martin – Manassas, Virginia
- CLFA Projectors: BAE – Nashua, New Hampshire
- CLFA Handling System: Naval Facilities Engineering and Expeditionary Warfare Center (NAVFAC EXWC) (Government Lab) – Port Hueneme, California
- HFM3: Scientific Solutions Incorporated (SSI) – Nashua, New Hampshire
- TL-29A Towed Arrays: Lockheed Martin – Syracuse, New York

Activity

- On February 24, 2014, DOT&E issued a classified Early Fielding Report for SURTASS/CLFA. This report was issued due to significant and uncertain delays in the completion of IOT&E that commenced in FY12.
- In September 2014, COTF resumed IOT&E and collected operational data during two events. Testing was conducted in accordance with a DOT&E-approved test plan.
  - The Navy conducted four days of ASW area search operations for SURTASS/CLFA in support of coordinated theater ASW that included surface and air assets during Valiant Shield 14.
  - COTF planned two, dedicated five-day test phases to achieve sufficient data to characterize SURTASS/CLFA detection capability against long-range submarine approaches. One of the test phases was cancelled due to the unavailability of the intended target submarine. During the remaining test phase, COTF completed four events during two and a half days with the SURTASS/CLFA conducting ASW large area search.
- One engineering development model and two production CLFA systems were available for operation on three of the five Western Pacific-based T-AGOS ships during FY14.

Assessment

- The final assessment of SURTASS/CLFA is not complete, as testing is expected to continue into FY15. However, the DOT&E classified Early Fielding Report concluded the following regarding performance:
  - SURTASS/CLFA was not operationally effective in supporting submarine prosecution during Valiant Shield 12. The fleet did not demonstrate the ability to correlate non-submarine CLFA detections to real-time surface ship positions during Valiant Shield 12. Failure to exclude the numerous surface ship detections, coupled with limited ASW-capable assets, will not support fleet prosecution of CLFA submarine localizations. Further details of the observed deficiencies are available in the classified report.
  - Limited operational test data demonstrated that the SURTASS/CLFA is capable of detecting submarines at long ranges using both active and passive sonar. However, data collected were insufficient to fully characterize the detection capability.
  - SURTASS/CLFA demonstrated that it can be operationally suitable. Poor reliability of HFM3 active sonar during the operational test significantly reduced the availability of CLFA and contributed to insufficient data collection. Federal law requires HFM3 active sonar to mitigate the taking of marine mammals by low-frequency active sonar, but the operation of this peacetime system does not affect the wartime capability of CLFA.
- The analysis of operational test data collected in FY14 is ongoing. DOT&E will report the results in FY15 at the completion of testing.

Recommendations

- Status of Previous Recommendations. The Navy should continue to address the remaining FY13 recommendation to improve procedures and training for correlating CLFA non-submarine, active detections with real-time surface vessel positions.
- FY14 Recommendation.
  1. The Navy should address the 10 classified recommendations listed in the February 2014 Early Fielding Report.

Air Force Programs

Air Force Programs

AC-130J Ghostrider

Executive Summary

- U.S. Special Operations Command (USSOCOM) is developing AC-130J through the integration of a modular Precision Strike Package (PSP) onto existing MC-130J aircraft. The PSP was previously developed and tested on several AC-130W aircraft since 2009.
- The AC-130J first flight was in January 2014.
- Developmental testing and evaluation (DT&E) identified several problems that require resolution and have delayed the operational assessment supporting the Milestone C decision by approximately four months.
- The U.S. Air Force Combat Effectiveness and Vulnerability Analysis Branch completed an initial qualitative survivability study of legacy aircraft to support the detailed AC-130J survivability analysis and evaluation plan development as laid out in the Live Fire Alternative Test Plan.

System

- The AC-130J is a medium-sized, multi-engine, tactical aircraft with a variety of sensors and weapons for air-to-ground attack.
- USSOCOM is developing AC-130J through the integration of a modular PSP onto existing MC-130J aircraft. USSOCOM continues to develop new PSP capabilities in parallel on legacy AC-130W aircraft prior to introduction on the AC-130J.
  - The current PSP provides a weapons suite composed of a 30 mm side-firing chain gun; wing-mounted, GPS-guided Small Diameter Bombs; and Griffin laser-guided missiles mounted internally and launched through the rear cargo door.
  - The PSP also provides an Intelligence, Surveillance, and Reconnaissance suite composed of two electro-optical/infrared sensor/laser designator pods; a synthetic aperture radar pod; and multiple video, data, and communication links. All PSP subsystems are controlled from a dual-console Mission Operator Pallet (MOP) in the cargo bay, with remote displays and control panels (including master arm and consent switches and a gun trigger) on the flight deck.
  - The program intends to add a 105 mm gun beginning with aircraft #3 (scheduled to complete modification in mid-FY16). Partially, as a result of this, the crew complement will increase from seven to nine, and some crew responsibilities will change.
  - Future updates will add a laser-guided variant of the Small Diameter Bomb, and wing-mounted laser-guided HELLFIRE missiles.
- The AC-130J will retain the ability to be refueled in flight, but it will not retain the external hose-and-drogue pods used to refuel other aircraft.
- The AC-130J retains all survivability enhancement features found on the HC/MC-130J aircraft. Susceptibility reduction features include the AN/ALR-56M radar warning receiver, AN/AAR-47(V)2 missile warning system, and AN/ALE-47 countermeasures dispensing system. Vulnerability reduction features include fuel system protection (fuel tank foam to protect from ullage explosion), redundant flight-critical components, and armor for crew and oxygen supply protection.
- The AC-130J will replace legacy AC-130H/U aircraft.

Mission

The Joint Task Force or Combatant Commander will use:

- The AC-130J to provide persistent and precision strike operations, including close air support, air interdiction, and armed reconnaissance.
- The AC-130J sensor, data, and communications suite to provide battlespace wide area surveillance and situational awareness; execute non-traditional Intelligence, Surveillance, and Reconnaissance operations; and support combat search and rescue operations.

Major Contractor

Lockheed Martin – Bethesda, Maryland

Activity

- DT&E began with ground tests on the first aircraft in October 2013 while integration was being completed; flight tests began in January 2014.
- The Air Force USSOCOM delivered the second MC-130J for conversion to an AC-130J in September 2014.
- The program selected a different intercommunication system for aircraft #2. This change, as well as delayed delivery of the necessary government-furnished information and equipment to the integrating contractor, has caused a projected two- to three-month delay in availability of aircraft #2 for testing.
- The LFT&E Integrated Program Team has drafted the Ballistic Vulnerability Analysis, the Anti-Aircraft Artillery Susceptibility Analysis, and the Proximity Burst Analysis plans. The team reviewed and summarized the available legacy aircraft survivability data to provide a more informed and more efficient set of analysis plans specifically tailored to the AC-130J Concept of Operations. The execution of these plans is expected to begin in 1QFY15.

Assessment

- DT&E identified several problems that require resolution and will affect the subsequent development test schedule:
  - In February 2014, during flying and handling qualities testing near the stall limit, the aircraft experienced a temporary departure from controlled flight. The recovery maneuver exceeded some speed and load limits on the aircraft. Flight testing was suspended for aircraft inspections and a safety incident investigation. Upon return to flight, testing was added to the DT&E plan to characterize the flight envelope more carefully. This will delay completion of DT&E by approximately two months.
  - Problems integrating the PSP weapon kit onto the aircraft continue to delay portions of developmental testing by prohibiting weapons employment.
    - The visual acuity of the electro-optical/infrared sensors installed on the AC-130J is not sufficient for accurate target identification and designation because the new aircraft causes more vibration than the legacy AC-130W aircraft on which the PSP was previously installed.
    - Electrical/radio-frequency interference between aircraft systems and the hand controllers used by crewmembers to direct the sensors and weapons has caused erratic sensor movements. This inhibits target tracking and is a safety hazard (risk of fratricide) during weapon employment.
    - The program is working on correcting the sensor vibration issue by collecting flight test data that can be used by the subsystem contractor to develop mechanical and software updates to reduce the effect of vibration. Similar efforts are underway to characterize and correct electrical interference with the controllers. The program has reported some progress in the laboratory environment on both issues, but definitive solutions have not yet been demonstrated on the aircraft.
  - The program has accomplished 36 test flights out of approximately 130 flights planned for a total of 97 flight hours (including flights added after the stall incident). Initial DT&E is now expected to be completed in May 2015.
- Delays in developmental testing have delayed the planned operational assessment by the 18th Flight Test Squadron by approximately four months. This diminishes the risk mitigation value of the operational assessment to both IOT&E and the Milestone C decision. IOT&E has been delayed until October 2015.
- Aircraft #2 is planned to undergo a second phase of DT&E prior to IOT&E in order to verify functionality of several design changes relative to aircraft #1, ranging from minor adjustments made to software and hardware integration learned from the first integration effort to more significant changes like the selection of a new intercommunication system. Since the second aircraft will not be ready until June 2015, this leaves minimal time for correction of any new deficiencies prior to IOT&E and very little time for the IOT&E crew to train on the test aircraft. This has been partially mitigated by providing both aircraft #1 and #2 to support training for IOT&E crews.
- The changes in aircraft configuration and crew complement between aircraft #2 (the test article for IOT&E) and aircraft #3 (the intended configuration for fielding) decrease the production-representative character of the IOT&E test article, diminish the utility of any crew workload studies in IOT&E, and increase the scope of the necessary FOT&E.
  - If IOT&E cannot be deferred until aircraft #3 is available, it may be made more operationally relevant by employing an eight-person crew that accounts for the movement of a combat systems operator to the flight deck and the addition of a special mission aviator (SMA) to the MOP; the ninth crewmember (the second added SMA) would not be needed without the 105 mm gun. This would allow IOT&E to more accurately evaluate tactics and workloads on the flight deck and at the MOP, and it would reduce the scope of FOT&E to focus on the addition of the 105 mm gun and final SMA.
- Draft survivability analysis plans are comprehensive, informed by legacy aircraft survivability data, and consider a range of engagement scenarios. Most of these analyses will be used to assess aspects of the AC-130J survivability using its current increment of capabilities but some are also applicable to future increment of capabilities (e.g. the Commando II Radio Frequency Countermeasures system), which is expected to be fielded in FY19.

Recommendations

- Status of Previous Recommendations. The program has addressed three of the four FY13 recommendations, and has made progress on the remaining recommendation to collect and provide DOT&E with all reliability data on the AC-130W that can augment the suitability evaluation for AC-130J. The Program Office provided some data to DOT&E, but the data are not complete. The Program Office will provide additional data to DOT&E in time for comparison to AC-130J IOT&E data.
- FY14 Recommendations. The Program Office should:
  1. Schedule sufficient time for IOT&E crew training prior to the start of IOT&E.
  2. Consider entering IOT&E with an eight-person crew to more accurately evaluate tactics and workloads.

AIM-120 Advanced Medium-Range Air-to-Air Missile (AMRAAM)

Executive Summary

- The Air Force and Navy completed FOT&E of the AIM-120 Advanced Medium-Range Air-to-Air Missile (AMRAAM) in July 2014 with the intent of making a production go-ahead decision in December 2014.
- The AMRAAM Program Office initiated System Improvement Program (SIP)-1 testing in September 2014. SIP-1 is one of several follow-on programs designed to enhance AIM-120D performance.
- The Air Force continued integrated testing on AIM-120 AMRAAM Electronic Protection Improvement Program (EPIP), a software upgrade to AIM-120C3-C7 variants, under a separate EPIP Test and Evaluation Master Plan that DOT&E approved in April 2012.

System

- AMRAAM is a radar-guided, air-to-air missile with capability in both the beyond visual-range and within visual-range arenas. A single-launch aircraft can engage multiple targets with multiple missiles simultaneously when using AMRAAM.
- The latest fielded version, the AIM-120C7, incorporated an upgraded antenna, receiver, signal processor, and new software algorithms to counter new threats. The use of smaller system components created room for future growth.
- The AMRAAM program periodically develops and incorporates phased upgrades. The AMRAAM EPIP is a software upgrade to AIM-120C3-C7.
- The AIM-120D is currently in development and the Air Force and Navy intend for it to deliver performance improvements beyond the AIM-120C7 using an internal GPS, enhanced datalink, improved kinematics, and new software. Following FOT&E, the contractor will execute a series of SIPs that will consist of software upgrades to AIM-120D.

Mission

- The Air Force and Navy, as well as several foreign military forces, use various versions of the AIM-120 AMRAAM to shoot down enemy aircraft.
- All U.S. fighter aircraft use the AMRAAM as the primary, beyond visual-range air-to-air weapon.

Major Contractors

- Raytheon Missile Systems – Tucson, Arizona
- Rocket Motor Subcontractors:
  - Alliant Techsystems (ATK) – Arlington, Virginia
  - Nammo (Nordic Ammunition Group) – Raufoss, Norway

Activity

- The Air Force and Navy conducted all testing in accordance with the DOT&E-approved Test and Evaluation Master Plan.

AIM-120D

- AIM-120D operational testing consisted of multiple live missile shots and captive-carry events. The Air Force and Navy completed AIM-120D FOT&E in July 2014.
- The Program Office plans to conduct SIP-1 integrated testing with two live missile shots during 2QFY15. Operational testing for SIP-1 is scheduled to begin in 3QFY15.
- The Air Force plans to make a production go-ahead decision on AIM-120D by December 2014.
- As of October 2, 2014, Raytheon had delivered a total of 1,031 AIM-120Ds for the Air Force and Navy.

AMRAAM EPIP

- In October 2014, the Air Force completed EPIP Basic Phase III operational testing for AIM-120C-7 missiles.
- The Air Force and Navy began EPIP Basic Phase II operational testing for AIM-120C-3, -4, -5, and -6 missiles in October 2014.

Lot Acceptance Test/Rocket Motors

- The Weapon System Explosives Safety Review Board completed acceptance and concurrence for fleet release for the ATK baseline rocket motor in June 2014. Alliant

Techsystems is delivering rocket motors to the Navy and Foreign Military Sales customers. Nammo is delivering rocket motors for U.S. AIM-120D and AIM-120C-7 Foreign Military Sales customers.

Assessment

- AMRAAM continues to be operationally effective and suitable.
- AIM-120D captive-carry performance, as measured during FOT&E, exceeded the Mean Time Between Failure requirement with 452.5 hours, exceeding the requirement of 450 hours desired two years after Initial Operational Capability.
- The Air Force identified deficiencies in missile performance that did not significantly degrade overall effectiveness. The Air Force and Raytheon Missile Systems developed solutions for specific deficiencies and will assess them during SIP-1 testing.
- The shortage in rocket motors due to unacceptable Lot Acceptance Test performance did not significantly affect AIM-120D testing, despite creating a backlog in production.

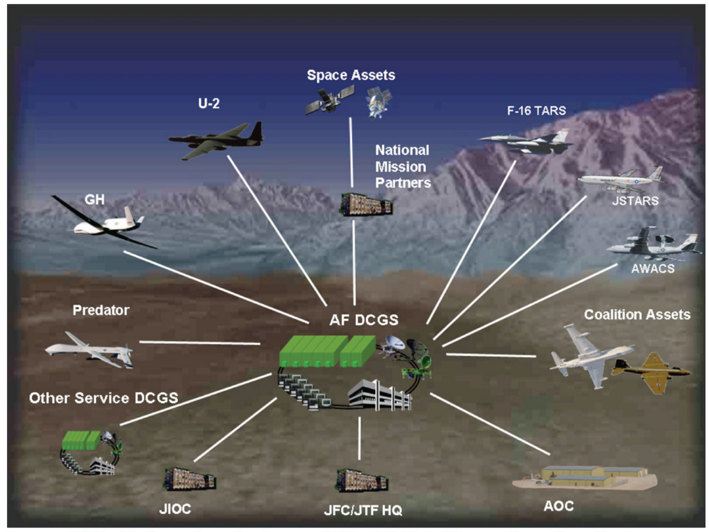
Recommendations

- Status of Previous Recommendations. The Air Force satisfactorily addressed the previous recommendations.
- FY14 Recommendation.
  1. The Air Force should complete SIP-1 operational testing to achieve the Service member's desired mission effectiveness improvements for AIM-120D.

Air Force Distributed Common Ground System (AF DCGS)

Executive Summary

- The Air Force 605th Test and Evaluation Squadron (TES) conducted two phases of a Force Development Evaluation (FDE) of the latest version of Air Force Distributed Common Ground System (AF DCGS) (Bulk Release 10B) in January and June 2014. Bulk Release 10B was delivered as a part of a Geospatial Intelligence (GEOINT) update. Key software enhancements of Bulk Release 10B degraded system performance to unacceptable levels, leading the Air Force to turn off the software in order to continue mission operations.
- The Air Force split the AF DCGS program into four Acquisition Category (ACAT) III programs after declaring Full Operational Capability in 2009 and moved the program from the development phase into the sustainment phase despite the program's immaturity. The four ACAT III programs lack appropriate and up-to-date test and evaluation, systems engineering, and requirements documentation.



AOC - Air Operations Center
AWACS - Airborne Warning and Control System
GH - Global Hawk
HQ - Headquarters
JFC - Joint Forces Command
JIOC - Joint Intelligence Operations Center
JSTARS - Joint Surveillance Target Attack Radar System
JTF - Joint Task Force
TARS - Tactical/Theater Airborne Reconnaissance System

System

- AF DCGS is an intelligence enterprise system that includes hardware housed in 5 core sites and 16 distributed sites, with a network that connects them to each other and to other intelligence networks, sensors, and mission command systems.
- The Air Force declared AF DCGS to be at Full Operational Capability in 2009. Since then, the Air Force has treated AF DCGS as if it is in sustainment, even though it is continuing to develop four ACAT III programs: Signal Intelligence (SIGINT) upgrades, GEOINT upgrades, Network Communications, and Data Links.
- The GEOINT upgrade, Bulk Release 10B, introduced a common baseline across the AF DCGS enterprise. A common baseline should allow for easier updates and modifications of the entire enterprise, and provide capabilities to handle new and emerging sensor information and the increased data loads resulting from the growing number of sensors being fielded. After the Bulk Release 10B FDE at DCGS Ground station (DGS)-2, the Air Force renamed the Bulk Release 10B to GEOINT Baseline 4.1.
- The AF DCGS System Release 3.0 is a SIGINT upgrade, which makes SIGINT data and services available to internal and external users; improves operations with the Airborne Signals Intelligence Payload low-band sensor; and improves processing, exploitation, and dissemination for high-band sensors. High-band sensors are used for Electronic Intelligence (collection of pulse and constant wave radars primarily), while low-band refers to Communications Intelligence (collection of radios of various type and special signals).
- AF DCGS has five core sites located at Langley AFB, Virginia (DGS-1); Beale AFB, California (DGS-2); Osan Air Base, Korea (DGS-3); Ramstein Air Base, Germany (DGS-4); and Hickam AFB, Hawaii (DGS-5). Worldwide, the Air Force has installed AF DCGS at an additional 16 sites: DGS-Experimental at Langley AFB, 7 Air National Guard Sites, and 8 distributed mission sites that include deployable sites to support special requirements.
- The DCGS Integration Backbone (DIB) provides the framework that allows sharing of intelligence services and data via web services. The Army, Navy, Air Force, and intelligence agencies developed and fielded their own versions of DCGS, which provide access to the DIB. Via the DIB, intelligence analysts can search for and download intelligence information and post the intelligence product they produce for others to use.

Mission

- The Air Force uses AF DCGS to connect to the DIB, manage requests for sensors, process sensor data, exploit sensor data from multiple sources, and disseminate intelligence products.
- The Joint and Combined Force Air Component Commander uses AF DCGS to produce and disseminate Intelligence, Surveillance, and Reconnaissance (ISR) information.

- The ISR products support intelligence preparation of the battlespace, predictive battlespace awareness, indications and warning, analysis of enemy courses of action, targeting and weapon selection, mission planning, and execution of air combat missions.

Major Contractors
- Raytheon – Garland, Texas
- Lockheed Martin – Denver, Colorado
- L-3 Communications – Greenville, Texas

Activity
- In August and November 2013, the 46th Test Squadron conducted developmental and regression testing on Bulk Release 10B. The system demonstrated major software shortfalls during both of these tests and the 46th Test Squadron recommended against entering the operational test.
- Despite not meeting the operational test entrance criteria (two CAT I and four CAT II software deficiencies), the Air Force Intelligence, Surveillance, and Reconnaissance Agency (AFISRA) approved entrance into operational testing. In January and June 2014, the 605th TES conducted phases 1 and 2 of a two-phase FDE to assess the operational effectiveness and suitability of AF DCGS Bulk Release 10B.
- In accordance with the DOT&E Guidelines for Operational Test and Evaluation of Information and Business Systems, the 605th TES conducted the risk assessment and determined that the FDE plans did not require DOT&E approval of the test plan. The operational test did not include cybersecurity testing by an independent cybersecurity Red Team.
- On August 28, 2014, DOT&E wrote a memorandum to USD(AT&L) summarizing the results of the FDE and outlining concerns with the progress of the program.
- The AF DCGS test and evaluation team is working with DOT&E to update the program's Test and Evaluation Master Plan.
- The 605th TES is working with DOT&E on the test plan for the next round of GEOINT upgrades.
- In August 2014, the 46th Test Squadron conducted developmental and regression testing on System Release 3.0. The system continues to exhibit major software shortfalls. The Air Force delayed the planned Operational Utility Evaluation from June 2014 to July 2015 to allow time for the software to be fixed and demonstrated in a developmental test prior to starting operational testing.

Assessment
- New software delivered with Bulk Release 10B caused such significant slowdowns in workflow that AFISRA decided to turn off the software in order to continue mission operations. Operators found the system difficult to use, and the software did not meet reliability or availability requirements.
- Although users were able to perform all necessary missions under normal load conditions, performance under heavy loads could not be determined. Heavier loads are expected in the future when new sensors are deployed and the number of simultaneous external users are increased.
- The system did not meet its reliability requirements because of the critical failures and downtime. While users can execute their missions with AF DCGS, key software enhancements are not maturing. The upcoming FDE will test fixes to some of the software problems observed during previous testing.
- In part because the Air Force placed AF DCGS in the sustainment vice development phase, the program lacks standard acquisition processes and documentation. Specifically, it lacks a strategy for testing and evaluation; documented performance requirements for planned enhancements; accurate software maturity trend information; and an approved system engineering plan including the DOD Architectural Framework products.
- Survivability could not be evaluated due to the lack of an independent cybersecurity test by a certified Red Team.

Recommendations
- Status of Previous Recommendations. DOT&E previously recommended an appropriate level of testing for the program; the Air Force conducted adequate developmental testing, but did not fix the problems discovered in developmental testing prior to conducting the FDE in FY14.
- FY14 Recommendations. The Air Force should:
  1. In the future, proceed to operational testing only when supported by successful development testing.
  2. Demonstrate the ability of AF DCGS to operate at anticipated workload levels.
  3. Complete a cybersecurity assessment with a certified Red Team, including operationally representative cyber attacks.
  4. Document the Air Force's requirements for each delivery for each of the four programs and conduct adequate test and evaluation based on a risk assessment in accordance with DOT&E guidelines.
  5. Submit a Test and Evaluation Master Plan for DOT&E approval, which includes an accurate description of AF DCGS requirements, architecture, and interfaces sufficient to justify the test approach.

Air Operations Center – Weapon System (AOC-WS)

Executive Summary

- The Air Operations Center – Weapon System (AOC-WS) 10.1 is a system-of-systems that contains numerous third-party software applications, including the Global Command and Control System – Joint (GCCS-J), Theater Battle Management Core Systems – Force Level (TBMCS-FL), Master Air Attack Plan Toolkit (MAAPTK), and Joint Automated Deep Operations Coordination System (JADOCS).
- The Air Force tests AOC-WS 10.1 during a three-phase Recurring Event (RE) test cycle, which includes event-based test periods primarily focused on software upgrades. The software upgrades and associated test event are designated using similar terms; for example, AOC-WS 10.1 RE12 is the system upgrade tested during RE12.
  - Phase 1 developmental testing is conducted at the Combined Air Operations Center – Experimental (CAOC-X) at Langley AFB, Virginia.
  - Phase 2 operational testing is conducted to assess effectiveness at CAOC-X.
  - Phase 3 operational testing is conducted at a fielded site to assess suitability.
- In January 2014, the Air Force delivered its final report on RE12 that included the results of Phase 3 operational testing at 612 AOC, Davis-Monthan AFB, Arizona.
- AOC-WS 10.1 RE12 has the capability to produce the primary products necessary to meet the established AOC battle rhythm at threshold levels. AOC-WS 10.1 RE12 demonstrated interoperability with other mission-critical systems. It provides a significant improvement to AOCs in both internal functionality and the ability to interoperate with respective Combatant Commands.
- AOC-WS 10.1 RE12 can be built, configured, and maintained adequately at operational sites without the assistance of a fielding team. Help desk support necessary to support the build, configuration, and maintenance of AOC-WS operations was inefficient and needs to be improved. The duration and nature of RE12 test events provided insufficient time to allow DOT&E to assess reliability, availability, and maintainability (RAM) under operationally realistic system usage.
- The legacy AOC-WS 10.1 RE11 has a valid "Authority to Operate" through November 2015. The AOC-WS Information Assurance manager determined that the RE12 update has no negative impact on the AOC-WS security posture and affirmed in a memorandum dated September 11, 2013, that the existing Authority to Operate remains valid.
- The Air Force has not yet used a DOD cyber Red Team to fully assess cybersecurity for AOC-WS 10.1 RE12. The Air Force intends to accomplish a complete cybersecurity test on AOC-WS 10.1 during RE13.

- Air Combat Command conducted a thorough analysis of the three AOC-WS 10.1 RE12 outstanding Category I (CAT I) deficiencies and accepted the risk of fielding AOC-WS 10.1 RE12 to meet critical operational needs; however, they did so while maintaining the expectation that the AOC-WS Program Office will fix those deficiencies in an expeditious manner. Two of the three CAT I deficiencies were re-identified from RE11 and one deficiency discovered was new to RE12.

System

- The AOC-WS is the senior command and control element of the U.S. Air Force's Theater Air Control System and provides operational-level command and control of air, space, and cyberspace operations, as well as joint and combined air, space, and cyberspace operations. Capabilities include command and control of joint theater air and missile defense; time-sensitive targeting; and Intelligence, Surveillance, and Reconnaissance management.
- The AOC-WS 10.1 (AN/USQ-163 Falconer) is a system-of-systems that contains numerous third-party-developed software applications and commercial off-the-shelf products. Each third-party system integrated into the AOC-WS provides its own programmatic documentation.
- The AOC-WS consists of:
  - Commercial off-the-shelf hardware
  - Separate third-party software applications GCCS-J, TBMCS-FL, MAAPTK, and JADOCS, from which the AOC-WS draws its capabilities
  - Additional third-party systems that accept, process, correlate, and fuse command and control data from multiple sources and share them through multiple communications systems

- AOC-WS 10.1 operates on several different local area networks (LANs), including Secret Internet Protocol Router Network, Joint Worldwide Intelligence Communications System, and a coalition LAN, when required. The LANs connect the core operating system and primary applications to joint and coalition partners supporting the applicable area of operation. Users can access web-based applications through the Defense Information Systems Network.
- The Air Force tests AOC-WS 10.1 software upgrades during REs. The Air Force refers to each software upgrade by the event during which it was tested. For example, AOC-WS 10.1 RE12 is the software upgrade tested during RE12.
- The future AOC-WS 10.2 is designed to deliver a modernized, integrated, and automated approach to AOC-WS operations.

Mission

The Commander, Air Force Forces, or the Joint/Combined Forces Air Component Commander use the AOC-WS to exercise control of joint (or combined) air forces including planning, directing, and assessing air, space, and cyberspace operations to meet operational objectives and guidance. An operational AOC is fundamental in enabling centralized command and decentralized execution of a theater air campaign.

Major Contractors

- AOC-WS 10.1 Production Center: Jacobs Technology Inc., Engineering and Technology Acquisition Support Services – Hampton, Virginia
- AOC-WS 10.2 Modernization: Northrop Grumman – Newport News, Virginia

---

Activity

- The Air Force uses a three-phase RE test cycle for major AOC-WS 10.1 upgrades, along with lower-level testing events, to sustain interoperability and cybersecurity and provide low-risk upgrades to third-party systems as required.
  - Phase 1 developmental testing is conducted at CAOC-X Langley AFB, Virginia.
  - Phase 2 operational testing is conducted at CAOC-X to assess effectiveness.
  - Phase 3 operational testing is conducted at a fielded site to assess suitability.
- In August 2013, the Air Force conducted operational testing of AOC-WS 10.1 RE12. AOC-WS 10.1 RE12 incorporated Defense Information Systems Agency upgrades to GCCS-J, updates to other third-party applications, and improvements to the system's cybersecurity posture.
- In January 2014, the Air Force completed its report on RE12, which included results from Phase 2 operational testing at CAOC-X, Langley AFB, Virginia, in August 2013, and Phase 3 testing at 612 AOC, Davis-Monthan AFB, Arizona, from November through December 2013. Testing at the 612 AOC focused on the ability of the install team to correctly upgrade and configure the AOC from the legacy AOC-WS 10.1 RE11 capability to the AOC-WS 10.1 RE12 configuration, and to perform backup and recovery actions on AOC-WS 10.1 RE12.
- DOT&E submitted an Interim Assessment Memorandum on January 30, 2014, on RE12 testing observed at both CAOC-X and 612 AOC. The data from these phases of testing formed the basis for the assessment of AOC-WS 10.1 RE12's operational effectiveness and suitability.
- In 4QFY14, the Air Force commenced the AOC-WS 10.1 RE13 build at CAOC-X in anticipation of beginning RE13 testing in 1QFY15.
- In 4QFY14, AOC-WS 10.2 experienced a 3.5-month slip in schedule due to the contractor not obtaining an Interim Authority to Test. Operational testing for AOC-WS 10.2 is now scheduled to begin in November 2015.
- The Air Force conducted RE12 testing in accordance with the DOT&E-approved test plans.

Assessment

- The Air Force adequately tested AOC-WS 10.1 RE12 through a combination of developmental and operational testing; however, there were significant known limitations to cybersecurity and RAM data collection. Testing was conducted in accordance with the DOT&E-approved test plan, which anticipated the lack of RAM data. Therefore, the Air Force adopted a mitigation strategy in which they will collect and provide the required data from fielded sites, allowing DOT&E to refine the assessment results based on the ongoing analysis.
- Following the completion of Phase 3 testing at 612 AOC, Air Combat Command conducted a thorough analysis of the three outstanding CAT I Urgent deficiencies and accepted the risk of fielding AOC-WS 10.1 RE12 to meet critical operational needs, while maintaining the expectation that the AOC-WS Program Office will fix unresolved CAT I deficiencies in an expeditious manner. This represents a significant improvement to the 11 open CAT I deficiencies in RE11.
- RE12 successfully closed 9 of the 11 RE11 CAT I deficiencies. Of the two remaining CAT I deficiencies from RE11, one affected operational suitability and one affected cybersecurity. The third RE12 deficiency was a new deficiency, which affected operational effectiveness.
- AOC-WS 10.1 RE12 has the capability to produce the primary products necessary to meet the established AOC battle rhythm at threshold levels. AOC-WS 10.1 RE12 demonstrated interoperability with other mission-critical systems. It provides a significant improvement to AOCs in both internal functionality and the ability to interoperate with respective

Combatant Commands. Four previously documented CAT I deficiencies in RE11, which were related to GCCS-J and affected operational effectiveness, have been closed. The new RE12 CAT I deficiency relates to audio deficiencies in Defense Connect Online as deployed within the AOC-WS. This deficiency could negatively affect mission-critical coordination activities. This deficiency was not previously discovered because the operational site used a thin client configuration, whereas the developmental testing used thick clients that did not exhibit this behavior.

- AOC-WS 10.1 RE12 can be built, configured, and maintained adequately at operational sites without the assistance of a fielding team. Help desk support necessary to support the build, configuration, and maintenance of AOC-WS operations was inefficient and needs to be improved. This operational help desk was not utilized during developmental testing, and during operational testing, the help desk had to maintain both the operational system and the system under test, doubling their workload. Of the five CAT I deficiencies in RE11 affecting operational suitability, the Air Force closed all but one. The remaining deficiency is related to the inability to release Cautions, Warning, and Notes as currently written to coalition partners; this deficiency does not adversely affect U.S.-only operations.
- The duration and nature of RE12 test events provided insufficient time to allow DOT&E to assess RAM under operationally realistic system usage. The Air Force must collect additional data at operational sites to assess the effects of RAM on AOC mission operations. The Air Force plans to implement a technical RAM collection solution in the modernization increment, AOC-WS 10.2.
- The AOC-WS 10.1 RE12 test article and associated documentation that entered OT&E was the direct output of the developmental test-fix-test cycle. Time constraints precluded entering OT&E with a "clean rebuild" of the test article and a cohesive consolidation of the documentation that incorporated all the supplements (software and configuration modifications) used to "fix" the previously discovered problems. Following Phase 2 testing, the 46th Test Squadron conducted an RE12 regression build event at Eglin AFB, Florida, that validated that the build process and documentation were stable and complete prior to proceeding to Phase 3 testing at 612 AOC.
- The legacy AOC-WS 10.1 RE11 has a valid Authority to Operate through November 2015. The AOC-WS Information Assurance manager determined that the RE12 update has no negative security impact on the AOC-WS security posture and affirmed in a memorandum dated September 11, 2013, that the existing Authority to Operate remains valid.
- The Air Force has not yet fully assessed AOC-WS 10.1 RE12 for cybersecurity. AOC-WS 10.1 RE12 and recurring periodic software patches should significantly improve the cybersecurity posture of the system. The Air Force intends to accomplish a complete cybersecurity test on AOC-WS 10.1 during RE13.
- The key to successful testing and fielding of AOC-WS 10.1 continues to be closer collaboration between the AOC-WS Program Office and Defense Information Systems Agency to ensure GCCS-J meets the operational needs of the AOCs. Early AOC-WS tester involvement in GCCS-J testing continues to identify critical problems early for corrective action.

Recommendations

- Status of Previous Recommendations. The Air Force has made progress in addressing the remaining two previous recommendations; however, cybersecurity testing needs improvement and still needs to be addressed. Over the past two years, the Air Force has increased its efforts with two long-term FY11 recommendations (below), and this engagement needs to continue.
  1. Coordinate with third-party programs to ensure that critical AOC-WS third-party systems (such as GCCS-J) have testable requirements that meet AOC-WS requirements. The requirements should be vetted within the appropriate user and program communities for schedule and funding priority.
  2. Ensure the AOC-WS users and test community continue to actively participate in GCCS-J developmental and operational testing and collaborate to develop a capability to adequately test GCCS-J to AOC-WS threshold stress levels.
- FY14 Recommendations. The Air Force should:
  1. Improve the procedures and implementation of help desk support to operational units fielding AOC-WS 10.1 RE12.
  2. Conduct an assessment of operational risk to the AOC warfighting mission using DOD cyber Blue and Red Teams in an operationally realistic environment, consistent with DOT&E cybersecurity testing procedures.
  3. Require operational AOC sites to collect and report all significant RAM data to the Program Office, assess the data for needed system improvements, and report on RAM improvement efforts monthly to the Configuration Review Board. DOT&E will continue to review RAM data periodically and adjust our findings in accordance with this analysis.

Battle Control System – Fixed (BCS-F)

Executive Summary

- The Air Force completed FOT&E on the Battle Control System – Fixed (BCS-F) Increment 3, Release 3.2.2 (R3.2.2) at all U.S. air defense sites in April 2014.
  - The BCS-F R3.2.2 is operationally effective with workarounds and operationally suitable, with deficiencies in documentation and training.
  - BCS-F R3.2.2 is still not survivable against potential cyber attacks despite the Air Force's efforts to improve R3.2.2's critical cybersecurity deficiencies.
- All U.S. air defense sites were utilizing R3.2.2 in February 2014. Upon completion of the FOT&E, the Air Force formally fielded R3.2.2.

System

- BCS-F is the tactical air battle management command and control system for the two continental U.S. North American Aerospace Defense Command (NORAD) air defense sectors, as well as the Hawaii and Alaska Regional Air Operations Centers. The system utilizes commercial off-the-shelf hardware within an open-architecture software configuration, and operates within the NORAD and U.S. Pacific Command air defense architecture. The system is employed by the U.S. and Canada.
- The R3.2 upgrade includes the following system enhancements:
  - Improved tactical datalinks with additional Link 16 and Link 11 message types that enable the operators to better digitally control fighters, send amplifying intelligence information, and create a more comprehensive air picture
  - Air Tasking Order and Airspace Control Order integration with Theater Battle Management Core Systems data sources that enables the operators to view the most current Air Tasking Order/Airspace Control Order and correlate the information with military aircraft
  - Data modification tools that enable system administrators to field changes to system files and to perform error checks with greater fidelity than R3.1
  - System control manager interface improvements that enable the system administrator to use improved system performance monitoring and diagnostics
  - Global Area Reference System coordinate conversion tool that facilitates a NORAD interface with global search and rescue efforts by using a common set of coordinates
  - Remote Gateway Manager control through the virtual network computing interface that provides the operators a complete picture of the available datalinks and flexibility to access link information from an operator workstation
  - Auxiliary server for offline training and support capabilities at the U.S. air defense sectors
  - Improved system capacities from 10,300 to 15,000 system tracks to support single sector, continental U.S. operations
- The R3.2.2 upgrade includes the following enhancements:
  - Ability to operate with mandatory International Civil Aviation Organization flight plan changes
  - Addition of external firewall/intrusion detection system sensor
  - Implementation of remote administrative management and log server capabilities
  - Audible and visual alert capabilities on the Computer Network Defense components
  - New network switch to support the Information Assurance-Demilitarized Zone architecture
  - Newly-designed protocol converter replacing the NORAD forward tell serial communications device. (This change replaces obsolete equipment and ensures the air picture from the sector will continue to be received at NORAD.)

Mission

- NORAD and U.S. Pacific Command Commanders use BCS-F to execute command and control and air battle management in support of air sovereignty and air defense missions for North American Homeland Defense and Pacific Command air defense.
- Air defense operators employ BCS-F to conduct surveillance, identification, and control of U.S. sovereign airspace and control air defense assets, including fighters, to intercept and identify potential air threats to U.S. airspace.

Major Contractor

Thales-Raytheon Systems – Fullerton, California

Activity

- The Air Force completed FOT&E on R3.2.2 at all U.S. air defense sites from September 2013 to April 2014. The Air Force Operational Test and Evaluation Center (AFOTEC) produced an FOT&E report on July 18, 2014.
- All U.S. air defense sites were utilizing R3.2.2 in February 2014. Canadian air defense forces were utilizing R3.2.2 in May 2014. Upon completion of the FOT&E, the Air Force formally fielded R3.2.2.
- AFOTEC and Air Combat Command conducted operational testing in accordance with a DOT&E-approved Test and Evaluation Master Plan and test plan.
- On August 13, 2014, DOT&E published a Major Automated Information System FOT&E report on BCS-F R3.2.2

Assessment

- R3.2.2 resolved two of the five major operational effectiveness deficiencies associated with battle management discovered during R3.2 and R3.2.0.1 operational testing. Additionally, FOT&E of R3.2.2 revealed four new deficiencies associated with battle management operations. Operator workarounds mitigated these deficiencies to an acceptable level.
- R3.2.2 is operationally suitable, although the Air Force did not collect sufficient operational test data to demonstrate the availability and reliability requirements with statistical confidence.
  - During 952.35 hours of testing, R3.2.2 did not experience any critical failures or downtime. One critical failure occurred after system fielding resulting in two hours of system downtime. Including this failure in total system operating time during the FOT&E resulted in an operational availability of 99.99 percent (80 percent confidence intervals are 99.78 and 99.99 percent).
  - Additionally, as of September 30, 2014, the system has operated at all four U.S. air defense sector sites without any additional critical failures since February 2014. This equates to over 23,000 hours (5,800 hours at each of four sites) with only one critical failure. The system requirement for Mean Time Between Critical Failure (MTBCF) is greater than or equal to 10,000 hours. Current data indicate with a 66.9 percent confidence that the MTBCF requirement has been met.
- R3.2.2 was maintainable for routine maintenance actions, but the observed 8.6 hour Mean Time Between Corrective Maintenance Action (MTBCMA) did not meet the 100-hour requirement. This was not a critical shortfall since the maintenance actions had no negative effect on operations or operator workload.
- While R3.2.2 is operationally suitable, technical documentation and training for the system administrators was deficient.
- R3.2.2 remains deficient in all cybersecurity assessment areas. The system is poorly equipped to detect, protect, react, and restore/recover from attacks by current cyber threats despite the fact that R3.2.2 was designed to resolve many critical cybersecurity deficiencies. The Air Force plans to address some of the outstanding cybersecurity deficiencies through implementation of the Computer Network Defense Service Provider agreement in 1QFY15.

Recommendations

- Status of Previous Recommendations. The Air Force satisfactorily addressed all but three of the previous recommendations. The Air Force still needs to:
  1. Correct and formalize all BCS-F Increment 3 system documentation and training deficiencies.
  2. Develop a plan for remote workstation management to include sustainment, training, documentation, and Information Assurance compliance.
  3. Upgrade the System Support Facility to support a more robust BCS-F developmental and operational testing capability in order to minimize the impact of overall testing at the operational sites.
- FY14 Recommendations. The Air Force should:
  1. Correct the three remaining operational effectiveness deficiencies discovered during R3.2 and R3.2.0.1 testing, as well as the four new deficiencies associated with battle management discovered during R3.2.2.
  2. Correct and formalize all BCS-F R3.2.2 documentation and training deficiencies.
  3. Improve reliability to meet the threshold requirement for MTBCMA.
  4. Fully assess system vulnerabilities and correct identified cyber deficiencies.
  5. Re-evaluate BCS-F survivability against cyber attacks after the Computer Network Defense Service Provider has been implemented. This evaluation is scheduled to occur in 1QFY15.
  6. Implement appropriate policies, procedures, and tools for system administrators to effectively respond to unauthorized intrusions.
  7. Correct network configuration deficiencies to more effectively detect unauthorized intrusions.

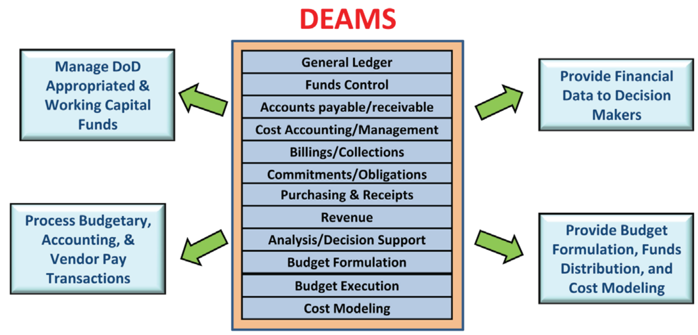
Defense Enterprise Accounting and Management System (DEAMS)

Executive Summary

- The Air Force Operational Test and Evaluation Center (AFOTEC) conducted an operational assessment (OA) of the Defense Enterprise Accounting and Management System (DEAMS) from August 2013 through February 2014. The test locations included Headquarters U.S. Transportation Command (HQ USTRANSCOM) and Headquarters Air Mobility Command (HQ AMC), both located at Scott AFB, Illinois; the Defense Finance and Accounting Service (DFAS) in Limestone, Maine; and base operations at five AMC bases.
- In conjunction with the OA, the 177th Information Aggressor Squadron conducted a Cyber Economic Vulnerability Assessment (CEVA) under the oversight of DOT&E. The assessment determined it would be possible for knowledgeable adversaries to penetrate DEAMS and conduct fraudulent activities, including exploiting DEAMS for economic gain.
- DEAMS demonstrated progress toward resolving previous effectiveness shortfalls and the OA found few new systemic defects, but some balances are still inaccurate. The quality of reports, responses to ad hoc queries, and usefulness of error messages remained poor.
- DEAMS demonstrated progress toward resolving previous suitability problems. The system met its reliability and availability requirements, but it experienced problems with cybersecurity, training, timely resolution of software defects, and interoperability with critical systems.
- The DEAMS IOT&E has been delayed due to performance issues.

System

- DEAMS is a Major Automated Information System that uses commercial off-the-shelf Enterprise Resource Planning software to provide accounting and management services for the Air Force and U.S. Transportation Command (USTRANSCOM).



- DEAMS operates on the Global Combat Support System – Air Force Integration Framework. It interfaces with approximately 40 other systems that provide travel, payroll, disbursing, transportation, logistics, acquisition, and accounting support. DEAMS will deploy to USTRANSCOM, the Air National Guard, and all Air Force major commands, including those overseas. There are expected to be nearly 30,000 users worldwide by 2017.

Mission

- USTRANSCOM and Air Force financial managers use DEAMS to compile and share accurate, up-to-the-minute financial management data and information across USTRANSCOM and the Air Force.
- USTRANSCOM, Air Force, and DOD leadership use DEAMS to access vital, standardized, real-time financial data and information to make strategic business decisions and to satisfy congressional and DOD requirements for auditing funds, standardizing financial ledgers, timely reporting, and reduction of costly rework.

