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Report to Congressional Requesters

July 1997

ELECTRONIC COMBAT

Consolidation Master Plan Does Not Appear to Be Cost-Effective

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National Security and
International Affairs Division

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July 10, 1997

The Honorable Connie Mack
The Honorable Bob Graham
United States Senate

The Honorable Joe Scarborough
House of Representatives

In response to your request, we have reviewed the Department of Defense's (DOD) Electronic Combat Consolidation Master Plan. As agreed with your office, our objective was to assess the costs and benefits of DOD's consolidation plans for open air ranges, hardware-in-the-loop facilities, and installed system test facilities used in electronic combat testing.

Background

In its report on the Fiscal Year 1996 National Defense Authorization Act, the Senate Armed Services Committee criticized DOD for not having a clear approach to consolidating test infrastructure and recommended reductions in DOD's Test and Evaluation support accounts. The Senate Appropriations Committee agreed with the authorizing committee, recommended reductions to the fiscal year 1996 Test and Evaluation support accounts, and acknowledged the need to constrain spending in this area. Subsequently, in the Fiscal Year 1996 National Defense Appropriations Act, the Congress limited the obligation of specified funds until DOD provided the defense authorizing and appropriating committees with an Electronic Combat Consolidation Master Plan to establish a DOD-wide infrastructure for electronic combat testing. In March 1996, DOD published its Master Plan.

In transmitting the Master Plan to the Congress, the Under Secretary of Defense for Acquisition and Technology stated that DOD would revisit the Plan in the broader context of section 277 of the National Defense Authorization Act for Fiscal Year 1996, and adjust the Plan as appropriate. Section 277 directs DOD to develop a consolidation and restructure plan for its laboratories and test and evaluation centers for the 21st century. This effort is not yet complete.

According to the Master Plan, DOD considered 17 of the services' electronic combat test facilities for consolidation. The Army controls 4 of the 17 facilities, the Navy controls 6, and the Air Force controls 7. The

conclusion of the Master Plan is that the assets of three of the seven facilities managed by the Air Force will be moved to other Air Force locations. No interservice consolidations and no intraservice consolidation of the four Army or six Navy facilities are proposed in the Plan. The three facilities to be relocated are

- the Air Force Electronic Warfare Evaluation Simulator (AFEWES) in Fort Worth, Texas;
- the Real-time Electronic Digitally Controlled Analyzer Processor (REDCAP) in Buffalo, New York; and
- the Electro-Magnetic Test Environment (EMTE) at Eglin Air Force Base, Florida.

AFEWES is a specialized hardware-in-the-loop facility that simulates individual radar and missile threats to aircraft and electronic combat hardware. REDCAP is a specialized hardware-in-the-loop facility that simulates an integrated air defense system with command, control, and communications networks. EMTE is an open air range providing radar and simulated missile threats to aircraft in flight; it is collocated at Eglin Air Force Base with the Air Force's development and test and evaluation activities for armaments. Installed system test facility consolidation was not proposed in the Master Plan. For purposes of this review, we focused on three open air ranges, two hardware-in-the-loop facilities, and two installed system test facilities. The remaining 10 are other kinds of electronic combat test facilities, such as research laboratories or radar cross-section measurement facilities or are service unique capabilities. DOD's electronic combat test process and the role the various kinds of facilities play in that process are explained briefly in appendix I.

Results in Brief

Implementation of the Electronic Combat Consolidation Master Plan will result in less effective electronic combat testing capabilities.

- The planned relocation of EMTE will eliminate DOD's current capability to test electronic combat systems in conditions that typify many potential threat locations. DOD will be left with two open air ranges with very similar environmental characteristics and will no longer have the ability to test in diverse conditions needed to understand environmental effects on electronic combat systems.
- The planned REDCAP relocation will mean replacing existing hardware simulation capability with digital computer models, thus reducing DOD's

current capability to simulate realistic aircraft strike scenarios with high confidence and fidelity.