Major Contractor

Accenture Federal Services – Dayton, Ohio

Activity

- In August 2014, AFOTEC observed developmental testing of DEAMS Release 3.
- AFOTEC conducted a DEAMS OA from August 2013 through February 2014. The test locations included HQ USTRANSCOM and HQ AMC, both located at Scott AFB, Illinois; the DFAS facility in Limestone, Maine; and base operations at five AMC bases.
- In conjunction with the OA, the 177th Information Aggressor Squadron conducted a CEVA under the oversight of DOT&E.
- DOT&E issued a report on the DEAMS OA on June 10, 2014.
- AFOTEC began the DEAMS IOT&E in October 2014 in accordance with a DOT&E-approved test plan. Only the end-of-year activities were observed. The Program Executive Office delayed certification of the program for the bulk of IOT&E due to performance issues. IOT&E is scheduled to resume in January 2015.

Assessment

- During the OA, DEAMS demonstrated progress toward resolving previous effectiveness shortfalls and the OA found few new systemic defects. Some balances are still inaccurate and the quality of reports, responses to ad hoc queries, and usefulness of error messages remain poor.
  - DEAMS now prevents the posting of transactions that exceed control targets. While maintenance of fiscal accountability in balancing funds for the General Ledger and subsidiary accounts (a Key Performance Parameter) is still unsatisfactory, it has improved.
  - Nine of 11 tested measures that quantify the quality of DEAMS financial information now meet thresholds, and the other two (standards compliance and General Ledger operations) are improving. All three timeliness thresholds (recording transactions, vendor payments, and period-end closings) were met and user access roles are generally being assigned properly.
  - DEAMS Release 3 includes a new software application for producing reports; it will be evaluated during the IOT&E.
- The DEAMS OA also demonstrated progress toward resolving previous suitability issues. The system met its reliability and availability requirements, but continues to suffer from problems with training, timely resolution of software defects, interoperability with critical systems, and cybersecurity issues.
  - Software reliability growth, as measured by reduction of defect reports, has been static. Although configuration management has improved, there are still a large number of unresolved defects. Several required capabilities and enhancements are scheduled for near-term release and are being tested during IOT&E.
  - One critical interface with the Departmental Cash Management System (which manages and reconciles cash disbursements, reimbursement, collections, and receipts) did not meet interoperability requirements. Not all interfaces were tested during the OA. All deployed critical interfaces must be operationally demonstrated in conjunction with IOT&E.
  - New user training was inadequate because it focused on how to navigate within DEAMS and did not provide users with a real understanding of the system and its application to their day-to-day work processes.
- The CEVA demonstrated that a cyber adversary with knowledge of DEAMS and DOD business practices could gain access to DEAMS and conduct denial-of-service and fraudulent activities, including exploiting DEAMS for economic gain. Further information can be found in the classified appendix to DOT&E's June 2014 OA report.
- DOT&E will prepare a report on the DEAMS IOT&E upon completion of testing.

Recommendations

- Status of Previous Recommendations. The FY12 recommendation for the Program Office and Functional Management Office to document workarounds at the base level remains unresolved. The Air Force has made progress on all FY13 recommendations. The recommendation to correct Information Assurance deficiencies and perform Information Assurance and financial fraud penetration testing was partially satisfied by conducting the CEVA; both cooperative and adversarial penetration testing will be conducted during IOT&E to further assess cybersecurity vulnerabilities. The Air Force also made progress toward updating training materials during the OA; training will be assessed again during IOT&E. The recommendation to provide more on-site technical support to new users at the base level has been addressed.
- FY14 Recommendations. The Program Office should:
  1. Accelerate the correction of balance accuracy defects in order to meet the Accurate Balance of Funds Key Performance Parameter and achieve full auditability.
  2. Address the cybersecurity recommendations provided in the classified CEVA appendix to DOT&E's June 2014 OA report.

F-15E Radar Modernization Program (RMP)

Executive Summary

- The Air Force Operational Test and Evaluation Center conducted IOT&E from March through September 2013 to assess the system's operational effectiveness, suitability, and mission capability.
- DOT&E published a classified report on the operational effectiveness, suitability, and mission capability of the F-15E Radar Modernization Program (RMP) system upon completion of IOT&E data analysis. The system entered full-rate production in March 2014.
- IOT&E results demonstrated:
  - The F-15E RMP is operationally effective with significant improvements in air-to-air capabilities.
  - RMP operating modes and pilot-vehicle interfaces are functionally equivalent to those of the legacy APG-70 radar.
  - APG-82(V)1 hardware operational reliability and maintainability support F-15E operational availability requirements.
  - Additional monitoring of system suitability will be required in order to fully assess system reliability and maintainability metrics due to the limited flight hours and low failure rate observed during IOT&E.
- At the conclusion of the IOT&E, there were unresolved RMP system supportability and deployability shortfalls. The Air Force has yet to resolve long-term support equipment provisioning, functionality, and overall APG-82(V)1 spares posture necessary to support the deployment of RMP-equipped F-15E operational squadrons.

System

- The F-15E is a twin-engine, tandem-seat, fixed-wing, all-weather, multi-role fighter aircraft. The F-15E has a fully-missionized cockpit and a multimode air intercept and air-to-ground radar, giving the aircrew the capability to employ air-to-air and air-to-ground munitions, a 20 mm cannon, and countermeasures for evading enemy fire.
- The RMP replaces the F-15E legacy APG-70 mechanically-scanned radar with an active electronically-scanned array (AESA) system designated the APG-82(V)1. The RMP is designed to retain functionality of the legacy radar system while providing expanded mission employment capabilities to include:
  - Near-simultaneous interleaving of selected air-to-air and air-to-ground functions
  - Enhanced air-to-air and air-to-ground combat identification capabilities
  - Longer range air-to-air target detection and enhanced track capabilities
  - Longer range and higher resolution air-to-ground radar mapping
  - Improved ground moving target track capability
- The RMP upgrade is also intended to address legacy F-15E radar system suitability shortfalls including: poor reliability, parts obsolescence, and high sustainment costs. The Air Force intends to retrofit the RMP across the existing F-15E fleet.
- The RMP APG-82(V)1 design leverages capabilities from currently fielded AESA radar systems. The APG-82(V)1 antenna and power supply are currently in use on the F-15C APG-63(V)3 program, and the radar receiver/exciter and Common Integrated Sensor Processor are based on the F/A-18E/F APG-79 AESA system.
- Other hardware and software modifications comprising the RMP effort include a more powerful Environmental Control System, updates to the aircraft Operational Flight Program and Electronic Warfare software, a new radio frequency tunable filter, and aircraft modifications to include a new wideband radome and wiring changes.

Mission

A unit equipped with the F-15E conducts all weather, day and night missions to include:

- Offensive and Defensive Counterair
- Conventional Air Interdiction and Nuclear Strike
- Close Air Support and Strike Coordination and Reconnaissance
- Suppression of Enemy Air Defenses
- Combat Search and Rescue

Major Contractors

- The Boeing Company – St. Louis, Missouri
- Raytheon – El Segundo, California

Activity

- The Air Force Operational Test and Evaluation Center conducted the F-15E RMP IOT&E, which completed in September 2013, in accordance with the DOT&E-approved Test and Evaluation Master Plan and IOT&E plan.
- In March 2014, DOT&E published a classified report on the operational effectiveness, suitability, and mission capability of the F-15E RMP system upon completion of the IOT&E data analysis.
- The F-15E RMP entered full-rate production in March 2014.

Assessment

- DOT&E assesses that the F-15E RMP:
  - Is operationally effective and operating modes and pilot-vehicle interfaces are functionally equivalent with those of the legacy APG-70 radar system.
  - Provides significantly improved capability in the air-to-air operational environment compared to that of the legacy APG-70 radar system.
  - Demonstrated comparable air-to-ground radar performance compared with that of the legacy system and improvements in target location accuracy.
  - Software stability did not meet the Air Force Mean Time Between Software Anomaly criteria of 30 hours during IOT&E. However, post-IOT&E flight testing of a subsequent radar software version corrected the single anomaly that resulted in 6 of 12 observed software stability events encountered in IOT&E.
  - Hardware operational reliability and maintainability support F-15E operational availability requirements. However, limited flight hours and the low failure rate observed throughout the evaluation period precluded DOT&E's ability to confirm, with confidence, that the APG-82(V)1 hardware reliability, maintenance man-hours per flight hour, mean repair time, and built-in test fault diagnostics requirements were met. Therefore, additional monitoring of system suitability will be required in order to fully assess system performance in these areas.
- At the conclusion of the IOT&E, there were unresolved RMP system supportability and deployability shortfalls to include:
  - The Air Force currently lacks a long-term programmatic solution for providing ground-cooling carts to service the APG-82(V)1 at operational unit locations.
  - The Gore® communications cables that connect the radar Common Integrated Signal Processor to the receiver/exciter cannot be functionally checked with the Joint Services Electronic Combat Systems Tester.
  - The Air Force has yet to define the Readiness Spares Package provisioning necessary to determine the number of 436L pallets and Gore® communications cables needed to support the deployment of RMP-equipped operational F-15E squadrons.

Recommendations

- Status of Previous Recommendations. The Air Force is addressing RMP software stability issues previously identified in the FY12 and FY13 Annual Report.
- FY14 Recommendations. The Air Force should:
  1. Correct the anomalies identified in IOT&E that resulted in software reliability events to ensure F-15E RMP software stability meets Air Force requirements.
  2. Provide a long-term solution for APG-82(V)1 ground cooling carts, Gore® communications cable spares posture and ground test set compatibility, and Readiness Spares Package provisioning and deployment pallet posture, in order for the F-15E RMP system to be fully supportable and deployable.
  3. Continue to monitor installed system reliability, availability, and maintainability metrics to confirm, with confidence, that APG-82(V)1 hardware reliability, maintenance man-hours per flight hour, mean repair time, and built-in test fault diagnostics performance meet the Air Force requirements.

F-22A Advanced Tactical Fighter

Executive Summary

- F-22A Increment 3.2A is a software-only modernization effort integrating Link 16 Receive, enhanced Combat Identification, and enhanced Electronic Protection capabilities. Increment 3.2A developmental testing proceeded throughout FY14. Software stability and radar performance shortfalls discovered late in developmental testing precluded the start of FOT&E planned by the Air Force Operational Test and Evaluation Center (AFOTEC) for FY14. This FOT&E is currently projected to begin in FY15.
- F-22A Modernization Increment 3.2B, a separate Major Defense Acquisition Program, achieved Milestone B in June 2013. Laboratory and flying test bed developmental testing continued throughout FY14. IOT&E is planned for FY17.
- AIM-120D weapons models required for Increment 3.2B IOT&E were not on contract to support planned FY17 IOT&E. Should these models not be available to meet planned IOT&E, operational testing will be delayed, or additional live-fire missile events beyond those already projected may be required during IOT&E.

System

- The F-22A is an air-superiority fighter that combines low observability to threat radars, sustained high speed, and integrated avionics sensors.
- Low observability reduces threat capability to engage F-22As with current adversary weapons.
- The aircraft maintains supersonic speeds without the use of an afterburner.
- Avionics that fuse information from the Active Electronically Scanned Array radar, other sensors, and datalinked information for the pilot enable employment of medium- and short-range air-to-air missiles, guns, and air-to-ground munitions.
- The Air Force designed the F-22A to be more reliable and easier to maintain than legacy fighter aircraft.
- F-22A air-to-air weapons are the AIM-120C radar-guided missile, the AIM-9M infrared-guided missile, and the M61A1 20 mm gun.
- F-22A air-to-ground precision strike capability consists of the 1,000-pound Joint Direct Attack Munition and the 250-pound Small Diameter Bomb (SDB) Increment One.
- The F-22A program delivers capability in increments. Incremental Enhanced Global Strike modernization efforts include the following current and projected increments:
  - Increment 3.1 provides enhanced air-to-ground mission capability, to include geolocation of selected emitters, electronic attack, air-to-ground synthetic aperture radar mapping and designation of surface targets, and SDB integration. Increment 3.1 is currently fielding in operational F-22A units.
  - Increment 3.2A is a software-only upgrade intended to provide improved electronic protection, Link 16 Receive, and Combat Identification capabilities in FY15. Increment 3.2A is a modernization effort within the scope of the F-22A Advanced Tactical Fighter baseline acquisition program of record.
  - Increment 3.2B is a separate Major Defense Acquisition Program modernization effort intended to integrate AIM-120D and AIM-9X missile systems and provide additional electronic protection enhancements and improved emitter geolocation capability. The Increment 3.2B IOT&E is currently planned for FY17.

Mission

A unit equipped with the F-22A:

- Provides air superiority over friendly and non-permissive, contested enemy territory
- Defends friendly forces against fighter, bomber, or cruise missile attack
- Escorts friendly air forces into enemy territory
- Provides air-to-ground capability for counter-air, strategic-attack, counter-land, and enemy-air defense suppression missions

Major Contractor

Lockheed Martin Aeronautics Company – Fort Worth, Texas

Activity

- The Air Force conducted F-22A testing in accordance with the DOT&E-approved Test and Evaluation Master Plan.
- F-22A Increment 3.2A developmental testing proceeded throughout FY14. Software stability and radar performance shortfalls discovered late in developmental testing precluded the start of AFOTEC's planned FY14 FOT&E. Additional unanticipated software releases required further developmental testing, and FOT&E is scheduled to begin in 1QFY15.
- F-22A Modernization Increment 3.2B achieved Milestone B in June 2013. Post Milestone B, F-22 Increment 3.2B developmental testing continued throughout FY14. IOT&E is planned for FY17.
- At the conclusion of the FY12 F-22A FOT&E, the Air Force reduced the level of support needed to sustain the Air-to-Air Range Infrastructure (AARI) capability and ensure system readiness for subsequent F-22A OT&E. In FY14, the Air Force undertook efforts to restore the system to support the planned FY14 Increment 3.2A FOT&E.

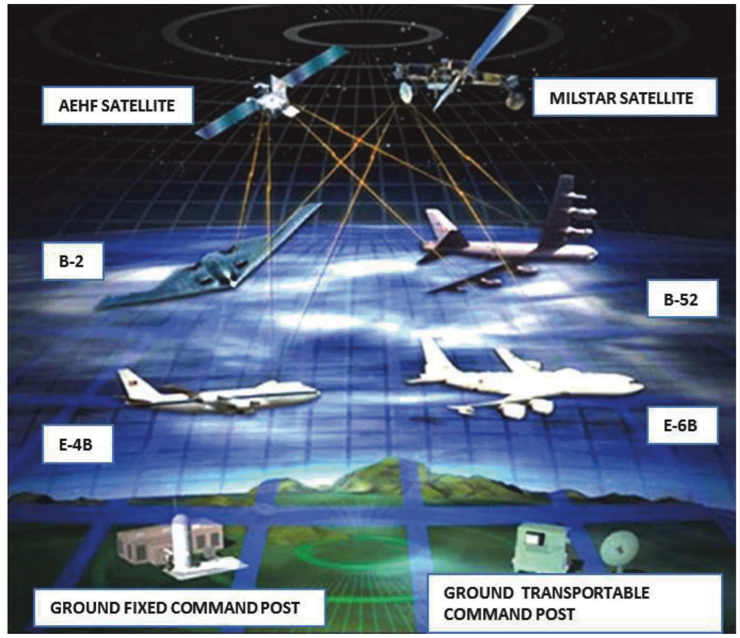
Assessment

- F-22 Increment 3.2A realized software stability and radar performance shortfalls late in the developmental flight test schedule. These shortfalls necessitated additional unplanned software releases in order to demonstrate readiness for FOT&E. Accordingly, the FOT&E planned for 3QFY14 was postponed pending resolution of the shortfalls and completion of developmental test and evaluation. FOT&E is now projected to begin in 1QFY15.
- F-22 Increment 3.2B requires upgraded threat and weapons models for IOT&E effectiveness evaluation trials that will be performed in both open-air flight test at the Nevada Test and Training Range and in the Lockheed Martin F-22 Advanced Combat Simulator (ACS) in Marietta, Georgia. At the end of FY14, AIM-120D modeling was not yet on contract to support FY17 IOT&E. Should the models not be available for FY17 ACS trials, IOT&E will be delayed.
- F-22A OT&E requires the use of the AARI instrumentation system for flight test missions at the Nevada Test and Training Range.
  - AARI is designed to enable testers to credibly shape air battles and resolve complex operational mission outcomes through real-time instrumented air and surface threat engagements.
  - The system aids real-time, open-air threat and friendly force removal assessments, and is required for F-22A OT&E flight test adequacy. AARI mission outcomes further serve as a foundation for ACS accreditation for F-22A OT&E effectiveness evaluations performed at the ACS.
  - The Air Force struggled to ensure AARI readiness to support planned FY14 F-22A Increment 3.2A testing. At the conclusion of FY12 F-22A testing, the Air Force began an extensive AARI network upgrade and the implementation of new weapons models to support future F-22A and F-35 operational testing. However, the level of effort the Air Force placed on maintaining AARI functionality was insufficient to ensure readiness for Increment 3.2A FOT&E, and AARI system test readiness experienced unplanned delays. To ensure readiness for FY15 and beyond F-22A operational testing, the Air Force will need to fully support development, modernization, and sustainment of the AARI system.

Recommendations

- Status of Previous Recommendations. The Air Force continues to address all previous recommendations.
- FY14 Recommendations. The Air Force should:
  1. Continue to resolve F-22 Increment 3.2A software anomalies and radar performance shortfalls in developmental testing before proceeding to formal AFOTEC FOT&E in FY15.
  2. Resolve AARI sustainment, test readiness, and modernization shortfalls in order to support both near-term F-22 Increment 3.2A and future Increment 3.2B IOT&E test adequacy.
  3. Commit sufficient resources necessary to ensure that AIM-120D models are available for F-22 Increment 3.2B FY17 IOT&E.

Family of Advanced Beyond Line-of-Sight Terminals (FAB-T)



Executive Summary

- In 2012, the USD(AT&L) directed the Air Force to award a contract to a second source to compete with the Boeing Company for development of the Family of Advanced Beyond Line-of-Sight Terminals (FAB-T) Command Post Terminal (CPT). The Air Force awarded a development contract to the Raytheon Corporation.
- On June 2, 2014, the Air Force down-selected from the two development contractors and awarded the Raytheon Corporation the production contract for the CPT. The Air Force plans to exercise production contract options to produce CPT terminals after a successful Milestone C decision.
- The program's CPT development is approximately four months behind Raytheon's originally proposed schedule. Continued delays may be experienced due to a highly-concurrent developmental test schedule.
- The Air Force Operational Test and Evaluation Center (AFOTEC) conducted an operational assessment from July through December 2014, based on contractor and government developmental flight testing to inform the Milestone C decision planned for March 2015.

System

- FAB-T consists of ground and aircraft communication terminals with two terminal types – CPTs and Force Element Terminals (FETs). FAB-T is part of the terminal and control segments of the Advanced Extremely High Frequency (AEHF) satellite system and is designed to operate with AEHF Low Data Rate (75 – 2,400 bits per second (bps)) and Extended Data Rate (up to 8.192 Megabits per second (Mbps)) waveforms.
- The CPT is intended to replace existing airborne (E-4B and E-6B), ground-fixed, and ground-transportable Milstar command post terminals. The CPT will include satellite and network control functions, end-user telecommunication device interfaces, and the ability to operate the terminal from a distant location using a remote node.
- The FET is intended to be installed in airborne force elements (B-2, B-52, and RC-135). The FET is a requirement but is currently neither funded nor on contract for development and production.

Mission

- The President, the Secretary of Defense, Combatant Commanders, and support Air Force component forces will use FAB-T to provide strategic nuclear and non-nuclear command and control with EHF, wideband, protected, and survivable communications terminals for beyond line-of-sight communications.
- U.S. Strategic Command will use the FAB-T to perform the satellite Telemetry, Tracking, and Commanding functions of the AEHF/Milstar constellation, including management of the satellites, communication networks and cryptologic keys.

Major Contractor

Raytheon Net-Centric Systems – Marlborough, Massachusetts

Activity

- In 2012, the USD(AT&L) directed the Air Force to award a contract to a second source to compete with the Boeing Company for development and production of the CPT with Presidential and National Voice Conferencing (PNVC). Additionally, USD(AT&L) directed the Air Force to defer development of the FET. The Air Force awarded the second sourcing contract for the CPT development to the Raytheon Corporation.
- The Defense Information Systems Agency is developing the PNVC equipment that FAB-T will use to provide strategic

services to Senior Leadership, which is a Key Performance Parameter.

- The FAB-T program manager planned to conduct contractor and government developmental flight testing for the Boeing variant from February through June 2013. Schedule delays and developmental regression testing extended this time through April 2014.
- The Raytheon Corporation conducted two system demonstrations in 2013 to provide the government confidence they had a viable solution that could interoperate with the EHF satellites and terminals.
- On June 2, 2014, the Air Force down-selected from the two development contractors and awarded the Raytheon Corporation the production contract for the CPT. The Air Force plans to exercise production contract options to produce CPT terminals after a successful Milestone C decision.
- AFOTEC compressed their normal planning timeline and rapidly developed an operational assessment test plan to support the FAB-T program manager's new schedule based on the Raytheon selection. DOT&E approved the operational assessment test plan on July 17, 2014. AFOTEC conducted an operational assessment in accordance with the DOT&E-approved test plan from 4QFY14 – 2QFY15 based on contractor and government developmental flight testing to inform the Milestone C decision projected for March 2015.
- With the selection of Raytheon as the producer of the FAB-T CPT, the schedule and developmental test strategy have significantly changed. Consequently, the previous Test and Evaluation Master Plan (TEMP) based on the Boeing variant is no longer valid. The Air Force is working to develop a new CPT Milestone C TEMP that supports the current test program.

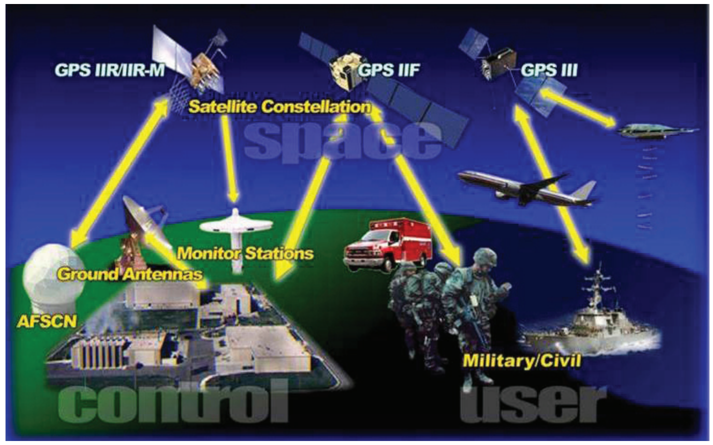
Assessment

- The Defense Information Systems Agency's PNVC development requires an Engineering Change Proposal because current variants do not meet environmental conditions sufficient for aircraft operations. This increases schedule risk in providing aircraft-variant production units for FOT&E projected for FY17.
- The program's CPT development is approximately four months behind Raytheon's original proposed schedule. Continued delays may be experienced due to a highly concurrent developmental test schedule.

Recommendations

- Status of Previous Recommendations. The Air Force has addressed the four previous recommendations.
- FY14 Recommendation.
  1. The Air Force should expedite staffing of the FAB-T TEMP in order to meet the proposed Milestone C date.

Global Positioning System (GPS) Enterprise



Executive Summary

- The Air Force conducted significant development for all three enterprise segments in 2014, including component testing for GPS III and prototype risk-reduction testing for Military GPS User Equipment (MGUE) Increment 1, but did not conduct any operational testing for the GPS enterprise in 2014.
- Expected operational testing dates for all three segments have changed from those listed in the current Enterprise Test and Evaluation Master Plan (ETEMP) approved in March 2012.
- Significant delays to the Next Generation Operational Control System (OCX) pose risks to the Air Force's ability to sustain the operational GPS constellation, as the Air Force may require operational use of GPS III satellites before OCX Block 1 is available to control those satellites. The Air Force is developing plans for a contingency operations capability.
- Other concerns include:
  - OCX delays add risk that OT&E will not discover GPS III satellite deficiencies until it is too late to correct them.
  - The Air Force's current plan for operational assessment of the MGUE Increment 1 will not provide sufficient data to support an informed Milestone C decision by USD(AT&L), adding risk to that decision.
  - Air Force and Army-requested MGUE Increment 1 Lead Platform changes will reduce the pathfinding value of Lead Platform testing, and the Air Force's proposed MGUE Increment 1 source selection approach may reduce post IOT&E competition and delay fielding of MGUE to non-Lead Platforms.
  - The Air Force is not mitigating several significant risks to the GPS enterprise, including the potential loss of a critical industrial production capability, the unfunded need for overseas monitoring stations, indications of receiver-host platform integration and compatibility problems, and sustainment of the de facto 27-satellite operational constellation.
  - Air Force GPS enterprise schedules provided to DOT&E and other OSD components are not accurate, current, or consistent with GPS segment schedules.
  - The Air Force has requested that USD(AT&L) waive the requirement for the MGUE Increment 1 operational assessment (OA). Failure to conduct an OA prior to the Milestone C decision for MGUE Increment 1 would add significant risk to the program.

System

- The GPS enterprise is an Air Force-managed, satellite-based radio navigation system-of-systems that provides worldwide military and civil users accurate position, velocity, and time.
- The current GPS enterprise consists of three operational segments:
  - Space Segment – The GPS spacecraft constellation consists of a minimum of 24 operational satellites in semi-synchronous orbit. The Air Force has successfully launched over 65 GPS satellites and currently operates over 30 healthy GPS satellites, comprised of Block IIA (launched 1990-1996), Block IIR (1997-2004), Block IIR-M (2005-2009), and Block IIF (2010-present).
  - Control Segment – The GPS control segment consists of primary and backup GPS master control stations, satellite control antennas, a pre-launch satellite compatibility station, and geographically-distributed operational monitoring stations. The current GPS control segment, the Operational Control System (OCS) supports (1) operation of GPS Block IIF and legacy satellites, (2) Selective Availability/Anti-Spoof Module capabilities in GPS User Equipment, and (3) Launch/Early Orbit, Anomaly Resolution, and Disposal Operations.
  - User Segment – There are many versions of military GPS mission receivers fielded on a multitude of operational systems and combat platforms, including the most common Defense Advanced GPS Receivers and embedded Ground-Based GPS Receiver Application Modules (GB-GRAM), numbering in the hundreds of thousands.
- In 2000, the DOD approved initiation of a GPS enterprise modernization effort to include upgrades to all three segments, along with new civil and military signals (M-code). In addition to replenishment of the constellation, this modernization is intended to improve both military and civil signal integrity and service quality in terrain- and geography-impeded environments, as well as in the presence

of unintentional and deliberate interference. Modernized GPS enterprise improvements include:

- Space Segment – GPS III satellites, an Acquisition Category (ACAT) 1D program, have a design life that far exceeds that of all earlier blocks. GPS III will be capable of transmitting a fourth civil signal and higher-powered M-code, as well as all legacy military and civil navigation signals of previous satellite blocks.
- Control Segment – OCX, an ACAT 1D program, replaces the current OCS/Architecture Evolution Plan control segment and is backward compatible with Block IIR and later satellites. OCX will provide (1) control of GPS III satellites and legacy signals, (2) full control of modernized civil and M-code signals, and (3) significant cybersecurity improvements over OCS.
- User Segment – MGUE Increments 1 and 2 are pre-Major Defense Acquisition Programs expected to be ACAT 1D. MGUE Increment 1 includes the Ground-Based GPS Receiver Application Module-Modernized (GB-GRAM-M) form factor for ground and low-dynamic platforms such as small unmanned aircraft systems, and the GPS Receiver Application Module-Standard Electronic Module-E/ Modernized (GRAM-S/M) for maritime and aviation applications. MGUE Increment 2 requirements are in development and presumed to address requirements and applications not addressed by MGUE Increment 1, including handheld, precision guided munition, and standard space receiver applications.

Mission

- GPS is a global utility, integral to U.S. national security, economic growth, transportation safety, homeland security, and the world's economic infrastructure. It is U.S. national policy to provide continuous worldwide access to GPS, for peaceful civil uses, and to employ GPS to satisfy U.S. civil and national security needs.
- Combatant Commanders, U.S. military forces, allied nations, and various civilian agencies rely on GPS to provide highly-accurate, real-time, all-weather, and time information to operational users worldwide. GPS provides force enhancement for combat operations and military forces in the field on a daily basis throughout a wide variety of global strategic, operational, and tactical missions.
- Properly equipped military forces will employ modernized GPS capabilities to (1) determine or contribute to their determination of their location and velocity, (2) support precision munitions targeting and employment, and (3) synchronize operations and secure communications in all environments.

Major Contractors

- Space Segment
  - Block IIR/IIR-M/III satellites: Lockheed Martin Space Systems – Denver, Colorado
  - Block IIF satellites: Boeing Space and Intelligence Systems – Seal Beach, California
- Control Segment
  - OCS: Lockheed Martin – Colorado Springs, Colorado
  - OCX: Raytheon Company, Intelligence, Information and Services – Aurora, Colorado
- User Segment (MGUE Inc 1)
  - L-3 Communications/Interstate Electronics Corporation– Anaheim, California
  - Rockwell Collins – Cedar Rapids, Iowa
  - Raytheon Company – El Segundo, California

Activity

- The Air Force conducted significant development for all three enterprise segments in 2014, including component testing for GPS III and prototype risk-reduction testing for MGUE Increment 1, but did not conduct any operational testing for the GPS enterprise in 2014.
- Expected operational testing dates for all three segments have changed from those listed in the current ETEMP approved in March 2012, as indicated below. Those schedule changes result from development and delivery delays to GPS III and OCX, and from Air Force-proposed changes to the MGUE Increment 1 Acquisition Strategy, as well as from Air Force and Army-proposed changes to their Service-nominated Lead Platforms for MGUE Increment 1.
- The Air Force currently expects to conduct operational tests for each GPS segment as follows:
  - OA of MGUE Increment 1 accelerated from late 2016 to late 2015, to support USD(AT&L)'s combined Milestone B/C decision for MGUE Increment 1, under an accelerated Air Force-proposed schedule.
  - IOT&E of MGUE Increment 1 accelerated from 2021 to 2017, to support USD(AT&L)'s Beyond Low-Rate Initial Production decision for MGUE Increment 1, leading to procurement and fielding of MGUE Increment 1 components by the Services, for their respective platforms.
  - The Operational Utility Evaluation of OCX Block I and GPS III satellite vehicle (SV) 01 slipped from early 2016 to early 2019, supporting an Air Force fielding decision for OCX Block 1 and operational acceptance of GPS III SV01.
  - Multi-service OT&E of the modernized GPS enterprise in 2020, including OCX Block II and all associated navigation warfare and modernized signal and messaging functions testing, supporting an Air Force fielding decision for OCX Block II.
- The next revision of the GPS ETEMP is in coordination within the Air Force and with Service Operational Test Agencies; DOT&E expects to receive the revised ETEMP in early 2015 for OSD approval, and it should describe developmental T&E (DT&E) and OT&E to take place in 2015 and beyond. The

ETEMP will require further revision to incorporate updated development and test planning assumptions entailed by changes to all three GPS enterprise segment schedules, and to describe OT&E for any contingency capability developed to operate GPS III satellites prior to the availability of OCX Block I.

Assessment

- No OT&E test data are available at this point.
- DOT&E's November 2014 memorandum to USD(AT&L) identified several significant concerns regarding sustainment of the GPS enterprise and execution of GPS enterprise modernization.
  - Impact of OCX delays on GPS III OT&E. OCX delays add risk that OT&E will not discover GPS III deficiencies until it is too late to correct them. OCX Block 1 is needed to operate and support OT&E of GPS III satellites. The schedule delays for OCX Block I delivery will delay OT&E of GPS III until after at least six, and as many as eight, GPS III satellites have been built and launched. This introduces significant risk that effectiveness and suitability deficiencies in GPS III satellites will not be discovered until it is too late to prevent their introduction to the operational constellation.
  - Risk to the MGUE Increment 1 OA. The Air Force's current plan for the MGUE Increment 1 OA will not provide sufficient data to support an informed Milestone C decision by USD(AT&L), adding risk to that decision.
    - The Air Force has proposed an accelerated acquisition strategy for MGUE Increment 1, which combines Milestones B and C, and eliminates the engineering, manufacturing, and development phase, requiring earlier execution of the OA for MGUE Increment 1. The Air Force does not currently intend to integrate MGUE Increment 1 onto any Lead Platforms prior to the scheduled OA in 2015. DOT&E informed the Air Force in December 2013 that an adequate OA for MGUE Increment 1 should encompass integration and developmental test of at least one Lead Platform per MGUE form factor being evaluated. This shortfall will significantly reduce the OA's utility in informing the Milestone C decision.
    - The Air Force MGUE risk-reduction activities to-date with the RQ-11B Raven small unmanned aircraft system have had mixed results, which underscore substantial remaining challenges for MGUE integration on other platforms, and reinforce the need for an adequate OA.
  - Lead Platform Changes and Source Selection. Air Force and Army-requested Lead Platform changes will reduce the pathfinding value of Lead Platform testing, and the Air Force's proposed MGUE Increment 1 source selection approach may reduce post IOT&E competition and delay fielding of MGUE to non-Lead Platforms.
    - MGUE Increment 1 Lead Platforms are pathfinders, intended to represent the operational environment and integration challenges for all DOD platforms using those respective form factors. The four Service-nominated Lead Platforms identified in the MGUE Increment 1 Capabilities Development Document are:
      - The RQ-11B Raven (Army) and Joint Light Tactical Vehicle (Marine Corps) for the GB-GRAM-M form factor
      - The F-15E (Air Force) and DDG-51, *Arleigh Burke* class destroyer (Navy) for the GRAM-S/M form factor.
    - The U.S. Army and Air Force recently requested to replace their designated Lead Platforms with the Defense Advanced GPS Receiver Distributed Device-equipped Stryker family of vehicles and the B-2 Spirit, respectively. This changes the range of integration challenges and operational factors that can be evaluated prior to a Beyond Low-Rate Initial Production decision, and may reduce the degree to which the Lead Platforms are able to "pathfind" for non-Lead Platforms. In turn, this may increase the integration challenges and OT&E requirements for non-Lead Platforms and ultimately delay fielding of MGUE Increment 1 receivers for the rest of the DOD.
    - The Air Force-proposed MGUE Increment 1 Acquisition Strategy source selection approach entails each Service selecting only a single vendor solution, from among the multiple vendor solutions that may be certified and available, to integrate with their Lead Platforms and undergo OT&E. There are two possible, undesirable outcomes to this strategy.
      - The two lead platforms for each MGUE form factor choose the same vendor. This leads to adequate operational testing of the single vendor chosen but inadequate operational testing of any other MGUE vendor solutions, reducing post-IOT&E competition.
      - The two lead platforms for each MGUE form factor choose different vendors. This leads to inadequate operational testing for each MGUE vendor solution because the IOT&E will not have tested any solution across the widest possible range of operational environments and integration challenges for that form factor. This could result in higher integration costs and will drive expanded OT&E for non-Lead Platforms that subsequently integrate MGUE Increment 1.
  - Inadequate Articulation of Risks. The Air Force is not mitigating several significant problems as risks to the GPS enterprise. Examples include:
    - The potential sale to foreign ownership of the only U.S. trusted foundry producing the application-specific integrated circuits for MGUE Increment 1, which would impede development and production of MGUE Increment 1.
    - The descoped and unprogrammed provision of M-code monitoring stations outside the continental U.S., which would impede M-code anomaly detection and resolution.

- Observed MGUE Increment 1 thermal, power, and interface implementation, which may adversely affect integration with host platforms.
- Risk to the probability of sustaining availability of a 27-satellite operational constellation, which has become the de facto expected standard of service for military GPS users due to its benefit for terrain-impeded users.

- Inaccurate, Implausible, and Incoherent Schedules. Air Force schedules for the GPS enterprise, provided in support of OSD acquisition decisions, reflect timelines for integration and test of MGUE Increment 1 that have not been endorsed by the responsible Lead Platform program offices or operational test agencies. Independent and OSD reviews have identified a lack of accuracy, currency, and coherence in GPS enterprise schedules, which negatively affects effective program management and oversight.
- Overstatement of MGUE Development Maturity. The Air Force requested in November 2014 that USD(AT&L) waive the requirements for Critical Design Review and OA of MGUE Increment 1, on the premise of technical maturity in the MGUE Increment 1 program. Based on the results of risk-reduction activities to date, and historical experience with complex and challenging host platform integration, MGUE Increment 1 has not demonstrated technical maturity that would warrant waiver of these critical assessment functions.

Recommendations

- Status of Previous Recommendations. The Air Force has partially addressed the five previous recommendations listed in the 2011 Annual Report:
  1. There has been no opportunity thus far for end-to-end testing of OCX with MGUE receivers, but the ETEMP incorporates planning for the Multi-service OT&E of the modernized GPS enterprise, which will address end-to-end testing. The Air Force is not yet planning for adequate integration on representative platforms to enable timely OT&E in representative environments in support of well-informed acquisition and fielding decisions. The Air Force should continue to plan for end-to-end testing of the GPS enterprise, including integration on Lead Platforms, and DT&E and OT&E in realistic operational environments, in time to support acquisition decisions.
  2. Synchronization of the development of the Space, Control, and User segments has only marginally improved. Descriptions of the impact of delays in each segment upon the GPS enterprise and other segment schedules are often not clearly articulated. The Air Force should ensure that status and critical interdependencies of each enterprise segment are well understood, and should promptly assess and disseminate to all stakeholders those predicted enterprise impacts resulting from forecast changes in segment schedules.
  3. The revised ETEMP now in Service coordination reflects clear improvements in planning for comprehensive and realistic cybersecurity testing of the GPS enterprise, although additional revisions will be necessary to reflect GPS segment changes and DOT&E's August 2013 guidance, Procedures for Operational Test and Evaluation of Cybersecurity in Acquisition Programs. The Air Force should continue to refine its cybersecurity testing approach to GPS.
  4. The Services have made progress in emphasizing/enforcing the use of crypto-keyed GPS receivers, but should redouble their efforts.
  5. The Services have made progress in developing concepts of operations and tactics, techniques, and procedures for keying GPS receivers, but that has not translated into use of encrypted receivers for all military operations.
- FY14 Recommendations. The Air Force should:
  1. Mitigate the risks to the GPS enterprise associated with delays to OCX delivery and the inability to conduct OT&E of GPS III SV01 prior to the launch of as many as eight GPS III satellites.
  2. Integrate and conduct DT&E of MGUE Increment 1 on at least one Lead Platform per form factor in time to support an OA informing MGUE Increment 1 Milestone C.
  3. Continue the engineering, manufacturing, and development of MGUE Increment 1 until it has demonstrated maturity in both functional performance and integration with host platforms.
  4. Assess the degree to which designated Lead Platforms for MGUE Increment 1 cover the range of operational factors and integration challenges for the complete portfolio of DOD platforms each MGUE form factor is intended to support.
  5. Ensure each available MGUE Increment 1 vendor solution for a given form factor is integrated with all Lead Platforms for that respective form factor to support adequate MGUE IOT&E.
  6. Identify and articulate a mitigation plan of action and milestones for all significant risks to the GPS enterprise.
  7. Maintain and disseminate coherent, accurate, and timely schedule information for all segments of the GPS enterprise, ensuring that each segment schedule and the enterprise master schedule reflect interdependencies between segments. Ensure these segment and enterprise schedules reflect the most current government estimates and are caveated to reflect any un-validated assumptions.

KC-46A

Executive Summary

- DOT&E approved the post-Milestone B Test and Evaluation Master Plan (TEMP) in January 2013. The TEMP approval memorandum identified planned test program shortfalls that require resolution prior to the Milestone C TEMP approval.
- Readiness for the scheduled start of IOT&E continues to be high-risk with a 12-month delay expected. It is unlikely that Boeing and the Air Force will develop a schedule that delivers 18 different certified receiving aircraft, as described in the Milestone B TEMP, prior to the start of familiarization training for the IOT&E.
- The program has made advances in collecting and analyzing live fire test data needed to address the KC-46A vulnerability to threat-induced dry bay fires, threat-induced wing structural failures, and flight deck armor effectiveness.

System

- The KC-46A aerial refueling aircraft is the first increment of replacement tankers (179) for the Air Force's fleet of KC-135 tankers (more than 400).
- The KC-46A design uses a modified Boeing 767-200ER commercial airframe with numerous military and technological upgrades, such as the fly-by-wire refueling boom, the remote air refueling operator's station, additional fuel tanks in the body, and defensive systems.
- The KC-46A is intended to provide boom (pictured) and probe-drogue refueling capabilities. The Air Force intends to equip the KC-46A with an air-refueling receptacle so that it can also receive fuel from other tankers, including legacy aircraft.
- The KC-46A is designed to have significant palletized cargo and aeromedical capacities; chemical, biological, radiological, nuclear survivability; and the ability to host communications gateway payloads.
- Survivability enhancement features are incorporated into the KC-46A design.
  - Susceptibility is reduced with an Aircraft Survivability Equipment suite consisting of Large Aircraft Infrared Countermeasures, the ALR-69A Radar Warning Receiver (RWR), and a Tactical Situational Awareness System. The suite is intended to compile threat information from the RWR and other on- and off-board sources and prompt the crew with an automatic re-routing suggestion in the event of a threat.
  - Vulnerability is reduced through the addition of fuel tank inerting and integral armor to provide some protection to the crew and critical systems.

Mission

Commanders will use units equipped with the KC-46A to:

- Perform air refueling to accomplish six primary missions to include nuclear operations support, global strike support, air bridge support, aircraft deployment, theater support, and special operations support. Secondary missions will include airlift, aeromedical evacuation, emergency aerial refueling, air sampling, and support of combat search and rescue.
- Operate in day/night and adverse weather conditions over vast distances to support U.S., joint, allied, and coalition forces.
- Operate in a non-permissive environment.

Major Contractor

The Boeing Company, Commercial Aircraft in conjunction with Defense, Space & Security – Seattle, Washington

Activity

- The KC-46A Integrated Test Team met quarterly from April 2011 through June 2014. The September 2014 meeting was postponed pending resolution of design and contractual issues.
- DOT&E approved the post-Milestone B TEMP in January 2013, with caveats.
- DOT&E approved the Air Force Operational Test and Evaluation Center's plan for a KC-46A operational assessment to support the Milestone C decision.
- Developmental, operational, and Federal Aviation Administration test planning is in progress. The contractor's preliminary Stage 4 (final build) test plans were submitted to the Air Force. More than 90 percent of the plans were accepted.
- Initial flight of the first Engineering and Manufacturing Development (EMD) aircraft is more than five months late, primarily due to electrical wiring design complexity. The

KC-46A has approximately 60 percent more wiring than Boeing's commercial 767-200 aircraft.
- Test venues for the ALR-69A RWR and the AAQ-24 Large Aircraft Infrared Countermeasures system have been agreed to by all parties. Detailed test planning for each venue remains to be completed.
- The Air Force planned and executed three major live fire test series: (1) Center Wing Dry Bay Fire Vulnerability, (2) Wing Hydrodynamic Ram Evaluation, and (3) Armor Effectiveness.
- Boeing is preparing draft detailed test plans for Electromagnetic Pulse (EMP) testing based on the contract-specified design margin of 6 decibels (dB), which provides a higher-risk hardening approach.