The Master Plan did not contain any cost analysis and did not identify any savings expected from the consolidations. Estimates used to support 1995 Base Closure and Realignment Commission (BRAC) deliberations, as well as data provided by users indicate that the consolidation may increase DOD's electronic combat testing costs. In addition, the Master Plan does not contain any analysis or recommendations regarding consolidation of installed system test facility workloads across the services although the Navy and the Air Force are spending $512 million for construction of another anechoic chamber to provide a controlled electromagnetic environment at Patuxent River, Maryland, and other upgrades to their current primary installed system test facilities at Patuxent River and Edwards Air Force Base, California.

Consequently, the Master Plan, if implemented, may not achieve the most cost-effective DOD-wide infrastructure. The root cause of this was DOD officials' inability to overcome service parochialism during the Master Plan's development. This parochialism resulted in a "gentlemen's agreement" between the Air Force and the Navy to focus on intraservice rather than interservice consolidations. Prior joint service studies performed on an interservice basis had identified alternatives for more cost-effective consolidations. However, the recommendations of these studies were never implemented. If this continues, service rivalry could adversely affect DOD's ongoing, congressionally mandated section 277/vision 21 consolidation effort, which is considering the broader issue of DOD's testing and laboratory facilities.

Principal Findings

Planned Consolidation of Open Air Ranges Will Reduce Effectiveness

The proposal in the Master Plan to relocate EMTE would eliminate a test facility that provides unique advantages and keep two testing facilities with overlapping capabilities. DOD's acquisition regulations require systems to be evaluated in operationally realistic environments, including the expected range of natural environmental conditions. Currently, its electronic combat open air ranges replicate diverse threat environments where the services must be prepared to conduct operations.

Testing Equipment in Diverse Environments Is Critical

DOD's 5000.2R acquisition regulations require testing in natural environmental conditions representative of intended areas of operations (e.g. temperature, pressure, humidity, fog, precipitation, clouds, blowing dust and sand, steep terrain, storm surge and tides, etc.). Testing in diverse conditions provides performance data needed to understand environmental effects on electronic combat systems. This information is critical to making informed acquisition and mission planning decisions, thereby reducing the risk of buying ineffective equipment and the potential for casualties during wartime.

DOD studies also document the importance of testing electronic combat equipment in diverse environments. For example, a 1994 joint service study of electronic combat open air ranges expressed the need for electronic combat testing in the correct natural environment. Test results for electronic combat systems demonstrate that performance can differ significantly in differing environments.

Testing in diverse environments is also important for collecting data to support development of realistic computer models. DOD believes modeling and simulation can be used to reduce the cost of live tests, but to improve levels of confidence in models they must be built on high fidelity data collected from diverse environments.

Plan Would Eliminate Diversity Found in Current Open Air Ranges

DOD's proposed open air range consolidation as described in the Master Plan would eliminate diversity by keeping only desert ranges and thereby reduce electronic combat open air range testing effectiveness. The Air Force and the Navy control three primary open air ranges for testing electronic combat systems. These include two western ranges, one at China Lake, California, and one managed by Edwards Air Force Base, California. Both feature dry, desert climates with steep, rocky terrain. The third range, EMTE, at Eglin Air Force Base on the Florida panhandle, features a land/sea interface, high humidity, and a subtropical, forested environment, and an over water test range.

The Master Plan states that preservation of militarily unique electronic combat test facilities was an important criterion for deciding which facilities to close. However, EMTE is unique among DOD's open air ranges, and the 1994 joint service study noted that one of the primary disadvantages of closing EMTE would be the loss of terrain and geographical diversity, since both remaining ranges would be located in the desert.

Current Open Air Ranges Represent Potential Threat Environments

Both western ranges provide a capability for conducting essential electronic combat testing over terrain representative of projected middle eastern threat environments. Conversely, EMTE provides DOD with an environment more typical of most of the other projected U.S. threat locations, including North Korea and the Balkans. Table 1 identifies the terrain of countries that are representative of possible locations for future conflicts that are of concern to the United States. In comparison, table 2 demonstrates that the unique environmental characteristics of EMTE—over water, land/sea interface, and foliage—are prevalent in most of the potential threat locations identified in table 1.

Table 1: Potential Threat Locations and Terrain Correlation

Location	Over water	Sea/land interface	Desert	Foliage	Mountain
Iraq			X		X
Iran	X	X	X	X	X
N. Korea	X	X		X	X
China	X	X	X	X	X
Libya	X	X		X	X
Cuba	X	X		X	X
Balkans	X	X		X	X

Table 2: Open Air Ranges and Terrain Correlation

Location	Over water	Sea/land interface	Desert	Foliage	Mountain
EMTE	X	X		X	
China Lake			X		X
Air Force Western Test Range			X		X

REDCAP at New Location Will Be Less Capable

The Master Plan proposal to move the REDCAP facility from Buffalo and colocate it with the Air Force's installed system test facility at Edwards Air Force Base will reduce electronic combat testing effectiveness. The intent is to reestablish what the Air Force calls a "core" REDCAP capability at the new location by developing a computer model to simulate REDCAP hardware. However, the model will not simulate all of the current REDCAP testing features.

Establishing a core REDCAP capability means not utilizing much of the REDCAP hardware, and its associated functions, even though the Air Force

completed upgrading this hardware in 1996 at a cost of $75 million over the past 8 years. The core REDCAP at the proposed new location will be less capable than the complete REDCAP at its current location.

Some of the REDCAP hardware functions that the Air Force does not plan to make available in core REDCAP do not exist anywhere else in DOD. According to DOD and Air Force officials, the REDCAP facility in Buffalo is unique. For instance, REDCAP can currently simulate a realistic scenario of a strike package of multiple aircraft approaching targets protected by multiple threat radars and threat aircraft incorporated into an integrated air defense system. The proposed core REDCAP will not be able to simulate this scenario. Simulating many aircraft versus many threat systems is important because integrated air defense systems exist in a number of potential threat locations and integrated defenses are projected by DOD to be a growth area among potential threat nations.

Planned Consolidations May Increase Costs

The Master Plan did not contain any cost analysis or identify the savings expected from the consolidations. Our analysis of prior estimates used to support the 1995 BRAC deliberations and other data provided by users indicates the consolidations may increase DOD's testing costs. More specifically (1) BRAC-related data indicates that a complete EMTE relocation would not be cost-effective, (2) cost estimates provided to BRAC regarding the relocation of REDCAP and AFEWES were understated, and (3) increased costs that will be incurred by user organizations were not considered in Air Force cost estimates.

Master Plan Includes No Evidence of Savings

Senior Air Force test officials told us that the Air Force selected EMTE, REDCAP, and AFEWES for consolidation because they believed they would ultimately save money by relocating them. The Electronic Combat Consolidation Master Plan, however, includes no evidence that any savings will result and, in fact, contains no cost data at all.

The Secretary of Defense recommended the relocation of REDCAP and AFEWES and the partial relocation of EMTE to the 1995 BRAC. BRAC approved the REDCAP relocation, rejected the AFEWES proposal, and significantly scaled back the partial relocation of EMTE. The Master Plan, however, incorrectly states that selecting EMTE for relocation reflects decisions of the 1995 BRAC.

BRAC Found No Savings in Relocating EMTE in Total

The 1995 BRAC scaled back the Secretary's recommendation to realign the EMTE open air range at Eglin Air Force Base. DOD proposed transferring 17 systems designed to simulate various threat radars and missiles, but BRAC determined that was too costly and would "never net a return on investment." Ultimately, however, BRAC did approve the movement of 10 systems (for which the BRAC account was eventually charged $6.1 million), but required DOD to leave limited capability systems at Eglin to support the Air Force's Special Operations Forces, Armaments Division, and Air Warfare Center, which are also at Eglin. Nevertheless, the 1996 Master Plan says the Air Force plans to "relocate" EMTE, not move just 10 systems.

According to Air Force officials, "relocate" means 17 systems will be moved. Ten will be operated at the new location and 7 will be cannibalized for parts. Air Force test officials maintain that the Special Operations Forces, Air Warfare Center and Armaments Division do not need these 17 systems at Eglin, and they will leave behind some systems to meet the customers' needs. EMTE users, such as the Special Operations Forces and the 53rd Test Wing and the Army Aviation Test Directorate, told us that the systems the Air Force plans to leave will not meet their needs for accomplishing realistic testing because they do not have the capability to receive and process testing data for subsequent analysis. Air Force test officials told us users can travel to the Air Force's western test range to meet their test requirements.