Assessment
- DOT&E identified shortfalls in the planned test program that require resolution prior to Milestone C TEMP approval. The TEMP requires increased detail in a number of areas. The Air Force is addressing shortfalls in the planned test program.
  - Mitigation is needed for the impact of concurrent activities and planned flying hours for the EMD program that place a high demand on limited aircraft and simulator resources.
  - The operational test aircrew and maintenance personnel must have time to attain their training requirements and establish proficiency in operationally representative conditions before the start of IOT&E.
  - The technical order verification process must be completed before the start of IOT&E.
  - Sufficient calendar time must be allotted for correction of discrepancies and/or deficiencies discovered during developmental testing prior to the planned start of operational testing.
- The Air Force is continuing to analyze existing schedule risks and potential mitigations. DOT&E analysis of Boeing schedules with regard to aerial-refueling certifications, aircraft and support equipment technical orders, and operator/maintainer training indicates that operational testing will likely slip at least 12 months. It is unlikely that Boeing and the Air Force will develop a schedule that delivers 18 different certified receiving aircraft, as described in the Milestone B TEMP, prior to the start of training for the IOT&E. Also, until all detailed test plans (known as Stage 4 test plans) are approved, DOT&E will not have sufficient insight to determine if there are adequate mitigations to reduce the schedule risks prior to the start of IOT&E.
- The test team is working a cybersecurity strategy to be consistent with DOT&E guidance; however; specific details to execute an adequate test are not yet defined.
- The first flight of the initial KC-46A aircraft scheduled for January 2015 is now planned for April 2015. This delay will alter the planned certification schedule of Phase I receiving aircraft and may delay the August 2015 Milestone C decision.
- Analysis of the wing-leading edge, wing-trailing edge, and live fire test data for the center wing dry bay fire confirmed the vulnerability of the KC-46A to dry bay fires. Subsequent analysis will follow completion of the Fuselage Dry Bay Fire Vulnerability and Wing Dry Bay Fire Sustainment test series in FY15 to determine if sufficient data were obtained to quantify the most significant dry bay fire ignition and sustainment factors affecting overall KC-46A survivability.
- Live fire test data identified the KC-46 threat-induced structural limitations as a function of several engagement conditions. Post-test data analysis is ongoing to: (1) improve modeling and simulation accuracy, (2) assess flight load-carrying capability for engagement conditions beyond the test design space, and (3) assess structural failure limits as a function of dynamic loads.
- Preliminary analysis of the KC-46 armor performance demonstrated the expected armor effectiveness against a specification threat with 80 percent confidence. Test data were also collected to assess the performance of the installed armor against the specification threat and two other operationally representative threats. Evaluation of the effects of these data on the overall crew protection assessment is ongoing and will address a range of engagement conditions.
- The KC-46 EMP design margin was based on Military Standard (MIL-STD)-2169. After the fixed-price contract was awarded, a new MIL-STD-3023 was released that called for tanker aircraft to meet a 20 dB EMP design margin versus a 6 dB EMP design margin. The actual KC-46 EMP design margin should be determined.
- The TEMP and other test documents do not address detailed Information Assurance (IA) protect, detect, react, and restore requirements. The program has begun to address these shortfalls by planning additional testing and crew IA training through the IA Working Group.

Recommendations
- Status of Previous Recommendations. The Air Force addressed one of the FY12 recommendations to incorporate realistic assumptions in test plans; however, additional work is still needed. The Air Force still needs to address the remaining FY12 and FY13 recommendations to:
  1. Submit a TEMP with a realistic schedule mitigating the above mentioned shortfalls.
  2. Provide an approach to correct the ALR-69A RWR shortfalls prior to integration on the KC-46A.
  3. Plan to begin IOT&E at least 12 months later than the current TEMP indicates to allow for completion of developmental test and initial training.
  4. Provide a comprehensive aerial-refueling certification plan for the KC-46A including all EMD Phase 1 and 2 receivers.
  5. Plan testing against realistic cybersecurity threats to identify vulnerabilities for correction. In addition, plan follow-on penetration testing to assess IA performance in terms of protect, detect, react, and restore functions.
- FY14 Recommendation.
  1. The Air Force should conduct EMP testing to assess the actual EMP design margin of the KC-46.

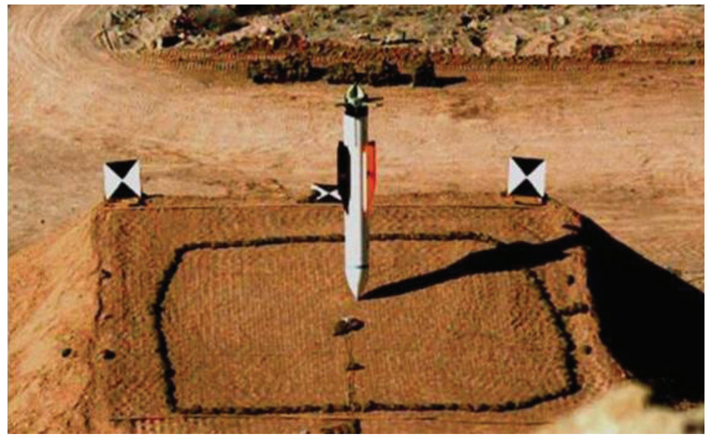
Massive Ordnance Penetrator (MOP)

Executive Summary

- In October 2014, the Air Force successfully completed one weapon drop from the B-2 aircraft on a representative target. The test, conducted at the White Sands Missile Range, New Mexico, demonstrated weapon behavior after planned enhancements were incorporated.
- DOT&E intends to publish a classified Early Fielding Report in early 2015 to summarize the FY15 testing of the Enhanced Threat Reduction (ETR) Phase 2 effort.

System

- The GBU-57 Massive Ordnance Penetrator (MOP) is a large, GPS-guided, penetrating weapon with the ability to attack deeply-buried and hardened bunkers and tunnels. The warhead case is made from a special high-performance steel alloy and its design allows for a large explosive payload while maintaining the integrity of the penetrator case during impact.
- The B-2 Spirit is the only aircraft in the Air Force programmed to employ the MOP.
- The GBU-57 warhead is more powerful than its predecessors, the BLU-109 and GBU-28.
- The MOP is an Air Force-led, Quick Reaction Capability that is on DOT&E oversight, as well as a Secretary of Defense special interest effort.



Mission

Combatant Commanders use MOP to conduct pre-planned, day or night attacks against defended point targets vulnerable to blast and fragmentation effects and requiring significant penetration, such as hardened and deeply-buried facilities.

Major Contractor

The Boeing Company, Defense, Space & Security – St. Louis, Missouri

Activity

- Prior to the live-flight missions, the Air Force conducted one static test and flew one captive-carry test in August and September 2014, to validate the hardware and software changes implemented in the MOP.
- In October 2014, the Air Force executed one weapon drop at White Sands Missile Range, New Mexico, on a representative target. This testing was to evaluate the effect of the ETR Phase 2 modifications to the weapon system performance. An Air Force B-2 aircraft flew one mission to complete the drop. Two free-flight missions, one inert and one live warhead, remain to complete ETR Phase 2 testing.

Assessment

- Both the static and captive-carry tests were successful and allowed the program to proceed to live weapons employment.
- The Air Force and DOT&E are currently assessing the results from the MOP ETR Phase 2 effort, and will report them in a classified DOT&E Early Fielding Report in early 2015.

Recommendations

- Status of Previous Recommendations. While there were no previous Annual Report recommendations for this program, the Air Force addressed all recommendations in the September 2013 Early Fielding Report.
- FY14 Recommendations. None.

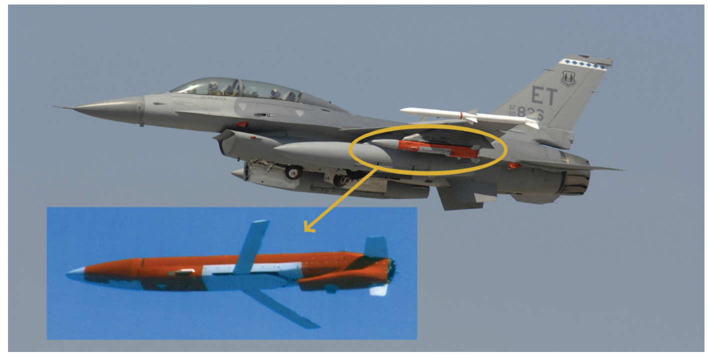
Miniature Air-Launched Decoy (MALD) and MALD-Jammer (MALD-J)

Executive Summary

- The Air Force Operational Test and Evaluation Center (AFOTEC) completed full mission-level simulation testing for the Miniature Air-Launched Decoy – Jammer (MALD-J) in February 2014.
- In FY14, the Air Force launched 3 MALD-J and 2 MALD vehicles in operational environments.
- Preliminary analysis of the Force Development Evaluation (FDE) indicates persistent problems exist with MALD-J navigational accuracy. The MALD-J Program Office has incorporated software upgrades to improve navigational accuracy, but the changes thus far have focused on improving the missile's altitude hold capability and have improved navigation accuracy only slightly.
- The 28th Test and Evaluation Squadron is currently executing an FDE, in conjunction with a MALD-J Reliability Assessment Program mission, to evaluate MALD-J's improvement to navigational accuracy due to software upgrades.
- Preliminary results of MALD and MALD-J IOT&E indicate the Air Force's corrective actions on MALD-J have improved the materiel reliability.

System

- The MALD is a small, low-cost, expendable, air-launched vehicle that replicates how fighter, attack, and bomber aircraft appear to enemy radar operators.
- The Air Force designed the MALD-J as an expendable, close-in jammer to degrade and deny an early warning or acquisition radar's ability to establish a track on strike aircraft while maintaining the ability to fulfill the MALD decoy mission.
- In FY12, the Program Office converted the MALD procurement line to MALD-J. The Air Force will no longer procure any MALDs without the jammer.



- The F-16C/D and B-52 are the lead aircraft to employ MALD and MALD-J.

Mission

Combatant Commanders will use units equipped with:

- MALD and MALD-J to improve battlespace access for airborne strike forces by deceiving, distracting, or saturating enemy radar operators and Integrated Air Defense Systems.
- MALD to allow an airborne strike force to accomplish its mission by deceiving enemy radars and forcing air defense systems to treat MALD as a viable target.
- MALD-J to allow an airborne strike force to accomplish its mission by jamming enemy radars and air defense systems to degrade or deny detection of friendly aircraft or munitions.

Major Contractor

Raytheon Missile Systems – Tucson, Arizona

Activity

- AFOTEC completed full mission-level simulation testing in February 2014 in accordance with the DOT&E-approved test plan.
- In April 2014, the Program Office completed a MALD-J Reliability Assessment Program that launched a single MALD vehicle to test and verify the software updates for navigation accuracy.
- The 28th Test and Evaluation Squadron is currently executing an FDE, in conjunction with a MALD-J Reliability Assessment Program mission, to evaluate MALD-J's improvement to navigational accuracy due to software upgrades. The test squadron has accomplished all six of the planned MALD-J missile launches.
- AFOTEC published an operational test report on MALD-J in February 2014. DOT&E is waiting to publish its IOT&E report until after MALD/MALD-J navigational improvements have been tested; the report is expected to be released in 2QFY15.
- In FY14, the Air Force launched 3 MALD-J and 2 MALD vehicles in operational environments.

Assessment

- DOT&E's April 2011 IOT&E report evaluated MALD as operationally effective for combat, but not operationally suitable due to poor materiel reliability. AFOTEC's MALD IOT&E report, published in January 2012, determined MALD to be operationally effective and suitable with identified mission planning and reliability shortfalls. DOT&E is using a combination of MALD and MALD-J IOT&E data to evaluate whether the Air Force has mitigated vehicle reliability problems. Since no failures in the MALD-J payload to date have occurred, and the missile bodies, flight control surfaces, and navigational systems are identical to MALD, combining these data is appropriate.
- Corrective actions appear to have improved the poor materiel reliability in the intended operational environment.
- Preliminary analysis of the FDE indicates persistent problems exist with MALD-J navigational accuracy. Although some corrections have demonstrated minor navigational accuracy improvements to date, overall navigational accuracy problems in most operational environments persist.
- The Air Force will fully implement and test navigational accuracy upgrades in FOT&E in FY15.
- Full mission-level planning and testing events for the MALD-J program indicate the time needed to plan a full load of MALD-J vehicles is excessive. Typically, planning time required for an F-16 is just over 2 hours for a full mission, but typical planning time for a B-52 can reach over 12 hours.

Recommendations

- Status of Previous Recommendations. The Air Force satisfactorily addressed one of three FY13 recommendations by addressing the validation and accreditation issues involved with the Digital Integrated Air Defense model. The Air Force is currently testing to address the remaining recommendations to improve navigational accuracy in operational environments and mission-planning capabilities for the MALD-J program to reduce the time needed to plan a full load of MALD-J vehicles.
- FY14 Recommendations. The Air Force should:
  1. Complete FDE testing to evaluate the MALD-J navigation system improvements due to software upgrades.
  2. Continue to develop a plan to fully test navigation system upgrades in FOT&E.

MQ-9 Reaper Armed Unmanned Aircraft System (UAS)

Executive Summary

- The MQ-9 Program of Record continues to face challenges with evolving content, prioritizing and maturing system software, and developing and delivering technical order data to meet development and fielding timelines for the MQ-9 Increment One Program of Record. The Air Force will complete MQ-9 remotely-piloted aircraft (RPA) production under Low-Rate Initial Production; there will be no Full-Rate Production decision.
- The Air Force completed a Force Development Evaluation (FDE) of the Block 1 RPA configured with Operational Flight Program (OFP) 904.2 in December 2013. This increment of operational testing assessed improvements to optical and infrared sensor target location accuracy; established a baseline measurement of radar target location accuracy and ground-moving target indicator detection capability; and evaluated system user interface improvements.
- Block 5 RPA developmental testing revealed aircraft overheating problems that precluded the completion of operationally representative hot-weather ground testing. At the end of FY14, the Air Force was pursuing corrective actions to include system redesign and additional developmental testing in FY15 in order to meet Air Force global operating environment requirements.
- The final configuration of the MQ-9 Increment One Unmanned Aircraft System (UAS) continued to evolve in FY14. The Air Force proposed further changes and enhancements to the MQ-9 UAS. These changes entail additional hardware, software, and enhanced capabilities beyond those addressed in the current MQ-9 Test and Evaluation Master Plan (TEMP). Changes to the Increment One UAS will be supported by a new MQ-9 acquisition strategy and new developmental and operational test and evaluation construct. A new TEMP is required to articulate the developmental and operational test construct and scope of resources necessary to support the testing of the MQ-9 UAS content proposed under the new Air Force acquisition strategy.

System

- The MQ-9 Reaper UAS is a remotely-piloted, armed, air vehicle that uses optical, infrared, and radar sensors to locate, identify, target, and attack ground targets.
  - The MQ-9 RPA is a medium-sized aircraft that has an operating ceiling up to 50,000 feet, an internal sensor payload of 800 pounds, an external payload of 3,000 pounds, and an endurance of approximately 14 hours.
  - The Ground Control Station (GCS) commands the MQ-9 RPA for launch, recovery, and mission control of sensors and weapons. C-band line-of-sight datalinks are used for RPA launch and recovery operations, and Ku-band satellite links are used for RPA mission control.
- The MQ-9 RPA carries AGM-114, HELLFIRE II anti-armor precision laser-guided missiles and GBU-12, 500-pound laser guided bombs.
- The Air Force is using an evolutionary acquisition approach for meeting Increment One Capability Production Document requirements, with Block 1 and Block 5 RPAs and Block 15 and Block 30 GCSs.
- The Air Force is currently fielding the Block 1 RPA and the Block 15 GCS.
- The Air Force designed the Block 5 RPA to incorporate improved main landing gear, an upgraded electrical system with more power, an additional ARC-210 radio, encrypted datalinks, a redesigned avionics bay and digital electronic engine control system, the BRU-71 bomb rack, high-definition video, and upgraded software to allow the two-person aircrew to operate all onboard systems.

Mission

- Combatant Commanders use the MQ-9 onboard sensors and weapons to conduct armed reconnaissance and pre-planned strikes. Units equipped with MQ-9s can find, fix, track, target, engage, and assess critical emerging targets (both moving and stationary).
- MQ-9 units can also conduct aerial intelligence gathering, reconnaissance, surveillance, and target acquisition for other airborne platforms.

Major Contractor

General Atomics Aeronautical Systems Inc. – San Diego, California

Activity

- The Air Force conducted all MQ-9 testing in accordance with the DOT&E-approved TEMP and test plan.
- Air Combat Command completed an FDE of the Block 1 RPA configured with OFP 904.2 in December 2013. This increment of operational testing assessed improvements to optical and infrared sensor target location accuracy; established a baseline measurement of radar target location accuracy and ground moving target indicator (GMTI) detection capability; and evaluated system user interface improvements.
- In June and July of 2014, the Air Force conducted MQ-9 Block 5 RPA developmental testing to include an Integrated System Evaluation of hot-weather capabilities. Block 5 RPA design shortfalls resulted in aircraft overheating on the ground that precluded the Air Force from successfully completing this testing.
- In July 2014, the Air Force 92d Information Operations Squadron and the Air Force Operational Test and Evaluation Center (AFOTEC) conducted a cybersecurity Cooperative Vulnerability Assessment of the Block 5 RPA and Block 30 GCS to support the planned FY15 FOT&E.
- Late in FY14, Air Combat Command began a Tactics Investigation to explore the potential for limited envelope employment of GBU-38 500-pound Joint Direct Attack Munition (JDAM) weapons from Block 1 RPAs configured with OFP 904.2. AFOTEC will fully test JDAM capabilities during planned FY15 FOT&E of the MQ-9 Block 5 RPA and Block 30 GCS configured with OFP 904.6.
- The final configuration of the MQ-9 Increment One UAS continued to evolve throughout FY14. As of the end of FY14, the Air Force indicated it intends to incorporate an improved Multi-Spectral Targeting System–B (MTS-B) electro-optical/infrared sensor, additional weapons, avionics hardware, and further system software revisions into the Increment One Program of Record capabilities.
- At the end of FY14, the MQ-9 System Program Office was exploring new acquisition strategy approaches to react to changing content desired by the Air Force and to deliver desired capabilities to the users.

Assessment

- The MQ-9 program continues to face systemic challenges in prioritizing and maturing software OFPs and developing technical order data to meet development and fielding timelines for the MQ-9 Increment One Program of Record. The Air Force has elected not to conduct a Full-Rate Production decision for the Block 5 RPA, and the MQ-9 system will complete delivery of all planned RPAs under Low-Rate Initial Production. FOT&E of the Increment One UAS configuration, originally planned for 2013, is projected to begin in late FY15.
- DOT&E assesses that results of the MQ-9 904.2 software upgrade FDE demonstrate:
  - The MTS-B electro-optical/infrared targeting accuracy is improved compared to that of the legacy OFP configuration, and supports employment of legacy AGM-114 HELLFIRE missiles and GBU-12 500-pound, laser-guided bombs.
  - The Lynx synthetic aperture radar (SAR) targeting accuracy supports target designation and employment of AGM-114 missiles and GBU-12 laser-guided bombs. Lynx SAR testing results further demonstrated system target location accuracies sufficient to support JDAM employment. However, JDAM testing was not accomplished as part of the OFP 904.2 FDE due to JDAM launch acceptability region software deficiencies. The Air Force intends to correct JDAM launch acceptability region shortfalls in future MQ-9 OFP 904.6.
  - The Lynx SAR GMTI demonstrated the ability to detect ground-moving targets; however, cross-cueing capability from the Lynx SAR to the MTS-B was poor.
  - Neither the RPA nor GCS met the Air Force Mean Time Between Critical Failure or Mean Repair Time threshold requirements during the FDE period. However, 16 of 16 RPA failures and 17 of 20 GCS failures were hardware failures not related to the OFP upgrade. The only software anomalies observed were confined to the GCS where two system software resets and one software reload occurred.
- Developmental testing of the MQ-9 Block 5 RPA revealed system deficiencies that precluded the successful completion of planned FY14 hot weather testing. Testers were unable to execute planned sorties in an operationally representative hot-weather environment due to the Block 5 RPA system overheating during ground operations prior to take-off.
  - Based on the performance shortfalls encountered, the Air Force is considering redesigned hardware, additional ground equipment, OFP software changes, and technical order changes to resolve the overheating problems.
  - However, at the end of FY14, a final solution had not been identified and additional developmental testing remained to be accomplished. The Air Force expects to resolve this problem prior to the start of planned FY15 FOT&E.
- Preliminary observations of Air Combat Command's Tactics Investigation exploring limited envelope operational employment of GBU-38 JDAMs indicate that although weapons can be employed from MQ-9 Block 1 RPAs configured with OFP 904.2, current displayed launch acceptability region shortfalls do not yet meet Air Force operational needs. JDAM employment remains to be fully evaluated during the FY15 FOT&E in conjunction with OFP 904.6 testing.
- The DOT&E-approved TEMP identifies OT&E requirements for the currently-defined final configuration of the MQ-9 Increment One UAS. Should the configuration change from that identified in the TEMP (Block 5 RPA, Block 30 GCS, and OFP 904.6), an updated TEMP will be required to address new Increment One UAS configurations, content, and associated T&E efforts. Regardless of any potential changes, DOT&E will evaluate the Block 5 RPA, Block 30 GCS, and OFP 904.6 in conjunction with the planned AFOTEC FOT&E in FY15.

Recommendations

- Status of Previous Recommendations. In FY14, the Air Force made progress towards satisfying previous years' recommendations to complete the development of the Increment One UAS hardware and software cybersecurity vulnerability testing.
- FY14 Recommendations. The Air Force should:
  1. Complete the development of the Increment One UAS hardware and software to support FOT&E of the Increment One system.
  2. Improve the Lynx SAR GMTI cross-cueing capability to enable effective hunter/killer operations against moving targets.
  3. Resolve the Block 5 RPA hot-weather operating shortfalls prior to the start of AFOTEC's planned FOT&E in FY15.
  4. Complete the development of the GBU-38 JDAM capability for MQ-9 and fully test it during AFOTEC's FOT&E in FY15.
  5. Update the MQ-9 Increment One UAS TEMP to accurately reflect the content being pursued under the evolving program of record.

QF-16 Full-Scale Aerial Target (FSAT)

Executive Summary

- The Air Force executed 99 QF-16 developmental and operational test sorties in FY13 and 14, completing IOT&E in September 2014.
- The QF-16 demonstrated progress toward mission effectiveness and suitability as a fourth-generation Full-Scale Aerial Target (FSAT) to support test, evaluation, and training of U.S. weapon systems at the Eglin Gulf Test and Training Range, Florida, and White Sands Missile Range, New Mexico.
- The Air Force should complete QF-16 radar cross section measurements and ensure procurement funding provides at least 25 FSAT targets per year beginning in FY16 to meet Service-coordinated aerial target requirements, in compliance with Resource Management Decision 700.
- The Air Force should provide plans for Phase II of the Air Superiority Target program to address shortfalls in testing against fifth-generation airborne threats.

System

- The QF-16 is the latest FSAT designed to test and evaluate U.S. weapon systems and assist in developing tactics, techniques, and procedures to counter fighter-size airborne threats. The DOD is replacing the current FSAT, the QF-4, due to its increasing dissimilarity from current and projected air-superiority threats, declining supportability, and depletion of suitable F-4 airframes.
- The QF-16 system is composed of regenerated F-16 Block 15, 25, and 30 aircraft equipped with Drone-Peculiar Equipment to enable remote command and control, missile trajectory scoring, and safe flight termination. Like the QF-4, the QF-16 is capable of manned and Not Under Live Local Operator (NULLO) flight operations. It will operate from Tyndall AFB, Florida, using the Gulf Range Drone Control System, and Holloman AFB, New Mexico, using the White Sands Integrated Target System located at White Sands Missile Range, New Mexico.
- The QF-16 retains F-16 flight performance characteristics and payload capabilities including supersonic, after-burning engines, high-G maneuvering, complex electronic attack, and expendable countermeasures.

Mission

The DOD uses FSATs to:

- Provide threat-representative presentations for developmental and operational test and evaluation for U.S. weapon systems, as mandated by Title 10 U.S. Code, Section 2366
- Continuously evaluate fielded air-to-air missile capabilities while providing live missile training for combat air crews through Air Force and Navy Weapon Systems Evaluation Programs

Major Contractor

The Boeing Company – St. Louis, Missouri

Activity

- QF-16 completed its last IOT&E flight on September 5, 2014. In total, QF-16 flew 99 developmental and operational test sorties, 19 of which were integrated test, and 4 dedicated operational test sorties (2 manned and 2 NULLO).
- The QF-16 program met Milestone C in October 2013 after nine months of developmental and integrated testing with the Eglin Gulf Test and Training Range at Tyndall AFB and Cecil Field in Florida.
- The QF-16 program relocated to Holloman AFB, New Mexico, to conduct developmental, integrated, and operational testing, including integration with the White Sands Integrated Target Control System.
- On May 8, 2014, the Program Executive Officer convened the Operational Test Readiness Review and certified QF-16 to begin IOT&E.
- QF-16 completed its first of two operational test flights in the NULLO configuration on June 25, 2014, at Holloman AFB. Mission events included testing of the Vector Scoring System utilizing the Center for Countermeasures at White Sands Missile Range and two surface-to-air missiles.

- The final operational test NULLO flight occurred on September 5, 2014, in conjunction with an AIM-9X Block II operational test live missile shot, which provided a realistic test of the QF-16 Vector Scoring System.
- The program scheduled the QF-16 Full-Rate Production decision for 2QFY15 with first delivery to the 82d Aerial Targets Squadron, Tyndall AFB, at the end of February 2015. The Air Force plans to achieve Initial Operational Capability at Tyndall AFB in 1QFY16.
- The Air Force conducted the IOT&E in accordance with the DOT&E-approved Test and Evaluation Master Plan.

Assessment

- QF-16 has demonstrated progress to provide an FSAT representing fourth-generation airborne threats for U.S. weapon systems testing. Analysis and reporting of IOT&E is incomplete but will conclude in 2QFY15; in particular, fixes to the Vector Scoring System that were identified in developmental testing remain to be verified.
- QF-16 has demonstrated progress in suitability metrics under the current Air Force concept of operations that generates a primary and backup FSAT for each chargeable scheduled sortie to achieve a 95 percent threshold supportability rating (defined as the ability to successfully launch in support of a scheduled test event). The Drone-Peculiar Equipment operating time totaled 776.6 hours with 25 failures, resulting in a 31.1-hour Mean Time Between Failure, below the Capabilities Development Document threshold requirement of 45 hours. The Army Materiel Systems Analysis Activity Maturity Project Model predicts QF-16 will reach 31.2 hours by Full Operational Capability in FY17.
- The Air Force did not require QF-16 to represent fifth-generation airborne threat systems (including radio frequency low observability characteristics, internally-carried advanced electronic attack, and low probability of intercept sensors). DOT&E continues to emphasize existing aerial targets, including the QF-16, are insufficient for adequate operational testing of U.S. weapon systems.
  - In the Air Superiority Target Phase I Analysis of Alternatives Final Report (March 15, 2007), the Air Force recommended further study to produce user consensus on critical characteristics of future aerial targets and to determine capabilities and shortfalls in existing test resources.
  - Multiple stakeholders within Congress, OSD, the Air Force, and the Navy, support the requirement for a fifth-generation FSAT.

Recommendations

- Status of Previous Recommendations. This is the first annual report for this program.
- FY14 Recommendations. The Air Force should:
  1. Complete radar cross section measurements for QF-16 to ensure current and future U.S. weapon systems programs have precise, reliable data on system performance against measured, low-observable target presentations.
  2. Ensure QF-16 procurement funding continues to comply with Resource Memorandum Decision 700-mandated levels of 25 aircraft per year beginning in FY16, in order to meet Service-coordinated and approved test and training resource requirements.
  3. Complete the user requirements and current capabilities studies and provide plans for Phase II of the Air Superiority Target program to address test and evaluation shortfalls for U.S. weapon systems with respect to threat-representative, fifth-generation FSATs.

RQ-4B Global Hawk High-Altitude Long-Endurance Unmanned Aerial System (UAS)

Executive Summary

- The 2015 Presidential Budget fully funded the Global Hawk program, resolving several years of programmatic uncertainty. As a result, the Air Force has taken delivery of 18 of 21 RQ-4B Block 30 and 11 RQ-4B Block 40 air vehicles. Additionally, the program has delivered all Mission Control Elements and Launch and Recovery Elements.
- The Air Force plans to re-establish and formalize a combined RQ-4B Global Hawk Block 30/40 baseline program. In preparation for a future Milestone C decision for the revised program, the Air Force is working to define baseline "as is" system configurations, define future operational capability requirements, develop a revised acquisition and sustainment strategy, and produce a comprehensive RQ-4B Global Hawk Test and Evaluation Master Plan (TEMP) to test and evaluate the correction of deficiencies and the effectiveness of future enhancements. In addition, the Air Force is developing RQ-4B Block 30 operational test schedules and strategies to submit to DOT&E for review in a revised program TEMP 90 days after the Block 30/40 Capabilities Production Documents are approved by the Joint Requirements Oversight Council.
- The Air Force continued developmental testing of the RQ-4B Block 40 system in FY14 in preparation for the planned IOT&E in FY15.
- The program continued to support operational employment with two Block 40 systems in the U.S. Central Command (USCENTCOM) area of operations and two systems to the U.S. Pacific Command (USPACOM) area of operations. The operational capability of these systems is limited, but supports the immediate requirements of the operational forces.
- The Air Force is currently developing follow-on operational test strategies for future system enhancements for FY15 and beyond.

System

- The RQ-4B Global Hawk is a remotely-piloted, high-altitude, long-endurance airborne Intelligence, Surveillance, and Reconnaissance system that includes the Global Hawk unmanned air vehicle, various intelligence and communications relay mission payloads, and supporting command and control ground stations.
- The RQ-4B Global Hawk Block 30 system is equipped with a multi-intelligence payload that includes both the Enhanced Integrated Sensor Suite imagery intelligence payload and the Airborne Signals Intelligence Payload (ASIP) signals intelligence sensor.
- The RQ-4B Block 40 system is equipped with the Multi-Platform Radar Technology Insertion Program (MP-RTIP) synthetic aperture radar payload designed to simultaneously collect imagery intelligence on stationary ground targets and track ground-moving targets.

Mission

Commanders use RQ-4 Global Hawk reconnaissance units to provide high-altitude, long-endurance intelligence collection capabilities to support theater operations.

- Operators collect imagery and signals intelligence data in order to support ground units and to identify intelligence essential elements of information for theater commanders. Units equipped with RQ-4B Global Hawk use line-of-sight and beyond line-of-sight satellite datalinks to control the Global Hawk system and transmit collected intelligence data.
- Distributed intelligence processing, exploitation, and dissemination systems receive intelligence data directly from the air vehicle or from the Global Hawk ground station via intelligence data transmission systems.
- Ground-based intelligence analysts exploit collected imagery, ground-moving target, and signals information to provide intelligence products in support of theater operations.
- Global Hawk can also provide imagery intelligence directly to forward-based personnel through direct line-of-sight datalink systems.

Major Contractor

Northrop Grumman Aerospace Systems, Strike and Surveillance Systems Division – San Diego, California

Activity

- The 2015 Presidential Budget fully funded the Global Hawk program, resolving several years of programmatic uncertainty. As a result, the Air Force has taken delivery of 18 of 21 RQ-4B Block 30, and 11 RQ-4B Block 40 air vehicles. Additionally, the program has delivered all nine Mission Control Elements and all 10 Launch and Recovery Elements.
- The Air Force is completing the requirements to achieve a Milestone C decision that will establish and formalize a combined and coherent Global Hawk Block 30/40 baseline program.

Block 30

- The Air Force is continuing to acquire and pursue upgrade programs for the ASIP sensor. In addition, the Air Force planned to modify some RQ-4B Block 30 ASIP sensors for transfer and deployment on the U-2 Dragon Lady in FY14.
- The Air Force is developing future RQ-4B Block 30 operational test schedules and plans to be submitted to DOT&E for review in a revised program TEMP 90 days after the Block 30/40 Capabilities Production Documents are approved by the Joint Requirements Oversight Council.
- No RQ-4B Block 30 operational testing was conducted in FY14.

Block 40

- The Air Force continued developmental testing of the RQ-4B Block 40 system in FY14 in preparation for the planned IOT&E in FY15.
- The program continued to support operational employment, with two systems in the USCENTCOM area of operations and two systems to the USPACOM area of operations. The operational capability of these systems is limited, but supports the immediate requirements of the operational forces.
- The Air Force is currently developing follow-on operational test plans for future system enhancements for FY15 and beyond.
- The Air Force completed six planned interoperability test flights and three integrated system evaluation test events with U.S. Air Force Distributed Ground Stations (AF DGSs) to demonstrate system maturity and improve the exploitation and dissemination of RQ-4B Block 40 data.
- The Air Force also implemented a number of radar system and image processing changes intended to address synthetic aperture radar image quality problems observed during the FY13 RQ-4B Block 40 Operational Utility Evaluation. The impact of these software and processing upgrades will be demonstrated and fully evaluated during RQ-4B Block 40 IOT&E in FY15.

Assessment

Previous acquisition strategies have resulted in Block 30 and Block 40 being managed as separate programs. With the full funding in the 2015 Presidential Budget, the Air Force has revised its acquisition strategy and is working to bring all Global Hawk variants into one cohesive program. Block 30 and Block 40 have separate operational test requirements, and the Air Force is working to develop a TEMP that will set a strategy for Block 30, Block 40, and any enhancements required in the future. This combined approach will codify the varied operational test requirements and identify test agencies and resources required to complete the evaluations.

Block 30

- Since the combined RQ-4B Block 30/ASIP IOT&E in 2011, the Air Force has corrected most RQ-4B air vehicle reliability and availability problems and implemented a limited number of previously planned system improvements. However, due to programmatic issues resulting from the previous DOD decision to retire the RQ-4B fleet, the Air Force has not yet conducted a comprehensive FOT&E to verify correction of all major IOT&E deficiencies. Currently fielded RQ-4B Block 30 systems continue to operate with many of the same operational performance and signals intelligence mission deficiencies identified during IOT&E.
- Preliminary program plans for the re-constituted RQ-4B Block 30 program include FOT&E events to assess SIGINT mission performance using the ASIP sensor, previously identified ground station, air vehicle, and communication system operational deficiencies, as well as a number of interoperability and cybersecurity shortfalls. The test schedule for future operational test events depends on the resolution of current program problems leading to a USD(AT&L)-approved program schedule.

Block 40

- The Air Force continued to execute planned developmental testing leading to IOT&E in FY15. Initial results from key developmental test integrated system evaluation events with AF DGS show improved maturity in MP-RTIP radar system stability and interoperability.
- The Program Office believes it has implemented fixes that will improve sensor stability and overall suitability prior to IOT&E. Field data from USCENTCOM early fielding appear to indicate that software fixes and procedural workarounds have improved suitability in comparison to FY13 Operational Utility Evaluation performance. All sensor modes and the enduring Tasking, Collection, Processing, Exploitation and Dissemination system will be rigorously tested and fully characterized during the IOT&E in FY15.
- Completion of Block 40 developmental test events was delayed due to slower than expected maturation of AF DGS software necessary to receive and exploit MP-RTIP radar data. IOT&E execution was delayed from 1QFY15 to 3QFY15 due to a combination of AF DGS software delays and expected adverse weather conditions at Grand Forks AFB, North Dakota.

Recommendations

- Status of Previous Recommendations. The Air Force has not yet completed an RQ-4B Block 30 or RQ-4B Block 40 TEMP to guide developmental and operational testing of these systems, nor has it proceeded with an ASIP sensor FOT&E event to verify correction of performance deficiencies identified during IOT&E. The Air Force has implemented some corrective actions for persistent RQ-4B Block 40/MP-RTIP sensor stability and radar image quality problems and is currently evaluating system performance in advance of IOT&E in FY15.
- FY14 Recommendations. The Air Force should:
  1. Develop an RQ-4B program TEMP to guide completion of post-IOT&E corrective actions and to define operational test requirements for future Block 30 and Block 40 system upgrades.
  2. Complete RQ-4B Block 40 developmental testing to verify MP-RTIP performance and stability prior to IOT&E in FY15.
  3. Develop a plan to complete the FOT&E for Global Hawk Block 30 signals intelligence mission to fully characterize system capability.

Small Diameter Bomb (SDB) II

Executive Summary

- The Small Diameter Bomb II (SDB II) program has completed eight Guided Test Vehicle (GTV) shots and one live fire test shot as part of developmental testing in preparation for System Verification Review and Milestone C decision, which is expected in FY15. An updated Test and Evaluation Master Plan is being finalized in support of a Milestone C decision.
- The Integrated Test Team completed work to examine test resource and planning requirements for developmental, live fire, and operational testing, resulting in an adequate test program as SDB II proceeds through Engineering and Manufacturing Development (EMD).

System

- The SDB II is a 250-pound, air-launched, precision-glide weapon that uses deployable wings to achieve stand-off range. F-15E aircraft employ SDBs from the BRU-61/A four-weapon carriage assembly.
- SDB II combines Millimeter-Wave radar, infrared, and laser-guidance sensors in a terminal seeker, in addition to a GPS and Inertial Navigation System to achieve precise guidance accuracy in all weather. The SDB II incorporates a multi-function (blast, fragmentation, and shaped charged jet) warhead, designed to defeat armored and non-armored targets. The weapon can be set to initiate on impact, at a preset height above the intended target, or in a delayed mode.
- SDB II provides increased weapons load per aircraft compared to legacy air-to-ground munitions employment against offensive counter-air, strategic attack, interdiction, and close-air support targets in adverse weather.

- SDB provides reduced collateral damage while achieving kills across a broad range of target sets by precise accuracy, small warhead design, and focused warhead effects.

Mission

- Combatant Commanders will use SDB II to attack stationary and moving targets in degraded weather conditions at standoff ranges. There are three principal attack modes: Normal Attack (NA), Semi-Active Laser (SAL) Attack, and Coordinate Attack (CA). SDB II can also be used against moving or stationary targets using its NA (radar/infrared sensors) or SAL modes, and fixed targets with its CA mode.
- An SDB II-equipped unit or Joint Terminal Attack Controller will use a weapon datalink network to provide in-flight target updates, in-flight retargeting, weapon in-flight tracking, and weapon abort.

Major Contractor

Raytheon Missile Systems – Tucson, Arizona

Activity

- Over the past two years, SDB II has flown 11 GTV and 2 live fire missions as part of developmental testing.
- The Program Office completed 11 rounds of seeker Captive Flight Test, resulting in over 1,000 target runs in a wide variety of terrain and environmental conditions providing terabytes of seeker performance data and over 400 hours of seeker operation without a single failure.
- Nearly 2,000 hours of reliability testing have been completed, and work on the Integrated Flight System has been done with verification and validation on track for completion prior to Milestone C.
- The Integrated Test Team fully examined test resource and planning requirements for developmental, live fire, and operational testing, resulting in an adequate test program as SDB II proceeds through EMD.
- The program is finalizing the Test and Evaluation Master Plan in support of Milestone C.

Assessment

- SDB II continues to progress through EMD with an adequately resourced test program and no major programmatic testing problems outstanding.
- Eight of the 11 GTV missions and 1 of 2 live fire missions were successful, leaving only 1 live fire mission remaining to meet the testing requirements to pass Milestone C. The failures were thoroughly investigated and corrective actions implemented before proceeding with additional tests. All corrective actions have been successful to date in preventing repeats of the observed failure modes.

- As SDB II has a small payload, degradation in weapon accuracy or warhead lethality can lead to a drop in weapon effectiveness. Seeker performance and the ability to properly assess that performance, as well as warhead lethality, are critical to program success. Flying test bed seeker results have been the predominant source of data on seeker performance during the first years of EMD. Modeling and simulation will provide tools to interpret that data and evaluate weapon performance throughout program development. Both are critical aspects of the EMD program.

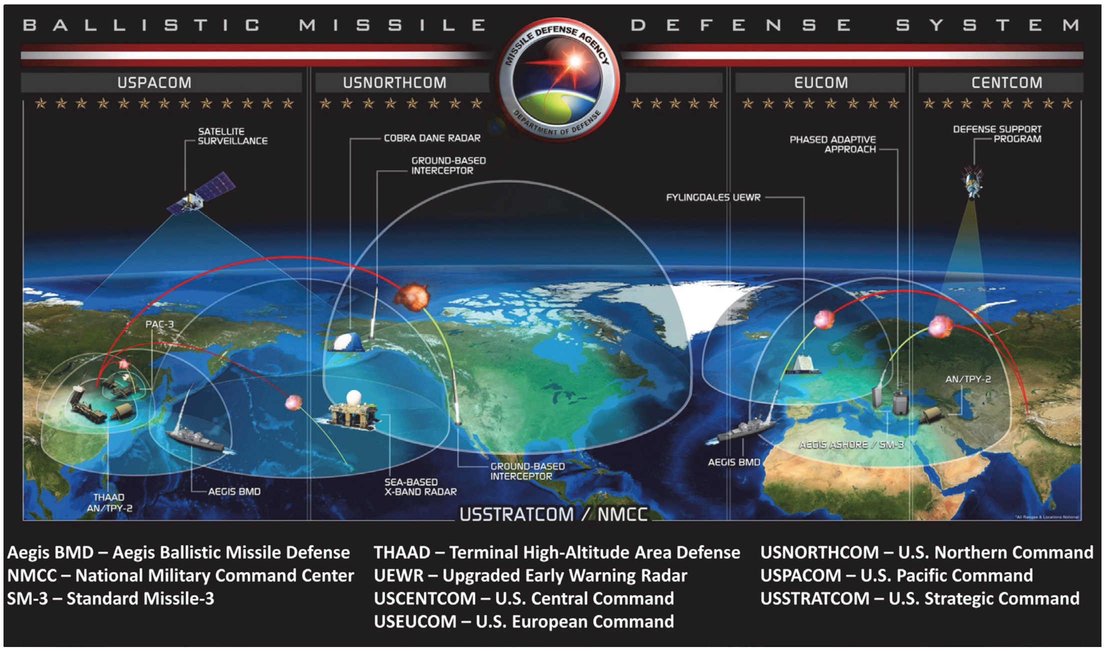
Recommendations

- Status of Previous Recommendations. The Air Force completed all previous recommendations.
- FY14 Recommendation.
  1. The SDB II Program Office should pay particular attention to the lethality of the modified warhead and impact on weapon accuracy of end-to-end flight testing in more challenging environments and conditions when moving to the Government Confidence Test phase of the program.

Ballistic Missile Defense Systems

Ballistic Missile Defense Systems

Ballistic Missile Defense System (BMDS)



Executive Summary

- The demonstrated Ballistic Missile Defense System (BMDS) theater/regional capability increased over this fiscal year.
  - The BMDS Operational Test Agency and the Missile Defense Agency (MDA) conducted the first system-level operational test based on theater/regional defense designs applicable to multiple Combatant Commands (CCMDs).
  - The new capabilities of Aegis Ballistic Missile Defense (BMD) version 4.0 with the Standard Missile-3 Block IB interceptor were demonstrated.
  - The Fast Exchange ground test showed additional system interoperability between two CCMDs.
- The BMDS homeland defense capability also increased over this fiscal year. The MDA conducted Flight Test Ground-based Interceptor-06b (FTG-06b) in June 2014. This first successful intercept by the Capability Enhancement II exoatmospheric kill vehicle allowed production manufacturing to resume.
- In September 2013, the BMDS Operational Test Agency and the MDA conducted Flight Test Operational-01 (FTO-01). The FTO-01 test mission demonstrated a layered upper-tier regional/theater BMDS defense against a raid of two simultaneously-launched and threat-representative medium-range ballistic missiles threatening a shared defended area.
  - No additional system-level flight testing occurred during FY14. The BMDS system-level flight test activity in FY14 focused on analyzing the test results from FTO-01 and planning for the FTO-02 test events in FY15.
- The MDA executed numerous ground tests and also conducted several wargames and exercises.
- The MDA enhanced the Integrated Master Test Plan (IMTP) by including direct linkage between the BMDS test program and future capability enhancements.
- FY14 capability to produce BMDS-level simulation-based performance assessments was significantly limited. The MDA should increase the development priority and associated funding for the BMDS high-fidelity, end-to-end, digital modeling and statistically significant simulation capability.

System

- The BMDS is a distributed system currently comprised of five elements (four shooter elements and one command and control element) and six sensor systems (five radar systems and one space-based system).

Elements

- Aegis BMD, including Aegis Ashore (shooter)
- Ground-based Midcourse Defense (GMD) (shooter)
- Patriot (shooter)
- Terminal High-Altitude Area Defense (THAAD) (shooter)
- Command and Control, Battle Management, and Communications (C2BMC) (command and control)

Sensors

- AN/SPY-1 Radar (Aegis BMD)
- AN/TPY-2 Forward-Based Mode (FBM) Radar
- COBRA DANE Radar Upgrade
- Upgraded Early Warning Radars (UEWRs)

- Sea-Based X-band (SBX) Radar
- Space-Based Infrared System/Defense Support Program (SBIRS/DSP)

Mission

- The U.S. Strategic Command (USSTRATCOM) synchronizes operational-level global missile defense planning and operations support for the DOD.
- U.S. Northern Command (USNORTHCOM), U.S. Pacific Command (USPACOM), U.S. European Command (USEUCOM), and U.S. Central Command (USCENTCOM) employ the assets of the BMDS to defend U.S. territory, deployed forces, and allies against ballistic missile threats of all ranges.
- USSTRATCOM, USNORTHCOM, USEUCOM, USCENTCOM, and USPACOM use the C2BMC element of the BMDS to maintain situational awareness. USEUCOM, USCENTCOM, and USPACOM also use the C2BMC to provide sensor management of theater AN/TPY-2 (FBM) radars.
- Combatant Commanders employ Patriot to provide theater defense for deployed forces against short- and medium-range threats.