REDCAP Relocation Costs Not Fully Disclosed

To mitigate the impact of the reduction in REDCAP effectiveness described earlier in this report, the Air Force has awarded a $6.2-million contract to design and build a digital computer model of REDCAP that it intends to use instead of the REDCAP hardware that will be stored. This additional cost, however, was not included in the Air Force cost estimate that BRAC used in deciding to relocate REDCAP.

The Air Force had recommended to the 1995 BRAC that the REDCAP facility be relocated to Edwards Air Force Base. The 1995 BRAC found that Air Force cost estimates to relocate were understated, but decided to accept the recommendation as they believed it would still result in overall savings. As a result, the BRAC account makes available to the Air Force $3.7 million to relocate REDCAP. Using Air Force cost figures, BRAC projected the operating cost to the government of REDCAP at the new location will be $100,000 compared to $1 million annually at the current

location, BRAC anticipated a 4-year return on investment (4 x $0.9 million). (The remainder of REDCAP's operations are funded by customer receipts.)

Since the cost of the new computer model was not taken into account, the Air Force will not achieve a relatively quick return on investment. The additional $6.2 million means it will take an additional 7 years to recoup costs based on Air Force projected savings of $0.9 million per year. This 11-year (4 + 7) return is well beyond the 1995 BRAC norm of seeking a 6-year or less return on investment.

AFEWES Move Delayed

The Air Force recommended to the 1995 BRAC that the AFEWES facility in Fort Worth be relocated to Edwards Air Force Base. The Air Force had estimated a cost of $8.9 million to close AFEWES and move it. BRAC did not accept the recommendation though because BRAC estimated it would cost $34.9 million to close the facility and would be over 100 years before a return on investment was realized. Nevertheless, the Air Force included the AFEWES relocation in the 1996 Master Plan. Air Force officials told us they are now attempting to modify their outyear budgets so they can move the AFEWES facility sometime in the year 2000 time frame.

User Costs Will Increase With EMTE Closure

Special Operations Forces based at Hurlburt Field, Florida, adjacent to Eglin Air Force Base, are users of EMTE. After the EMTE relocation, however, Special Operations Forces' electronic combat testing will be conducted at the Air Force's western test range. As a result, Special Operations Forces officials estimate that their electronic combat testing will cost $23 million over the next 5 years, whereas they have spent only $4 million for electronic combat testing over the last 4 years.

We reviewed the analysis supporting this estimate and found it to be realistic. The $19 million in additional cost results from sending aircraft, their crews, and support personnel temporarily to the western test range more often than in the past. In contrast, there are no temporary duty costs associated with testing Special Operations Forces aircraft at EMTE.

In addition to the Special Operations Forces, another user organization based at Eglin, the 53rd Test Wing, estimates that the proposed EMTE relocation may cost them as much as an additional $1 million per year. This additional cost would provide for an estimated 20 additional trips to the Air Force's western test range to perform electronic combat testing that in the past has been performed at Eglin Air Force Base.

Installed System Test Facility Consolidation Not Practical

DOD's Master Plan does not contain any analysis or recommendations regarding consolidation of installed system test facility workloads across the services. The Navy and the Air Force are spending $512 million for construction of a new anechoic chamber to provide a controlled electromagnetic environment at Patuxent River, Maryland, and other upgrades to their current primary installed system test facilities at Patuxent River and Edwards Air Force Base, California. These projects have progressed too far to make any interservice consolidation practical at this time, however.

The Navy has a fighter-sized anechoic chamber, has already spent $227 million, and has plans to spend an additional $101 million, to (1) add a new, medium-sized anechoic chamber and (2) upgrade the electronic combat test laboratory shared by both the fighter and medium-sized chambers. The Navy is planning to have the medium-sized chamber completed in fiscal year 1999.

Completion of this work is timed to conduct testing on the Navy's E-6 and P-3 aircraft. (These specialized aircraft are too large to fit into the fighter sized facility.) Meanwhile, the Air Force has plans to spend over $184 million through fiscal year 2002 to make the same electronic combat test upgrades to its Edwards Air Force Base installed system test facility as the Navy is making at Patuxent River.

The Edwards Air Force Base facility is large enough to accommodate any military aircraft except a C-5 transport. Navy officials agreed that the Edwards facility is large enough to accommodate their medium-sized E-6 and P-3 aircraft; however, they maintain that the Edwards facility is not advanced enough right now to conduct the testing on these aircraft. Navy officials also insist they cannot postpone their testing until fiscal year 2002 when the Edwards facility upgrade is scheduled to be completed. Furthermore, they say, the Air Force has blocked out most of the available test time at the Edwards facility for its future F-22 fighter, an aircraft that would fit in the Patuxent River chamber.

More Cost-Effective Alternatives to Planned Relocations Ignored

In the past 3 years, DOD has conducted two joint service studies of possible consolidation of electronic combat test facilities. One study done in 1994 is referred to as the Board of Directors study and is cited as justification for the conclusions in the Master Plan.[1] The other study is known as the 1995 Joint Cross Service Group study, which was done in support of the 1995 BRAC process.[2] These studies identified a more cost-effective interservice electronic combat consolidation as compared to the intraservice approach reflected in the Master Plan. However, the lack of interservice cooperation undermined the more cost-effective efforts.

Open Air Range Consolidation Does Not Reflect a More Effective Alternative

To reduce excess capacity, the Master Plan recommends relocating test assets from EMTE to the western test range managed by Edwards Air Force Base and cites the 1994 Board of Directors Study as justification. According to the study, DOD's open air range workload capacity is 6,000 test hours per year, while actual workload in fiscal year 1993 was 4,867 test hours, and actual workload is projected to decline to 4,000 hours per year. Based on this workload data, DOD determined it will only need two of the three current open air range facilities in the future.

However, that 1994 study, as well as the 1995 Joint Cross Service Group study done in support of the BRAC process, ranked EMTE as a more valuable electronic combat test capability than the Navy's China Lake open air range. The 1994 study also projected that relocating test assets from China Lake to EMTE and the Air Force's western test range would produce about $47 million more in savings over 5 years than relocating EMTE.

DOD and Air Force officials with knowledge of the studies told us that the Navy participated fully in both studies, but once it became apparent that EMTE would rank higher than China Lake, the Navy would not cooperate in implementing the study's conclusions.

Electronic Linking of REDCAP and AFEWES a More Cost-Effective Alternative

In addition to comparing the EMTE and China Lake open air ranges, the 1994 Board of Directors Study considered the possibility of achieving "synergy" between hardware-in-the-loop facilities, like AFEWES or REDCAP, by colocating them with installed system test facilities, like those

[1]The Board of Directors is made up of the Service Vice Chiefs in their role as the Test and Evaluation Executive Agent. Board of Directors study team members were drawn from each of the services.

[2]The Joint Cross Service Group was led by representatives of the Office of the Secretary of Defense and included team members from each of the services. The group examined potential consolidations for airframe and armaments testing, as well as electronic combat testing.

maintained by the Air Force at Edwards, or the Navy at Patuxent River, Maryland. However, the Board of Directors study concluded that relocation would require 200 years to net a return on investment. Instead, according to a 1995 study conducted for the Air Force, electronic linking of REDCAP and AFEWES to an installed system test facility was far more cost-effective than relocating them.

Despite the findings of these studies, the Air Force plans to relocate AFEWES and REDCAP. At the same time, the Office of the Secretary of Defense and the Navy are undertaking the High Level Architecture Project to electronically link REDCAP and AFEWES' hardware with the Navy's installed system test facility at Patuxent River. This link will allow DOD to test electronic combat systems on an aircraft in an installed system test facility and do hardware-in-the-loop testing without having to physically move the systems to REDCAP or AFEWES. This approach is consistent with the 1995 study commissioned by the Air Force.

Master Plan Process Stifled by Intraservice Focus

The failure of the Master Plan effort to achieve any DOD-wide electronic combat testing consolidations despite direction from the Congress to do so is due to service parochialism. This resulted in focusing on intraservice rather than interservice consolidations.

"Gentlemen's Agreement" Prevented Interservice Open Air Range Consolidation Effort

According to officials involved in the development of the Master Plan, because no DOD-wide consolidations could be agreed upon, Air Force and Navy representatives responsible for writing the Master Plan reached a "gentlemen's agreement." The agreement was that there would be no interservice consolidation until all intraservice consolidations were complete. The impact of this agreement was that the Master Plan consolidation effort for open air ranges focused only on whether to relocate EMTE or the western test range since they are both Air Force facilities, instead of focusing on all three open air ranges to ensure that the two kept would represent what was in the best interest of all of DOD.