Major Contractors

- The Boeing Company
  - BMDS and GMD Integration – Huntsville, Alabama
- Lockheed Martin Corporation
  - Aegis BMD, Aegis Ashore, and AN/SPY-1 Radar – Moorestown, New Jersey
  - C2BMC – Gaithersburg, Maryland
  - SBIRS – Sunnyvale, California
  - THAAD Weapon System and Patriot Interceptors – Dallas, Texas
  - THAAD Interceptors – Troy, Alabama
- Northrop Grumman Corporation
  - DSP – Redondo Beach, California
  - GMD Fire Control and Communications – Huntsville, Alabama
- Orbital Sciences Corporation
  - GMD Booster Vehicles – Chandler, Arizona
- Raytheon Company
  - GMD Exoatmospheric Kill Vehicle and Standard Missile-3 Interceptors – Tucson, Arizona
  - Patriot, AN/TPY-2 Radar, Cobra Dane Radar, SBX Radar, and UEWRs/EWRs – Tewksbury, Massachusetts

---

Activity

- The BMDS Operational Test Agency and the MDA conducted the first operational system-level flight test (FTO-01) in September 2013.
  - The FTO-01 test mission demonstrated a layered upper-tier regional/theater BMDS defense against a raid of two simultaneously-launched and threat-representative medium-range ballistic missiles threatening a shared defended area.
  - No additional system-level flight testing occurred during FY14, which was in accordance with the DOT&E-approved IMTP.
  - The next system-level operational flight test, FTO-02, is scheduled for FY15.
  - The BMDS system-level flight test activity in FY14 focused on analyzing the test results from FTO-01 and planning for the FTO-02 test events.
- The MDA conducted FTG-06b in June 2014. FTG-06b was a system-level flight test of the BMDS Homeland Defense capability.
- During FY14, the MDA executed four major ground tests, including examining cross-CCMD sharing of sensor data in its Fast Exchange test. The MDA also conducted several wargames and exercises.

Assessment

- The FTO-01 test mission demonstrated a layered theater/regional upper-tier ballistic missile defense using a BMDS instantiation consisting of the Aegis BMD, THAAD, C2BMC, AN/TPY-2 (FBM), and SBIRS/DSP elements. The classified DOT&E February 2014 BMDS Annual Report, Appendix E, assesses the results from this mission and includes six key findings covering system-level performance, effectiveness, and suitability.
  - Although a layered defense was demonstrated in FTO-01, true system integration was not demonstrated due to system network configuration errors, interoperability limitations, and component failures.
- The BMDS theater/regional capability increased over this fiscal year.
  - FTO-01 demonstrated an operationally representative scenario based on five theater/regional defense designs applicable to USPACOM, USEUCOM, and USCENTCOM.
  - Aegis BMD version 4.0, together with the SM-3 Block IB interceptor, brings new capabilities to theater/regional engagements that successfully completed operational testing. Details of this testing and the Aegis BMD/SM-3 Block IB assessment are reported in the individual article on Aegis BMD later in this section.
  - The Fast Exchange ground test showed additional system interoperability between USEUCOM and USCENTCOM areas of responsibility. System-level ground testing is reported in the individual article on C2BMC later in this section.
- The BMDS homeland defense capability increased over this fiscal year. The first successful intercept by the

Capability Enhancement II exoatmospheric kill vehicle allowed production manufacturing to resume. The FTG-06b assessment is reported in the individual article on GMD later in this section.

- The MDA, in collaboration with DOT&E, updated the FY13 version of the IMTP to incorporate BMDS element maturity, program modifications, and fiscal constraints. They also enhanced the IMTP by including direct linkage between the BMDS test program and future capability enhancements as defined by the BMDS Phased Implementation Plan.
- FY14 capability to produce BMDS-level performance assessments was significantly limited. The MDA is developing a new high-fidelity, end-to-end, digital performance assessment modeling and simulation capability for the BMDS. This effort began in FY12 and is currently in the requirements definition phase. Requirements definition is funded through FY15. In addition, three Small Business Innovative Research contracts were awarded in FY14 to explore a simulation capability to produce statistically significant run sets. The MDA will assess future funding needs for the implementation of the final design requirements as these initiatives proceed through the remainder of the development program.

Recommendations

- Status of Previous Recommendations. The MDA has addressed previous system-level recommendations.
- FY14 Recommendations. The MDA should:
  1. Address recommendations made in the DOT&E FTO-01 assessment found in the classified DOT&E February 2014 BMDS Annual Report, Appendix E.
  2. Increase the development priority and associated funding for the BMDS simulation-based performance assessment capability, as the ability to produce high-fidelity and statistically significant BMDS-level performance assessments is critical.

Aegis Ballistic Missile Defense (Aegis BMD)

Executive Summary

- The Aegis Ballistic Missile Defense (BMD) program conducted one intercept mission in FY14 and one in early FY15. Two ballistic missile targets were intercepted, and two anti-air warfare targets were engaged.
- In FY14, Aegis BMD completed the IOT&E flight test program for the Aegis BMD 4.0 system and Standard Missile-3 (SM-3) Block IB guided missile, in accordance with the DOT&E-approved Integrated Master Test Plan.
- The final IOT&E flight test was a successful intercept of a medium-range ballistic missile, and was the fifth successful intercept of the Aegis BMD 4.0/SM-3 Block IB system.
- In the first live fire event using Aegis Baseline 9.B0 (i.e., Aegis BMD 5.0), Aegis Ashore (a future land-based component of the European Phased-Adaptive Approach (EPAA)) demonstrated a capability to fire, control, establish uplink/downlink communication, provide guidance commands, and provide target information to an SM-3 Block IB guided missile.
- The Aegis BMD program continued testing of the Aegis BMD 5.0 system (Capability Upgrade version, Baseline 9.C1) by conducting two tests in early FY15: a simulated engagement of a medium-range ballistic missile and a live intercept of a short-range ballistic missile while simultaneously engaging a raid of two subsonic cruise missiles.
- Aegis BMD continued to improve interoperability with other Ballistic Missile Defense System (BMDS) elements and sensors during flight and ground testing in FY14.
- Hardware-in-the-loop (HWIL) ground testing demonstrated Aegis BMD capability to contribute to theater, regional (including EPAA), and strategic-level defense missions spanning a range of ballistic missile defense scenarios.

System

- Aegis BMD is a sea-based missile defense system that employs the multi-mission shipboard Aegis Weapon System, with improved radar and new missile capabilities to engage ballistic missile threats. Capabilities of Aegis BMD include:
  - Computer program modifications to the AN/SPY-1 radar for long-range surveillance and track (LRS&T) of ballistic missiles of all ranges.
  - A modified Aegis Vertical Launching System, which stores and fires SM-3 Block IA and Block IB guided missiles (on select ships), and modified SM-2 Block IV guided missiles (on select ships).
  - SM-3 Block IA and Block IB guided missiles, which use a maneuverable kinetic warhead to accomplish midcourse engagements of short-, medium-, and intermediate-range ballistic missiles.
  - Modified SM-2 Block IV guided missiles, which provide terminal engagement capability against short-range ballistic missiles.

- Aegis Ashore is a land-based version of Aegis BMD, with an AN/SPY-1 radar and Vertical Launching System to enable engagements against medium- and intermediate-range ballistic missiles with SM-3 guided missiles. Once it is deployed to Romania in 2015, Aegis Ashore will become the central, land-based component of the second phase of the EPAA for the defense of Europe.
- Aegis BMD and Aegis Ashore are capable of performing autonomous missile defense operations and operations that exploit networked sensor information; they can send/receive cues to/from other BMDS sensors through tactical datalinks.

Mission

The Navy can accomplish three missile defense-related missions using Aegis BMD:

- Defend deployed forces and allies from short- to intermediate-range theater ballistic missile threats
- Provide forward-deployed radar capabilities to enhance defense against ballistic missile threats of all ranges by sending cues or target track data to other elements of the BMDS
- Provide all short- to long-range ballistic missile threat data to the Command and Control, Battle Management, and Communications (C2BMC) system for dissemination to Combatant Commanders' headquarters to ensure situational awareness

Major Contractors

- Aegis BMD Weapon System: Lockheed Martin Corporation, Mission Systems and Training – Moorestown, New Jersey
- AN/SPY-1 Radar: Lockheed Martin Corporation, Mission Systems and Training – Moorestown, New Jersey
- SM-3 Missile: Raytheon Company, Missile Systems – Tucson, Arizona

Activity

- The MDA completed the IOT&E flight-testing phase for Aegis BMD 4.0 and SM-3 Block IB guided missiles with the conclusion of Flight Test Standard Missile-21 (FTM-21) (FY13), FTM-22, and Flight Test Other-18 (FTX-18). All flight testing was accomplished in accordance with the DOT&E-approved Integrated Master Test Plan.
- The Aegis BMD program executed modeling and simulation runs-for-the-record in FY14 to supplement flight test data and aid in the assessment of Aegis BMD 4.0 system effectiveness. DOT&E published a classified IOT&E report on Aegis BMD 4.0 and SM-3 Block IB operational effectiveness and operational suitability in December 2014 to support the Full-Rate Production decision for SM-3 Block IB missiles. The Full-Rate Production decision is planned for FY15.
- Although the program completed FOT&E for the Aegis BMD 3.6.1 system in FY11, the program continued to use variants of the Aegis BMD 3.6 system (i.e., 3.6.1 and 3.6.3) in BMDS-level tests in FY14 to assess system-level engagement capability and interoperability.
- The Aegis BMD program conducted one intercept mission in FY14 and one in early FY15. Two ballistic missile targets were intercepted, and two anti-air warfare targets were engaged.
  - During FTM-22 in October 2013, an Aegis BMD 4.0.2 cruiser intercepted a medium-range, separating target with an SM-3 Block IB guided missile. The FTM-22 engagement was the fifth successful intercept mission conducted with the Aegis BMD 4.0 system with an SM-3 Block IB guided missile, and the second of two IOT&E flight test missions (the other being FTM-21 in September 2013). The FTM-22 engagement was also the first intercept of a medium-range target with the Aegis BMD 4.0 system and an SM-3 Block IB guided missile.
  - FTM-25 in November 2014 was an integrated air and missile defense mission wherein an Aegis Baseline 9.C1 (i.e., Aegis BMD 5.0 with Capability Upgrade) destroyer in integrated air and missile defense priority mode detected, tracked, and performed an SM-3 Block IB intercept of a short-range ballistic missile, while simultaneously conducting an anti-air warfare raid engagement against two subsonic cruise missile surrogates.
- Aegis BMD ships and Aegis Ashore participated in simulated engagements using live targets, a controlled vehicle test with a live interceptor, and a multi-element test event with the AN/SPY-1 radar acting as a forward-based sensor in FY14.
  - During FTX-18 in January 2014, an Aegis BMD 4.0.2 destroyer detected, tracked, and conducted simulated SM-3 Block IB engagements against three, short-range ballistic missile targets in a raid scenario. FTX-18 was the last of three Aegis BMD 4.0 IOT&E test missions. An Aegis BMD 3.6.1 ship and Aegis Ashore (Aegis Baseline 9 Lab at Surface Combat Systems Center, Wallops Island, Virginia) also participated in FTX-18 for data collection purposes and to exercise simulated engagements using remote data sent from the Aegis BMD 4.0.2 ship.
  - In May 2014, Aegis Ashore Control Test Vehicle-01 (AACTV-01) demonstrated the capability of the Aegis Ashore test site at the Pacific Missile Range Facility to fire, control, establish uplink/downlink communication, provide guidance commands, and provide target information to an SM-3 Block IB guided missile. AACTV-01 was the first live fire event using Aegis Baseline 9.B0 (i.e., Aegis BMD 5.0) and the first SM-3 guided missile firing from Aegis Ashore.
  - In June 2014, an Aegis BMD 3.6.1 destroyer participated in Flight Test Ground-Based Interceptor-06b (FTG-06b) to provide LRS&T support to the Ground-Based Midcourse Defense (GMD) system. The ship acquired the intermediate-range ballistic missile target and transmitted track information over Link 16 to support the generation of GMD's weapon task plan and a cue to the Sea-Based X-band radar.
  - In Flight Test Other-20 (FTX-20) in October 2014, a destroyer with Aegis Baseline 9.C1 software conducted a simulated SM-3 Block IB engagement of a separating medium-range ballistic missile.
- In FY14, Aegis BMD ships and HWIL facilities also participated in several flight and ground tests to assess Aegis BMD 4.0.2 and 3.6.1/3.6.3 system functionality and interoperability with the BMDS.
  - Ground Test Integrated-04e (GTI-04e) Part 1a runs-for-the-record in October 2013 explored theater/regional defense capabilities (beyond those tested in GTI-04e Part 1 in FY13) using updated software builds for AN/TPY-2 (Forward Based Mode (FBM)), C2BMC, and Terminal High-Altitude Area Defense (THAAD), in addition to Aegis BMD 4.0.2 and 3.6.3.
  - Aegis BMD participated in Fast Phoenix in December 2013, which the Missile Defense Agency (MDA) executed in the U.S. Pacific Command area of responsibility, while simulating U.S. European Command and U.S. Central Command interoperability architectures. The test's purpose was to assess a new communications architecture between Aegis BMD ships using the Link Monitoring Management Tool and C2BMC S6.4 Maintenance Release 2. Fast Phoenix used both operational and HWIL assets and operational communications.
  - GTI-04e Part 2 in April and May 2014 tested the engagement capabilities of fielded and to-be-fielded missile defense elements and sensors against ballistic missiles of all ranges in a HWIL environment. Participants included Aegis BMD 4.0.2 and 3.6.3 (laboratory sites), C2BMC, Patriot, THAAD, Space-Based Infrared System, AN/TPY-2 (FBM), and GMD.
  - Fast Fire, which the MDA conducted as part of GTI-04e Part 2 in May 2014, tested the capability of Aegis BMD 4.0.2 to support its designed-to maximum number of simultaneous ballistic missile and anti-air warfare engagements and control all standard missiles in those

engagements. An AN/TPY-2 (FBM) radar provided forward-based radar data to support the engagements.
  - Aegis BMD participated in Fast Exchange in both HWIL (June 2014) and distributed (August 2014) representations to assess cross-Area of Responsibility engagements. Additional participants included AN/TPY-2 (FBM), THAAD, Patriot, C2BMC, and Space-Based Infrared System.
- Early developmental testing of the SM-3 Block IIA guided missile began in FY14.
  - In October 2013, the SM-3 Cooperative Development Propulsion Test Vehicle-01 (SCDPTV-01) flight test fired an SM-3 Block IIA guided missile. The missile included a live Mk 72 Mod 2 booster with an inert 21-inch-diameter mass equivalent upper-stage assembly in the Mk 29 Mod 0 lightweight canister, specifically developed for the SM-3 Block IIA guided missile. All assets under test performed as designed. SCDPTV-01 was a follow-on test from a restrained firing conducted in FY13, and the second of a series of six test events to validate missile and canister designs of the next variant of the SM-3.

Assessment

- Flight testing and supporting modeling and simulation demonstrated that Aegis BMD 4.0 has the capability to engage and intercept non-separating, simple-separating, and complex-separating ballistic missiles in the midcourse phase with SM-3 Block IB guided missiles. However, flight testing and modeling and simulation did not test the full range of expected threat types, threat ground ranges, and threat raid sizes. Details can be found in the classified December 2014 Aegis BMD IOT&E Report.
- Reliability and maintainability data from FY14, in combination with data collected during a maintenance demonstration and previous flight testing, suggest that overall Aegis BMD 4.0 Weapon System availability is adequate for the midcourse defense mission against short- and medium-range ballistic missiles. Testing showed that improvements in Aegis BMD hardware reliability are needed, although the impact on operational availability was not significant due to the low repair times.
- The limited number of SM-3 Block IB firings (nine) and the two, third-stage rocket motor (TSRM) failures (FTM-16 Event 2 in FY11 and the second missile failure in FTM-21 in FY13) lower certainty in overall SM-3 Block IB missile reliability. The program addressed and tested a correction for the first of the SM-3 TSRM problems when it modified the TSRM's inter-pulse delay time. The Aegis BMD program has exercised the new inter-pulse delay without incident in three flight tests and a number of ground-based static firings. The correction, however, did not prevent the TSRM failure in the second of two salvo-launched SM-3 Block IB guided missiles in FTM-21, which also suffered a reliability failure of the TSRM aft nozzle area during second pulse operations of the two-pulse motor (the first missile had already achieved a successful intercept). The MDA established a Failure Review Board (FRB) to determine the root cause of this failure and the Board has uncovered enough evidence to determine that a re-design is needed for the TSRM nozzle. The program has a preliminary design for the new nozzle, and began the ground testing of new design concepts in FY14. The new design will be retrofittable into current SM-3 Block IA and Block IB missiles.
- Flight testing and modeling and simulation have demonstrated the Aegis BMD 4.0 capability to perform the LRS&T mission, albeit with only a single threat. Additionally, the FTG-07 mission in FY13 highlighted the need to further explore and refine tactics, techniques, and procedures (TTPs) for the transmission and receipt of Aegis BMD track data for GMD use.
- Testing of the Aegis BMD 4.0 system did not evaluate automated engagement coordination in flight testing; due to lack of ship availability. However, the MDA tested it during Ground Test Focused-04e and it will be operationally tested during FOT&E.
- The program demonstrated that Aegis Ashore can fire, detect, and control an SM-3 Block IB guided missile during AACTV-01. This is an important first step toward proving that Aegis Ashore can perform missile defense operations similar to those on an Aegis BMD ship for the defense of Europe as part of EPAA Phase 2. An engagement of a ballistic missile target by Aegis Ashore will take place in Event 1 of Flight Test Operational-02 (FTO-02) in FY15.
- During FTX-20, an Aegis Baseline 9.C1 destroyer (Aegis BMD 5.0 with Capability Upgrade) successfully detected, tracked, and conducted a simulated engagement of a separating medium-range ballistic missile target.
- During FTM-25, an Aegis Baseline 9.C1-configured destroyer, operating in integrated air and missile defense priority mode, intercepted a short-range ballistic missile target using an SM-3 Block IB guided missile while simultaneously engaging two subsonic cruise missile targets using two SM-2 Block IIIA missiles.
- The MDA continues to utilize Aegis BMD ships and HWIL representations of the Aegis BMD 4.0 and 3.6 variants, which has helped to refine TTPs and overall interoperability of the system with the BMDS. However, the test events routinely demonstrated that inter element coordination and interoperability are still in need of improvement.

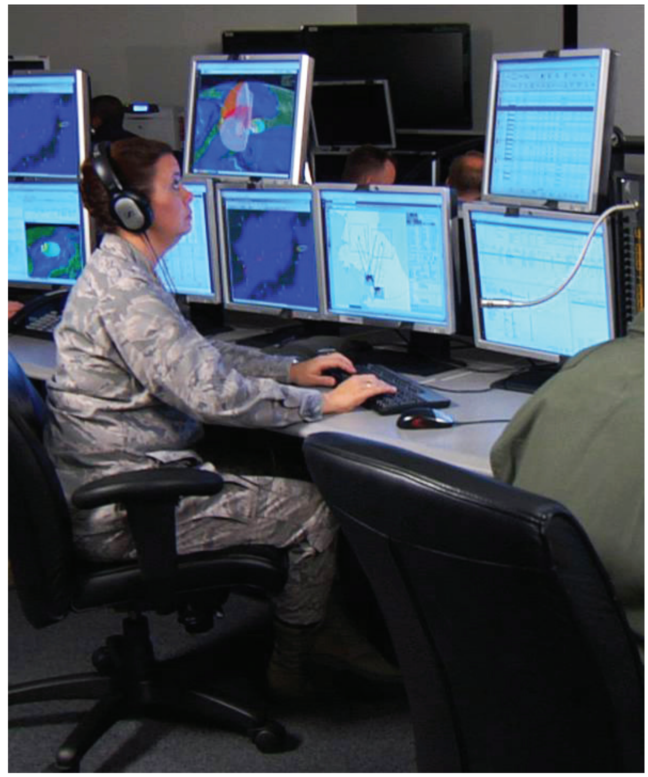
Recommendations

- Status of Previous Recommendations.
  - The program has not addressed the first two recommendations (out of five) from FY13 to conduct:
    - Flight testing of the Aegis BMD 4.0 remote authorized engagement capability against a medium-range ballistic missile or intermediate-range ballistic missile target using an SM-3 Block IB guided missile. FTO-02 Event 2, scheduled for 4QFY15, is planned to demonstrate this capability

  - Operationally realistic testing that exercises Aegis BMD 4.0's improved engagement coordination with THAAD and Patriot
- The program addressed the third recommendation from FY13 to continue to assess an Aegis BMD 4.0 intercept mission during which the ship simultaneously engages an anti-air warfare target to verify BMD/anti-air warfare capability, when it conducted the FTM-25 mission using Aegis Baseline 9.C1.
- The program partially addressed the fourth recommendation from FY13 to use the FRB process to identify the failure mechanism responsible for the FTM-21 second missile failure and determine the underlying root cause that may be common to both the FTM-16 Event 2 and FTM-21 second missile failures. The MDA established an FRB following FTM-21 and, although it is still ongoing, preliminary findings from the FRB have pointed to a similar root cause, prompting the program to begin a re-design of the TSRM nozzle.
- The program partially addressed the fifth recommendation from FY13 to deliver sufficient Aegis BMD 4.0 validation data and evidence to support BMDS modeling and simulation verification, validation, and accreditation (VV&A) of the Aegis HWIL and digital models. They did so when the Commander, Operational Test and Evaluation Force provided VV&A evidence for the digital models used for element-level performance analyses in support of the operational assessment of the Aegis BMD 4.0 system with SM-3 Block IB guided missiles. Aegis BMD provided V&V data from element post-flight reconstruction events for FTM-16 Event 2, FTM-18, and FTM-21, based on BMDS Operational Test Agency performance parameters and acceptability criteria as evidence supporting accreditation of Aegis BMD HWIL models participating in BMDS level ground testing. The BMDS Operational Test Agency is reviewing the data for an accreditation recommendation.

- FY14 Recommendations. The program should:
  1. Conduct flight tests or high-fidelity modeling and simulation analyses to demonstrate the Aegis BMD 4.0 system's capability to perform LRS&T of a raid of long-range threats.
  2. Determine the appropriate LRS&T TTPs for the transmission and receipt of Aegis BMD 4.0 track data for GMD use.
  3. Ensure that sufficient flight testing of the Aegis Baseline 9.C1 system is conducted to allow for VV&A of the modeling and simulation suite to cover the full design to Aegis BMD battlespace of threat ballistic missiles.
  4. Conduct sufficient ground and flight testing of the re-designed SM-3 Block IB TSRM nozzle after completion and installation of the new design concept to prove the new design works under the most stressing operational flight conditions.

Command and Control, Battle Management, and Communications (C2BMC) System



Executive Summary

- The Missile Defense Agency (MDA) continued to demonstrate an increased maturity of Command and Control, Battle Management, and Communications (C2BMC) Spiral 6.4 (S6.4) software during FY14.
  - Ground and flight testing demonstrated automated management of multiple AN/TPY-2 Forward-Based Mode (FBM) sensors. Ground testing further demonstrated tasking of the AN/TPY-2 radar in the presence of post-intercept debris.
  - C2BMC demonstrated the capability for Combatant Command (CCMD) sensor managers to direct AN/TPY-2 (FBM) radars to execute focused search plans or respond to precision cues.
  - C2BMC demonstrated timely and accurate forwarding of radar track data during numerous ground and flight tests.
- Ground and flight testing have identified numerous C2BMC S6.4 deficiencies in situational awareness and system-level interoperability. Furthermore, C2BMC S6.4 does not have an engagement management capability. The MDA is relying on C2BMC Spiral 8.2 (S8.2) (FY17-18) to address these deficiencies.
- During FY14, the MDA and Red Teams from the Threat Systems Management Office conducted three cyber assessments of future C2BMC software spirals using the newly created DOD Enterprise Cyber Range Environment (DECRE). In response, the MDA is examining solutions and procedures that can reduce the likelihood of occurrence or effect of cyber penetration.

System

- The C2BMC system is a CCMD interface to the Ballistic Missile Defense System (BMDS). More than 70 C2BMC workstations are fielded at U.S. Strategic, U.S. Northern, U.S. European, U.S. Pacific, and U.S. Central Commands (USSTRATCOM, USNORTHCOM, USEUCOM, USPACOM, and USCENTCOM); numerous Army Air and Missile Defense Commands; Air and Space Operations Centers; and other supporting warfighter organizations.
  - The current C2BMC provides CCMDs and other senior national leaders with situational awareness on BMDS status, system coverage, and ballistic missile tracks by displaying selective data from the Global Communications Network for strategic/national missile defense and from the Joint Tactical Information Distribution System Link 16 for theater/regional missile defense.
  - The C2BMC also provides upper echelon deliberate planning at the CCMD and component level. BMDS elements (Aegis Ballistic Missile Defense [BMD], Ground-based Midcourse Defense [GMD], Patriot, and Terminal High-Altitude Area Defense [THAAD]) use their own command and control battle management systems and mission planning tools for stand-alone engagements.
  - The C2BMC S6.4 suite provides command and control for the AN/TPY-2 FBM radar. The S6.4 Global Engagement Manager Suite provides updated sensor management, track processing, and reporting.
- Through the Global Communications Network, the C2BMC forwards AN/TPY-2 (FBM) and AN/SPY-1 tracks to GMD. Additionally, through the Joint Tactical Information Distribution System Link 16, it forwards AN/TPY-2 (FBM) tracks for THAAD and Patriot cueing and Aegis BMD engagement support.
- The C2BMC S8.2 is intended to improve and expand on S6.4 capabilities as the next step toward integrated sensor management and engagement coordination.

Mission

USSTRATCOM, USNORTHCOM, USEUCOM, USPACOM, and USCENTCOM use C2BMC to support ballistic missile defense engagements. More specifically, Combatant Commanders use C2BMC for:

- Deliberate and dynamic planning
- Situational awareness
- Track management
- AN/TPY-2 (FBM) sensor management and control
- Engagement monitoring
- Data exchange between C2BMC and BMDS elements
- Network management

Major Contractor

Lockheed Martin Corporation, Information Systems and Global Solutions – Gaithersburg, Maryland

---

Activity

- The MDA conducted C2BMC testing during FY14 in accordance with the DOT&E-approved Integrated Master Test Plan.
- C2BMC S6.4 Maintenance Release 2 (MR2) participated in the Flight Test Operational-01 (FTO-01) BMDS-level flight test in September 2013.
- The MDA executed Fast Phoenix in December 2013, a distributed ground test for USPACOM testing a new communications architecture between Aegis BMD ships using the Link Monitoring Management Tool and C2BMC S6.4 MR2. Fast Phoenix used both operational and hardware-in-the-loop (HWIL) assets and operational communications.
- C2BMC participated in Ground Test Integrated-04e (GTI-04e) Part 1a and GTI-04e Part 2, during which C2BMC S6.4 MR2 managed multiple AN/TPY-2 (FBM) radars.
  - Part 1a provided data for theater/regional interoperability assessments and focused on sensor debris mitigation (DM) functionality in defense of USEUCOM and USCENTCOM. The MDA conducted Phase I in April 2013 with DM disabled and Phase II in October 2013 with DM enabled.
  - Part 2 took place in March 2014 and focused on supporting the defense of USPACOM and USNORTHCOM. The test exercised several updates to C2BMC S6.4 MR2, including the tasking/managing of the Kyoga-Misaki AN/TPY-2 (FBM) radar, boost phase cueing by the AN/TPY-2 (FBM) radars, and updates to the focused search plans and threat enumerations. Part 2 also demonstrated interoperability with Aegis BMD in simulations for USCENTCOM.
- In June 2014, C2BMC S6.4 MR2 participated in Flight Test Ground-Based Interceptor-06b (FTG-06b). C2BMC provided situational awareness and forwarded track data from Aegis BMD and Link 16 data to the GMD Fire Control.
- C2BMC S6.4 MR2 participated in the Fast Exchange ground tests in both HWIL (June 2014) and fielded (August 2014) representations. C2BMC managed three AN/TPY-2 (FBM) radars in a cross-Area of Responsibility environment.
- During FY14, the MDA and Red Teams from the Threat Systems Management Office conducted three cyber assessments of future C2BMC software spirals using the newly created DECRE. The first assessment examined cyber effects that previous Red Teams were in a position to deliver on operational networks during an USEUCOM assessment. Each subsequent event added additional network elements and operational realism.

Assessment

- The classified DOT&E February 2014 BMDS Annual Report, Appendix E, assesses the results from the FTO-01 mission and includes six key findings covering C2BMC participation and system-level performance, effectiveness, and suitability.
- Fast Phoenix demonstrated accurate and timely data sharing over Link 16 between Aegis BMD and C2BMC using the Link Monitoring Management Tool and C2BMC Air Defense Systems Integrator.
- During the GTI-04e Parts 1a and 2, C2BMC S6.4 MR2 received AN/TPY-2 (FBM) and Link 16 data and forwarded system tracks to Link 16. C2BMC provided situational awareness and demonstrated interoperability with theater BMDS elements. It controlled two AN/TPY-2 (FBM) radars for tasking by USEUCOM, USPACOM, USNORTHCOM, and USCENTCOM. Further, C2BMC demonstrated boost phase cue capabilities when managing two AN/TPY-2 radars for USPACOM. Testing uncovered problems with missile-threat acquisition using focused search plans designed for the new USPACOM radar and new threat characteristics. The MDA is investigating improvements to AN/TPY-2 radar search-plan designs and C2BMC sensor-tasking algorithms to address these problems.
- The C2BMC S6.4 MR2 performed nominally during the FTG-06b mission. It provided situational awareness and forwarded radar track information as designed. However, it did not receive the expected Sea-Based X-band radar-generated engagement hit assessment from the GMD fire control component. The MDA is investigating why this event did not occur.
- Fast Exchange demonstrated passing of pertinent, geographically-filtered sensor track data between BMDS elements in USEUCOM and USCENTCOM. Two C2BMC suites sent and received AN/TPY-2 (FBM) data over Link 16 involving the Aegis BMD, THAAD, and Space-Based Infrared System elements.
- The Red Team demonstrated a number of potential cyber vulnerabilities during the DECRE events. More importantly, MDA engineers were given access to all Red Team activities during the event execution. They benefited greatly from first-hand observations and the opportunity to query the Red Team regarding steps to preclude invasive activities. In response, the MDA is examining solutions and procedures that can reduce the likelihood of occurrence or effect of cyber penetration. Further, the MDA is actively planning additional cyber assessments using the DECRE environment.

Recommendations

- Status of Previous Recommendations. The MDA addressed 9 of the previous 11 recommendations. The MDA continues to make progress on the outstanding FY06 recommendation to include cyber assessments during BMDS-centric C2BMC testing. A pathfinder exercise is planned during the Ground Test-06 campaign in FY15-16 with a more complete cyber assessment during the Ground Test-07 campaign in FY17-18. The MDA is relying on C2BMC S8.2 (FY17-18) to address the remaining FY13 recommendation on C2BMC interoperability and engagement management deficiencies uncovered during numerous tests, including most recently FTO-01.
- FY14 Recommendations. None.

Ground-Based Midcourse Defense (GMD)

Executive Summary

- Ground-based Midcourse Defense (GMD) has demonstrated a limited capability to defend the U.S. Homeland from small numbers of intermediate-range or intercontinental ballistic missile threats launched from North Korea or Iran.
- In a developmental test environment, the Missile Defense Agency (MDA) conducted the first successful intercept by the Capability Enhancement II (CE-II) exoatmospheric kill vehicle (EKV) since the failure of the CE-II vehicle during intercept flight tests in FY10 and FY11.
- The MDA Director commissioned an Independent Expert Panel, which completed a comprehensive assessment of the Ground-Based Interceptor (GBI) program to identify deficiencies that could preclude predictable, reliable GBI operations.

System

GMD is a Ballistic Missile Defense System (BMDS) element that counters intermediate-range and intercontinental ballistic missile threats to the U.S. Homeland. The GMD consists of and operates:

- GBIs at Fort Greely, Alaska, and Vandenberg AFB, California
- GMD ground system including GMD Fire Control (GFC) nodes at Schriever AFB, Colorado, and Fort Greely, Alaska; Command Launch Equipment at Vandenberg AFB, California, and Fort Greely, Alaska; and In-Flight Interceptor Communication System Data Terminals at Vandenberg AFB, California; Fort Greely, Alaska; and Eareckson Air Station, Alaska
- GMD secure data and voice communication system including long-haul communications using the Defense Satellite Communication System, commercial satellite communications, and fiber-optic cable (both terrestrial and submarine)
- COBRA DANE Upgraded Radar at Eareckson Air Station (Shemya Island), Alaska
- Upgraded Early Warning Radars at Beale AFB, California; Royal Air Force Fylingdales, United Kingdom; and Thule Air Base, Greenland
- External interfaces that connect to Aegis BMD; North American Aerospace Defense/U.S. Northern Command Command Center; and the Command and Control, Battle Management, and Communications system at Peterson AFB, Colorado; Space-Based Infrared System/Defense Support Program (SBIRS/DSP) at Buckley AFB, Colorado; AN/TPY-2 (Forward-Based Mode) radar at Shariki Air Base, Japan; and the Sea-Based X-band (SBX) radar, a sea-based mobile sensor platform

Mission

Military operators for the U.S. Army Space and Missile Defense Command/Army Forces Strategic Command (the Army service component to U.S. Strategic Command) will use the GMD system to defend the U.S. Homeland against intermediate-range and intercontinental ballistic missile attacks using the GBI to defeat threat missiles during the midcourse segment of flight.

Major Contractors

- The Boeing Company, Network and Space Systems – Huntsville, Alabama
- Orbital Sciences Corporation, Missile Defense Systems – Chandler, Arizona
- Raytheon Company, Missile Systems – Tucson, Arizona
- Northrop Grumman Corporation, Information Systems – Huntsville, Alabama

Activity

- The MDA conducted testing in accordance with the DOT&E-approved Integrated Master Test Plan.
- The MDA conducted Ground Test Integrated-04e (GTI-04e) Part 2 in April through May 2014. The MDA used hardware and software representations of the GMD; the SBIRS/DSP; the Command and Control, Battle Management, and Communications; the AN/TPY-2 (Forward-Based Mode) radar; the Aegis BMD radar in its long-range surveillance and track capability; the Upgraded Early Warning Radars; and the SBX radar to investigate GMD capabilities against intercontinental ballistic missile threats.
- The MDA executed an intercept flight test of a GBI equipped with a CE-II EKV against an intermediate-range ballistic missile target in June 2014. During this developmental test, Flight Test GBI-06b (FTG-06b), the MDA demonstrated fixes made to the CE-II EKV subsequent to the FTG-06a Failure Review Board findings. They also demonstrated GBI performance under more challenging threat engagement conditions than previous intercept flight tests.
  - The MDA launched an intermediate-range ballistic missile target from the U.S. Army's Reagan Test Site on Kwajalein Atoll, Republic of the Marshall Islands.
  - The Aegis BMD radar performed long-range surveillance and track. The SBX radar performed long-range detection, tracking, and target discrimination. The SBIRS/DSP also participated in this test.
  - The GFC planned the intercept and a GFC military operator directed launch of the test GBI from Vandenberg AFB, California.
- The MDA Director commissioned an Independent Expert Panel in August 2013 to characterize the deployed GBI fleet. Their goal was to identify design, manufacturing, and quality deficiencies that would negatively affect predictable and reliable GBI operations. The panel completed their assessment in March 2014.

Assessment

- GTI-04e Part 2 demonstrated upgraded GMD software builds with other BMDS elements and the SBIRS/DSP. The MDA identified limitations and is continuing to investigate.
- During FTG-06b, the MDA demonstrated a long interceptor time-of-flight, medium-closing velocity engagement of an intermediate-range ballistic missile by the CE-II GBI. The system performed all EKV functions to discriminate and intercept a lethal object from a representative intercontinental ballistic missile target scene with countermeasures. All key performance parameters were within prescribed constraints and pre-mission predictions. The intercept was confirmed by multiple data sources.

Recommendations

- Status of Previous Recommendations. The MDA has addressed previous recommendations with the exception of the FY13 recommendation to retest the CE-I EKV in order to accomplish the test objectives from the failed FTG-07 mission. The first opportunity to address this recommendation will be 4QFY17.
- FY14 Recommendation.
  1. The MDA should extend the principles and recommendations contained in the Independent Expert Panel assessment report on the GBI fleet to all components of the BMDS instantiation for Homeland Defense.

Sensors

Executive Summary

- The Missile Defense Agency (MDA) has gained significant operational experience with each of the Ballistic Missile Defense System (BMDS) sensors since the completion of sensor upgrade and development programs.
- During FY14, BMDS sensors participated in two major ground tests, three flight tests, and observed numerous targets of opportunity such as domestic or foreign launch events.
- Accreditation of each of the sensor models for use in performance assessments continues to progress, but is still incomplete.

System

The BMDS sensors are systems that provide real-time ballistic missile threat data to the BMDS. The data are used to counter ballistic missile attacks. These sensor systems are operated by the Army, Navy, Air Force, and the MDA, and include a satellite-based, infrared sensor system and five phased array radar system types. The sensor systems are:

- Space-Based Infrared System/Defense Support Program (SBIRS/DSP), a satellite constellation of infrared sensors operated by the Air Force with an external interface to the BMDS located at Buckley AFB, Colorado

SBIRS/DSP

- Fixed site, fixed orientation, phased array radars
  - COBRA DANE Radar Upgrade (CDU), an L-band radar (one radar face that provides 120-degree azimuth field of view) operated by the Air Force and located at Eareckson Air Station (Shemya Island), Alaska.

COBRA DANE

  - Upgraded Early Warning Radars (UEWRs), ultra-high frequency radars operated by the Air Force and located at Beale AFB, California (two radar faces that provide 240-degree azimuth field of view); Fylingdales, United Kingdom (three radar faces that provide 360-degree azimuth field of view); and Thule, Greenland (two radar faces that provide 240-degree azimuth field of view). The MDA and Air Force Space Command (AFSPC) awarded a contract in July 2012 for the upgrade of the Early Warning Radar (EWR) at Clear Air Force Station, Alaska. In December 2012, a contract option was exercised for the upgrade of the EWR at Cape Cod Air Force Station, Massachusetts.

UEWR

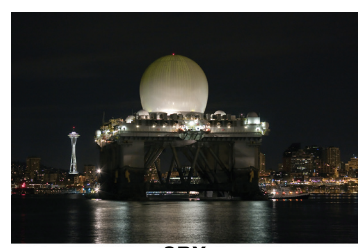
- Mobile/transportable phased array radars
  - AN/TPY-2 Forward-Based Mode (FBM) radars, X-band radars operated by the Army and located at sites in Japan, Israel, Turkey, and the U.S. Central Command area of responsibility.

AN/TPY-2

  - AN/SPY-1 radars in track and cue mode, S-band radars (four radar faces that provide 360-degree azimuth field of view) operated by the Navy and located aboard 33 Aegis Ballistic Missile Defense (BMD)-capable cruisers and destroyers.

Aegis BMD

  - SBX radar, an X-band radar operated by the MDA and located aboard a twin-hulled, semi-submersible, self-propelled, ocean-going platform.



SBX

Mission

Military operators for the U.S. Strategic Command, U.S. Northern Command, U.S. European Command, U.S. Pacific Command, and U.S. Central Command will use the BMDS sensors to:

- Detect, track, and classify ballistic missile threats that target the United States and U.S. allies
- Provide data for situational awareness and battle management to the Combatant Commands through the BMDS Command and Control, Battle Management, and Communications (C2BMC)
- Provide data that support engagement of ballistic missile threats by ballistic missile defense systems

Major Contractors

- AN/SPY-1 Radar (Aegis BMD): Lockheed Martin Corporation, Mission Systems and Training – Moorestown, New Jersey
- AN/TPY-2 (FBM) Radar, CDU Radar, SBX Radar, and UEWRs/EWRs: Raytheon Company, Integrated Defense Systems – Tewksbury, Massachusetts
- SBIRS: Lockheed Martin Space Systems – Sunnyvale, California
- DSP: Northrop Grumman Corporation, Aerospace Systems – Redondo Beach, California

---

Activity

The MDA conducted testing during FY14 in accordance with the DOT&E-approved Integrated Master Test Plan.

Aegis BMD Radar

- The MDA used hardware and software representations of the Aegis BMD radar in its hardware-in-the-loop (HWIL) test, Ground Test Integrated-04e (GTI-04e) Part 2, in April and May 2014. In this test, the Aegis BMD radar representation detected and tracked simulated intercontinental ballistic missile (ICBM) threats to the U.S. Homeland and forwarded the track data to an HWIL representation of the C2BMC.
- The Aegis BMD radar, in its long-range surveillance and track mode, participated in Flight Test Ground-Based Interceptor-06b (FTG-06b) in June 2014. The Aegis BMD radar detected and tracked the intermediate-range ballistic missile (IRBM) target and forwarded the track data to the C2BMC system.

AN/TPY-2 (FBM) Radar

- The MDA used HWIL representations of the AN/TPY-2 (FBM) radar in GTI-04e Part 2 in April and May 2014. The AN/TPY-2 (FBM) radar representations detected and tracked simulated ICBM threats to the U.S. Homeland and forwarded the track data to an HWIL representation of the C2BMC.
- The MDA used HWIL representations of the AN/TPY-2 (FBM) radar in its Fast Exchange HWIL ground test in June 2014. The MDA used three AN/TPY-2 (FBM) radars in its Fast Exchange distributed ground test in August 2014. In the Fast Exchange ground tests, the MDA investigated the level of mutual sensor support between multiple AN/TPY-2 (FBM) radars and the C2BMC system.

CDU Upgrade

- In FY14, the U.S. Air Force used the CDU radar to observe targets of opportunity. The AFSPC also used the CDU radar as a contributory sensor to the Space Surveillance Network to track orbital debris and active satellites.

SBIRS/DSP

- In FY14, the U.S. Air Force used the SBIRS/DSP system to observe domestic and foreign launch events and provide launch event data to the operational BMDS. The SBIRS/DSP system also participated in Flight Test Operational-01, Flight Test Standard Missile-22, and FTG-06b.
- A digital representation of the SBIRS/DSP system participated in GTI-04e Part 2 in April and May 2014.

SBX Radar

- In FY14, the SBX began in limited test support status but now serves as both a test and operational asset. The SBX radar can be deployed based on warning of an ICBM threat to the U.S. Homeland and for BMDS flight testing.
- A HWIL representation of the SBX radar participated in GTI-04e Part 2 in April and May 2014. In GTI-04e Part 2, the SBX radar representation detected, tracked, and discriminated simulated ICBM threats to the U.S. Homeland and forwarded the track data to an HWIL representation of the Ground Based Midcourse Defense (GMD) Fire Control (GFC).
- The SBX radar participated in FTG-06b in June 2014. The SBX radar accepted sensor task plans from the GFC, detected, tracked, and discriminated the IRBM target, and forwarded track data to the GFC.

UEWRs/EWRs

- In FY14, the MDA transferred the sustainment responsibility for the Beale, Fylingdales, and Thule UEWRs to AFSPC.
- In FY14, the U.S. Air Force used the Beale, Fylingdales, and Thule UEWRs, and the Clear and Cape Cod EWRs, to observe targets of opportunity. The AFSPC also used these radars as collateral sensors to the Space Surveillance Network to track orbital debris and active satellites.

Assessment

The MDA has gained significant operational experience with each of the BMDS sensors since the completion of the sensor upgrade and development programs. The MDA and the BMDS Operational Test Agency, however, have not fully accredited models and simulations of the BMDS sensors for performance assessment. Representations of the AN/TPY-2 (FBM) radar, the SBX radar, the UEWR, the Aegis BMD radar, and the SBIRS/DSP system have been accredited for limited uses. Representations of the CDU radar have not been accredited.

Aegis BMD Radar

- In GTI-04e Part 2, the MDA demonstrated a capability of the Aegis BMD radar to support GMD engagement of IRBM and ICBM threats. The Aegis BMD radar provided data that supported BMDS situational awareness, BMDS sensor tasking, and GMD engagement planning.
- During FTG-06b, Aegis BMD acquired target objects using its pre-defined autonomous search plan, generated tracks of the target objects, and reported two clusters of objects

to the C2BMC. Based on pre-mission analysis, the MDA anticipated only one cluster of objects being detected and is investigating why this second cluster was observed. Although not experienced in this test and under different circumstances, this second cluster of objects could have generated a second engagement, potentially resulting in Ground-based Interceptor wastage.

AN/TPY-2 (FBM) Radar

- In GTI-04e Part 2, the MDA demonstrated a capability of the AN/TPY-2 (FBM) radar to support GMD engagement of IRBM and ICBM threats. The AN/TPY-2 (FBM) radar representations provided data on the simulated missile threats to the C2BMC system that supported BMDS situational awareness, BMDS sensor tasking, and GMD engagement planning.
- In the Fast Exchange ground tests, the MDA proved the concept of multiple AN/TPY-2 (FBM) radars being mutually supportive across Combatant Command's areas of responsibility. The AN/TPY-2 (FBM) radars detected and tracked simulated missile threats to multiple locations, forwarded the track data to the C2BMC system, and received and responded to C2BMC system tasking.

CDU Upgrade

- Due to its location and field of view, the CDU radar has not participated in BMDS intercept flight tests. However, the CDU radar did observe numerous targets of opportunity.

SBIRS/DSP

- SBIRS/DSP performance and its capability to support BMDS engagement of IRBM and ICBM threats are classified. Detailed analysis can be found in DOT&E's February 2014 BMDS Annual Report.