Intraservice Focus Could Interfere With Broader Consolidation Effort

In a memorandum transmitting the Master Plan to the Congress in March 1996, the Under Secretary of Defense for Acquisition and Technology stated that DOD would revisit the Master Plan in the broader context of section 277 of the National Defense Authorization Act for Fiscal Year 1996, and adjust the Plan as appropriate. Section 277 directs DOD to develop a consolidation and restructure plan for its laboratories and test and evaluation centers for the 21st century.

This plan, which DOD calls vision 21, will be based on the requirements to support the test and evaluation of future weapon systems and identify the critical test facilities needed to support them. DOD maintains that vision 21 will include both intraservice and interservice restructuring. However, based on the inability of DOD to implement proposed interservice consolidations originating from its prior studies of electronic combat test consolidation, we are concerned that the intraservice focus that interfered with development of a DOD-wide Electronic Combat Master Plan will undermine the vision 21 effort.

Recommendation

Because (1) the loss of electronic combat effectiveness was not given adequate consideration in the development of DOD's Electronic Combat Consolidation Master Plan, (2) the Master Plan contained no costs or evidence of savings, and (3) service parochialism was allowed to interfere with development of the Master Plan, we recommend that the Secretary of Defense take steps to make sure that the methodology for the ongoing section 277/vision 21 effort include the following criteria: (1) accurate, comparable, and reliable data on the true cost of operating the services' test and evaluation infrastructure; (2) the needs of and costs to test facility customers; (3) the maintenance of geographical and topographical diversity in the test facility base; (4) the requirement that proposed consolidations be cost-effective for DOD as a whole; and (5) measures to ensure that implementation of cost-effective decisions cannot be constrained or avoided.

Matter for Congressional Consideration

Because DOD's Electronic Combat Consolidation Master Plan may not provide for the most cost-effective DOD-wide infrastructure for electronic combat testing as directed by the Congress, the Congress may wish to consider directing the Secretary of Defense to defer the transferring of electronic combat test assets until DOD completes its vision 21 plan for restructuring its laboratories and test and evaluation centers.

Agency Comments and Our Evaluation

In commenting on a draft of this report, DOD indicated that it did not agree with our findings, recommendation, or matter for congressional consideration. According to DOD's response, the consolidations proposed in the Electronic Combat Consolidation Master Plan and addressed in our report are in keeping with the intent of the Congress to reduce the test infrastructure. We disagree. The Congress directed DOD to develop a DOD-wide infrastructure for electronic combat testing. DOD's Master Plan

did not consider any of the Army and the Navy electronic combat test facilities as possibilities for consolidation and merely transfers Air Force test functions to other Air Force locations.

DOD's response indicated that the services made decisions to consolidate in areas that would have the least impact on DOD's ability to perform effective test and evaluation. This response is not supported by the facts. For instance, the plan to close the EMTE electronic combat open air range at Eglin Air Force Base will leave DOD with no non-desert electronic combat test range for tactical fighters and two desert test ranges—one each for the Navy and the Air Force. This is not consistent with DOD's testing policy that calls for testing to be conducted in a range of natural environments.

DOD commented that its planned consolidations reflect the 1995 BRAC legislation and the services' plans to implement congressional direction. Our review showed that the planned actions will go beyond, not "reflect," the 1995 BRAC legislation as the Air Force intends to relocate the entire EMTE function from Eglin Air Force Base, not limit itself to the BRAC-directed realignment of 10 systems (8 threat and 2 podded systems.) The Air Force intends to move AFEWES, as well. This planned move is inconsistent with direction from the 1995 BRAC.

DOD believes diversity in the testing environments is desirable, but inconsequential, so long as DOD maintains the capability to replicate geographical and topographical characteristics through modeling and simulation and other work arounds. Our review indicated that DOD does not need to rely in large measure on computer models and work arounds. Instead, DOD could have considered keeping its non-desert range at Eglin, and could have considered consolidating the Air Force's and the Navy's desert ranges into one to keep the diverse test environments required by its regulations and still reduce from three ranges to two. We have modified the language from our draft report concerning our matter for congressional consideration to ensure that it is not misconstrued and to help focus attention on the desirability of considering a more cost-effective alternative. DOD's comments are reprinted as appendix II, along with our detailed evaluation of them.