SBX Radar

- In GTI-04e Part 2, the MDA demonstrated the capability of the SBX radar to support GMD engagement of IRBM and ICBM threats. After detecting, tracking, and discriminating the inbound missiles, the SBX radar transmitted engagement-quality data to the GFC for intercept prosecution.
- The SBX radar performed nominally during the FTG-06b mission. It detected and tracked the target missile, accurately discriminated all target objects, and transmitted and received target information with the other elements in a timely manner. It correctly determined the engagement hit assessment and reported such to the GMD fire control component.

UEWRs/EWRs

- Due to their locations and fields of view, the UEWRs at Thule and Fylingdales have not participated in BMDS intercept flight tests in an operationally realistic manner. Beale has participated in all flight tests within its field of view and has supplied critical data in analysis of these flight tests. Data from targets of opportunity and ground tests support performance estimates for the current configuration of the UEWRs.
- The MDA and the U.S. Air Force have not yet upgraded the EWRs at Clear and Cape Cod Air Force Stations, and these radars are not yet part of the MDA's sensor network.

Recommendations

- Status of Previous Recommendations. The MDA addressed all but two previous recommendations. The FY09 recommendation on developing sensor concepts of operations in conjunction with the Combatant Commands and demonstrating them in operational testing has yet to be completed. The FY12 recommendation to conduct AN/TPY-2 (FBM) cyber testing also remains open.
- FY14 Recommendations. None.

Terminal High-Altitude Area Defense (THAAD)

Executive Summary

- The Terminal High-Altitude Area Defense (THAAD) Project Office performed many obsolescence redesigns, hardware and software upgrades, and corrective actions during FY14. Additionally, the Missile Defense Agency (MDA) advanced the characterization of its associated AN/TPY-2 radar debris mitigation algorithms. The MDA should plan to rigorously test the THAAD Configuration 2 system in order to assess these changes.
- The THAAD Project Office has closed 18 of the 39 Conditional Materiel Release conditions imposed on the first two THAAD batteries. Fixes and testing of the remaining conditions are scheduled through FY17.
- THAAD system reliability and maintainability measures have improved, but still vary greatly from event to event. Additional testing, planned for FY15, is required to determine if overall system reliability is maturing.

System

- The THAAD ballistic missile defense system consists of five major components:
  - Missiles
  - Launchers
  - Radar (designated AN/TPY-2 Terminal Mode [TM])
  - THAAD Fire Control and Communications
  - THAAD Peculiar Support Equipment
- THAAD can accept target cues for acquisition from Aegis Ballistic Missile Defense, satellites, and other external theater sensors and command and control systems.
- THAAD is intended to complement the lower-tier Patriot system and the upper-tier Aegis Ballistic Missile Defense system.

Mission

U.S. Strategic Command intends to deploy THAAD to protect critical assets worldwide. Commanders will use THAAD to intercept incoming short- to intermediate-range ballistic missile threats in the endo- or exoatmosphere.

Major Contractors

- Prime: Lockheed Martin Corporation, Missiles and Fire Control – Dallas, Texas
- AN/TPY-2 Radar (TM): Raytheon Company, Integrated Defense Systems – Tewksbury, Massachusetts

Activity

- The Flight Test Operational-01 (FTO-01) Ballistic Missile Defense System (BMDS)-level flight test in September 2013 included two THAAD engagements.
- No additional THAAD flight testing occurred during FY14, which was in accordance with the DOT&E-approved Integrated Master Test Plan. However, the THAAD Project Office performed many obsolescence redesigns, software and hardware upgrades, and corrective actions throughout FY14, which could contribute to significant capability changes in FY15.
- During FY14, THAAD participated in numerous BMDS-level ground tests: Ground Test Integrated-04e Part 1a and Part 2, Fast Phoenix, and Fast Exchange.
- The THAAD program conducted qualification testing and demonstrations of THAAD training devices, and system integration and checkout of THAAD Configuration 2.
- The THAAD program conducted planning for three major test events scheduled for FY15: FTO-02 Event 2, Flight Test THAAD-18, and the Reliability Growth Test.

- The Army reviewed and assessed reliability and maintainability data from the FTO-01 flight test.

Assessment

- The classified DOT&E February 2014 BMDS Annual Report, Appendix E, assesses the results from the FTO-01 mission and includes six key findings covering THAAD participation and system-level performance, effectiveness, and suitability.
- During ground tests in FY14, THAAD exercised debris mitigation algorithms, advancing the characterization of this key component of THAAD Configuration 2 capability. However, flight testing will be required to complete the characterization.
- The THAAD program continued efforts to achieve a Full Materiel Release of the first two THAAD batteries, which achieved Conditional Materiel Release in February 2012. The THAAD Project Office continued to address the 39 conditions that need to be resolved before the Army could grant a Full Materiel Release. Fixes and testing of the 21 open conditions are scheduled through FY17. In addition to the 7 conditions closed in FY12 and FY13, 11 were closed in FY14:
  - Verification of technical manuals
  - Hazard classification for missile transport
  - A safety review of the technical manuals
  - Verifying missile non-operating performance requirements in cold environments
  - Verifying the missile Thermally Initiated Venting System in a flight test
  - Correcting common datalink messaging issues for Precision Position Location Information message generation and receipt
  - Changing contingent lethal object logic in the fire control
  - Safety verification of insensitive munitions requirements
  - Implementing configuration control for software and firmware management
  - Resolving radar software message problems with fixes installed in fielded batteries
  - Completing missile field and storage maintenance and inspection procedures
- Comparing the reliability and maintainability data from FTO-01 to the previous results from Flight Test Integrated-01 (1QFY13), Flight Test THAAD-12 (1QFY12), and the Reliability Confidence Test (4QFY11) shows that reliability and maintainability measures are still fluctuating greatly between test events. FTO-01 results were generally improved from Flight Test Integrated 01, but given the differences between events, data from a longer, operationally realistic test event such as the upcoming Reliability Growth Test in FY15 are needed to determine if the overall system reliability is maturing.

Recommendations

- Status of Previous Recommendations.
  - The classified DOT&E February 2012 THAAD and AN/TPY-2 Radar Operational and LFT&E Report contained 7 recommendations in addition to and not associated with the original 39 Conditional Materiel Release conditions established. Two recommendations have been addressed. The MDA should continue to address the remaining three classified recommendations (Effectiveness #2, Effectiveness #5, and Survivability #4). In addition, the MDA and the Army should conduct electronic warfare testing and analysis (Suitability #3) and implement equipment redesigns and modifications identified during natural environment testing (Suitability #11).
  - DOT&E made one additional recommendation in FY13 for the THAAD Project Office to reassess their reliability and maintainability growth planning curve. Progress was made on this recommendation; however, it was hampered by THAAD component configurations remaining in flux.
- FY14 Recommendation.
  1. The MDA should plan to rigorously test the THAAD Configuration 2 system in order to assess obsolescence and other redesigns of hardware and software.

Live Fire Test and Evaluation

Live Fire Test and Evaluation

Live Fire Test and Evaluation (LFT&E)

DOT&E executed oversight of survivability and lethality test and evaluation for 121 acquisition programs in FY14. Of those 121 programs, 21 operated under the waiver provision of U.S. Code, Title 10, Section 2366, by executing an approved alternative Live Fire Test and Evaluation (LFT&E) strategy in lieu of full-up system-level testing. DOT&E submitted eight reports on LFT&E results prior to programs entering into full-rate production.

DOT&E published reports on the following programs during the past year (reports marked with an asterisk were sent to Congress):

LFT&E Reports

- HELLFIRE Romeo Final Lethality Assessment
- HELLFIRE R-9E Initial Lethality Assessment
- Modernized Expanded Capacity Vehicle-Survivability (MECV-S) Survivability Assessment Report*

DOT&E Reports (with combined OT&E/LFT&E results)

- Joint High Speed Vessel (JHSV) Initial Operational Test and Evaluation (IOT&E) and LFT&E Report*
- M982E1 Excalibur Increment 1b IOT&E and LFT&E Report*
- P-8 Poseidon Multi-Mission Maritime Aircraft (MMA) IOT&E Report*
- Littoral Combat Ship (LCS) Early Fielding Report*

Special Reports

- DOT&E Response to Chief of Naval Operations Report to Congress on the Current Concept of Operations and Expected Survivability Attributes of the Littoral Combat Ship*

In addition to satisfying acquisition oversight requirements, the LFT&E program:

- Funds and executes technical oversight on investment programs that provide joint munitions effectiveness data (Joint Technical Coordinating Group for Munitions Effectiveness)
- Funds projects to develop advanced technologies and analytical methods to increase aircraft survivability (Joint Aircraft Survivability Program)
- Conducts vulnerability and lethality testing of fielded platforms and weapons systems and improves survivability analysis tools (Joint Live Fire Program)
- Supports quick reaction efforts addressing urgent operational commander's needs.

JOINT TECHNICAL COORDINATING GROUP FOR MUNITIONS EFFECTIVENESS (JTCG/ME)

Joint Logistics Commanders chartered the Joint Technical Coordinating Group for Munitions Effectiveness (JTCG/ME) more than 40 years ago to serve as the DOD's focal point for munitions effectiveness information. This has taken the form of widely used Joint Munitions Effectiveness Manuals (JMEMs), which address all major, non-nuclear U.S. weapons. JTCG/ME authenticates weapons effectiveness data for use in operational weaponeering, strike mission planning, training, systems acquisition, weapon procurement, and combat modeling and simulation. The Armed Forces of the U.S., NATO, and other allies use JMEMs to plan operational missions, support training and tactics development, and support force-level analyses. JTCG/ME also develops and standardizes methods for evaluation of munitions effectiveness and maintains databases for target vulnerability, munitions lethality, and weapon system accuracy. The JMEM requirements and development processes continue to be driven by operational lessons learned and the needs of Combatant Commands, Services, Military Targeting Committees, and Operational Users Working Groups for specific weapon-target pairings and methodologies.

The primary JMEM application is weaponeering, which is the detailed technical planning of a combat strike. Strike planning occurs at multiple levels in the operational chain of command before actual combat. JTCG/ME produces, distributes, and regularly updates JMEMs, which provide computerized effectiveness tools and data for rapid evaluation of alternative weapons and their delivery against specific targets. In many cases, effectiveness and collateral damage estimates generated by these tools are part of the decision criteria for strikes approved at the highest levels of the U.S. Government.

JOINT MUNITIONS EFFECTIVENESS MANUAL (JMEM) TARGETING AND WEAPONEERING SOFTWARE

U.S. Africa Command (USAFRICOM) and U.S. Central Command (USCENTCOM) used JTCG/ME Joint Munitions Effectiveness Manual Weaponeering System (JWS) v2.1 software and Collateral Effects Radii tables for operational weaponeering and collateral damage estimation in direct support of operations in the USAFRICOM and USCENTCOM Areas of Responsibilities. The JTCG/ME developed various analytical and operational methodologies and target models to provide continued support to operational commanders, weaponeers, and planners. Additionally, JTCG/ME released the air-to-air and surface-to-air planning model, the Joint Anti-air Combat Effectiveness System (J-ACE) v5.2.1, in April 2014 to provide aircraft survivability data.

The fielded JWS v2.1 software incorporates integral building analysis and hardened target modules to create a merged tool that generates weapon effectiveness and damage assessments against infrastructure targets to include buildings, bunkers, and tunnels. JWS v2.1 contains new/updated targets and munitions, new explosive equivalent weights based on blast testing, as well as an improved 3-D viewer. JWS v2.2 development is ongoing to support coalition partners for fielding in FY15.

J-ACE v5.2.1 simulates air-to-air and surface-to-air engagements and includes Blue, Red, and Gray air-to-air missile and Red and Gray surface-to-air missile fly-out models. J-ACE v5.2.1 provides an updated Joint Anti-Air Model (JAAM), a missile fly-out model including hundreds of weapon target pairings and JAAM-Enhanced surface-to-air missile countermeasures simulation. J-ACE v5.2.1 also provides new Endgame Manager (EM) software and data sets, which add missile lethality and target vulnerability. EM allows explicit evaluation of weapon miss distance, fuze performance, weapon lethality, and target vulnerability. EM provides a Probability of Kill given an intercept. In addition, J-ACE v5.3 is being developed to provide extended and updated data sets for missile and aircraft target aero-performance, anti-air missile lethality, and air target vulnerability.

OPERATIONAL SUPPORT TO MISSION PLANNING

The JTCG/ME provided updates for Collateral Effects Radii values for newly-fielded/updated weapons (e.g., Small Diameter Bomb (SDB) II, Griffin, HELLFIRE, GBU-49, BLU-133, etc.), in support of the Combatant Commands. In addition, the JTCG/ME released the Digital Precision Strike Suite Collateral Damage Estimation (DCiDE) v1.1.1 tool, which has the capability to calculate collateral damage estimates along a route. This new capability has been used in support of multiple kinetic strikes by the task force in Afghanistan. Additionally, JTCG/ME trained nearly 300 users at 12 different commands to support Collateral Damage Estimation decisions.

JWS v2.1 has ongoing initiatives to include a new imagery interface to implement aimpoint development that leverages the Tasked Target Text Data (T3D) format implemented by currently fielded mission planning systems. JWS software and the T3D imagery interface will be modified to support integration of electronic light table viewers. Also, Modernized Integrated Database and Joint Targeting Toolbox interfaces will be developed with additional capabilities to support connectivity. These developments will enable the integration of weaponeering, precision point mensuration, and collateral damage estimation, decreasing the speed at which strike planning can be conducted.

To more effectively support operational mission planning, particularly at U.S. Strategic Command, the J-ACE v5.2.1 release also provides a direct interface to force-level simulations. The fidelity is adequate for studying tactics, training evaluation, relative missile performance, and scenario planning. Additionally, U.S. Strategic Command integrated JAAM into the Individual Combat Aircrew Display System and the Personal Computer Debriefing System for direct use for tactics, planning, and training at operational test squadrons for fighters and bombers.

INFORMATION OPERATIONS TOOLS AND CAPABILITIES

To address an emerging Cyber Operations JMEM, JTCG/ME re-deployed the following Joint Capability Analysis and Assessment System (JCAAS) tools: Computer Network Attack Risk and Effectiveness Analyzer, Network Risk Assessment Tool, Communications Radar Electronic Attack Planning Effectiveness Reference, Effectiveness of Psychological Influence Calculator, and Joint Broadcast Analysis Tool. JCAAS will provide a shared interface for operational users in selecting the capabilities to best meet given objectives based on effectiveness derived from target vulnerability and capability characteristics. The JCAAS scope includes weapon characterization; coordinating test and target data development; testing and evaluation of cyber data standards; and developing a new database schema for electronic warfare mission planning.

JOINT AIRCRAFT SURVIVABILITY PROGRAM (JASP)

The Joint Aircraft Survivability Program (JASP) office funds development of techniques and technology to improve the survivability of U.S. military aircraft. Working with Joint Staff, Service organizations, other government agencies, and industry, JASP develops new capabilities and works to assure they are pursued jointly by the Services.

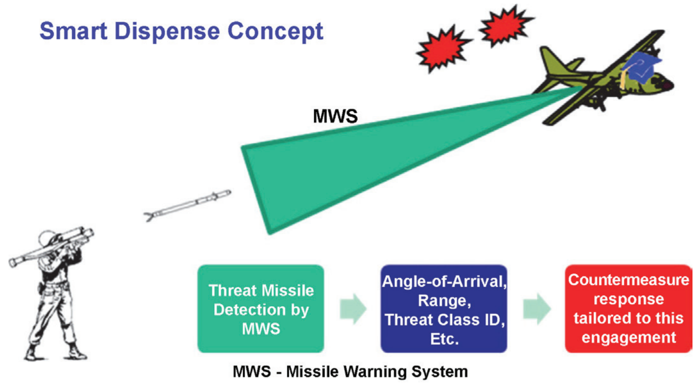
DOT&E sponsors and funds JASP. The Naval Air Systems Command, the Army Aviation and Missile Command, and the Air Force Life Cycle Management Center charter the program. DOT&E establishes objectives and priorities for the JASP and exercises oversight of the program.

JASP is supporting the Joint Multi-Role (JMR) Technology Capabilities Demonstration (TCD) program as a member of the Platform Integrated Product Team. The JMR TCD is expected to demonstrate transformational vertical lift capabilities to prepare the DOD for developing the next-generation, vertical lift fleet. JASP was a driving force in establishing the assumptions and requirements for the vulnerability analysis used in evaluating the initial three government model prototypes.

JASP funded 66 multi-year survivability projects and delivered 48 final reports in FY14. The following summaries highlight selected JASP efforts in four focus areas: susceptibility reduction, vulnerability reduction, survivability assessment, and combat damage assessment.

SUSCEPTIBILITY REDUCTION

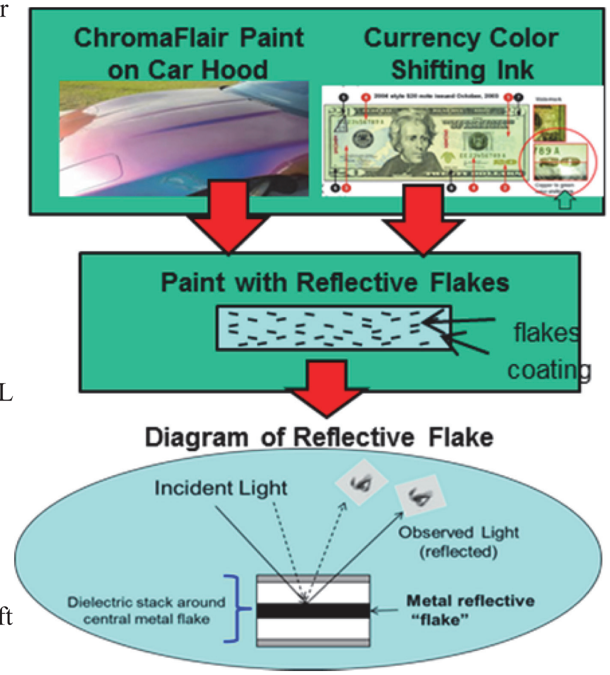
Multiple Objective Differential Evolution Smart-dispense Techniques (MODEST). The Naval Research Laboratory (NRL) in conjunction with the Naval Surface Warfare Center - Crane Division (NSWC-Crane) and the Air Force Research Laboratory are developing techniques to improve dispensing infrared countermeasures (IRCM).



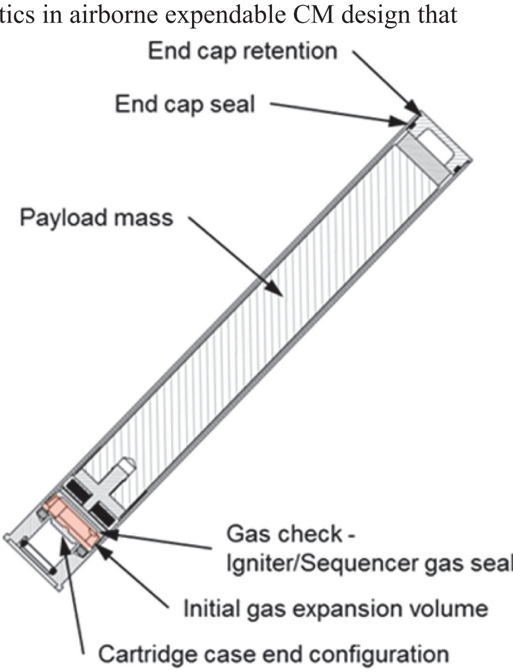
They have leveraged recent advances in multiple objective differential evolution to develop a methodology/tool to obtain near-optimal, smart-dispense techniques for infrared decoys. They also formulated an optimal, non-linear effectiveness measure for jam codes based on measurements from actual test scenarios. The improved dispense algorithms will reduce flare usage and improve other countermeasure synergistic effects. The initial plan is for the Navy to implement new dispense techniques on Navy/Marine Corps aircraft. Other services plan to assess techniques and implement as needed.

High Resolution Infrared Clutter Measurement and Analysis. The Army Communications-Electronics Research, Development and Engineering Center/Intelligence and Information Warfare Directorate is studying techniques for developing a cross-Service definition of clutter and creating a database of high-resolution narrow field of view (FOV) clutter for all Services. The study will improve the government's ability to adequately define and test the effectiveness of missile warning systems to pointer/tracker handoff. The project intends to establish clutter-level definitions and a narrow FOV/high-resolution clutter database to support development of tri-Service directed IRCM systems. The Army Program Manager Aircraft Survivability Equipment is providing data and funding to develop a test tool and clutter scene injection capability. The project is also leveraging additional data collected from the Advanced Threat Infrared Countermeasures (ATIRCM) program. The project will result in more reliable and effective directed IRCM systems by allowing the government to ensure pointer trackers perform per specification. The Army will use the capability to improve fielded algorithms for ATIRCM and/or the Common Infrared Countermeasures systems.

Ultraviolet Reflective Coating. The NRL is leveraging commercial technology for visibly-reflective coatings that contain reflective dielectric multi-layer flakes. This technology will help them design and fabricate a coating using reflective polymer flakes to approach 100 percent ultraviolet reflectivity without compromise in the visible and infrared wavelength performance. NRL will test and evaluate coating performance and durability as applied to representative aircraft surfaces. Initial methods to disperse polymer flakes into coating have been identified. NRL has completed modeling of best-candidate, commercially-available polymers to determine preliminary designs for multi-layer polymer stacks. NRL will contract with a commercial vendor to fabricate multi-layer polymer stacks using co-extrusion techniques based on NRL designs. The improved coating will make aircraft less susceptible to anti-aircraft systems. The NRL and Army Aviation Applied Technology Directorate plan to test coatings in conjunction with other IRCM trials.



Airborne Expendable Countermeasure (CM) Velocity Study. The NSWC-Crane started this project in FY14 to determine the critical characteristics in airborne expendable CM design that effect ejection velocity in order to optimize performance. Demonstrating a more consistent, optimized velocity will improve decoy effectiveness and aircraft survivability. A consistent ejection velocity will give accurate placement of the CM, greatly assisting threat defeat. Additionally, once



a desired ejection velocity is obtained and parameters that affect it are identified, a common impulse cartridge for all Services will be more easily achievable, thereby reducing support costs. In the next phase, NSWC-Crane will conduct a flight test to determine how tailored flares improve effectiveness. Methods to adjust ejection velocity will be used to enhance effectiveness of current expendables.

VULNERABILITY REDUCTION

JASP vulnerability reduction projects address the survivability of the crew and passengers, as well as the aircraft itself. A portion of these projects have focused on improving armor and developing lighter-weight opaque and transparent ballistic protection systems. In FY14, projects were initiated that focus on fuel containment technologies and their related fire protection systems, along with numerous structures and materials projects, including self-healing composites. JASP has begun to explore occupant seat technology, in order to make them more crash-worthy, and helicopter transmission technology, to make them and their lubrication systems more tolerant to ballistic damage.

Improved Advanced Survivable Canopy Transparent Armor. The Army Research Laboratory (ARL)-Weapons and Materials Research Directorate teamed with Naval Air Warfare Center – Weapons Division (NAWC-WD) to work this project, which completed in FY14. Transparent armor is typically made of several layers of materials separated by polymer interlayers. The outer layer is usually a type of glass, such as soda-lime silica or borosilicate, and the inner plies are usually a polymer, such as a polycarbonate or polyurethane with a thicker interlayer. The use of these different materials induces inherent stresses due to the thermal expansion mismatches across the material's depth. Additionally, the principal requirements of unhindered visibility for situational awareness and defeat of a designated threat with a multi-hit capability have to be considered.

Multi-hit Transparent Armor

The goal of this project was to reduce total system weight, while improving performance at temperature extremes found in current combat areas. Variables considered for improvement included surface treatments, ply layup alterations, and edge framing. This was a successful proof of concept effort achieving systems in the five pounds per square foot range over a greater temperature range, compared to current advanced prototype systems weighing more than seven pounds per square foot.

Unmanned Aerial Vehicle (UAV) Self-Sealing Polymer. As unmanned aerial vehicles (UAVs) become more prevalent and greater contributors in the battlespace, their survivability becomes more crucial. NAWC-WD investigated ways to improve the survivability of the MQ-8B Fire Scout using lightweight polymer coatings for fuel leak mitigation. UAVs do not typically employ any type of fire detection and suppression systems, nor system hardening to protect against projectiles or other threats. Applying a coating that self-seals (closes over a fragment or projectile penetration) and prevents fuel leakage onto a hot surface and subsequent possible ignition is a valuable contributor to vulnerability reduction. The project focused on applying a coating to a thin aluminum fuel cell tray that sits above the engine bay and holds the aft fuel cell. Test scenarios observed different impact angles, coating thickness, and configuration (entry or exit side of fuel tray). Test results showed that coating the bottom of the fuel tray (entry configuration) with a nominal coating of a polyurea is effective in preventing hot surface fuel ignition at a very minimal weight (under six pounds) and material cost ($150). The Fire Scout Program Office is currently evaluating the retrofit of aircraft during depot-level maintenance.

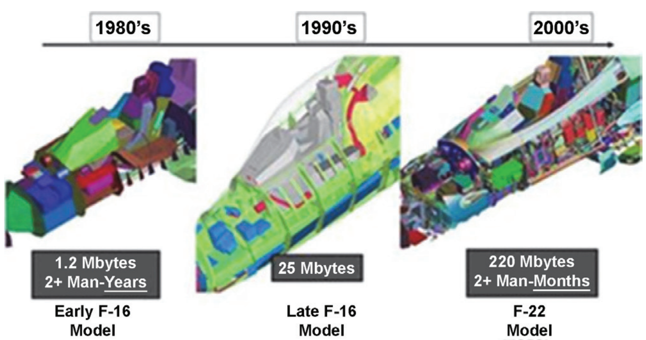
Adaptive Seat Energy Absorber for Enhanced Crash Safety. The ARL-Vehicle Technology Directorate is investigating seat energy dispersion technologies for aircraft cockpits to enhance crash safety. The focus of the project is to evaluate and demonstrate two novel energy absorber (EA) technologies: Rotary Magnetorheological EA with Magnetic Bias (MREA) and Magnetostrictive Friction EA (MFEA). In the MREA system, a fluid that changes physical properties in the presence of a magnetic field is used, allowing changes in the applied current to alter the viscosity of the fluid for optimum performance. In the MFEA system, magnetostrictive materials change dimensions when magnetized and can be used to adjust the normal force between two surfaces to modulate frictional energy absorption. In each case, the system is tuned to the actual occupant weight and crash scenario to optimize occupant survival. The project team has made substantial progress with the MREA system—fabrication of a seat-level test asset is near completion. The MFEA component device is being redesigned. Due to the limited stroking capability of magnetostrictive technology, force amplification is needed to meet the design load requirements for the crash application.

SURVIVABILITY ASSESSMENT

JASP continues to develop and maintain survivability assessment tools that are widely used by acquisition programs for analyses of alternatives, design studies, and specification development and compliance. JASP also supports the test community to assess survivability in pilot training exercises and countermeasure effectiveness.

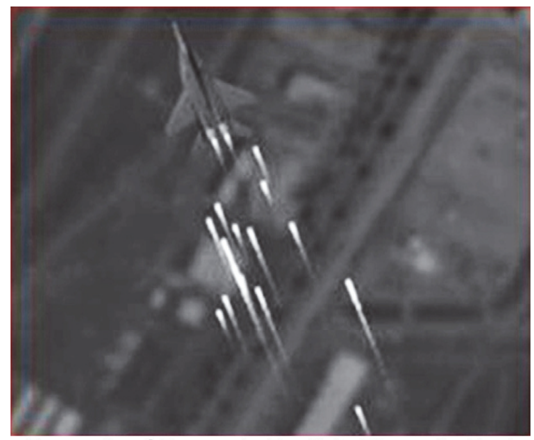
Improved Fire Modeling. Based on testing and analysis, fire has been identified as the largest contributor to aircraft vulnerability. For many years, JASP has supported development of the Fire Prediction Model (FPM) to provide a tool for analysts and testers to understand and mitigate this vulnerability. JASP currently has three projects addressing fire modeling deficiencies. The Air Force 96th Test Group (96TG) is developing a hydrodynamic ram engineering model that will provide accurate fuel spurt characteristics to determine the likelihood of fire ignition. The ARL/Survivability Lethality Analysis Directorate (ARL/SLAD), with participation from the 96TG and NAWC-WD, is conducting a review of all of the documents and test data referenced in the FPM Analyst and User Manuals to identify discrepancies between the documents and the FPM code. In the third project, Next Generation Fire Modeling Plan, the 96TG, in partnership with NAWC-WD and the Air Force Life Cycle Maintenance Center, is generating a long-term plan to guide the development of a credible and validated dry bay fire assessment capability for armor-piercing incendiary and fragment threats. These projects all affect the development of the next generation FPM that will be used for live fire test planning and survivability assessments of future combat vehicles, providing a better understanding of the vulnerability of these systems to combat initiated fires.

Improved Target Geometries. Target descriptions (geometries) for aircraft vulnerability analyses have grown so detailed, with attendant enormous computer run times, that they restrict the ability for development programs to conduct analyses in time to affect design decisions. Interrogation, via ray tracing methods, of target geometric models is a cornerstone of vulnerability assessments. JASP has funded two projects to improve ray tracing and target geometry optimization. Ray Tracing Speed Enhancements is investigating several ways to speed up the ray tracing process. The Air Force Life Cycle Maintenance Center is leading this project with participation from ARL/SLAD. Benchmark testing accomplished to date has demonstrated a 30 percent decrease in run times. The enhanced ray tracing algorithms will be integrated into the Computation of Vulnerable Area Tool (COVART) for use on future vulnerability assessments. The Target Geometry Optimization Utility project is investigating ways to optimize the target geometry. The goal is to reduce files sizes by 33 percent while changing presented area estimates by less than 1 percent. NAWC-WD is leading this project with participation from ARL/SLAD. The results of this project will be distributed with COVART as part of the Defense Systems Information Analysis Center Vulnerability Toolkit for use on future vulnerability assessments.



Example of Target Geometry Growth

Imaging Infrared (IIR) Threats. JASP has three related projects to address countermeasures for the challenging Imaging Infrared (IIR) threat. In the Physics-Based IRCM Modules project, NSWC-Crane investigated the specific data and level of detail required to model flares in an IIR environment. This project developed formats for physics-based models for both pyrotechnic and pyrophoric IRCMs that are integrated in the Fast Line-of-Sight Imagery for Targets and Exhaust Signatures (FLITES) software. FLITES is an industry standard scene generation software package. This new format is referred to as the Dynamic Particle Flare representation. In the Flare Aerodynamic Modeling Environment and Tri-Service Flare Database Modernization project, NSWC-Crane is updating the Flare Aerodynamic Modeling Environment model to add 3-D aircraft flow fields and modernize the Tri-Service Flare Database so it can accommodate flare models in the Dynamic Particle Flare format. In the Imaging Flare Models for Missile Simulations project, the NRL, with NSWC-Crane participation, will produce 12 validated flare models in the Dynamic Particle Flare format that are compatible with the FLITES scene generation software. This project will also develop the Flare Imagery Analysis Tool to generate radiometrically- and spatially-correct imagery of flares used in FLITES. These projects will provide tools, available through the Defense Systems Information Analysis Center, to evaluate the effectiveness of advanced flares against IIR threats.


Example of Dynamic Particle Flares in Fast Line-of-Sight Imagery for Targets and Exhaust Signatures (FLITES)

COMBAT DAMAGE ASSESSMENT

JASP continued to support the Joint Combat Assessment Team (JCAT) in FY14. JCAT is a team of Air Force, Army, and Navy personnel deployed in support of combat operations. JCAT continued its operation in Afghanistan with full-time deployments in Regional Commands – South, Southwest, and East. Iraq and other areas of the world were supported remotely or by rapid deployment from Afghanistan or the Continental U.S.

JCAT inspects damaged and destroyed aircraft, acquires maintenance records, and conducts interviews with aircrew and intelligence personnel to develop an accurate and comprehensive assessment of each aircraft combat damage event. They provide consultation to weapons, tactics, and logistics personnel and comprehensive briefings to commanders in charge of daily air operations. These efforts inform battlefield commanders, allowing them to adjust operational tactics, techniques, and procedures based on accurate threat assessments. As of August 31, 2014, the JCAT had initiated 131 and completed 69 aircraft combat damage assessments in FY14.

The JCAT strengthened aircraft combat damage incident reporting in the Services and the DOD. The Combat Damage Incident Reporting System is the repository for all U.S. aircraft combat damage reports. JCAT worked with OSD and USCENTCOM to continue collecting combat incident reports from USCENTCOM's databases to more quickly identify, assess, document, and distribute aircraft combat damage incident data to the Services and DOD. JASP and the Office of the Deputy Assistant Secretary of Defense for Systems Engineering submitted a revision to DOD Instruction 5000.02, released in November 2013, which included combat data reporting requirements for major weapon systems. Language providing additional guidance for the aircraft combat damage reporting process is included in the draft revision of the Defense Acquisition Guide.

The JCAT trains the U.S. aviation community on potential aircraft threats and combat damage. This training includes, but is not limited to: capabilities briefs; intelligence updates; recent "shoot-down" briefs to discuss enemy tactics, techniques, and procedures; and the combat damage collection and reporting mentioned above. The attendees include aircrews, maintenance personnel, intelligence sections, Service leadership, industry, and coalition partners.

JOINT LIVE FIRE (JLF)

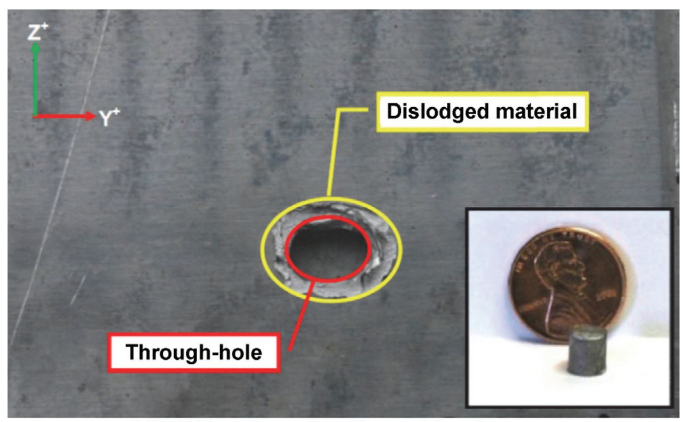
The purpose of the Joint Live Fire (JLF) program is to test fielded systems, identify vulnerable areas, and understand damage mechanisms to provide the information needed for design changes, modifying tactics, techniques, and procedures, or improving analytical tools. The need for these tests results from systems being exposed to new threats; being used in new, unanticipated ways; or being operated in new combat environments, thereby requiring an updated assessment of their performance.

JLF supplements LFT&E of systems by testing systems against new threats the requirements community did not anticipate during original development or against old threats employed in new ways. The rocket-propelled grenade (RPG) is an example of a threat employed differently than initially intended. Originally developed as an anti-tank or anti-personnel weapon, hostile forces in combat often use the RPG as an anti-aircraft weapon.

AIRCRAFT SYSTEMS PROGRAM

JLF-Air completed six test series in FY14. Seven of this year's projects will continue into FY15. Below are selected examples of this year's projects.

Advanced Hit Efficiency and Destruction (AHEAD) Sub-projectile Characterization Testing. This project determined the penetration characteristics for a modern threat, anti-aircraft artillery projectile—the air burst Advanced Hit Efficiency and Destruction (AHEAD) projectile. The penetration characteristics of its tungsten sub projectiles were measured for three thicknesses and three obliquities of aluminum panels representative of aircraft structures and flight critical components. Data will help the development of a penetration model to effectively model air burst munitions sub-projectiles, providing an analysis capability presently unavailable in commonly used aircraft vulnerability codes, such as COVART and the Advanced Joint Effectiveness Model (AJEM). ARL/SLAD conducted 248 tests in FY14 and calculated the V50 (the velocity at which 50 percent of the projectiles penetrate the target material) ballistic limits, and associated 80 percent confidence intervals for each material thickness-obliquity pairing. Additional data collected included impact orientation, residual mass, and flash characterization.



AHEAD sub-projectile and its damage

Man-portable Air Defense System (MANPADS) Residual Fuel. This project collected blast pressures produced by stationary and moving Man-portable Air Defense System (MANPADS) missiles when a portion of the missile's rocket motor fuel remains at the time of warhead detonation. Results will be coupled with blast pressures measured during previous JLF-Air tests and used to further improve MANPADS threat models used in aircraft vulnerability assessment codes, such as COVART and AJEM, as well as damage prediction and assessment tools such as LS-DYNA and the Combat Assessment Tool.

The NAWC-WD, Weapons Survivability Laboratory, located at China Lake, California, conducted testing. They collected 42 pressure measurements at radial distances of 12, 20, 30, 40, and 72 inches from the MANPADS warhead centroid for 2 stationary detonation events and a single detonation event with a surrogate MANPADS missile traveling at 1,600 feet per second.

Crew Compartment Fire Survivability. This project collected data to determine the effects of fuel fires on temperatures, oxygen depletion, carbon monoxide, and other toxic gases. The aircraft survivability community can use these data to support assessments of physiological hazards within military aircraft crew compartments as a function of time and distance from the fire source under realistic ventilation conditions. Collected data will establish baseline assumptions for future crew casualty models and analysis efforts.

Crew Compartment Fire Testing

ARL/SLAD, located at Aberdeen, Maryland, conducted testing. They completed 48 tests using Design of Experiments (DOE) techniques along with several excursion tests in FY14. The DOE test matrix was based on factors of fluid pressure, piping diameter, ventilation configuration, mean airflow, and fire location. Excursion tests used baseline (Halon 1301, CO2) hand-held fire extinguishers and potential replacement fire extinguishers with selected repeats using hydraulic fluid instead of aircraft fuel.

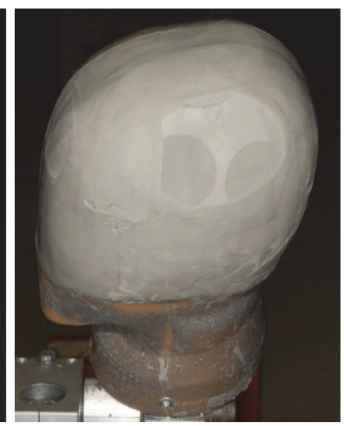
GROUND SYSTEMS PROGRAMS

Sustained Fire-Start from Near-Field Detonations of Blast/Frag Weapons. The JLF-Ground program funded the Air Force Research Laboratory and ARL to conduct a study of sustained fire start research as it relates to weapons effects against ground vehicle targets. Initiation of sustained fires is one of several lethal mechanisms, which can impart significant levels of damage to a materiel target. Experiments are being conducted on fuel tanks at varying ranges from a threat, using optical pyrometry to characterize the fireball. Physical understanding and empirical data will be transitioned to fire start prediction models improving developer and evaluator predictions of effectiveness, especially catastrophic kill of ground targets.

Adobe Wall Combatant Commander Validation Test. The Army conducted a series of tests to evaluate the protection provided by an adobe wall from fragments from MK82 and HELLFIRE Romeo warheads. These tests will provide benchmark data for warhead fragments from two weapons that undergo extensive operational use against high-interest targets in theater. The results of this testing will provide understanding of the methodology not previously available, along with updated lethality data of warheads that will improve effectiveness and collateral damage analyses for Combatant Commanders.

Assessment of Peepsite Generation 2 (PG2) Headform for Ballistic Testing of Helmets. This project assessed the capability of the PG2 headform to measure back face deformation (BFD) for helmet testing compared to the National Institute of Justice (NIJ) headform. The current, single-sized NIJ headform has limitations due to its current design, which utilizes two clay channels and four aluminum pillars that interfere with BFD. Phase I of testing encompassed 48 subtests (each subtest had 3 shots per helmet) comparing BFD repeatability. Phase II assessed test-induced variation and explored additional capabilities of the PG2 headform. Phase II was completed with 48 subtests (each subtest had one shot per helmet).

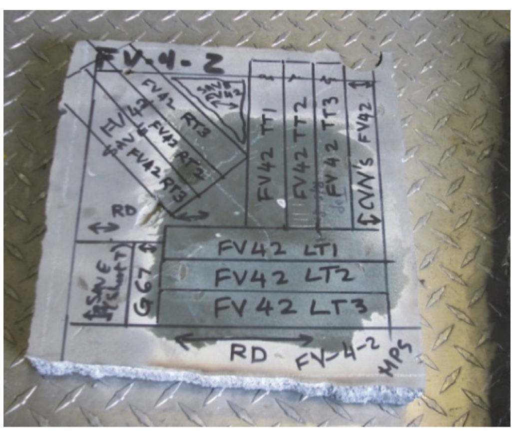

National Institute of Justice (NIJ) Back Face Deformation (BFD) Headform


Peepsite Generation 2 (PG2) Back Face Deformation (BFD) Headform

Enhanced Modeling of Behind-Armor Debris from Kinetic Energy Penetrators. ARL conducted tests of medium-caliber kinetic energy penetrators to support the modeling of the behind-armor debris (BAD) from the penetrators. Physical characteristics (mass, velocity, spatial distribution, shape factor) of the residual penetrating fragments were collected with flash x-ray, plywood/Celotex bundles, and witness panels. ARL will use these data to enhance the current BAD algorithm in the Army's primary vulnerability/lethality model by producing a more accurate physical representation of medium-caliber residual fragments.

Testing and Evaluation of Current U.S. Army Body Armor against Emerging Threats. This project quantifies and compares the penetrative capability of selected emerging or persistent non-standard threats against particular U.S. Army body armor protection levels. Data collected of resistance to penetration and ballistic protection limits will determine a logistic regression prediction of the V05, the V50, and the V95 (velocities at which 5 percent, 50 percent, and 95 percent of projectiles penetrate the armor, respectively) ballistic limits. Data from the ballistic protection limit (V50) will include BAD characterization against a ballistic gelatin backing. The selected threats for ballistic testing are undergoing cross-sectional profile characterization, including optical microscopy, digital photography, evaluation of material composition (elemental and alloy analysis), cross-section dimensional characterization, and hardness testing. ARL/SLAD and the Aberdeen Test Center are currently performing the resistance to penetration and ballistic limit testing for this project.

Environmental Aging Effects on the Protection Levels of Armor. The USMC Combat Development Command (MCCDC) conducted a series of ballistic and material tests on aluminum specimens removed from original manufactured Amphibious Assault Vehicle hulls to understand potential effects of age that can affect a variety of material properties. With an anticipated platform upgrade utilizing existing hulls, knowledge of present protection levels is imperative. Plates were removed from several locations that had been exposed to varying heat levels over their lifetime. MCCDC executed V50 tests for several penetrators at various obliquities to determine if the plates still met the original minimum requirements for armor protection. MCCDC also performed material tests (tensile, hardness, metallographic, inter-granular corrosion susceptibility, and Charpy impact) to assess current material properties and extent of change due to aging that occurred. Testing showed that while the materials incurred significant aging, the plates still meet the original minimum protection requirements of the armor.



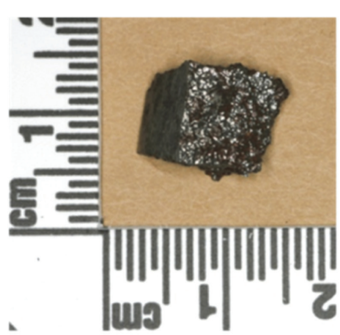
Test Specimen Cut from Amphibious Assault Vehicle (AAV) Hull

Collaborative Validation of Mandible Blunt Impact Methodology. To better evaluate the efficacy of mandible protection systems, this project obtained operationally-realistic blunt impact loadings that vehicle occupants may experience. Data collected from instrumented headforms included, but were not limited to: mandible and nasal force, head acceleration, and neck-bending moments. ARL used these values to determine whether existing simplified test apparatuses, such as a drop tower or pendulum, could be used to evaluate blunt impact loadings.

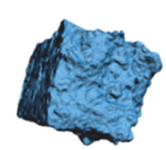

Helmet with Mandible Protection under Test

Characterizing the Penetration of an Explosively-Formed Penetrator Mine. The Army conducted testing to determine the lethality of an explosively-formed penetrator mine and its lethality against underbody armor. The data obtained from these tests provide the ability to better assess the vulnerabilities of armored combat vehicles to the penetration of this mine. Penetration tests documented the penetrator formation, flight characteristics, and penetration performance into semi-infinite and spaced rolled homogenous steel targets. Additionally, BAD tests determined the amount of fragmentation resulting from both the residual threat and the spall production.

Irregular Fragment Penetration Characterization and Model Validation. The objective of this project is to identify and validate the most appropriate Fast Air Target Encounter Penetration model representation of irregular fragments. To accomplish this, ARL collected and laser scanned approximately 125 irregular fragments from an OF540 152 mm artillery shell to develop multiple shape characterizations.



Irregular Fragment


Scanned Fragment

ARL will fire the 125 fragments against steel plates at a sufficient distance to allow random tumbling to occur. Fragment orientation, striking and residual mass, and velocity will be collected. Pre-shot penetration characterizations of the multiple shape models will then be compared to the test data and a determination made on the most appropriate shape factor model. This project will improve future LFT&E through improved pre-test prediction capabilities and/or reduced number of tests required due to increased confidence in modeling.