Scope and Methodology

To accomplish our objective, we examined DOD's March 1996 Electronic Combat Consolidation Master Plan and DOD studies of potential electronic combat test facility consolidations. Because the Electronic Combat

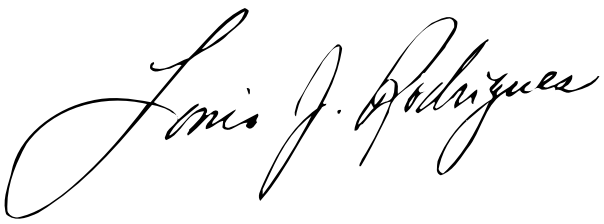
Consolidation Master Plan did not include any cost data, we gathered cost data from affected sites, as well as the Air Force Materiel Command, and other DOD studies of electronic combat test consolidation. We interviewed officials from the Office of the Secretary of Defense, the Army, the Navy, and the Air Force responsible for or involved in the electronic combat test process. We also interviewed contractor personnel involved in the electronic combat test process. We visited open air ranges, hardware-in-the-loop facilities, installed system test facilities, and observed electronic combat tests in progress. We reviewed DOD policy and guidance on testing and evaluation, as well.

We performed our work at the Offices of the Secretaries of Defense, the Navy, and the Air Force; the Offices of the Chief of Naval Operations and the Air Force Chief of Staff; the Air Force Materiel Command, Wright-Patterson Air Force Base, Ohio; Edwards Air Force Base, California; Nellis Air Force Base, Nevada; Eglin Air Force Base, Florida; Hurlburt Field, Florida; Army Aviation and Technical Test Center, Fort Rucker, Alabama; Army Missile Command, Redstone Arsenal, Huntsville, Alabama; Naval Air Warfare Centers at Patuxent River, Maryland, China Lake, California, and Point Mugu, California; and REDCAP at Buffalo, New York.

We performed our review from March 1996 to March 1997 in accordance with generally accepted government auditing standards.

We are sending copies of this report to interested congressional committees; the Secretaries of Defense, the Army, the Navy, and the Air Force; the Director, Office of Management and Budget; and other interested parties. We will make copies available to others upon request.

If you have any questions about this report, I may be reached at (202) 512-4841. Major contributors to this report are listed in appendix III



Louis J. Rodrigues
Director, Defense Acquisitions Issues

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Abbreviations

AFEWES	Air Force Electronic Warfare Evaluation Simulator
BRAC	Base Closure and Realignment Commission
DOD	Department of Defense
EMTE	Electro-Magnetic Test Environment
REDCAP	Real-time Electronic Digitally Controlled Analyzer Processor

The Department of Defense's Electronic Combat Test Process

Predict-Test-Compare Replaces Fly-Fix-Fly

Electronic combat systems, such as radar jammers and warning receivers, are most often associated with tactical fighter aircraft because of the threat posed to them by modern surface-to-air missiles. However, electronic combat systems are found today on all types of platforms. These include ground vehicles, surface and subsurface naval vessels, missiles, helicopters, and other fixed-wing aircraft besides tactical fighters. Hence, wherever the services and their contractors develop or test platforms and major subsystems for those platforms, electronic combat test facilities have been established as necessary support functions.

In the past 10 years, the Department of Defense (DOD) has spent more than $300 million to build and upgrade electronic combat test capabilities. The vast majority of this new investment has gone into hardware-in-the-loop and installed system test facilities, which are highly scientific, laboratory type facilities, and open air ranges that try to replicate real world environments. These new and upgraded facilities were designed and built to accommodate DOD's revised electronic combat test process.

DOD's revised electronic combat test process utilizing hardware-in-the-loop, installed system test facilities, and finally, open air ranges fits into a broader test philosophy referred to as "Predict-Test-Compare." According to a former test official, Predict-Test-Compare was implemented to ensure more rigorous testing was done before fielding because of a general belief in DOD that its electronic combat systems did not work very well. According to the Air Force, past electronic warfare programs have displayed a pattern of latent deficiencies manifesting themselves in operational test and evalution, necessitating expensive fixes and retesting. Predict-Test-Compare replaced DOD's "fly-fix-fly" model that emphasized open air range testing as the primary test method.