SEA SYSTEMS PROGRAM

The JLF Sea Systems Program made significant progress in FY14 towards improving the capability to assess the survivability of submarines and surface ships. These projects benefit ship and submarine acquisition programs, as well as the fleet of fielded U.S. Navy vessels.

Large Volume Shipboard Space Fire Protection. Large volume spaces such as aircraft hangars on aircraft carriers and vehicle stowage areas on amphibious ships are frequently used to stow large quantities of ordinary combustible (Class A) material. These spaces are usually protected with overhead Aqueous Film Forming Foam (AFFF) sprinkling systems, which testing has shown have limited effectiveness against shielded, large Class A, vehicle, and weapon-induced fires. As part of this project, a fire hazard analysis determined that supplementing legacy AFFF sprinkling systems with bulkhead-mounted AFFF monitors or water/foam cannons could potentially improve the system's capability against these fires. During FY14, NRL designed and installed a water/foam cannon system and monitor control system in the hangar bay test area of the ex-USS *Shadwell* Full-Scale Fire Research and Test Ship. The system was commissioned and preliminary fire testing completed in October 2014. In FY15, NRL will conduct full-scale testing against large and obstructed Class A and pool and running-liquid fuel fires to demonstrate the capability of the system against these difficult fires. Testing will include low visibility conditions.

Deep-Depth Underwater Explosion Testing of Asymmetric Cylinders. Future submarine pressure hull design will likely include structural features that will influence the primary mode of collapse when subjected to a deep-depth underwater explosion. This project will provide a new and experimentally-based understanding of asymmetric pressure hull failure modes and an assessment of the effects of unique geometries on lethal depth. This new understanding will improve future submarine vulnerability assessments. Additionally, the data set provided by this program will be used to validate computational models, leading to increased confidence in lethal depth predictions for asymmetric pressure hulls. During FY14, the NSWC – Carderock Division designed test cylinders and identified shot geometries. They will fabricate the test cylinders in FY15 and test them during FY16.

LFT&E SPECIAL INTEREST PROGRAMS

PERSONNEL PROTECTION EQUIPMENT

DOT&E continues to exercise oversight over personal protective equipment. The U.S. Special Operations Command (USSOCOM) and Services continue to implement rigorous, statistically-principled testing protocols approved by DOT&E for hard body armor inserts and military combat helmets. In partnership with USSOCOM and the Services, DOT&E has begun developing a protocol for soft armor vest testing that will standardize testing of soft armor vests and require them to meet rigorous statistical measures of performance. This represents the final commodity area (in addition to hard armor plates and combat helmets) for which DOT&E intends to develop a statistically-based protocol for future testing.

The National Research Council (NRC) completed its independent review of helmet testing protocols. The NRC's final report contained several recommendations that closely align with ongoing efforts to improve helmet performance and testing within the Department. DOT&E has also modified the relevant protocols to reflect recommendations from the NRC and other external reviews. This revised protocol reduces government risk and achieves simplification, both of which the NRC recommended.

As noted by the NRC in their final report on helmet testing, a clear scientific link to the modes of human injury from ballistic impact, blast, and blunt trauma do not exist. This is a serious limitation for the test and evaluation of all personal protective equipment. DOT&E is monitoring a JLF-funded effort to establish injury risk criteria for one type of injury due to behind-helmet blunt trauma; the initial results of this study should be available next year. DOT&E is also monitoring a multi-year Army program to investigate behind-helmet blunt trauma, determine injury mechanisms and risks, and develop an injury criterion that can be used for helmet testing. DOT&E is overseeing and participating in the Army's effort to improve helmet test mount headforms by developing multiple-sized headforms to replace the single-sized headform currently used to test all helmet sizes. This year, the Army completed initial testing of a multiple-sized headform and is determining how to implement it in future testing. DOT&E will work with USSOCOM and the Services to update personal protective equipment test standards and procedures to incorporate the results of these efforts.

WARRIOR INJURY ASSESSMENT MANIKIN (WIAMAN)

DOT&E continued its oversight of the Warrior Injury Assessment Manikin (WIAMan) project, an Army-led research and development effort to design a biofidelic prototype anthropomorphic test device (ATD) specifically for underbody blast testing. In FY14, the project faced challenges as a result of a disruption in the supply of post-mortem human subjects (PMHS) available for medical research. This disruption was the consequence of a combined state and federal investigation into the practices of a PMHS supplier who provided specimens to both DOD and non-DOD research facilities all over the country, and resulted in the temporary suspension of PMHS testing in the project. The WIAMan Project Management Office, along with the ARL Health and Safety Office with guidance from the Army Medical Research and Material Command, implemented an improved protocol for vetting specimen suppliers to minimize the probability of similar disruptions in the future. In FY14, DOT&E contributed financially to this process, which will ultimately establish a DOD-trusted PMHS supply network for future PMHS testing conducted within the Department.

The restructuring of the WIAMan medical research program DOT&E reported in FY13 resulted in significant progress on this front in FY14. In addition to developing initial biofidelity response corridors to guide the design of the ATD, the project completed concepts for the ATD and its instrumentation/data system. Another key accomplishment in FY14 was the creation of an injury research plan responsive to LFT&E needs as expressed in the 2010 DOT&E issue paper on this subject; the original medical research approach had not previously been refined in a manner suitable for the development of an LFT&E-specific research plan. This plan also incorporates data derived from the WIAMan project's efforts to examine imagery from combat injuries to better define the specific types of injuries that should be assessed, and ultimately prevented, when using the new ATD in underbody blast LFT&E. An example of the success of the current approach is the emergence of new injury probability curves for the foot and ankle using velocity data derived from the LFT&E environment, in conjunction with examination of x-rays of lower limb injuries that occurred during underbody IED events in combat. The combat data trends revealed that foot and ankle fractures are prevalent injuries in theater. In addition, the radiographic images gave the medical researchers insights into what kinds of fractures are representative of combat injuries when conducting their experiments, using inputs representative of the loading imparted through the vehicle and into the occupant during a live fire test. The timely and ongoing provision of de-identified medical imagery and data to the project are critical to complementing the refined injury research plan to ensure the injuries produced by the medical researchers are representative of injuries occurring in combat operations. Such knowledge will continue to facilitate the success of the WIAMan project as it significantly improves the Department's underbody blast LFT&E capabilities and builds better, more protective vehicle platforms for our Soldiers, Sailors, Airmen, and Marines.

SMALL BOAT SHOOTERS' WORKING GROUP

Small boats represent a growing threat class to ships operating in littoral waters. They have been identified as a required class of targets for a wide variety of tactical missile, rocket, and gun weapon programs on DOT&E oversight, including 25 mm, 30 mm, and 57 mm ammunition; HELLFIRE, Joint Air-to-Ground Missile (JAGM), Evolved SeaSparrow Missile, Rolling Airframe Missile, SDB II. They are also threats of concern for ships, including the LCS and the DDG 1000.

On September 11, 2014, DOT&E sponsored the third meeting of the Small Boat Shooters' Working Group at the Naval Surface Warfare Center in Dahlgren, Virginia, which 55 warfighters, evaluators, and weapons designers from all Services attended. The objective of the meeting was to: 1) examine the general nature of the small boat threat in littoral waters; 2) summarize the threat classes and available targets and models available for ammunition, rocket, and tactical missile weapon systems; and 3) attempt to "harmonize" various LFT&E and other operational test approaches among the various programs/Services by sharing the breadth of test and evaluation options available to evaluators.

An important success story reported at the Small Boat Shooters' Working Group is the sudden, widespread use of a standard Fast Attack Craft (FAC) boat target, the decommissioned Coast Guard 41-foot patrol boat (CG-41). Two years ago, DOT&E learned the Coast Guard was phasing out this boat class, and determined that it would likely provide a good interim structural and mechanical live fire surrogate for FAC threats. DOT&E rapidly informed the Services, and worked with them to alter live fire plans to accommodate the test articles. The Services responded and reported at the meeting that they obtained 26 of the 54 available ex-CG-41 boats for tests of HELLFIRE, JAGM, the SDB II, F-35 Joint Strike Fighter ammunition, and LCS. Most of these boats were obtained free of charge from the Coast Guard.

U.S. Coast Guard CG-41

Briefings this year centered on the nature of the small boat threat; the availability of targets and lethality models representing those threats; and the data collection, test techniques, and instrumentation that have been applied to small boats. Attendees also discussed upcoming test plans for the HELLFIRE R-9E missile, JAGM, Griffin missile, SDB II, and F-35 Joint Strike Fighter ammunition against a variety of FAC and Fast Inshore Attack Craft threats. Of special interest were test results from

HELLFIRE Romeo missiles fired against the ex-Coast Guard CG-41 FAC surrogate, and HELLFIRE Longbow missiles vertically fired from a ship against ex-Coast Guard, 25-foot "Guardian" boats.

Two of the central observations from the group are the need for a broader variety of surrogate small boat targets and better live fire data collection from operational test events. Participants stressed the need for evaluating the likelihood of mobility kills in conjunction with live fire evaluations against small boats, since this is the most clearly observable kill mode in fleet exercises. Evaluators also encouraged the increased use of small, easy-to-place "in-situ" camera and overpressure measurement packages on the boats in order to better observe and record the types of damage to target boats during weapons tests.

Cybersecurity

Cybersecurity

Cybersecurity

SUMMARY

DOT&E cybersecurity efforts in FY14 included 16 Combatant Command (CCMD) and Service assessments completed as part of the Cybersecurity Assessment Program, 21 cybersecurity operational test and evaluation (OT&E) events of acquisition systems, and continued efforts to enhance assessment capabilities via cyber-range events. During this year's CCMD exercises and acquisition program operational tests, cyber Opposition Forces (OPFOR) portraying adversaries with beginner or intermediate cyber capabilities were able to demonstrate that many DOD missions are currently at risk from cyber adversaries. CCMD and Service authorities have yet to consistently show that critical missions can be assured in scenarios where an intermediate or advanced cyber adversary contests these missions.

During the Turbo Challenge 14 exercise, a combination of skilled local defenders and security-conscious network users and administrators denied the Cyber OPFOR's attempts to impact missions on the U.S. Transportation Command's network. This is one of the few times a CCMD quickly detected and effectively responded to thwart an attack by an intermediate-level cyber adversary. During this assessment, the U.S. Transportation Command demonstrated the following key security tenets:

- Implementation and enforcement of strong passwords and password storage requirements
- Hardening of outward-facing servers
- Consistent review of network logs using automated scripts
- Effective incident response and reporting processes.

Notwithstanding this infrequent success, the continued development of advanced cyber intrusion techniques makes it likely that determined cyber adversaries can acquire a foothold in most DOD networks, and could be in a position to degrade important DOD missions when and if they chose to. It is therefore critical that DOD network defenders, and operators of systems residing on DOD networks, learn to 'fight through' cyber attacks, just as they are trained to fight through more conventional, kinetic attacks.

DOD continued to improve compliance with policies intended to improve cybersecurity, such as ensuring known software patches are installed on time. Consequently, during FY14 DOT&E assessments, Red Teams report that some beginner- and intermediate-level network intrusion exploits did not work as frequently as they have in the past. However, fundamental vulnerabilities continue to persist in most networks, and processes to ensure accountability for security policy violations have not matured.

Exercise authorities permitted more realistic OPFOR activities on operational networks in FY14 than during previous years, but tended to limit activities to acquiring network accesses and exfiltration of information, rather than more disruptive activities such as denial of service attacks. While these limits are understandable due to constraints associated with operational networks, operationally realistic assessments require realistic cyber effects. Without realistic cyber effects, the training audience may have a false sense of security that their missions were not subject to degradation, and the operators and network defenders miss the opportunity to detect and respond to realistic cyber attacks. To address this requirement, DOD needs improved methods and range environments to better characterize and simulate cyber effects for both assessments and training.

In FY14, DOT&E began examining CCMDs' ability to sustain critical missions when subjected to realistic cyber threats. These efforts focus on missions deemed most critical by the CCMDs, and will help increase the visibility and realism of cybersecurity assessments.

DOD initiatives such as the Joint Information Environment (JIE) and the Cyber Mission Force are intended to address some of the inherent challenges with securing DOD networks. DOT&E will examine the effectiveness of new Cyber Protection Teams during future assessments with CCMDs and Services, and will fully test the JIE as it is implemented.

During FY14, DOT&E refocused cybersecurity assessments to help CCMDs and Services reduce the number of persistent cybersecurity vulnerabilities that DOT&E has reported on in previous years. Assessments now include a "fix" phase outside of the formal assessment, during which a DOT&E-sponsored team will advise CCMD and Service personnel on the implications of existing vulnerabilities, ways to address critical cybersecurity vulnerabilities, and points of contact for further assistance.

At the request of U.S. Pacific Command and several other CCMDs, DOT&E has begun executing more frequent cyber assessments, including "fix" phases, to help improve the commands' cybersecurity posture and assess the impacts of emerging cyber threats.

During FY14, DOT&E increased the interaction between cyber Red Teams and network defenders following assessments to help improve defender awareness of the signs and optimal responses to cyber intrusions. DOT&E sponsored the development of 'cyber playbooks' and battle drills during which network defenders can practice enhanced tactics, techniques, and procedures (TTPs).

Realistic cybersecurity assessments require operationally representative participation by network defenders. 'Tier 2' network defenders, which provide regional network defense, provide critical capabilities that augment the local network defenders' ability to detect and react to network intrusions. During FY14, Tier 2 network defenders provided more active

support to DOT&E assessments, although more consistent Tier 2 involvement is required in the future.

In FY14, DOT&E revised and published procedures for cybersecurity OT&E of acquisition programs, providing specific measures and standards for conducting cybersecurity tests. Cybersecurity OT&E will continue to focus on identifying significant cybersecurity vulnerabilities, and characterizing the impact of the vulnerabilities on operational missions. DOT&E identified critical cybersecurity vulnerabilities in most of the acquisition programs that were operationally tested during FY14.

During FY14, the demand for resources and skilled cybersecurity personnel needed to support operations, training, and assessment increased across the DOD. Cyber experts were needed in greater numbers to develop cyber-secure capabilities; to defend networks and systems; to provide cyber Red Teams to support training, assessments, and tests; to plan, conduct, and analyze tests and assessments; and to create ranges and range environments to support the activities discussed in this section. Demand has begun to exceed the capacity of existing personnel able to portray cyber threats, and projected FY15 personnel needs for cybersecurity tests and assessments, as well as training for the Cyber Mission Force personnel in support of U.S. Cyber Command, may not be met unless critical resource shortfalls are addressed.

During FY14, leadership at U.S. Strategic Command, U.S. Cyber Command, and U.S. Pacific Command approved Standing Ground Rules for a Persistent Cyber Opposing Force (PCO). These ground rules, proposed by DOT&E, permit year-round operations by the cyber OPFOR to enable a more representative portrayal of potential cyber adversaries. U.S. Northern Command also agreed to a PCO beginning in FY15. The PCO construct will allow heavily-tasked Red Team assets to support more assessments by optimizing Red Team targeting boards and aggressing more targets throughout the year. Results of the PCO are also expected to help set initial conditions for cybersecurity OT&E.

To improve DOD's cybersecurity posture, DOT&E recommends the CCMDs and Services do the following:

- Demonstrate fight-through capabilities and resiliency for all critical missions; these demonstrations should include realistic Cyber OPFOR play and active involvement by Tier 2 computer network defense service providers.
- Require higher levels of cybersecurity accountability for networks and systems needed for critical missions.
- Routinely include the effects of a representative cyber OPFOR in training exercises, as opposed to training in the unlikely benign cyber environment.
- Emphasize network defense fundamentals
  - Implementation and enforcement of strong passwords and storage requirements
  - Hardening of outward-facing servers
  - Consistent review of logs at all tiers
- Exercise and improve incident response and reporting processes.

FY14 ACTIVITIES

Cybersecurity Assessment Program Events

In FY14, DOT&E, in conjunction with the Army Test and Evaluation Command; the Commander, Operational Test and Evaluation Force; the Marine Corps Operational Test and Evaluation Activity; the Joint Interoperability Test Command; and the Air Force Operational Test and Evaluation Center completed 15 cybersecurity assessments. The assessments were of nine CCMD and three Service exercises, and of three visits to operational sites not during an exercise (see Table 1).

DOT&E's Cybersecurity Assessment Program included planning and conduct of events, both during large-scale training exercises and at operational sites during events other than a training exercise. DOT&E also conducted Theater Cyber Readiness Campaign (TCRC) assessments, which comprised a series of smaller assessment events focused on specific problems and topics of interest to improve cybersecurity. These sub-events assessed vulnerabilities identified during prior assessments and the impacts of emerging cyber threats. Each TCRC phase culminated in a capstone assessment event—usually a major exercise—where all elements of the TCRC could be simultaneously assessed. DOT&E has conducted TCRC activities at three CCMDs to date, and will expand these efforts to other CCMDs in the future.

Persistent Cyber Opposing Force (PCO)

During FY14, leadership at U.S. Strategic Command, U.S. Cyber Command, and U.S. Pacific Command approved Standing Ground Rules, proposed by DOT&E, for a Persistent Cyber OPFOR (PCO). The rules permit year-round operations by the cyber OPFOR to enable a more representative portrayal of potential cyber adversaries. U.S. Northern Command also agreed to a PCO beginning in FY15. The PCO will allow heavily-tasked Red Teams to support more assessments by optimizing Red Team targeting boards and aggressing more targets throughout the year. Results of the PCO are also expected to help set initial conditions for cybersecurity OT&E of acquisition programs.

Although the PCO construct may—through efficiencies—reduce the OPFOR workload for a given event, these efficiencies are not expected to offset the growth in demand for cyber experts.

Improvement of Cyber Threat Assessments

DOT&E has partnered with multiple DOD organizations to form teams possessing cyber, T&E, cyber range, and other expertise to support cybersecurity assessments, including:

Exercise Support Team. The Defense Intelligence Agency Exercise Support Team developed detailed threat folders to improve the understanding and portrayal of cyber-adversary capabilities, and also supported the design and execution of exercise scenarios.

Standing Test, Assessment, and Rehearsal Team (START). The START helped ensure the right talent sets were integrated into DOT&E-sponsored assessment activities. In FY14, the START supported a series of cyber-range events (Project C) that stressed range capabilities and environments, while also affording new Cyber Protection Teams the opportunity to defend against cyber attacks on realistic networks. U.S. Cyber Command partnered with DOT&E on these cyber-range events, and is employing the results, which included a draft Cyber Protection Team (CPT) tactics guide, to help identify the appropriate training curriculum for the 68 CPTs, refine CPT tactics, and identify metrics to assess CPT performance. CPT personnel were appreciative of these training opportunities, and DOT&E will continue to look for opportunities to engage with CPTs and provide CPT assessment results to U.S. Cyber Command.

DOD Enterprise Cyber-Range Environment (DECRE). The DECRE continued to mature its cyber-range capabilities, but at a slower pace than desired by U.S. Cyber Command, the training community, and the Research, Development, Test, and Evaluation community. Major accomplishments in FY14 by the DECRE components include:

- The Test Resources Management Center (TRMC) fielded the cloud-based Regional Service Delivery Point for enhanced range capability and connectivity.
- The Joint Staff J6 created several cyber environments in which to examine cyber effects not suitable for operational networks.
- The TRMC's National Cyber Range became fully operational and is now looking at ways to expand capacity to meet the growing demand for range events.

All of these DECRE accomplishments are positive and noteworthy, but the demand for repeatable, routine, and distributed events exceeds current capabilities, and demand is expected to increase significantly across the Future Years Defense Program.

Partnerships and Collaboration. Several Research and Development organizations have made existing lab environments available and performed important assessments to characterize the effects of cyber attacks. Mission areas examined included:

- Ballistic Missile Defense – DOT&E partnered with the Missile Defense Agency (MDA) to plan and execute four events of increasing complexity and realism to examine potential cyber vulnerabilities.
- Aegis – DOT&E partnered with Navy Red Team, Wallops Island and Dahlgren test facilities, and Combat Direction Systems Activity (Dam Neck) to characterize and understand vulnerabilities focused on the Aegis Combat Systems. Events provided information on the scope and duration of cyber effects to inform Program Office development.
- Command, Control, and Intelligence Systems – DOT&E partnered with the Joint Staff J6 Command, Control, Communications, and Computers Assessment Division to create an environment to examine cybersecurity aspects of the common operating picture and situational awareness systems. Events identified and characterized cyber effects to be introduced into training exercises. Continuing efforts will expand the systems and environment to explore a wider variety of cyber effects.

Both the MDA and the Navy have identified ways to improve cybersecurity for their respective programs through these assessment activities.

The Naval Postgraduate School developed a Malicious Activity Simulation Tool (MAST), which is ready for testing in realistic network environments. DOT&E is overseeing the efforts to test this capability on a cyber range to confirm readiness to support training and assessment of network personnel.

Several National Labs (Sandia National Labs, Johns Hopkins Applied Physics Lab, and MIT Lincoln Labs) delivered or are developing prototypes of new instrumentation and visualization capabilities, new products for traffic generation, and new ways to automate or virtualize network environments and activities. These new capabilities will help make cyber-range environments more operationally realistic, and will also help optimize the employment of range capabilities in repeatable and distributed events.

The Army's Threat Systems Management Office (TSMO) played a leading role in the planning and execution of many DOT&E-sponsored cyber-range experiments, identification and acquisition of new Red Team capabilities, testing and fielding of cyber-range Regional Service Delivery Points, and management and operation of the PCO. TSMO and the other Service Red Teams continued to provide Cyber OPFOR support to many of the FY14 exercise assessments, as well as acquisition testing. Other Service Red Teams also provided critical support in portraying cyber adversaries in exercise, tests, and range events.

TABLE 1. CYBERSECURITY ASSESSMENT PROGRAM EVENTS IN FY14		
EXERCISE AUTHORITY	EVENT	ASSESSMENT AGENCY
U.S. Africa Command	Epic Guardian 2014 (exercise cancelled, conducted as Site Visit)	ATEC
U.S. Central Command	Site Visit – Special Operations Command Central	ATEC
U.S. Cyber Command	Cyber Flag 2014	ATEC
U.S. European Command	No Assessment Opportunity	ATEC
U.S. Northern Command	Vigilant Shield 2014	AFOTEC
U.S. Pacific Command	Cyber Readiness Campaign Event – Physical Security	START
	Cyber Readiness Campaign Event – Network Hygiene	
	Cyber Readiness Campaign Event – Knowledge Management	
U.S. Southern Command	Site Visit – Joint Interagency Task Force South	ATEC
U.S. Special Operations Command	Tempest Wind 2014	ATEC
U.S. Strategic Command	Global Thunder 2014	JITC
	Global Lightning 2014	JITC
U.S. Transportation Command	Turbo Challenge 2014	JITC
U.S. Army	Warfighter 2014-4	ATEC
U.S. Navy	Valiant Shield 2014	COTF
U.S. Air Force	No Assessment Opportunity	AFOTEC
U.S. Marine Corps	Ulchi Freedom Guardian 2014	MCOTEA

AFOTEC – Air Force Operational Test and Evaluation Center
ATEC – Army Test and Evaluation Command
COTF – Commander, Operational Test and Evaluation Force
JITC – Joint Interoperability Test Command
MCOTEA – Marine Corps Operational Test and Evaluation Activity
START – Standing Test, Assessment, and Rehearsal Team

Cybersecurity OT&E of Acquisition Programs

In FY14, DOT&E approved cybersecurity test plans for 82 Service and DOD systems, including 62 Test and Evaluation Master Plans, 26 operational test plans, and 25 related test documents. DOT&E cybersecurity subject matter experts observed cybersecurity tests and reviewed test data for 21 systems across the warfare domains.

In August 2014, DOT&E issued updated procedures for OT&E of cybersecurity in acquisition programs. The procedures specify the information needed for planning, conducting, and reporting cybersecurity operational testing that includes a cooperative vulnerability and penetration assessment, and an adversarial assessment. The purpose of the cooperative assessment is to identify the cybersecurity vulnerabilities of a system in cooperation with the program manager and to allow the program to fix them. The adversarial assessment then evaluates the ability of a unit equipped with the system to support assigned missions in the expected operational environment in the presence of a realistic cyber threat.

FINDINGS, TRENDS, AND ANALYSIS

Assessment Structure

FY14 continued the FY13 trend of fewer exercises available or suitable for assessment; the impetus for this in FY13 was the sequester, and reductions in exercise funds continued into FY14 (see Figure 1). The assessments outside of an exercise reflect both the declining number of large-scale exercises and the implementation of focused opportunities to find, fix, and verify. Service-level assessment remained at a level of one per Service.

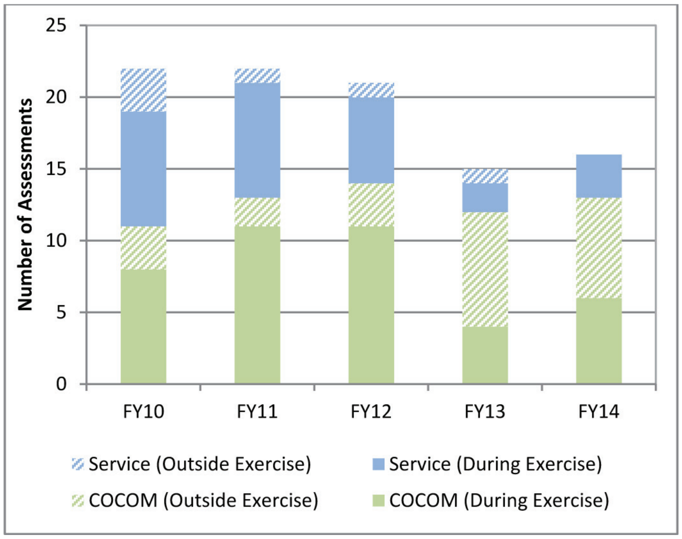


Figure 1. Cybersecurity Assessments FY10 – FY14

As in previous years, the most common adversary cyber activity permitted and portrayed during FY14 exercises was the compromise and exfiltration of critical operational information. The exercise authority's desire not to affect exercise operations usually prevented the opposing force from using the compromised information to influence operations. These limitations minimized the value of cybersecurity actions for training and assessment. In several exercises, exercise authorities allowed Red Teams to conduct some level of denial of service and data manipulation. This is a welcome move towards improving threat realism and the creation of observable mission effects.

FY14 assessments increasingly included active participation of the local network defenders and the next higher layer of network defense, the Tier 2 computer network defense service providers. The increased participation is a notable improvement over that observed in previous years, and enables assessment of both the local/proactive defenses (standards compliance, patch management, vulnerability management) and the defensive activities conducted at higher echelons that involve the detection, reaction, and response to cyber threats. Furthermore, realistic participation by network defenders is required for an adequate assessment of the ability of CCMDs and Service components to sustain critical missions when under cyber attack.

Assessment Findings

Red Teams portraying a Cyber OPFOR successfully accessed target networks primarily through vulnerable web services and social engineering (phishing). Similar to FY13, Red Teams routinely expanded access across networks using stolen credentials. The asymmetric nature of cyber operations allows even a single default or weak password to lead to rapid access and exploitation of the network. This is particularly true when the password belongs to an individual with elevated privileges. FY14 assessments revealed numerous violations of DOD password security policies, which indicates the policies are either too difficult to implement, too hard to enforce, or both.

On the other hand, compliance with relevant network security standards exceeded 85 percent overall, and compared to FY13, was higher in all areas except security design and configuration, and identification and authentication (passwords). Compliance assessments determine whether network defensive measures are in place. The generally poor defensive performance against dedicated attacks by Red Teams shows that a network is only as secure as its weakest link. Unless compliance levels approach 100 percent, it is likely a dedicated cyber adversary will succeed in accessing a network. Hence it is critical that network users and defenders learn to fight through and accomplish missions in the face of network security breaches.

In FY14, certain areas of network defense improved over previous years. Regional (Tier 2) computer network defense service providers, which provide key support to the local defenders, participated in half of the assessed exercises. Protective defense, in the forms of phishing discovery and perimeter defense configurations, prevented several attempted Red Team incursions. These successes reflect improved personnel awareness to recognize and report phishing emails, better filters for identifying and blocking phishing emails, and implementation of settings to block common intrusion techniques used in these emails. Defenses would be further improved by hardening outward-facing servers and limiting the amount of sensitive information available on public portals.

Some network defenders demonstrated the ability to detect intrusions by reviewing logs of network and sensor activity, and initiating actions to counter the adversary presence on the network. In over half of the FY14 assessments, local network defenders initiated these detections and responses, and coordinated the response with regional computer network defenders. Such coordinated responses, when executed well, can protect critical mission systems from cyber attacks.

In many cases, however, the response actions were not quick enough to preclude an intermediate or advanced cyber adversary from pivoting to another foothold or escalating privileges within the compromised network. Additionally, some responses were to reboot or reload software for systems believed to be compromised or in a degraded mode. Depending on the operational phase of the exercise, rebooting or reloading software denies users mission-critical services, and does not contribute to the commander's ability to fight through a cyber attack. Reloading software can also result in the loss of previously installed software patches, making systems more susceptible to cyber attack.

Although many of the elements of network protection and defense were observed in FY14 exercises, the lack of mature and well-rehearsed procedures often precluded effective integration of network defense capabilities, placing missions at risk. DOT&E assessed that at least one mission in each exercise assessment was at high risk because of observed cyber activities, including:

- Loss of operational security resulting from the compromise of sensitive information
- Data manipulation
- Denial of service

Several CCMDs have initiated development of Cyber Playbooks that are intended to achieve more accurate and timely execution of responses to cyber attacks. To encourage these efforts, and to evaluate their effectiveness, DOT&E initiated planning with three CCMDs to begin a focused examination of the CCMD's ability to sustain important missions when subjected to realistic cyber stress. These efforts will result in multi-year Cyber Assessment Master Plans (CAMPs) centered on the missions deemed most critical by the CCMDs. Execution of CAMPs will support implementation of the Chairman of the Joint Chiefs of Staff Execute Order, published in February 2011, and re-emphasized by the Secretary in December 2012, which required routine training and validation of procedures that enable execution of critical missions in contested cyber environments. To date, DOT&E has yet to observe a mission demonstration in an advanced cyber-threat environment.

DOT&E found significant vulnerabilities on nearly every acquisition program that underwent cybersecurity OT&E in FY14. Program managers worked to resolve vulnerabilities found from cybersecurity testing in prior years, but FY14 testing revealed new vulnerabilities. Corrections to past vulnerabilities have required modifications to system architecture; hardware, firmware, and configurations; system software; training; and operational procedures. As in FY13, significant vulnerabilities found during OT&E could have been found and/or remedied during earlier phases of development. Nearly all the vulnerabilities were discoverable with novice- and intermediate-level cyber threat techniques. The cyber assessment teams did not need to apply advanced cyber threat capabilities during operational testing.

DOT&E found that some programs had not adequately planned for cybersecurity testing. This resulted in insufficient time to perform adequate cooperative testing, implement fixes, and achieve successful adversarial testing results. It also negatively impacted the ability of cyber teams to plan and execute their test activities across different programs.

REPORTS

For the Cybersecurity Assessment Program, DOT&E issued an assessment report for each exercise or site visit that discussed observations, findings, and discovered vulnerabilities. DOT&E also issued separate reports to DOD, CCMD, and Service leadership highlighting high-priority observations. For OT&E of acquisition programs, DOT&E reported the cybersecurity test results as an integrated part of operational effectiveness, suitability, and survivability.

DOT&E also published five memoranda of findings in areas of concern in FY14. Finding memoranda detail specific problems that need senior leadership attention. DOT&E addressed the finding memoranda to the responsible leadership for action. DOT&E will evaluate corrective actions in future assessments.

New finding memoranda published in FY14 were:

- Defense Connect Online (Released November 2013). This was a follow-on to a September 2010 finding that reported means by which the DOD chat/collaboration system could be compromised. It reported on new findings as well as the efficacy of prior remediation. DISA has responded to this report noting corrections that will be made to the system in question.
- Host-Based Security System (Released April 2014). This was a follow-on to an October 2012 finding that reported shortfalls in how the DOD network security tool was providing inventory data. It reported on new findings of how the tool could be exploited. DISA/CIO have responded to this report noting the actions that will be taken to correct the finding.
- Electronic Security of Special Handling Documents (Released April 2014). This finding reported shortfalls regarding how sensitive Alternate Control Measure programs were being handled on classified networks. The Joint Staff, DOD CIO, and USD(I) have provided a coordinated response describing corrective measures that have or will be taken to address this finding.
- Shipboard Datalinks (Released June 2014). This finding reported on issues identified with off-ship datalink security. The Navy has responded with specific actions that are being taken to address the finding.
- Assessment of DOD Cybersecurity during Major Combatant Command and Service Exercises and Major Program Acquisitions (released September 2014). This detailed report provided classified observations and analysis concerning common vulnerabilities and issues uncovered during major exercises and acquisition tests. No response was required.

FY15 GOALS AND PLANS

A major goal of the Cybersecurity Assessment Program in FY15 is to assist the CCMDs and Services in improving their cybersecurity postures by finding cybersecurity problems, providing information to fix problems, and verifying the status of implemented fixes to previously discovered problems. An additional goal for cybersecurity OT&E is to implement the new test procedures to improve rigor and consistency of cybersecurity testing for acquisition programs.

Specific FY15 goals include:

- Publish finding memoranda to recommend solutions to significant cybersecurity problems that could have an impact on DOD missions.
- Include a "fix" phase in each of the planned assessments of nine large-scale training exercises, four operational site visits outside of exercises, and four cyber readiness campaigns having multiple events (see Table 2).
- Expand the Standing Ground Rule authorities for PCO operations to additional CCMDs.
- Ensure availability of certified and properly trained and equipped Red Teams to provide representative Cyber OPFOR support to OT&E and exercise assessments.
- Improve realism of the cyber threat levels and effects portrayed during all tests and assessments.
- Expand DOD cyber-range environments to support demonstration of advanced cyber effects, and development and verification of cybersecurity solutions.
- Publish a Handbook for the Cybersecurity Assessment Program to update the procedures, expectations, and requirements for cybersecurity assessments of CCMDs and Services.
- Work with DOD test organizations to plan more robust cybersecurity testing during OT&E, including participation by cyber defenders and the creation of mission effects.
- Provide technical recommendations to programs and acquisitions organizations based on the data gathered from cybersecurity assessments during OT&E.

TABLE 2. CYBERSECURITY ASSESSMENTS PROPOSED FOR FY15

EXERCISE AUTHORITY	EVENT	ASSESSMENT AGENCY
U.S. Africa Command	Judicious Response 2015	ATEC
U.S. Central Command	Site Visit – Air Forces Central Command	ATEC
	Site Visit – Marine Corps Forces Central Command	ATEC/MCOTEA
U.S. Cyber Command	Cyber Guard Exercises	JITC
U.S. European Command	Austere Challenge 2015	ATEC
	Cyber Readiness Campaign Events	ATEC
North American Aerospace Defense Command/U.S. Northern Command	Vigilant Shield 2015 Cyber Readiness Campaign Events	AFOTEC
U.S. Pacific Command	Cyber Readiness Campaign Events	START, AFOTEC, ATEC
U.S. Southern Command	Integrated Advance 2015	ATEC
U.S. Special Operations Command	To Be Identified	MCOTEA
U.S. Strategic Command	Global Lightning 2015	JITC
	Cyber Readiness Campaign Events	JITC
U.S. Transportation Command	Turbo Challenge 2015	JITC
U.S. Army	Warfighter 2015-4	ATEC
U.S. Navy	Joint Task Force Exercise – USS *Roosevelt*	COTF
U.S. Air Force	Site Visit – U.S. Pacific Air Forces	AFOTEC
U.S. Marine Corps	Site Visit II – Marine Expeditionary Force	MCOTEA

AFOTEC – Air Force Operational Test and Evaluation Center
ATEC – Army Test and Evaluation Command
COTF – Commander, Operational Test and Evaluation Force
JITC – Joint Interoperability Test Command
MCOTEA – Marine Corps Operational Test and Evaluation Activity
START – Standing Test, Assessment, and Rehearsal Team

Test and Evaluation Resources

Test and Evaluation Resources

Test and Evaluation Resources

Public law requires DOT&E to assess the adequacy of operational and live fire testing conducted for programs under oversight, and to include comments and recommendations on resources and facilities available for operational testing and evaluation (OT&E) and on levels of funding made available for OT&E activities. DOT&E monitors and reviews DOD and Service-level strategic plans, investment programs, and resource management decisions to ensure capabilities necessary for realistic operational tests are supported. This report highlights general areas of concern in testing current systems and discusses significant issues, DOT&E recommendations, and T&E resource and infrastructure needs to support operational and live fire testing. FY14 focus areas include:

- Adjustments to DOT&E FY15 Budget Request
- Army Support of OT&E
- Operational Test Agency Support for Missile Defense Testing
- Cyber Warfare
- Joint Strike Fighter (JSF) Advanced Electronic Warfare Test Resources
- Electronic Warfare for Land Combat
- Navy Advanced Electronic Warfare Test Resources and Environments
- Equipping Self-Defense Test Ship (SDTS) for Aegis Combat System, Air and Missile Defense Radar (AMDR) and Evolved SeaSparrow Missile (ESSM) Block 2 Operational Testing
- Multi-Stage Supersonic Targets
- Fifth-Generation Aerial Target
- Torpedo Surrogates for Operational Testing of Anti-Submarine Warfare (ASW) Platforms and Systems
- Submarine Surrogates for Operational Testing of Lightweight and Heavyweight Torpedoes
- Threat Modeling and Simulation (M&S) to Support Aircraft Survivability Equipment (ASE) Testing
- Foreign Materiel Acquisition Support for T&E
- Real-Time Casualty Assessment (RTCA)
- Joint Urban Test Capability (JUTC)
- Hypersonic Weapons Test Infrastructure
- Range Sustainability
- Continuing Radio Frequency Spectrum Concerns

Adjustments to DOT&E FY15 Budget Request

Action by the House Armed Services Committee (HASC), the Senate Armed Services Committee (SASC), the House Appropriations Committee, and the Senate Appropriations Committee on the FY15 budget request included:

- HASC and SASC approval of the President's Budget request in the FY15 National Defense Authorization Act.
- Appropriations increases for –
  - Cyber force training and resiliency ($10.0 Million)
  - U.S. Pacific Command cyber range training ($4.9 Million)
  - Cyber Red Team and training ($3.8 Million)
  - Threat Resources Analysis ($5.0 Million)
  - Joint T&E ($18.0 Million)

Army Support of Operational Test and Evaluation

For the fifth year in a row, the Army is reducing the funding level for the direct support of OT&E of Army programs. In FY10, the Army's budget for "Support of Operational Testing" (PE 0605712A) was ~$78.4 Million, and as of FY15, that budget is ~$49.2 Million (FY10 $45.4 Million), a 42 percent reduction from FY10 funding levels. In FY10, the Army's budget for the "Army Evaluation Center" (PE 0605716A) was ~$63.9 Million, and as of FY15, that budget is ~$55.0 Million (FY10 $50.8 Million), a 21 percent reduction from FY10 funding levels.

These cuts have resulted in staff level reductions in both the Army Operational Test Command (OTC) and the Army Evaluation Center (AEC) of approximately 22 and 25 percent, respectively, from FY10 to FY14. Further cuts in staff of 10 and 6 percent, respectively, are anticipated in FY16. These reduced staff levels are likely to cause delays to developmental and operational testing, the inability to conduct simultaneous operational test events, and longer timelines for the release of test reports. Delays in test execution and test reporting may delay acquisition decisions. The small savings generated by further reducing the staff of OTC and AEC may result in a cost penalty to acquisition programs that is proportional to spend rates multiplied by the duration of delay. Other smaller but still valuable programs may be delayed even longer, as priority will be given to the Major Defense Acquisition Programs.

These reductions to the Army T&E operational accounts are part of broader cuts that the Army has taken across the T&E enterprise, including in the office of the Army T&E Executive. The Army T&E Executive performs various critical roles managing the Army T&E enterprise and ensuring T&E adequacy within the Army and Chemical and Biological Defense Program (CBDP), including the following:

- Establishing, reviewing, and enforcing Army and CBDP T&E policy and procedures.
- Coordinating and facilitating communication with OSD on all T&E matters.
- Providing oversight and policy for the management and operation of the Headquarters, Department of the Army

(HQDA) Major Range and Test Facility Base activities and major investments. A roughly $1 Billion/year-enterprise.
- Managing the staffing and approval process for Army Test and Evaluation Master Plans that require HQDA and OSD approval.
- Supporting the Vice Chief of Staff Army by serving as a member of the Board of Directors Executive Secretariat.
- Administering the Army portion of the Under Secretary of Defense for Acquisition, Technology and Logistics' Central Test and Evaluation Investment Program and Resource Enhancement Program, and provide representation on the OSD Test Investment Coordinating Committee.
- Ensuring that threat-representative targets and threat simulators are validated to support accreditation for test.

In 2008, the Army eliminated the office of the Director, Test and Evaluation Management Agency (TEMA) within the Office of the Chief of Staff of the Army, and moved many of TEMA's responsibilities under the Army T&E Executive. The duties of these two offices are now being performed by a staff of 11 individuals, with an additional 12 individuals dedicated to the CBDP. This is a nearly 50 percent reduction over the past 5 years and staffing levels are now such that the ability of the Office to function effectively is at risk.

In a memorandum dated November 12, 2014, DOT&E recommended the Secretary of the Army reverse these trends. In particular, DOT&E recommends that the Army restore budgets that will maintain FY14 staffing levels at OTC and AEC, as well as assure staffing levels of the Army T&E Executive are consistent with its mission.

Operational Test Agency Support for Missile Defense Testing

The Ballistic Missile Defense System (BMDS) Operational Test Agency (OTA) is customer-funded by the Missile Defense Agency (MDA). The BMDS OTA's mission includes test planning and execution; system evaluation, analysis, and assessment; and system-level Modeling and Simulation (M&S) accreditation across the entire MDA. However, all BMDS OTA funding is channeled through the Test Directorate. Because of this structure, the BMDS OTA budget has suffered percentage cuts proportional to MDA test program budget reductions over the past two years. Further, as Congress has restored funding to the MDA test program, the BMDS OTA funding remained constant. Over the last two years, the BMDS OTA budget has been reduced $3.6 Million per year from its requested $16.1 Million per year, resulting in significant staff reductions. The Test Directorate recently reduced the BMDS OTA's FY15 budget an additional $1.0 Million to a total of $11.5 Million per year, and additional reductions are anticipated throughout the Future Years Defense Program. These cuts are not consistent with the BMDS OTA's mandate and have resulted in the BMDS OTA operating at risk in critical mission areas such as system-level M&S accreditation and Ground-based Midcourse Defense operational test and evaluation. The currently unfunded requirement for these two areas alone require an additional $1.3 Million per year funding for M&S accreditation and an additional $3.8 Million per year funding for Ground-based Midcourse Defense operational test and evaluation. DOT&E strongly recommends that the BMDS OTA funding line be 1) realigned at the agency level within MDA, and 2) restored to a level of funding appropriate to its entire mission.

Cyber Warfare

Experimentation, development, testing, training, and mission rehearsal of offensive and defensive cyber-warfighting capabilities require representative cyber environments. Such environments are created with distributed cyber ranges and labs that provide or host realistic network environments; emulation of adversary targets and offensive/defensive capabilities; and representative warfighter systems, network defenses, and operators. Cyber ranges and environments can be joined with other DOD ranges as critical enablers of operations in the air, land, sea, and space domains.

In FY11 and FY12, DOT&E proposed enhancements to existing facilities to create the DOD Enterprise Cyber Range Environment (DECRE) comprised of the National Cyber Range (NCR), the DOD Cybersecurity Range, the Joint Information Operations Range (JIOR), and the Joint Staff J-6 Command, Control, Communications, and Computers (C4) Assessments Division (C4AD). Approved enhancements include an additional $172 Million and 10 civilian positions for the DECRE, and are intended to provide:
- Consistent portrayal of operationally realistic, threat-representative cyber environments
- Expansion of JIOR operations capacity to plan and rigorously execute approximately 100 distinct events per year
- Upgrades to introduce cloud-based Regional Service Delivery Points
- Incorporation of technologies emerging from the NCR for rapid design, reconfiguration, and sanitization of networks
- Incorporation of various Live, Virtual, and Constructive capabilities
- Range environments where advanced cyber-attacks can be conducted to understand the scope and duration of cyber effects, and where training and tactics, techniques, and procedures development and validation can be performed
- Archival capabilities to record and play back live events, and blend mixes of live and previously-recorded events

The four elements of the DECRE received the first increment of new funding in FY14, and have begun to reverse some of the negative trends that motivated DOT&E to propose these enhancements. With assistance from DOT&E, the C4AD Team developed a high-fidelity environment to examine the effects of cyber-attacks on systems that support Combatant Commands' (CCMD) Common Operating Picture. This environment has performed multiple demonstrations to characterize potential cyber effects in this mission area, and several assessment teams for FY15 CCMD exercises will employ this environment to increase the threat realism of their assessments. C4AD is growing the operational and network realism of this and several other environments that they host.

Other environments in use or in development include those for missile defense, satellite systems, and remote testing of interoperability and cyber security by acquisition programs via connection to the DECRE. This last environment will permit a program manager to routinely access the archives of information-exchange requirements to confirm interoperability, subject system software to known cyber-attacks, and receive automated reports of the cybersecurity and interoperability status of the system software. C4AD and the T&E community will test this new environment in 2QFY15, and it should be accessible via the DECRE by the end of FY15.

The NCR experienced a substantial increase in customers in FY14, and needs to develop options for expanding significant NCR capabilities and making these accessible to a growing customer base. The Test Resource Management Center (TRMC), which oversees the NCR, has initiated studies to examine new capabilities to further expedite the planning, execution, and sanitization of NCR events.

The JIOR initiated an upgrade of its nearly 100 Service Delivery Points (SDPs) with the new Pico SDP, and plans to migrate to a new capability set that will interoperate fully with the new capability under development by the TRMC's Joint Mission Environment Test Capability (JMETC) Program (i.e., both JIOR and JMETC are migrating to a new set of interoperability standards that define the future DECRE). These migrations will provide efficiencies for the DOD, and will be essential to maximize the utility of the next-generation Regional SDP (RSDP) technology. The TRMC has completed assembly of the third RSDP and is resourced to build and deliver a new RSDP each year across the Future Years Defense Program. RSDPs are effectively cloud-based mini-ranges that can host virtual environments, instrumentation, and traffic generation capabilities, and connect to other nodes or RSDPs via the JIOR or JMETC.

As funding permits, DOT&E will initiate development of several additional environments each year, often driven by the need to characterize cyber effects that are not permissible on operational networks. DOT&E expects that these high-fidelity cyber environments will become essential to cybersecurity and interoperability assessments, OT&E, and also to the training of the DOD Cyber Mission Force being implemented by U.S. Cyber Command.

Although many improvements are in progress, DOT&E expects the demand for high-fidelity cyber environments and range events will continue to outpace the nascent DECRE capabilities. For example, U.S. Cyber Command alone estimates that the Cyber Mission Force will require more than 100 training activities each month, a great deal more than the current capability for 100 events per year across all DOD customers. DOT&E projects that by FY19, 160 range events will be needed annually to support OT&E for oversight programs, and many more by the Services for non-oversight programs. DOT&E also projects that in FY15, approximately 50 range events will be needed for various non-OT&E events that DOT&E will support on behalf of CCMDs and other partner organizations.

The integration of key U.S. and coalition range nodes and laboratories for distributed, secure, operationally realistic, and threat-representative cyber environments will further expand the demand. DOT&E will continue to monitor and report on the evolution of DECRE during FY15. DOT&E recommends that the currently fragmented management and resourcing of DECRE be consolidated under an Executive Agent with the authority to identify requirements, standards, and priorities across DECRE elements.

Joint Strike Fighter (JSF) Advanced Electronic Warfare Test

Since February 2012, when DOT&E identified shortfalls in electronic warfare test resources, progress in procuring these assets has been very slow. These shortfalls prevent development, testing, and timely fielding of U.S. systems capable of operating successfully against threats that currently exist, are proliferating, and are undergoing an accelerating pace of significant upgrades. While FY13-18 funding was identified to address these shortfalls, and this was updated in the FY15-19 budget, the delay in acting to use the funding is jeopardizing the opportunity to make the needed test resources available in time to support developmental and operational testing of systems, including the JSF. Capabilities under development in JSF, F-22 Increment 3.2 A/B, B-2 Defensive Management System, Long-Range Strike Bomber, Next Generation Jammer for the EA-18G, Countermeasures upgrades, as well as several other programs, require the combination of improved government-owned anechoic chambers and new open-air range test assets recommended by DOT&E. DOT&E recommendations and current statuses are shown in the table below.

TABLE 1. RECOMMENDATIONS ON ELECTRONIC WARFARE TEST RESOURCES

DOT&E Recommendation	Current Status
Developing a combination of open- and closed-loop threat radar simulators in the numbers required for operationally realistic open-air range testing of JSF and other systems beginning in 2018.	Risk reduction efforts have begun; however, the opportunity to procure the number and type of systems needed to represent the threat before 2018 is fleeting.
Upgrading the government anechoic chambers with adequate numbers of signal generators for realistic threat density.	Initial studies of materiel solutions to achieve realistic densities have begun • The Navy chamber has procured initial test support equipment for direct injection capability and executed a limited F-35 electronic warfare test in September 2014. • The JSF program has yet to develop plans to integrate chamber testing into the verification test strategy.
Upgrading the JSF mission data file reprogramming lab to include realistic threats in realistic numbers.	An initial study to determine upgrade requirements has begun.
Providing Integrated Evaluation and Analysis of Multiple Sources intelligence products needed to guide threat simulations.	Products have been completed and delivered, additional requests for information have been submitted.

Regarding the shortfall with respect to JSF testing and the time lost so far, the challenges to delivering the desired test environment so as to verify performance in the 2018 Initial Operational Test and Evaluation (IOT&E) can be largely overcome with efficient and aggressive use of the available funds. The risk of not doing so is two-fold: a) the JSF IOT&E of Block 3F capability will not be adequate—performance in the existing threat environment will not be known; b) the development environment sufficient and necessary for Block 4 will be late to meet the need.

Electronic Warfare for Land Combat

Networked mission command systems that support the commander's mission execution across the Brigade Combat Team (BCT) are a cornerstone of the Army's modernization plan. These integrated network capabilities are distributed throughout a combat formation and its support elements, from the brigade command posts down to the individual dismounted Soldier. Commanders using tactical network systems have the unprecedented ability to transfer information such as voice, video, text, position location information, and high-resolution photographs throughout the BCT, and provide individual Soldiers access to information needed to complete their mission. The expanded use of these radio frequency datalink-based systems also exposes the BCT to new electronic warfare threat vectors the enemy may utilize.

While the Army Threat Systems Management Office has continued to improve their threat electronic warfare simulator equipment, it has not kept pace with the advances in the tactical network systems or the known threat capabilities such as advanced jamming and direction-finding techniques. As the Army becomes more dependent on these sophisticated network technologies, it is critical that the developmental/operational test communities continue to identify vulnerabilities of these systems. Decision makers must understand these inherent vulnerabilities, as well as the ways in which an enemy may choose to exploit and/or degrade the network. These critical threat capabilities are needed to support testing of Warfighter Information Network – Tactical Increment 2, Nett Warrior, Mid-Tier Networking Vehicular Radio, Manpack radio, and Joint Battle Command – Platform. DOT&E recommends the Army make additional resources available to improve and expand its ground-based threat electronic warfare capabilities to support operational testing.

Navy Advanced Electronic Warfare Test Resources and Environments

Capability for Realistic Representation of Multiple Anti-Ship Cruise Missile (ASCM) Seekers for Surface Electronic Warfare Improvement Program (SEWIP) Operational Testing

This gap in test capability was identified in DOT&E's FY13 Annual Report as "Additional Electronic Warfare Simulator Units for Surface Electronic Warfare Improvement Program (SEWIP) Operational Testing." The Navy addressed it with development of a programmable seeker simulator that could represent different ASCM seekers by specifying the electronic waveform emission characteristics for one of several possible threats. The effective radiated power (ERP) was not among those characteristics, with the result that simulated attacks by ASCM representations displayed disparate levels of ERP that were unlikely to be encountered during a stream raid attack of two ASCMs (along the same bearing and elevation and within close proximity of one another). The programmable seeker simulator, termed the "Complex Arbitrary Waveform Synthesizer," needs to be modified such that its ERP more realistically represents the second ASCM of a dual ASCM stream raid.

The next SEWIP Block 2 OT&E is projected for FY19. This is to be followed by Follow-On Operational Test and Evaluation (FOT&E) on a Product Line Architecture-compliant DDG 51 with Block 2 actually integrated with the Aegis Combat System. This integration was not part of the Block 2 IOT&E. Subsequent FOT&E would be with the DDG 1000 and CVN-78 combat systems. Estimated cost to add the ERP improvement is $5.0 Million.

Long-Term Improvement in Fidelity of ASCM Seeker/Autopilot Simulators for Electronic Warfare Testing

This gap in test capability was identified in DOT&E's FY13 Annual Report due to the continued reliance on manned aircraft for captive-carry of the ASCM seeker simulators. Such simulators will be unable to demonstrate kinematic response to electronic attack by SEWIP Block 3. The manned aircraft fly too high and too slow for credible ASCM representation and are unable to represent ASCM maneuvers. Credible ASCM representation requires a vehicle that can fly at subsonic ASCM speeds and lower altitudes than the current Lear Jets; can home on a platform representing a SEWIP Block 3-mounted ship, using a threat-representative radar seeker and autopilot; and can respond realistically to Block 3 electronic jamming. Plausible approaches might include:

- Recoverable, unmanned aerial vehicles using embedded, miniaturized simulators that are maneuverable at ASCM speeds and altitudes
- Encrypted telemetry to track seeker/autopilot responses to electronic attack
- Human-controlled override capability
- Use of an unmanned, remotely controllable Self-Defense Test Ship (SDTS) that would tow a ship target for the unmanned aerial vehicles to home on. SEWIP Block 3 would be mounted on the SDTS, as would hard-kill elements (missile and gun systems) such that the integrated hard-kill/soft-kill (Block 3) combat system could demonstrate capability. Currently, such testing is at the combat system element level, leaving integrated combat system capability unknown.

SEWIP Block 3 IOT&E is projected for FY19. FOT&E of Block 3 integrated with the DDG 1000 combat system, as well as FOT&E with the CVN-78 combat system, should occur subsequent to the IOT&E. Estimated costs are $120.0 Million for development, testing, and acquisition. Estimated unit cost is $15.0 Million.

Equipping Self-Defense Test Ship (SDTS) for Aegis Combat System, Air and Missile Defense Radar (AMDR) and Evolved SeaSparrow Missile (ESSM) Block 2 Operational Testing

The close-in ship self-defense battle space is complex and presents a number of challenges for OT&E. For example, this environment requires:

- Weapon scheduling with very little time for engagement
- AMDR and Close-In Weapons System (CIWS) (to deal with debris fields due to previous successful engagements of individual ASCMs within a multi-ASCM raid)
- Rapid multi-salvo kill assessments for multiple targets
- Transitions from ESSM Command Midcourse Guidance mode to Home-All-the-Way guidance mode
- Conducting BMD and area air defense missions (i.e., integrated air and missile defense) while simultaneously conducting ship self-defense
- Contending with stream raids of multiple ASCMs attacking along the same bearing, in which directors illuminate multiple targets (especially true for maneuvering threats)
- Designating targets for destruction very close-in by CIWS

Multiple hard-kill weapons systems operate close-in, including the Standard Missile 2 (SM-2), the ESSM, and the CIWS. Soft-kill systems such as Nulka Mk 53 decoy launching system also operate close-in. The short timelines required to conduct successful ship self-defense place great stress on combat system logic, combat system element synchronization, combat system integration, and end-to-end performance.

Navy range safety restrictions prohibit close-in testing on a manned ship because the targets and debris from successful intercepts will pose an unacceptable risk to the ship and personnel at the ranges where these self-defense engagements take place. These restrictions were imposed following a February 1983 incident on the USS *Antrim* (FFG 20), which was struck with a subsonic BQM-74 aerial target during a test of its self-defense weapon systems, killing a civilian instructor. The first unmanned, remotely controlled SDTS (the ex-*Stoddard*) was put into service that same year. A similar incident occurred in November 2013, where two sailors were injured when the same type of aerial target struck the USS *Chancellorsville* (CG 62) during what was considered to be a low-risk test of its combat system. This latest incident underscores the inherent dangers of testing with manned ships in the close-in battlespace.

While the investigation into the *Chancellorsville* incident has caused the Navy to rethink how they will employ subsonic and supersonic aerial targets near manned ships, the Navy has always considered supersonic ASCM targets a high risk to safety and will not permit flying them directly at a manned ship. The Navy has invested in a current at-sea, unmanned, remotely-controlled test asset (the SDTS) and is using it to overcome these safety restrictions. The Navy is accrediting a high-fidelity M&S capability utilizing data from the SDTS, as well as data from manned ship testing, so that a full assessment of ship self-defense capabilities of non-Aegis ships can be completely and affordably conducted. While the Navy recognizes the capability as integral to the test programs for certain weapons systems (the Ship Self-Defense System, Rolling Airframe Missile Block 2, and ESSM Block 1) and ship classes (LPD-17, LHA-6, Littoral Combat Ship, LSD 41/49, DDG 1000, and CVN-78), they have not made a similar investment in an SDTS equipped with an Aegis Combat System, AMDR, and ESSM Block 2 for adequate operational testing of the DDG 51 Flight III Destroyer self-defense capabilities. The current SDTS lacks the appropriate sensors and other combat system elements to test these capabilities.

On September 10, 2014, DOT&E issued a classified memorandum to the Under Secretary of Defense for Acquisition, Technology and Logistics with a review of the Design of Experiments study by the Navy Program Executive Office for Integrated Warfare Systems, which attempted to provide a technical justification to show the test program did not require an SDTS to adequately assess the self-defense capability of the DDG 51 Flight III Class Destroyers. DOT&E found that the study presented a number of flawed justifications and failed to make a cogent argument for why an SDTS is not needed for operational testing.

DOT&E recommends equipping an SDTS with capabilities to support Aegis Combat System, AMDR, and ESSM Block 2 OT&E to test ship self-defense systems' performance in the final seconds of the close-in battle and to acquire sufficient data to accredit ship self-defense performance M&S. The estimated cost for development and acquisition of these capabilities over the Future Years Defense Program is approximately $284 Million. Of that, $228 Million would be recouped after the test program completes by installing the hardware in a future DDG 51 Flight III Destroyer hull. The Navy previously agreed with this "re-use" approach in their December 2005 Air Warfare/Ship Self Defense Test and Evaluation Strategy stating that "…upon completion of testing and when compatible with future test events, refurbish and return the test units to operational condition for re-use."

Multi-Stage Supersonic Targets (MSST)

The Navy initiated a $120 Million program in 2010 to develop an adequate multi-stage supersonic target (MSST) required for adequate operational testing of Navy surface ship air defense systems. The MSST is critical to the DDG 1000 Destroyer, CVN-78 Aircraft Carrier, DDG 51 Flight III Destroyer, AMDR, Ship Self-Defense System, Rolling Airframe Missile Block 2, and ESSM Block 2 operational test programs. The MSST program is currently undergoing a re-structure/baseline to address technical deficiencies as well as cost and schedule breaches that will postpone its initial operational capability (IOC) to late CY19. FY15 decrements to the MSST program will delay MSST IOC until late CY20, further delaying the completion of operational testing for those programs.

Fifth-Generation Aerial Target

Current aerial targets, including the QF-16 (in development) and sub-scale drones, do not adequately represent fifth-generation fighter capabilities, including low observability, low probability of intercept sensors, and embedded electronic attack. Aerial targets with the capacity to represent these characteristics are required for the operational test adequacy of U.S. air-to-air and surface-to-air weapons systems. With the projected deployment of foreign fifth-generation fighters in the next five years, the feasibility of completing operationally realistic testing will decline significantly without a new full-scale aerial target solution. The risk to the DOD in assessing the mission effectiveness of surface-to-air and air-to-air missile weapon systems will be unacceptable without a representative fifth-generation aerial target. Over the next decade, the production and proliferation of foreign fifth-generation fighter aircraft will enhance their Anti-Access/Area Denial capabilities and, without question, challenge U.S. air superiority in future conflicts. Current weapon system testing is limited to segmented approaches using a combination of captive carry against the F-22 and live-fire against sub-scale and fourth-generation full-scale aerial targets. The capacity to conduct end-to-end testing, from weapon system radar acquisition and tracking, missile launch, and post-launch seeker acquisition to end-game fusing against a fifth-generation fighter threat with electronic attack capabilities does not exist and constitutes a critical shortfall.

DOT&E initiated studies in 2006 on the design and fabrication of a dedicated fifth-generation aerial target to evaluate U.S. weapon systems effectiveness. The study team, comprised of Air Force and Navy experts, retired Skunk Works engineers, and industry, completed a preliminary design review for a government-owned design. DOT&E requested $83 Million in the FY15 program review to complete final design, tooling, and prototyping efforts. U.S. industry and the Canadian Government informally expressed interest in potential public-private partnership opportunities to develop this target system.

Torpedo Surrogates for Operational Testing of Anti-Submarine Warfare (ASW) Platforms and Systems

Operational testing of ASW platforms and related systems includes the ability to detect, evade, counter, and/or destroy an incoming threat torpedo. The determination of system or platform performance is critically dependent on a combination of the characteristics of the incoming torpedo (e.g., dynamics, noise, fusing, sensors, logic, etc.). Due to differences in technological approach and development, U.S. torpedoes are not representative in many of these torpedo characteristics for many highly proliferated torpedoes, particularly those employed in Anti-Surface Warfare by other nations. Operational testing that is limited to U.S. exercise torpedoes will not allow the identification of existing limitations of ASW systems and related systems against threat torpedoes and will result in uninformed decisions in the employment of these same systems in wartime. A January 9, 2013 DOT&E memorandum to the Assistant Secretary of the Navy (Research, Development & Acquisition) identifies specific threat torpedo attributes that the threat torpedo surrogate(s) must be evaluated against. The non-availability of threat-representative torpedo surrogates will prevent adequate operational testing for ASW platforms and related systems, as well as adversely affect tactics development and validation of these tactics within the fleet.

Naval Undersea Warfare Center (NUWC) Division Keyport commenced a study of threat torpedo surrogates in FY14. The $480,000 study is jointly funded by the Navy and DOT&E. The study focuses on the identification of capability gaps between existing torpedo surrogates and threat torpedoes. The study will provide an analysis of alternatives for improvements to current torpedo surrogates and development of new torpedo surrogates that address critical gaps in threat representation.

NUWC Division Keyport is also pursuing a prototype technology development project that will deliver a threat-representative high-speed quiet propulsion system. The development of a propulsion system prototype will leverage the critical gaps identified in the torpedo threat surrogate capability gap analysis, discussed in the preceding paragraph. This effort is funded by DOT&E at approximately $1.0 Million with delivery in 4QFY16. The NUWC Division Keyport study and prototype development could support future development of a threat torpedo surrogate. Procurement of adequate threat torpedo surrogates, however, is dependent on future Navy decisions. DOT&E believes further development and production of threat torpedo surrogates will benefit from an enterprise approach to prevent burdening a single acquisition program.

Submarine Surrogates for Operational Testing of Lightweight and Heavyweight Torpedoes

The Navy routinely conducts in-water operational testing of lightweight and heavyweight ASW torpedoes against manned U.S. Navy submarines. Although these exercise torpedoes do not contain explosive warheads, peacetime safety rules require that the weapons run above or below the target submarine with a significant depth stratum offset to avoid collision. While this procedure allows the torpedo to detect, verify, and initiate homing on the target, it does not support assessment of the complete homing and intercept sequence. One additional limitation is the fact that U.S. nuclear attack submarines may not appropriately emulate the active target strength (sonar cross-section) of smaller threats of interest, such as diesel-electric submarines. During the Mk 50 lightweight torpedo operational test, the Navy conducted some limited set-to-hit testing against manned submarines, which included impact against the target hull, but that practice has been discontinued.

In preparation for the 2004 Mk 54 lightweight torpedo operational test, DOT&E supported the development and construction of the unmanned Weapon Set-to-Hit Torpedo Threat Target (WSTTT) using Resource Enhancement Project funding. The WSTTT was a full-sized steel mockup of a small diesel-electric submarine, with an approximate program cost of $11 Million. As a moored stationary target, the WSTTT was limited in its ability to emulate an evading threat but its use in the Mk 54 operational test demonstrated the value of such a dedicated resource. Unfortunately, the Navy did not properly maintain the WSTTT and abandoned it on the bottom of the sea off the California coast in 2006. In subsequent years, the Navy was able to make some limited use of the WSTTT hulk as a bottomed target for torpedo testing.

In a separate effort, the Navy built the Mobile Anti-Submarine Training Target (MASTT), designed to serve as a full-sized threat surrogate for use in training by surface and air ASW forces. The Chief of Naval Operations initiated the program in 2010 with the goal of achieving operational capability by late 2011. After four years and an expenditure of approximately $15 Million, the Navy has yet to use the MASTT in training and seems to be on the brink of abandoning the asset. The Navy resisted design input from the operational test community and made it clear that the MASTT was not intended to support torpedo testing.

In support of a 2010 Urgent Operational Need Statement, the Navy funded the construction of the Steel Diesel-Electric Submarine (SSSK), a full-sized moored set-to-hit target consisting of an open steel framework with a series of corner reflectors to provide appropriate sonar highlights. The Navy used the SSSK as a target for the Mk 54 torpedo in a 2011 Quick Reaction Assessment and 2013 FOT&E. As part of the Test and Evaluation Master Plan approval for the latter, DOT&E sent a memorandum indicating that the Navy must develop an appropriate mobile target to support future Mk 54 testing.

Since early 2013, DOT&E has participated in a Navy working group attempting to define the requirements for a mobile set-to-hit torpedo target. The group has identified a spectrum of options and capabilities, ranging from a torpedo-sized vehicle towing a long acoustic array to a full-sized submarine surrogate. At the very least, the target is expected to be mobile, autonomous, and certified for lightweight torpedo set-to-hit scenarios. More advanced goals might include realistic active and passive sonar signatures to support ASW search and reactive capability to present a more realistically evasive target. Cost estimates range from under $10 Million for a towed target to over $30 Million for a full-sized submarine simulator.

Threat Modeling and Simulation (M&S) to Support Aircraft Survivability Equipment (ASE) Testing

Building actual threat representations for widespread testing is expensive; therefore, DOT&E focused on funding incremental efforts that advance the use of authoritative threat M&S for systems T&E. Although threat M&S capabilities have been used in T&E for many years, these were not always threat-representative, and different M&S instantiations of the same threats produced different results. DOT&E's objective is to improve the consistency of threat M&S at various T&E locations while reducing overall costs.

Throughout the T&E processes, M&S represents threats when actual threat components are not available; provides more complete testing than possible through open-air and hardware-in-the-loop test facilities; and provides testing when operational reasons such as flight safety preclude physical tests, especially with crew. For example, test programs may conduct 10 – 20 live threat missile firings using actual threats. Using threat M&S extends those results across a much larger range, typically 20,000 cases covering different threats, ranges, altitudes, aspect angles, atmospheric conditions, and other environmental variables affecting weapon system performance.

DOT&E implemented controls and distribution management for threat M&S to ensure integrity for realistic T&E and to ensure test results were not affected by using various threat M&S across T&E regimes. The T&E Threat M&S Configuration Management System provides mechanisms to effectively identify and correct anomalies between threats and threat representations, maintain critical documentation such as interface descriptions and validation documents, control model configuration changes, and disperse updated threat M&S to multiple T&E facilities for consistency. The T&E Threat M&S Configuration Control Board, comprised of representatives from intelligence organizations and the T&E community, prioritizes existing threat M&S developments and changes to ensure updates are provided efficiently to T&E user facilities. Requests for T&E threat M&S, report anomalies, or request changes are managed through an interface on DOD's Secret Internet Protocol Router Network.

During FY14, the T&E Threat Resource Activity provided standardized and authoritative threat M&S to multiple T&E facilities operated by the Army, Navy, and Air Force who implemented them into various T&E uses supporting Aircraft Survivability Equipment (ASE) testing. DOT&E also engaged close U.S. allies to implement same threat M&S for allied T&E, leveraging worldwide implementation of standard, authoritative threat M&S capabilities for T&E.

DOT&E also developed a threat M&S roadmap for ASE T&E to provide a comprehensive plan and to prepare future test capabilities using standardized and authoritative threat M&S. For example, Joint Standards Instrumentation Suite captures threat data from live fire test events to support threat M&S development. Starting with a systematic analysis of problems and projects that support effective testing, the roadmap lays out a path for the development of threat-representative test M&S to support U.S. and allied missile warning and infrared countermeasure systems. DOT&E estimates that $10 to 13 Million will be needed between FY16 – 20 to fully implement this roadmap.

Foreign Materiel Acquisition Support for T&E

DOT&E is responsible for ensuring U.S. weapons systems are tested in realistic threat environments. Ideally, operational testing should use actual threat systems to create realistic threat environments. Because limited resources are available to acquire foreign threats, DOT&E annually develops a prioritized list of threat requirements tied to upcoming testing of programs on the OSD T&E Oversight List and submits them to the Defense Intelligence Agency Joint Foreign Materiel Program Office. These requirements are consolidated with Service needs and then processed through various Service and intelligence community collection activities. DOT&E then coordinates with the Department of State to identify sources and increase opportunities to acquire foreign materiel for use in operational test and evaluation.

Foreign materiel requirements span all warfare areas, but recently DOT&E has placed a priority on the acquisition of Man-Portable Air Defense Systems (MANPADS) to address significant threat shortfalls that affect testing for infrared countermeasures (IRCM) programs like Common IRCM (CIRCM), Large Aircraft IRCM (LAIRCM), and Department of the Navy (DoN) LAIRCM. In many cases, hundreds of MANPADS are required for the development of threat M&S, for use in hardware-in-the-loop laboratories, and for live-fire T&E, all to present realistic threats to IRCM equipment. Using actual missiles with actual missile seekers aids evaluators in determining the effectiveness of IRCM equipment, but is also invaluable in development of effective countermeasures throughout the U.S. weapon system's life.

Due to the inherent challenge of developing reliable sources for foreign materiel, negotiating the acquisition of foreign materiel, and the difficulty of using annual appropriations for foreign materiel acquisitions, DOT&E recommends establishment of dedicated, non-expiring funding authority to support foreign materiel acquisitions.

Real Time Casualty Assessment (RTCA)

Force-on-force battles between tactical units are the best method of achieving a realistic environment in which to conduct operational testing of land and expeditionary warfare systems. Simulated force-on-force battles must contain realism to cause Soldiers in their respective units to make tactical decisions and react to the real-time conditions on the battlefield. Real Time Casualty Assessment (RTCA) systems integrate Live, Virtual, and Constructive components to enable these simulated force-on-force battles. RTCA capability provides a means for simulated engagements to have realistic outcomes based on the lethality and survivability characteristics of both the systems under test and the opposing threat systems. RTCA systems must replicate the critical attributes of real-world combat environments such as direct and indirect fires, Improvised Explosive Devices and mines, realistic battle damage, and casualties. RTCA systems must record the time-space position information and firing, damage, and casualty data for all players in the test event. Post-test playback of these data provides a critical evaluation tool to determine the combat system's capability to support Soldiers/Marines as they conduct combat missions.

DOT&E has requested that Army Test and Evaluation Command (ATEC) use its available RTCA capability to improve operational realism and to provide RTCA data collection and post-event playback in support of the operational testing of land combat systems. During FY14, two separate systems, The ATEC Player and Event Tracking System (TAPETS) and the Homestation Instrumentation Training System (HITS), were used by ATEC to provide RTCA. Both interface with the Instrumentable Multiple Integrated Laser Engagement System (I-MILES) for direct fire engagement simulation.

TAPETS/I-MILES, the legacy RTCA system operated by Army Operational Test Command (OTC), was used successfully during Network Integration Evaluation (NIE) 14.1 and NIE 14.2. The birds-eye-view playback of data collected during NIE 14.1 proved to be instrumental during the evaluation of the AN/PRC-117G radio, and data collected during NIE 14.2 supported the evaluation of the AN/PRC-155 Manpack radio. ATEC should continue to work to optimize the current TAPETS/I-MILES system and look for ways to reduce its operational costs. The Army should update the probability of kill tables that are the foundation of I-MILES engagements, as they have not kept pace with the fielding of new vehicles and onboard communication and networking equipment.

The Army developed HITS to provide tactical engagement simulation for units during force-on-force training; this capability already exists on a number of Army training installations. HITS/I-MILES were used to support the Joint Light Tactical Vehicle Limited User Test at Fort Stewart, Georgia. This is the first attempted use of HITS to support OT&E, and early indications are that HITS has some shortfalls as a test tool. Most significantly, the HITS system is not able to save its database to support post-test analysis and playback, which reduces its effectiveness as an evaluation tool. The Army should make the necessary modifications to the HITS software immediately so that it can continue to be used to support testing.

These proposed near-term improvements to HITS and TAPETS will give ATEC the flexibility to select the most capable and cost-effective RTCA instrumentation available based on where operational test is being conducted. In support of future test requirements, the Army created a new program within the Project Manager Instrumentation, Targets, and Threat Systems called RTCA Integrated Test Live, Virtual, and Constructive Environment (ITLE). ITLE will provide a much-needed stream of funding to address the shortfalls identified in the recent ATEC RTCA study. These shortfalls include improving the ability to seamlessly simulate indirect fire weapons, IEDs/mines, and air-to-ground/ground-to-air combat. DOT&E is encouraged by the increase in resources the Army has dedicated to RTCA development and use. RTCA is essential to realistic force-on-force testing of current and future land and expeditionary warfare systems, and DOT&E requires RTCA for systems such as Family of Light Amphibious Vehicles, Bradley and Abrams Upgrades, Armored Multi-purpose Vehicle, AH-64E Block III, Joint Light Tactical Vehicle, and Stryker upgrades. The estimated cost to make the necessary improve to the ATEC RTCA systems is $40 Million over the next five years. The Army has made a commitment that is commensurate with this need.

Joint Urban Test Capability (JUTC)

Operations in urban environments present unique challenges to Service members and their equipment. Degraded mobility, communications, and situational awareness; a large civilian presence; the risk of collateral damage; reduced stand-off distances; and unique threat profiles are some of the conditions present during urban operations. These challenges underpin the requirement that systems be tested in operationally realistic urban environments.

The Army is currently developing the Joint Urban Test Capability (JUTC) at White Sands Missile Range with funding provided by the OSD Central Test and Evaluation Investment Program. DOT&E is supportive of the JUTC requirement, but the proposed physical surface urban area of 200 meters by 240 meters is not large enough to support operational testing of mechanized units of company size and greater. The remote location chosen for JUTC will make support of operational testing difficult, which could limit its utilization. DOT&E recommends the urban area be expanded to the JUTC objective requirement of 900 meters by 900 meters originally proposed in the Urban Environment Test Capability study, and that the proposed location be reconsidered to support future operational test events. The cost of the current JUTC effort is estimated at $75-95 Million.

Hypersonic Weapons Test Infrastructure

After 60 years of research, the U.S. is on the verge of developing operational hypersonic weapons. The United States is not alone in its pursuit of these capabilities and, as recently noted by the Acting Assistant Secretary of Defense for Research and Engineering, "We…do not want to be the second country to understand how to control hypersonics." Hypersonic weapons will present a challenge to potential adversaries that have invested in anti-access and area-denial capabilities. Consequently, the U.S. Air Force Chief of Staff has identified hypersonic weapons as one of five "game-changing" technologies in Air Force strategic planning.

The current U.S. hypersonic T&E infrastructure is not adequate to accomplish critical operational or developmental test objectives, reduce risk, and adequately inform acquisition decisions for hypersonic weapon programs. There are gaps in important ground test capabilities for aero-propulsion, aerodynamic, aerothermodynamic, and material evaluation, and in test assets for lethality, sensor integration and guidance, navigation, and control. Current flight test ranges cannot support over-the-horizon testing of long-range hypersonic weapons. Modeling & simulation tools are not mature enough to supplement ground and flight testing.

In the past 20 years, over half of the nation's hypersonic T&E ground facilities built in the 1950s through the 1970s to support U.S. space and missile programs have been closed or demolished. Many of the remaining 19 "critical," one of a kind hypersonic Research, Development, and T&E facilities are in poor or dilapidated condition from fiscal neglect. For example, in one of the most critical hypersonic test facilities, plastic tarps are being used to prevent sensitive equipment from damage by rainwater leaking through the roof. Adequate hypersonic test infrastructure is required to support the development of engineers and technicians skilled in hypersonics. The shrinking and aging workforce is currently insufficient to support future hypersonic testing needs.

Without additional investment in hypersonic T&E infrastructure and personnel, hypersonic weapon acquisition programs will need to rely on expensive and high-risk flight tests, without adequate precursor ground testing. Premature, catastrophic termination of four out of six recent test flights for the X-51, Advanced Hypersonic Weapon and Hypersonic Technology Vehicle 2 underscore that cost and risk. Existing ground-based hypersonic T&E facilities that help prevent future flight test failures are already overtaxed. As hypersonic programs mature, ground test requirements will increase. The Test Resource Management Center (TRMC) estimates the requirement for additional hypersonic T&E resource investments from FY16–20 at $330 Million.

DOT&E recommends funding these investments to address existing hypersonic T&E gaps, and to better maintain current hypersonic T&E infrastructure, without which the U.S. will risk ceding the advantage of hypersonic weapons to potential adversaries.

Range Sustainability

DOT&E must advocate for the testing of new and upgraded military capabilities in the most realistic threat-representative environment possible. Due to safety and security imperatives, these environments are limited to geographic areas set aside for military testing and training. DOD test and training ranges are located in once-remote and relatively-undisturbed areas of the country—the same areas that today are sought after for development of renewable energy and associated electrical power transmission infrastructure. Yet energy encroachment is not the only impact to a robust and sustainable range infrastructure. Other factors continue to challenge DOD's ability to test advanced weapons systems in real-world, open-air environments throughout systems' operational envelopes. These include populations moving into these same areas, incompatibility issues from urban growth, competition for resource use (e.g., water, land, airspace, frequency spectrum), an increasing number of (and associated requirements to protect) listed and candidate-threatened and endangered species, and increased government regulation. Already, test envelopes to evaluate weapons systems are constricted due to increased combat radii for threat engagement. The Major Test and Range Facility Base is also threatened by the impacts of extreme weather and potential water shortages and other effects from a changing climate.

As reflected in past annual reports, DOT&E has engaged on behalf of the DOD test community to ensure required capabilities remain available to test DOD systems' effectiveness, reliability, and lethality. Two current major areas of concern are availability of frequency spectrum (addressed later in this section) and encroachment posed by the development of renewable energy and transmission line projects. This new form of encroachment risks the Department's ability to test systems under realistic conditions using operational resources. While M&S is used increasingly for testing, development of realistic models requires data that can only be obtained from live testing.

DOT&E is a co-chair of the DOD Siting Clearinghouse, along with the Deputy Under Secretary of Defense for Installations and Environment and the Deputy Assistant Secretary of Defense for Readiness (DASD(Readiness)). The number of projects received by the Clearinghouse under the Federal Aviation Agency Obstruction Evaluation Airport Airspace Analysis (FAA/OE-AAA) process increased by 13 percent from FY13 to FY14 (from an average of 173/month to 220/month). Of the total number of projects, 14 currently under review have a significant potential impact on DOD range capabilities in the absence of acceptable mitigations. In addition, there are other renewable energy and electrical power transmission infrastructure project that have potential impact to test capabilities that have been addressed with other Federal Departments and Agencies.

Mitigation measures such as curtailment of wind turbine operations during test periods, identification of alternative siting for renewable energy infrastructure, alternative siting for affected tests, and updates to DOD test hardware and software are considered during review of each proposed projects. In addition, research is being pursued to determine the effect various renewable energy projects may have on DOD's instrumentation capabilities, such as from electromagnetic interference from electrical power transmission infrastructure, and glint and glare from utility-scale solar energy projects. The Department has invested significant time and resources over the past three years to identify the impact of wind turbines on ground-based and airborne radars, and this investment may help mitigate interference of wind turbines with test range infrastructure. Additionally, the advent of electrical power transmission infrastructure near the test and training ranges can be an obstruction to low-level flight tests, and mitigation options such as burial of the power line may be required.

Over the coming year, DOT&E will continue to work with the Clearinghouse, the TRMC, the Deputy Under Secretary of Defense for Installations and Environment, DASD(Readiness), Military Departments, and other Federal Departments and Agencies, such as the FAA and Department of the Interior, to refine processes for resolving compatibility issues between renewable energy projects and DOD test and training requirements.

Continuing Radio Frequency Spectrum Concerns

Test range use of frequency spectrum continues to be challenged by pressures to repurpose spectrum to broadband wireless and other uses such as medical telemetry and wireless microphone use. DOT&E documented the pending loss of 1755 – 1780 MegaHertz (MHz) and compression into 1780 – 1850 MHz in its FY13 Annual Report. Table 2 illustrates the frequency bands used for test and evaluation and identifies resource issues and their potential mitigations. An additional development during 2014 is the DOD's work to implement its Electromagnetic Spectrum Strategy (EMS), as well as understanding of how implementation will affect DOD testing. Adequate frequency spectrum is a critical resource for testing. It is required to both upload and download test data between the article being tested to test instrumentation, and to control resources during test operations.

The spectrum allocated is used full time during the range day (i.e., from 6:00am to 6:00pm), and continued unimpeded use is vital to accommodate the increasing volume of test data (e.g., that of the F-35 JSF). As Table 2 points out, both the range's primary L- and S-bands are now being targeted for repurposing to broadband wireless use. The cost impacts to the Services' T&E infrastructure for transitioning capabilities from the L-band are:

- Army – $27.7 Million is required to retrofit the Aerial Telemetry Systems (AMTs) at White Sands Missile Range that are operating in the 1755 – 1850 MHz band. With the loss of the lower 25 MHz (1755 – 1780 band), the proposed solution is to compress operations of the AMTs into the retained 1780 – 1850 MHz band without having to relocate/transition into another spectrum. $1 Million is required to replace three point-to-point datalinks at Aberdeen Test Center that are operating in the 1755 – 1780 MHz band. New equipment will be installed to operate in the 4 GigaHertz (GHz) (C-band) to accommodate testing of robotics which will be relocating to 4 GHz.
- Navy – $180 Million for transitioning Aeronautical Mobile Telemetry using an approved transition plan.
- Air Force – $100 Million over 5 to 8 years to modify 95 antennas, 628 receivers, and 53 transmitters for compressing aeronautical telemetry into the 1780 – 1850 MHz band.

The test ranges' primary band for telemetry, 1435 – 1525 MHz, has two pressing challenges. The first is from pending Federal Communication Commission rulemaking to allow shared use with wireless microphones used for major concerts and sports events, and the second from proposed World Radiocommunications Conference (WRC) repurposing for worldwide wireless broadband use. The first issue can be mitigated, as has been worked between DOD and industry, through adoption of use agreements (such as not-to-interfere agreements) and use of electronic keys to coordinate use. The second issue, WRC re-purposing the spectrum for worldwide broadband use, is more difficult for the test ranges. Canada has engaged with DOD and the aircraft industry to define protection methodologies, and Mexico has been approached to work mitigation strategies. Due to the location of many of the test ranges in the Southwest continental United States and aircraft manufacturers' testing proximate to the U.S. and Canadian border, repurposing of the 1435 – 1525 MHz spectrum is of major concern.

The second most-used band for test range telemetry is the 2360 – 2390 MHz spectrum. The issue confronting the ranges is the assignment of adjacent spectrum 2345 – 2360 MHz for wireless broadband use. This problem is resolvable if the vendor using the adjacent spectrum implements International Telecommunications Union rules, which prescribe out-of-band emissions protection. DOD is working this issue with both the Federal Communication Commission and the vendor.

Since the DOD EMS was published in 2013, there has been ongoing work to develop implementation action plans. Many of these action plans address issues the test community has already been working, such as securing sufficient frequency to sustain test operations, and developing technologies to use available frequency more efficiently. Apart from these similar approaches, other action plans address operational use of spectrum. The conceived new EMS operational environment will influence DOT&E oversight of test planning, given consolidation and development of operational spectrum tools (spectrum identification, characterization, assignment). When implemented, many of the EMS action plans could "simplify" the operating environment by stipulating clear policy, procedures, and master architectures, and eliminating the myriad of stove-piped systems that have been deployed. Thus, the EMS has the potential to change the operating environment for Spectrum Dependent Systems, and the ways such systems are operated during testing. The TRMC, acting as the proxy for the DOD T&E community, will have varying degrees of participation in 88 of the 349 action plan tasks identified by DOD (primary responsibility for 10, and coordinating responsibility for 78).

Frequency spectrum is a limited resource with many more demands than supply. With allocations, both domestically and internationally, being repurposed for non-defense wireless transmission needs, DOT&E will need to remain actively engaged with DASD(DT&E), TRMC, and the DOD Chief Information Officer to ensure frequency spectrum allocations are sufficient for the conduct of test operations, and also that these operations use frequency efficiently.

TABLE 2. FREQUENCY ALLOCATIONS USED FOR TESTING AND DOD RESOURCE ISSUES AND POTENTIAL MITIGATIONS				
Frequency	**Use**	**Users**	**Resource Issue and Potential Mitigation**	**Notes**
406.1 - 420 MHz	Land mobile radio	Test control and field ops		
1350 - 1390 MHz	Time, Space, Position Information	Critical to almost all open-air tests; range surveillance radar (Air Route Surveillance Radar-4)		
1435 - 1525 MHz	L-Band Telemetry - Primary Telemetry Band	SDB, UH1/AH, T-45, SH-60, VH-S, V-22, F-18, F-18E, F-22, F-35, B-2, F-16, B-1, B-2, B-52, Global Hawk	• Issue: Wireless microphone use. • Potential Mitigation: Alternate user coordination with assigned key codes for spectrum access in allotted time periods. • Issue: WRC assignment to worldwide wireless broadband use. • Potential Mitigation: Ongoing negotiations with Canada and Mexico.	The Light Squared (satellite/terrestrial network proposed and abandoned) proposal targets 1505 - 1525 MHz
1675 - 1710 MHz	Weather, including wind speed measurement	Critical to almost all open-air tests		
1755 to 1780	L-Band Telemetry	F/EA-18G, Aerostar, ASVS, SM-2, RAM, SSRT, Classified UAV (WSMR), ARAV, X-47, the only band for miss-distance indicators used to score missile shots	• Issue: Auction pending • Potential Mitigation: Use relocation to 4400 – 4940 MHz and 5091 – 5150 MHz with Spectrum Relocation Fund reimbursement.	
1780 - 1850 MHz	L-Band Telemetry	F/EA-18G, Aerostar, ASVS, SM-2, RAM, SSRT, Classified UAV (WSMR), ARAV, X-47, the only band for miss-distance indicators used to score missile shots		This spectrum will be auctioned over the next 10 years, and some sharing has been proposed
2200 - 2290 MHz	S-Band Telemetry	AIM-9X, AIM-120, JAASM, JDAM, WCMD, JSOW, SDB, Aerostar, ASVS, WSI, 6DOF, MDA, Patriot, SM-2, ATACMS, F-15, F-16, F-22, F-35, T-38, B-1, B-2, B-52, C-17, Global Hawk, X-51 Waverider		
2360 - 2390 MHz	Upper S-Band Telemetry	F-18E/400, E2-D, P-8A, Exdrone, Silver Fox, THAAD, F-16, F-22, B-1, B-2, B-52, C-17, Global Hawk	• Issue: AT&T wireless communications use of 2345-2360 MHz without Out of Band Emissions protections. • Potential Mitigation: Pending	
2390 - 2395 MHz	Upper S-Band Telemetry	F-18E/400, E2-D, P-8A, Exdrone, Silver Fox, THAAD, F-16, F-22, B-1, B-2, B-52, C-17, Global Hawk		Shared for additional Upper S-Band coverage
2700 - 2900 MHz	Range surveillance radar	Critical to almost all open-air tests		
4400 - 4940 MHz	Range Telemetry	F-15SA, F-15 (pending), fixed point-to-point microwave, tactical radio, UAV, threat simulators	• Issue: Pending Federal Communications Commission(FCC) Rulemaking. • Potential Mitigation: FCC has allowed band use	Band is just now coming into use
5091 - 5150 MHz (Region 2: 5091 - 6700 MHz)	Range Telemetry	F-15SA	• Issue: Pending FCC Rulemaking. • Potential Mitigation: FCC has allowed band use	Shared with Federal Aviation Administration. Band is just now coming into use; DoD has requested that the band be extended to 5250 MHz when 1755 - 1850 MHz is auctioned.

Joint Test and Evaluation

Joint Test and Evaluation

Joint Test and Evaluation (JT&E)

The primary objective of the Joint Test and Evaluation (JT&E) Program is to provide solutions rapidly to operational deficiencies identified by the joint military community. The program achieves this objective by developing new tactics, techniques, and procedures (TTPs) and rigorously measuring the extent to which their use improves operational outcomes. JT&E projects may develop products that have implications beyond TTPs. Sponsoring organizations submit these products to the appropriate Service or Combatant Command as doctrine change requests. Products from JT&E projects have been incorporated into joint and multi-Service documents through the Joint Requirements Oversight Council process and through coordination with the Air, Land, Sea Application Center. The JT&E Program also develops operational testing methods that have joint application. The program is complementary to, but not part of, the acquisition process.

The JT&E Program has two test methods available for customers: the traditional Joint Test and the Quick Reaction Test (QRT).

The traditional Joint Test method is, on average, a two-year joint test project, preceded by a six-month Joint Feasibility Study. A Joint Test involves an in-depth, methodical test and evaluation of issues and seeks to identify solutions. DOT&E funds the sponsor-led test team, which provides the customer periodic feedback and useful, interim test products. The JT&E Program charters two new Joint Tests annually. The program managed six Joint Tests in FY14 that focused on the needs of operational forces. Projects annotated with an asterisk (*) completed in FY14.

- Joint Advanced Capability Employment (J-ACE)*
- Joint Base Architecture for Secure Industrial Control Systems (J-BASICS)
- Joint Counter Low, Slow, Small Unmanned Aircraft Systems (JCLU)
- Joint Deployable Integrated Air and Missile Defense (JDIAMD)*
- Joint Tactical Air Picture (JTAP)
- Unmanned Aircraft Systems – Airspace Integration (UAS-AI)

QRTs are intended to be less than a year in duration and solve urgent issues. The program managed 19 QRTs in FY14:

- Command and Control of Ballistic Missile Defense (C2BMD)
- Cyber Agility and Defensive Maneuver (CAADM)
- Electromagnetic Battle Management Concept of Operations Development and Evaluation (E-CODE)*
- En-Route Mission Command Capability (EMCC)*
- Heterogeneous Sensor Integration (HSI)*
- Joint Assessment Doctrine Evaluation (JADE)
- Joint Automated Net-Centric Satellite Communications (SATCOM) Electromagnetic Interference (EMI) Resolution (J-ANSER)
- Joint Cyberspace Intelligence, Surveillance, and Reconnaissance (JCISR)
- Joint Decision Support – Air (JDeS-A)
- Joint Graphical Rapid Assessment of Mission Impact (J-GRAMI)*
- Joint Homeland Mining Prevention and Response (JHMPR)
- Joint Integration of Cyber Effects (J-ICE)*
- Joint Integrated Standoff Weapons Employment (JISOWE)
- Joint Logistics Enterprise Data Sharing (JLEDS)*
- Joint National Capital Region (NCR) Air Surveillance Concept of Operations (CONOPS) – Accelerated (JNASC-A)
- Joint Positive Hostile Identification (J-PHID)*
- Joint Precise Timing (JPT)
- Joint Sensor Awareness to Target Tracking (J-SATT)*
- Mortuary Affairs Contaminated Remains Mitigation Site (MACRMS)

As directed by DOT&E, the program executes special projects that address DoD-wide problems. The program managed one special project in FY14:

- Joint Personnel Recovery Collaboration and Planning (JPRCaP)

JOINT TESTS

JOINT ADVANCED CAPABILITY EMPLOYMENT (J-ACE)* (CLOSED AUGUST 2014)

Sponsor/Start Date: U.S. Strategic Command (USSTRATCOM)/August 2011

Purpose: To develop, test, and evaluate a standardized process to support the Joint Force Commander's ability to employ enhanced special programs to overcome complex targeting challenges.

Products/Benefits:

- A repeatable operational employment process that will enhance planning by developing, evaluating, and coordinating concepts of employment (CONEMP) that can be used by the Joint Staff, Combatant Commands, Services, and National Security Agency to solve complex targeting challenges
- Multiple enhanced special program CONEMPs to overcome complex targeting challenges that are approved and signed at the General Officer/Flag Officer level and maintained by the appropriate Combatant Command or Service component
- Relevant training scenarios and vignettes
- Documented effects associated with techniques against representative targets
- Developed CONEMPs allow for expeditious development of concept of operations (CONOPS) and improved special program capability approval packages

JOINT – BASE ARCHITECTURE FOR SECURE INDUSTRIAL CONTROL SYSTEMS (J-BASICS)

Sponsor/Start Date: U.S. Cyber Command/February 2014

Purpose: To develop, test, and evaluate Advanced Cyber Industrial Control System (ICS) TTPs to improve the ability of ICS network managers to detect, mitigate, and recover from nation-state-level cyber attacks.

Products/Benefits:
- Resiliency (fight-through capability) to DOD ICS networks and immediate supporting Information Technology infrastructures
- Advanced means, in the form of TTPs, for ICS network managers to detect nation-state-level presence in DOD ICS networks; mitigate damage to underlying processes supported by the ICS in the event of a cyber attack; and quickly recover the ICS network to a condition free of any nation-state-level cyber presence
- Increased Commander confidence resulting from the ability of ICS managers to defend ICS networks from active nation-state-level attacks, ensuring mission readiness of ICS-dependent activities
- Policy and implementation guidance recommendations on ICS network security to Commander, U.S. Cyber Command and USD(AT&L)/Installations and Environment Business Enterprise Integration

JOINT COUNTER LOW, SLOW, SMALL UNMANNED AIRCRAFT SYSTEMS (JCLU)

Sponsor/Start Date: Air Force/August 2012

Purpose: To develop, test, and evaluate integrated air and missile defense (IAMD) operator TTPs that increase operators' ability to detect, track, and identify adversary low, slow, and small Unmanned Aircraft Systems (UAS) and provide timely notification to the Area Air Defense Commander.

Products/Benefits:
- TTPs to increase the operators' ability to detect, track, and identify this UAS threat category
- Integration of information from National Technical Means into a tactical datalink to support situational awareness and target identification
- Development of the operational architecture and organizational relationships that will increase the sharing of tactical information to improve the operators' ability to execute the joint engagement sequence

JOINT DEPLOYABLE INTEGRATED AIR AND MISSILE DEFENSE (JDIAMD)*
(CLOSED JUNE 2014)

Sponsor/Start Date: North American Aerospace Defense (NORAD), U.S. Northern Command (USNORTHCOM), Army Space and Missile Defense Command/August 2011

Purpose: To develop joint planning and execution processes and procedures for deployable IAMD for the homeland.

Products/Benefits:
- IAMD process modeling that provides a comprehensive view of the integrated planning and execution process
- NORAD and USNORTHCOM current operations planning processes, checklists, and procedures for IAMD
- Continental NORAD Region, Alaska NORAD Region, and Air Forces North planning and execution TTPs for IAMD
- Naval Forces North and Third Fleet planning and execution TTPs for naval support of IAMD
- Army North planning and execution TTPs for operational control of ground-based IAMD forces
- 263rd Army Air and Missile Defense Command planning and execution TTPs for IAMD

JOINT TACTICAL AIR PICTURE (JTAP)

Sponsor/Start Date: U.S. Pacific Command (USPACOM)/February 2014

Purpose: To develop, evaluate, and validate joint TTPs to improve the joint air picture and engagement opportunities, which decreases the risk of hostile attack and fratricide.

Products/Benefits:
- Link 16 implementation procedures that reduce radio frequency network loading by moving participants to internet protocol architecture
  - Improves combat identification consistency
  - Increases the number of tracks containing fire control quality data
  - Enhances track update rates
- Multi-Service TTPs that enhances integrated fire control for defensive counter air engagements

UNMANNED AIRCRAFT SYSTEMS AIRSPACE INTEGRATION (UAS-AI)

Sponsor/Start Date: NORAD-USNORTHCOM, and the Army Test and Evaluation Command/August 2012

Purpose: Standardize and evaluate procedures to effectively operate UAS in the National Airspace System (NAS).

Products/Benefits:
- Standardized procedures for predictably operating UAS in the NAS under routine, lost command link, lost two-way radio communications, and lost sense and avoid conditions
- A common lexicon for UAS operations in the NAS
- Partnership and collaboration with the Federal Aviation Administration to integrate UAS into the NAS by 2015

QUICK REACTION TESTS

COMMAND AND CONTROL OF BALLISTIC MISSILE DEFENSE (C2BMD)

Sponsor/Start Date: Air Force Joint Test Office/February 2014

Purpose: To develop, test, and refine joint TTPs leveraging current Command and Control, Battle Management and Communications (C2BMC) capabilities resident, but not fully utilized, to enhance intra- and inter-theater joint BMD operations planning and re-planning efforts.

Products/Benefits:
- Improve BMD coordination among the Air Operations Center, Maritime Operations Center, and Army Air and Missile Defense Command in support of intra- and inter-theater BMD operations
- Enhance the ability of theaters to successfully plan and employ limited organic BMD assets
- Improve use of capabilities resident, but underutilized, in fielded C2BMC 6.4 software

CYBER AGILITY AND DEFENSIVE MANEUVER (CAADM)

Sponsor/Start Date: USPACOM/August 2014

Purpose: To develop, test, and refine TTPs to enhance moving target technologies to enable cyber agility and defensive cyber maneuver for the protection of selected critical command and control capabilities and information resources from advanced threats. Also, to provide recommendations for amendments of joint doctrine (principally Joint Publication 3-12) to introduce more comprehensive operational concepts for defensive maneuver in cyberspace.

Products/Benefits:
- Develop TTPs and recommend changes to joint doctrine to provide the following:
  - Assist commanders and network defenders in overcoming disadvantages inherent in static cyber defenses
  - Decrease vulnerability to enemy surveillance of and attacks against DOD network enclaves
  - Enhance ability to rapidly adapt cyber defenses in the face of changing missions and threats
  - Improve capability to counter and observe enemy actions in cyberspace
  - Increase wherewithal to shift initiative from attackers to network defenders
  - More effective application of technology for agile defense of key terrain in cyberspace
- Will underpin more effective joint planning and operations for defense of critical capabilities and information resources

ELECTROMAGNETIC SPECTRUM BATTLE MANAGEMENT CONCEPT OF OPERATIONS DEVELOPMENT AND EVALUATION (E-CODE)*
(CLOSED MAY 2014)

Sponsor/Start Date: USSTRATCOM/March 2013

Purpose: To validate a CONOPS for establishing a Joint Electromagnetic Spectrum Operations Cell at the Combatant Command or Joint Task Force-level.

Products/Benefits:
- Integrated Joint Electromagnetic Spectrum Operations cell planning, tasking, coordination, and conflict resolution processes
- Synchronized operations to shape the electromagnetic battlespace to meet the commander's objectives
- Codified processes to gain and maintain freedom of movement in the electromagnetic operating environment while denying access to adversaries
- Improved information exchange, situational awareness, and command and control decision processes to reduce the timeline for dynamic reallocation of the congested and contested electromagnetic spectrum
- Improved processes for prioritizing, nominating, and neutralizing electromagnetic spectrum targets

EN-ROUTE MISSION COMMAND CAPABILITY (EMCC)*
(CLOSED JULY 2014)

Sponsor/Start Date: XVIII Airborne Corps/May 2013

Purpose: To develop, test, and refine TTPs for installation and operational use of a robust EMCC that provides global response forces with the ability to establish and maintain optimal situational awareness while airborne, en-route, and on the ground to conduct forcible entry operations.

Products/Benefits:
- Formalized TTPs for EMCC installation and operation for the 82nd Airborne Division and 75th Ranger Regiment
- Provided guidance for leveraging EMCC to support forcible entry operations
- Developed supporting architectures for EMCC connectivity

HETEROGENEOUS SENSOR INTEGRATION (HSI)*
(CLOSED JULY 2014)

Sponsor/ Start Date: USPACOM/March 2013

Purpose: To develop and test TTPs for training, alignment, and integration of experimental sensors with existing, signature-based sensors to enhance situational awareness of key terrain in cyberspace. The objective is to demonstrate, through the test and evaluation process, a significant reduction in false-positive reporting and an improvement in the precision of detection of intrusions when employing heterogeneous sensor pairs in accordance with the HSI-developed TTPs.

Products/Benefits:
- Improved network defenders' detection rates while reducing false-positive alert rates associated with network intrusions, enhancing the Joint Force Commander's situational awareness of key terrain in cyberspace
- The associated operational CONEMP describes when and where it is appropriate to employ the HSI-developed TTPs by showing how the capability fits within the broader context of joint operations

JOINT ASSESSMENT DOCTRINE EVALUATION (JADE)

Sponsor/Start Date: U.S. European Command; USPACOM; U.S. Special Operations Command; Center for Army Analysis, Army Materiel System Analysis Activity/February 2014

Purpose: Refinement and validation of the assessment process and methodology developed from observations at the joint forces level, and identifying how to better integrate assessments into existing plans and operations processes. The process will initially look at using a checklist guide in a handbook format aimed at the end user, working closely with the Joint Staff J7 Joint Doctrine Note on assessments to vet and synchronize identified assessments process and methodology.

Products/Benefits: Standardize processes and doctrinal guidance to assist planners and operators on how to develop an assessment strategy for identifying indicators, triggers to decision points, and methods to measure progress (or lack of it) towards a desired end state.

JOINT AUTOMATED NET-CENTRIC SATCOM EMI RESOLUTION (J-ANSER)

Sponsor/Start Date: USSTRATCOM, Air Force Joint Test Office/November 2013

Purpose: To develop SATCOM EMI TTPs leveraging recently fielded net-centric systems to immediately detect, characterize, and cue geolocation assets.

Products/Benefits:
- Allows commanders and operators to advance operations in a SATCOM-denied and/or degraded environment by visually displaying SATCOM lines of communication health and status
- Improve SATCOM operators responsiveness to SATCOM interference or breadth of attack
- Enhance real-time situational awareness by reducing SATCOM EMI resolution timelines from hours to minutes

JOINT CYBERSPACE INTELLIGENCE, SURVEILLANCE AND RECONNAISSANCE (JCISR)

Sponsor/Start Date: USPACOM/January 2014

Purpose: To develop and evaluate TTPs that enable a joint cyber center to integrate the Intelligence Community (IC) cyberspace ISR into joint operation planning, joint targeting, and operations.

Products/Benefits:
- Establish and refine processes for full integration of the IC cyberspace ISR into planning, targeting, and execution of offensive cyber operations by Combatant Commander's Cyber Mission Forces (CMFs)
- Provide a framework for the IC to communicate with newly-formed Combatant Command CMFs
- Develop a doctrine, organization, training, materiel, leadership and education, personnel, facilities, and policy change request on factors that impede IC support for offensive cyber operations
- Validate TTPs through an assessment of developed processes across Combatant Commands

JOINT DECISION SUPPORT – AIR (JDES-A)

Sponsor/Start Date: NORAD/November 2013

Purpose: To develop, test, and refine TTPs for use by operators of the Air/Event Information Sharing Service (A/EISS) to bring A/EISS formally into the Operation NOBLE EAGLE threat decision processes and to achieve its full operational capability.

Products/Benefits:
- Enhanced A/EISS TTPs to deliver air-domain situational awareness and decision support and enable the Commander, NORAD-USNORTHCOM, Civil Aircraft Engagement Authorities, Canadian Recommending Authorities, and all participating joint, interagency, intergovernmental, and multinational air defense and security mission partners to make responsible and timely decisions during air events over North America
- Training and evaluation products to ensure implementation of TTPs is consistent and reliable

JOINT GRAPHICAL RAPID ASSESSMENT OF MISSION IMPACT (J-GRAMI)*
(CLOSED MARCH 2014)

Sponsor/Start Date: USSTRATCOM/December 2012

Purpose: To develop and evaluate TTPs for mission impact documentation, collaboration, and visualization of problem sets for USSTRATCOM's space missions and nuclear command and control. The TTPs leveraged the proof-of-concept Graphical Mission Impact Tool that USSTRATCOM's Mission Assurance Division created to graphically display mission effects resulting from loss or disruption of critical systems, assets, and infrastructure.

Products/Benefits:
- TTPs that provide USSTRATCOM and USPACOM an operational mission impact evaluation methodology for loss or disruption of critical systems, assets, or infrastructure
- Extensive detailed directions for using the Graphical Mission Impact Tool to do the following:
  - Dynamically identify vulnerabilities in critical systems, assets, and defense infrastructure needed to support assigned missions and mission-essential tasks

- Assess and graphically represent potential impacts resulting from loss or disruption of critical systems, assets, or infrastructure
- Provide decision makers with rapid capability to support informed decision making

JOINT HOMELAND MINING PREVENTION AND RESPONSE (JHMPR)

Sponsor/Start Date: NORAD-USNORTHCOM/August 2013

Purpose: To develop a standardized, cross-departmental, interagency CONOPS to support the expediency and accuracy of the information necessary to better enable detection and mine countermeasures (MCM) response to a mine or an underwater improvised explosive device (UWIED) incident in the United States.

Products/Benefits:
- CONOPS for the rapid, accurate, and standardized information exchange between the Department of Homeland Security mission of mine/UWIED detection and prevention and the DOD's MCM response
- Timely and effective MCM responses, which will better allow the quick restoration of commerce and port security

JOINT INTEGRATION OF CYBER EFFECTS (J-ICE)* (CLOSED NOVEMBER 2013)

Sponsor/Start Date: USPACOM/October 2012

Purpose: To develop and evaluate TTPs that enable a joint cyber center to integrate cyber effects into joint planning, targeting, and operations.

Products/Benefits:
- Established and refined processes for planning, targeting, and executing offensive cyber operations
- Enabled the Combatant Commander's application of operational art to project cyber power's capability to achieve an objective
- Provided a framework for command and control of newly-formed cyber forces within the command
- Developed inputs for doctrine, organization, training, materiel, leadership and education, personnel, and facilities on factors that impede planning for offensive cyber operations
- Validated TTPs through an assessment of developed processes across the Combatant Commands

JOINT INTEGRATED STANDOFF WEAPONS EMPLOYMENT (JISOWE)

Sponsor/Start Date: USPACOM/February 2014

Purpose: To develop and evaluate TTPs enabling more efficient and effective employment of scarce stand-off resources by enhancing mission planning and analysis for execution with the right number of standoff weapons at the right place and at the right time to ensure successful mission accomplishment and minimize fratricide.

Products/Benefits:
- Qualitative and empirical data analysis to support findings, conclusions, and recommendations for Combatant Command leadership, the United States Air Force Warfare Center, and the 561st Joint Tactics Squadron leadership on system employment
- Effective joint TTPs for the integrated planning and employment of joint packages of standoff munitions, decoys, and jammers

JOINT LOGISTICS ENTERPRISE DATA SHARING (JLEDS)* (CLOSED APRIL 2014)

Sponsor/Start Date: Joint Staff, U.S. Transportation Command/January 2013

Purpose: To develop and test credentialed-access, web-based enterprise interfaces to multiple sources of data regarding redeployment and retrograde of materiel from the U.S. Central Command theater. The interface will present these data with aggregated or detailed visualizations.

Products/Benefits:
- User manual and TTPs that provide step-by-step guidance regarding the use of the Cargo Movement Report widget. It describes the system and environments in which the widget resides and describes the functionality existing within the widget to access logistics data relevant to Afghanistan retrograde operations
- The JLEDS-developed CONOPS is a Microsoft Word-based user guide document, which can be delivered to customers in either electronic format or hard copy. The CONOPS describes how an Authoritative Data Source (ADS) can expose logistics data, or, for a user organization to establish a process to access data from an ADS. It includes use case examples, requirements definitions, and best practices regarding systems architectures.

JOINT NATIONAL CAPITOL REGION AIR SURVEILLANCE CONCEPT OF OPERATIONS – ADVANCED (JNASC-A)

Sponsor/Start Date: NORAD-USNORTHCOM/August 2013

Purpose: To develop the procedures to enable Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS) to detect, track, and characterize items of interest within the JLENS field of view supporting the air surveillance of the NCR and surrounding areas to positively identify contacts and increase the time available to take action to counter air and missile threats.

Products/Benefits:
- The JLENS TTPs provide Eastern and Western Air Defense Sector operators efficient and effective detection and identification capabilities to improve the NORAD homeland defense mission of the NCR
- Hastens the ability of commanders to utilize the JLENS for homeland defense by expediting the development of joint TTPs 6 to 12 months earlier than previously possible

JOINT POSITIVE HOSTILE IDENTIFICATION (J-PHID)* (CLOSED JUNE 2014)

Sponsor/Start Date: NORAD-USNORTHCOM/March 2013

Purpose: To develop and evaluate TTPs to improve IAMD decision-making processes that will enable faster and more accurate responses in an increasingly dynamic air- and missile-defense environment. The goal of this QRT was to decrease the time required to positively identify a contact of interest and increase the time available to take action to counter air and missile threats.

Products/Benefits:
- IAMD TTPs to more efficiently and effectively execute the joint engagement sequence in defense of the homeland
- J-PHID-developed algorithm assigns a confidence level to a contact of interest, resulting in an improved IAMD decision-making process, reduced response time, and increased accuracy while executing the joint engagement sequence

JOINT PRECISE TIMING (JPT)

Sponsor/Start Date: Office of the Chief of Naval Operations/August 2013

Purpose: To develop, test, and refine TTPs to provide overarching guidance and best practices for the standardization and operation of DOD Precision Time and Time Interval (PTTI) systems.

Products/Benefits:
- TTPs that provide overarching guidance for the standardization and operation of DOD PTTI distribution systems
- Formalizes and documents the best practices that provide a methodical, repeatable, and verifiable set of guidelines to improve the reliability, redundancy, and assurance of DOD systems and provide system installers, maintainers, and operators with a more comprehensive understanding of PTTI effects for DOD systems
- Enables the joint force to achieve and sustain accurate, synchronized time of day and frequency worldwide to support joint operations

JOINT SENSOR AWARENESS TO TARGET TRACKING (J-SATT)* (CLOSED MAY 2014)

Sponsor/Start Date: USPACOM/March 2013

Purpose: To develop and evaluate TTPs for the rapid injection of fused track data derived from the Dynamic Time Critical Warfighting Capability into available tactical datalinks.

Products/Benefits:
- Provided methods to disseminate unverified intelligence over tactical networks for timely situational awareness of mobile threats to warfighters
- The datalink message supplements the original track information, specifically highlighting the type of threat, when it was last detected, and accuracy

MORTUARY AFFAIRS CONTAMINATED REMAINS MITIGATION SITE (MACRMS)

Sponsor/Start Date: U.S. Army Quartermaster School/February 2014

Purpose: To test and evaluate the MACRMS TTPs during a simulated chemical, biological, radiological, or nuclear incident in order to accomplish the following:
- Capture lessons learned and best practices related to the operation of a MACRMS
- Refine and validate the TTPs for joint personnel conducting the MACRMS mission, including hazard mitigation, processing remains, performing identification tasks, and preparing contaminated human remains for evacuation
- Assess personnel protective equipment, site equipment, and training support for the safe execution of the MACRMS mission

Products/Benefits:
- Validated TTPs for processing contaminated human remains and their personal effects resulting from a chemical, biological, radiological, or nuclear incident overseas or in the United States
- Update to Mortuary Affairs school curriculum for training
- Update to applicable Service and joint doctrine

SPECIAL PROJECTS

JOINT PERSONNEL RECOVERY COLLABORATION AND PLANNING (JPRCAP)

Sponsor/Start Date: Joint Personnel Recovery Agency/January 2013

Purpose: To develop, test, and evaluate procedures that will formalize planning, crisis response, and information sharing between the Combatant Commands, senior defense officials, and State Department defense attachés prior to and during personnel recovery responses where a State Department Chief of Mission (generally the ambassador), and not a DOD official, is the lead U.S. Government authority for activity in a country.

Products/Benefits:
- Processes and products that provide formal personnel recovery planning and training protocols that inform senior defense officials and State Department defense attachés in United States embassies, in coordination with the Combatant Commands, on how to build and implement country-specific personnel recovery plans tailored for the Chief of Mission

Center for Countermeasures

Center for Countermeasures

Center for Countermeasures

The Center for Countermeasures (the Center) is a joint activity that directs, coordinates, supports, and conducts independent countermeasure/counter-countermeasure (CM/CCM) test and evaluation (T&E) activities of U.S. and foreign weapon systems, subsystems, sensors, and related components. The Center accomplishes this work in support of DOT&E, Deputy Assistant Secretary of Defense for Developmental Test and Evaluation DASD(DT&E), weapon system developers, and the Services.

The Center's testing and analyses directly support evaluation of the operational effectiveness and suitability of CM/CCM systems. Specifically, the Center:

- Performs early assessments of CM effectiveness against threat and DOD systems and subsystems.
- Determines performance and limitations of missile-warning and aircraft survivability equipment (ASE) used on rotary-wing and fixed-wing aircraft.
- Determines effectiveness of precision guided weapon (PGW) systems and subsystems when operating in an environment degraded by CMs.
- Develops and evaluates CM/CCM techniques and devices.
- Develops and tests new CMs in operationally realistic environments.
- Provides analysis and recommendations on CM/CCM effectiveness to Service Program Offices, DOT&E, DASD(DT&E), and the Services.
- Supports Service member exercises, training, and pre-deployment activities.

During FY14, the Center completed over 36 T&E activities. The Center's support of these activities resulted in analysis and reporting on more than 30 DOD electro-optical systems or subsystems with special emphasis on rotary-wing survivability.

The Center participated in operational/developmental tests for rotary- and fixed-wing ASE, PGWs, hostile fire indicator (HFI) data collection, experimentation tests, and pre-deployment/exercise support involving the use of CM/CCM. To best represent the level of effort resourced to support T&E, the Center tracks funding expended in each test area.

- Approximately 55 percent of the Center's efforts were spent on ASE testing, with the majority of these efforts in support of rotary-wing aircraft.
- Approximately 21 percent of the Center's efforts were spent on PGW, foreign system, and other types of field testing not related to ASE.
- Approximately seven percent of the Center's efforts were dedicated to overseas contingency operations support, with emphasis on CM-based pre-deployment training for rotary-wing units.
- Approximately 15 percent of the Center's efforts were spent on internal programs to improve test capabilities and develop test methodologies for new types of T&E activities.
  - The Center continued to develop multiple test tools for evaluating ASE infrared countermeasure (IRCM) systems and HFI systems.
  - In addition, the Center is improving its electronic warfare capability with the development of the high-power Portable Range Threat Simulator that will provide a more comprehensive integrated ASE T&E environment.
- The Center dedicated about two percent of its efforts to providing subject matter expertise to numerous working groups (WGs) and task forces.

The following activities are representative of those conducted by the Center during the past year.

ASE AND HFI ACTIVITIES

RESEARCH AND DEVELOPMENT ACTIVITY

Army: Phase 2 Hostile Fire Tower Test for Sensor Upgrade Technology

- **Sponsors:** Program Management Office Aircraft Survivability Equipment (PMO-ASE) and Navy Program Executive Officer, Advanced Tactical Aircraft Protection Systems Program Office (Program Manager Air (PMA)-272)
- **Activity:** The Center provided Joint Mobile IRCM Testing System (JMITS), ultraviolet, and infrared (IR) missile simulations. The sensors under test were the Common Missile Warning System-Generation 3/4A, Enhanced Ultraviolet Sensor, Passive Infrared Cueing System-A, Electro-Optic Missile Sensors, and Advanced Threat Warner (ATW). All sensors were mounted on a tower at a distance of 1.5 kilometers from the JMITS.
- **Benefit:** The data collected allowed PMO-ASE to evaluate the sensors under test in support of their sensor technology upgrade efforts. The data also allowed PMA-272 to evaluate ATW algorithm updates.

ROTARY-WING TEST EVENTS

Navy: Distributed Aperture Infrared Countermeasure (DAIRCM) MH-6 Test

- **Sponsors:** Naval Research Laboratory, the U.S. Army Technology Applications Program Office (TAPO), and 160th Special Operations Aviation Regiment Systems Integration and Maintenance Office

- **Activity:** The Center provided JMITS two-color, IR simulations and static IR seekers to verify the performance of the DAIRCM laser as installed on the MH-6 Little Bird.
- **Benefit:** The data collected from this effort allowed the sponsors to assess the performance of the DAIRCM laser against threat seekers. The data also allowed the Naval Research Laboratory to identify any needed improvements for the DAIRCM system.

Army: Special Operations Aircraft Flight Testing and Training

- **Sponsors:** U.S. Army TAPO and 160th Special Operations Aviation Regiment Systems Integration and Maintenance Office
- **Activity:** The Center provided JMITS ultraviolet missile simulations and a threat-representative laser beamrider during flight testing of the MH-60M and MH-47G aircraft.
- **Benefit:** The data collected from this effort allowed TAPO to gather information on their advanced ASE suite, the Common Missile Warning System, acoustic HFI, and AN/AVR-2B laser-detecting set.

Navy: CH-53E Department of the Navy (DoN) Large Aircraft Infrared Countermeasures (LAIRCM) Advanced Threat Warner (ATW) Sensor Upgrade Weapons and Tactics Instructor Flight Test

- **Sponsor:** Navy Program Executive Officer, Advanced Tactical Aircraft Protection Systems Program Office
- **Activity:** The Center provided the Multi-spectral Sea and Land Target Simulator (MSALTS) and JMITS two-color, IR missile simulators along with jam beam radiometers, threat-representative laser beamriders, and a designator and rangefinder.
- **Benefit:** The testing provided a cost-effective test venue for collecting critical data needed to assess the performance of the DoN LAIRCM ATW upgrade.

Navy: CH-53E DoN LAIRCM ATW Sensor Integrated Test and Evaluation Phase I

- **Sponsor:** Navy Program Executive Officer, Advanced Tactical Aircraft Protection Systems Program Office
- **Activity:** The Center provided threat-representative laser beamriders and a designator and rangefinder during flight testing of the CH-53E DoN LAIRCM ATW system.
- **Benefit:** The testing provided a cost-effective test venue for collecting critical data needed to evaluate and update DoN LAIRCM ATW laser-warning receiver algorithms.

Navy: CH-53E DoN LAIRCM ATW Sensor Integrated Test and Evaluation Phase II

- **Sponsor:** Navy Program Executive Officer, Advanced Tactical Aircraft Protection Systems Program Office
- **Activity:** The Center provided JMITS and MSALTS two-color, IR missile simulations and jam beam radiometers during flight testing of the CH-53E DoN LAIRCM ATW system.
- **Benefit:** The testing provided a cost-effective test venue for collecting critical data needed to evaluate and update DoN LAIRCM ATW missile-warning algorithms.

Navy: CH-53E DoN LAIRCM Super Backend Processor Regression Flight Testing

- **Sponsor:** Navy Program Executive Officer, Advanced Tactical Aircraft Protection Systems Program Office
- **Activity:** The Center provided MSALTS and JMITS two-color, IR missile simulations and jam beam radiometers to support a proof of Engineering Change Proposal upgrade to the DoN LAIRCM system.
- **Benefit:** The testing provided a cost-effective test venue for collecting critical data needed to evaluate and update DoN LAIRCM Super Backend Processor algorithms.

Reduced Optical Signature Emissions Solution IR Countermeasure Test VIII

- **Sponsors:** U.S. Army TAPO and 160th Special Operations Aviation Regiment Systems Integration and Maintenance Office
- **Activity:** The Center provided subject matter expertise during the IRCM effectiveness test for the MH-60M and MH-47 aircraft. These tests evaluated new flare CM sequences and variations of current flare CM sequences using improved flares, or different flares within the sequences. The Center provided an independent assessment of test results to TAPO leadership.
- **Benefit:** The data collected from this effort allowed TAPO to use the test results to enhance the protection of the MH-60M and MH-47 aircraft against IR Man Portable Air Defense Systems (MANPADS).

NATO: Trial PULSATILLA 2014

- **Sponsor:** Joint Countermeasures T&E Working Group (JCMT&E WG)
- **Activity:** The Center served as trial manager and radiometric data collector during Trial PULSATILLA 2014 at the Military Training Area in Hradiště, Czech Republic. There were 23 organizations representing 10 NATO countries that provided sensors and ASE systems to the trial.
- **Benefit:** Trial PULSATILLA 2014 provided an opportunity for NATO Sub-Group 2 member nations to expand and develop alliances, Quick Reaction Assessment (QRA) capabilities, and measure weapon and ammunition signatures, all of which will be used to create a NATO database. Data will also be collected from threat warning sensors for use in refining algorithms.

NATO: Trial MACE XVI

- **Sponsor:** JCMT&E WG
- **Activity:** The Center provided three analysts to help process data and produce reporting products during Trial MACE XVI at the Military Training Area in Lešť, Slovakia.

- **Benefit:** Trial MACE provided an opportunity for NATO Sub-Group 2 member nations to understand the potential vulnerabilities within modern, multi-function radars and integrated air defense systems. An outcome of MACE XVI will be to develop radio-frequency countermeasures advice for inclusion in a NATO handbook.

FIXED-WING TEST EVENTS

Air Force: LAIRCM AC-130U Flight Test

- **Sponsor:** 46th Test Wing Test Squadron Defensive Systems and Mobility Directorate, Air Force Life Cycle Management Center
- **Activity:** The Center provided JMITS missile simulators and personnel to perform two-color, IR simulations to collect system response data for assessing the LAIRCM system as installed on the AC-130U. The test was conducted at Eglin Air Force Base (AFB), Florida.
- **Benefit:** The testing provided the Air Force with a cost-effective test venue for collecting critical data needed to assess performance of the LAIRCM system as installed on a new platform, the AC-130U.

Air Force: LAIRCM MC-130H Flight Test

- **Sponsors:** 46th Test Wing Test Squadron Defensive Systems and Mobility Directorate, Air Force Life Cycle Management Center
- **Activity:** The Center provided JMITS missile simulators and personnel to perform two-color, IR simulations to collect system response data for assessing the LAIRCM system as installed on the MC-130H. The tests were conducted at Eglin AFB, Florida.
- **Benefit:** The testing provided the Air Force with critical data needed to assess performance of the LAIRCM system as installed on the MC-130H.

Air Force: LAIRCM System Processor Replacement Flight Test

- **Sponsors:** 46th Test Wing Test Squadron Defensive Systems and Mobility Directorate, Air Force Life Cycle Management Center
- **Activity:** The Center provided JMITS missile simulators and personnel to perform two-color, IR simulations to collect system response data for assessing the upgraded system software with the new system processor. The tests were conducted at Eglin AFB, Florida.
- **Benefit:** The testing provided the Air Force with critical data needed to assess performance of the upgraded LAIRCM system.

Air Force: QF-16 Live Fire

- **Sponsors:** Air Force Operational Test and Evaluation Command, Detachment 2
- **Activity:** The Center provided two remote-launch systems and operators to launch surface-to-air missiles at a QF-16 to demonstrate the installed Vector Scoring System capabilities.
- **Benefit:** The results of this live fire test will help support a Full-Rate Production decision.

Air Force: F-35 IR Countermeasure Test

- **Sponsors:** Joint Strike Fighter Program Office
- **Activity:** The Center provided personnel to support the Missile and Space Intelligence Center with the operation of reactive- and preemptive-configured IR seekers.
- **Benefit:** The data collected from this effort allowed the sponsors to assess the performance of various IRCM flare sequences.

Navy: C-40 Guardian Pod Flight Testing

- **Sponsor:** Navy Program Executive Officer, Advanced Tactical Aircraft Protection Systems Program Office
- **Activity:** The Center provided JMITS two-color, IR missile simulations during flight testing of the C-40 ASE. The Center provided all data collected to the sponsors for their assessments.
- **Benefit:** The testing provided the critical data needed to support a fleet introduction decision for the Guardian Pod as installed on the U.S. Navy C-40A aircraft.

PGW CM ACTIVITIES

Army: Dazzler

- **Sponsor:** U.S. Army Research, Development and Engineering Command, Armament Research, Development and Engineering Center
- **Activity:** The Center coordinated, directed, conducted, and collected data for this event. The test was performed to characterize and evaluate the effectiveness of new pyrotechnic CM.
- **Benefit:** The data collected will be used to evaluate the effectiveness of the CM as intended and to adjust the CM formulation if required.

Air Force: Small Diameter Bomb (SDB) II Obscurants Test

- **Sponsor:** SDB II Program Office
- **Activity:** The Center, in conjunction with the sponsors, the 46th Test Wing and 782nd Test Squadron, Eglin AFB, Florida, coordinated, directed, and conducted the captive-carry test of this air-to-ground missile system. The Center provided some obscurants and deployed all obscurants.
- **Benefit:** The field test provided an opportunity for the SDB II Program Office to determine seeker performance against static- and moving-ground mobile targets in obscurant environments.

National Ground Intelligence Center: Grackle Oyster

- **Sponsor:** National Ground Intelligence Center and SDB Program Office
- **Activity:** The Center, in conjunction with the sponsors, the 46th Test Wing, and 782nd Test Squadron, Eglin AFB, Florida, coordinated, directed, and conducted the field exploitation of this foreign battlefield obscurant.
- **Benefit:** This event provided field characterization data for use in the modeling and simulation of the performance of weapon system sensors.

CM-BASED PRE-DEPLOYMENT TRAINING FOR SERVICE MEMBER EXERCISES

Surface Attack Training – Nellis AFB, Nevada
160th Special Operations Aviation Regiment Radio Frequency Training – Hill AFB, Utah
Joint Forcible Entry – Nellis AFB, Nevada
Advanced Integration Exercise – Nellis AFB, Nevada
Joint Readiness Training Center Training Support – Fort Polk, Louisiana
Emerald Warrior – Hurlburt Field, Florida
10th Aviation Brigade, 6th Squadron, 6 Cavalry Training – Fort Polk, Louisiana
509th Weapons Squadron KC-135 Support – Roswell, New Mexico

- **Sponsors:** Various
- **Purpose:** The Center's equipment and personnel provided a simulated threat/CM environment and subject matter expertise to observe aircraft sensor/ASE systems and crew reactions to this environment. Specifically, the Center emphasized simulated MANPADS and radio-frequency threat engagements for participating aircraft. Additionally, the Center provided MANPADS capabilities and limitations briefings to pilots and crews and conducted "hands-on" training at the end of the briefings.
- **Benefit:** Provided realism to the training threat environment for the Service member pilots and crews to facilitate understanding and use of CM equipment, especially ASE. The Center provided collected data to the trainers for assisting units in the development/refinement of techniques, tactics, and procedures to enhance survivability.

SURVIVABILITY INITIATIVES

Hostile Fire Signature (HSIG) Model
The Center led development of the HSIG model to support HFI T&E and modeling efforts. The HSIG Model project, sponsored by the Threat Systems WG with oversight by the Test and Evaluation Threat Resource Activity, has developed a physics-based electro-optic model that produces signatures for the 12.7 mm Armor Piercing Incendiary Tracer round and a rocket-propelled grenade (RPG 7) tracer and hardbody. Final model validation report was completed in FY14. Additional support is being sought to incorporate RPG back blast and small-arm muzzle flash features to the models.

Enhanced Missile Signature (EMSIG) Model
The Center was instrumental in identifying the need to fund the development and integration of six additional missile signature models along with the Army's Re-programming Analysis Team and Services' Program Offices at the Common IRCM missile summit. These additional models will provide all of the Services' ASE and countermeasure programs with a more comprehensive threat signature database.

Joint Countermeasures T&E Working Group (JCMT&E WG)
The JCMT&E WG is co-chartered by DOT&E and DASD(DT&E) to improve the integration of:

- Aircraft self-protection and countermeasure developments
- Live-fire threat weapon open-air T&E
- Developmental and OT&E
- Development of standardized test methodologies
- Common instrumentation and standards
- Overseas threat and air electronic warfare systems performance and effectiveness data

The JCMT&E WG includes DOT&E, DASD(DT&E), all four of the U.S. Services, Australia, Canada, Great Britain, New Zealand, and NATO Air Force Armaments Group Sub-Group 2 as members of a coalition warfare sub-WG. The group is tasked with actively seeking mutually-beneficial T&E opportunities to measure performance and suitability data necessary to provide relevant operational information to deploying joint/coalition Service members and for U.S. acquisition decision makers. Specific efforts included the following.

The JCMT&E WG, in the capacity of the Chairman of the eight-year bilateral ASE Cooperative Test and Evaluation Project Arrangement Steering Committee, worked with Great Britain to ensure smooth and highly-effective testing of ASE. The United States and Great Britain have developed and successfully implemented three WGs in order to more effectively manage the growing level of efforts. The two nations' defense organizations, ASE Program Offices, developmental testing, operational testing, and LFT&E agencies have been able to collaborate on common test equipment methodologies and measure threat missiles, guns, and rockets' effects on ASE using actual threat gunners, weapons, and environmental data that will continue to improve Service member survivability.

The JCMT&E WG, in the capacity of the Chairman of the 10-year bilateral ASE Cooperative Test and Evaluation Project Arrangement Steering Committee, worked with Australia to ensure smooth and highly-effective testing on both sides of the Pacific. The United States and Australia developed and successfully implemented three WGs to more effectively manage the growing level of efforts. As a result, the Center participated in the planning of the Australian Trial OXIDIZER II and other data collection opportunities using the Marine Rotational Force in Darwin, Northern Territory. These data will be used to improve U.S. threat detection algorithms while reducing both nations' test costs.

The JCMT&E WG was the U.S. Technical Advisor to the official negotiations of the Multinational Test and Evaluation Program memorandum of understanding with Australia, Canada, Great Britain, New Zealand, and the United States. In support of high-level NATO multinational approaches initiatives and DOT&E initiatives to NATO, the Center developed, organized, and conducted a highly-successful, 10-nation NATO QRA in the Czech Republic. The calibrated data and expert analysis measured has been hailed as the model for NATO to expand use for future QRAs. Due to the Center's efforts, the NATO National Armaments Directors Representative designated the Defensive Aids Suite effort a Smart Defence Tier 1 project.

The JCMT&E WG worked with the Office of the Deputy Assistant Secretary of the Army for Defense Exports and Cooperation; the Navy International Program Office; the Deputy Under Secretary of the Air Force, International Affairs; and the Services' program managers to spear-head the development of the four-nation Aircraft Electronic Warfare Cooperative Test and Evaluation Project Arrangement that will be negotiated in November 2014. This effort will coalesce many of the redundant testing conducted by Australia, Canada, Great Britain, and the United States while significantly expanding performance and suitability data at reduced cost for all four nations.

The JCMT&E WG worked with NATO Air Force Armaments Group Sub-Group 2 to develop, plan, and conduct a major threat data collection effort in the Czech Republic. Joined by 10 nations and over 80 technicians, the Center managed the firing of operationally significant types and measured the performance of surface-to-air missiles, anti-tank weapons, rockets, and Soldier-fired weapons in Trial PULSATILLA. This trial provided the United States and our allies with substantive data for use by threat-warning systems' developers and improvements in tactics, techniques, and procedures by our Service members.

THREAT SIMULATOR TEST AND EVALUATION TOOLS

The Center has continued to develop tools for T&E of IRCM systems funded by the USD(AT&L), Test Resource Management Center, and Central Test and Evaluation Investment Program. Currently, the Center is leading the development of MSALTS and the Joint Standard Instrumentation Suite (JSIS).

- The MSALTS is a small, mobile missile simulator that can fire while moving and simulate all current tier-one missile threats. The Center has designed the MSALTS to provide simulated signatures for the new and more capable missile-warning systems, such as LAIRCM Next Generation, DoN LAIRCM, and the DoN ATW. The Center initiated development of the first two systems in FY11 and the third system in FY12. The developer completed fabrication, assembly, and integration, and executed government acceptance testing of the first MSALTS system in April 2014. Acceptance testing of subsequent units completed in October 2014.
- The JSIS is a transportable, fully-integrated instrumentation suite that will be utilized for collecting signature, Time-Space-Position Information, acoustic, and related metadata of threat missile and hostile fire munitions. The transportability of JSIS will allow it to be used both in the United States and abroad with the intent of reducing costs and expanding the types of threats available in the United States. JSIS data collected during these live fire events will be used to support ASE systems development, modeling and simulation activities, T&E ground truth data, and anomaly investigation. All data collected from JSIS will be calibrated, measured, and stored according to the standards defined by the Joint Tactical Missile Signatures Handbook and will be available to the ASE community. The JSIS has been endorsed by the U.S. Navy (PMA – 272), Army (PMO – ASE), and the Air Force (LAIRCM System Program Office) and will be an integral part in each Program Office's ASE development. In July 2013, the JSIS was selected as a "Resource Enhancement Project New Start" project and received FY14 funding from the Test Resource Management Center and Central Test and Evaluation Investment Program. In FY14, the Center, partnered with the Arnold Engineering Development Center, actively created program plans, refined requirements from the ASE T&E community, created and refined a concept of operation, and began identifying specific instrumentation that meets JSIS requirements. A successful Critical Design Review was conducted in May 2014.

Additionally, as a result of an internal electronic warfare study conducted by the Center in FY13, and the increasing demands for test tools that support multi-spectral, integrated ASE threat environments, the Center internally funded the procurement of two radio-frequency threat emitters. A low-powered Portable Range Threat Simulator system will be delivered in early FY15 and a high-powered Portable Range Threat Simulator capability is scheduled to be delivered in FY16. These systems are being designed to replicate short-range acquisition and targeting radar systems.

THREAT LIVE WEAPON FIRE TEST AND EVALUATION TOOLS

The Center has continued to develop tools for the T&E community for threat, live-fire IRCM testing. In FY14 a new remote-missile launcher was developed by Missile and Space Intelligence Center for the Center. This launcher system was developed to support remote firing of larger vehicle-launched IR surface-to-air missiles. The system was delivered and is expected to be operationally verified during live fire acceptance testing in early FY15.

Index

INDEX OF PROGRAMS

www.dote.osd.mil