Fly-fix-fly relied too much on trial and error at open air ranges to find and correct problems. Often the systems were concurrently built and tested and already fielded before successful fixes were identified. Typical outcomes of a fly-fix-fly philosophy are the costly, repeated, and continuing attempts to fix the ALQ-161 electronic warfare suite on the Air Force's B-1 Bombers, and the SLQ-32 electronic warfare suite on the Navy's surface combatants.

In contrast to trial and error, Predict-Test-Compare is based on the scientific method of interplay between inductive and deductive reasoning.

After subjecting systems to testing on the ground under tightly controlled conditions, testers compare the test outcomes to their predictions to induce hypotheses that explain the outcomes. The inductive hypotheses, in turn, are analyzed by developers and testers to deduce what hypothetical fixes are necessary to produce more desirable outcomes in subsequent tests. Thus, Predict-Test-Compare is an iterative process in which understanding why a system behaves as it does is essential to successfully predicting how the system will behave when it is modified.

Hardware-in-the-Loop Facilities Provide Controlled Conditions for Test

Controlling for the conditions of a test is the number one requirement for ensuring that test outcomes are explainable. Hardware-in-the-loop facilities provide this capability in the electronic combat test process. In their laboratory type environments, testers can control for external variables found in realistic environments such as terrain effects and background noise that might influence test outcomes.
Hardware-in-the-loop testing provides the capability to provide repeatable measurements and verification of protection techniques and system effectiveness.

The hardware-in-the-loop facility is the first place a new or modified piece of electronic combat equipment faces an actual or simulated threat radar. Prior to hardware-in-the-loop testing, a developer begins with a concept for electronic combat equipment to fill a requirement, say an ability to deceive a new threat radar. The developer typically will design a computer model representative of the concept. The electronic combat tester will then subject the conceptual model to an increasingly rigorous test against validated computer models of threat radars. Once a computer model that works against the threat models is developed, real electronic combat hardware that tries to replicate the model's behaviour is built. The electronic combat hardware is then subjected to the hardware-in-the-loop testing, that is, it is tested against actual or simulated threat radar hardware.

If testers cannot demonstrate that the hardware will work as predicted within the controlled conditions of the hardware-in-the-loop facility, a system should not proceed to the next phases of the test process. Success at installed system test facilities or open air ranges after failure in the hardware-in-the-loop facility might be evidence of a positive effect from environmental influences, for example, electronic signals bouncing uncontrollably off of terrain features to confuse a threat radar, a factor that will not always be present in every wartime environment.

In addition, systems that have failed in the real world can be brought back to the hardware-in-the-loop facility to evaluate and improve their performance. According to test officials, serious problems with the ALQ-99 system used on the EA-6B and EF-111 stand-off jamming aircraft were unraveled and solutions identified in the Real-time Electronic Digitally Controlled Analyzer Processor (REDCAP) hardware-in-the-loop facility before the ALQ-99 went on to successful testing at the open air range. In a more recent example, the Air Force Electronic Warfare Evaluation Simulator (AFEWES) hardware-in-the-loop facility was able to recreate and simulate the conditions that led to the shootdown of Captain Scott O'Grady's F-16 over Bosnia in 1995. The AFEWES results were subsequently proven in real aircraft testing at the Electro-Magnetic Test Environment (EMTE) Open Air Range at Eglin Air Force Base.

Effects of Electronic Combat System on Platform Determined in Installed System Test Facility

After the hardware is tested in the hardware-in-the-loop facility, it is then placed on the platform intended to eventually carry the hardware for installed system testing. Installed system test facilities consist of anechoic chambers in which simultaneous operation of electronic warfare systems and host platform avionics and munitions can be conducted. It is in the installed system test facility that systems and subsystems are tested together for electromagnetic interference and electromagnetic compatibility, both of which have been major problems in the past. For instance, a number of U.S. aircraft have had radar jammers, radars, and radar warning receivers in the past that conflicted with each other. By identifying the conflicts before flying at the open air range, testers can more quickly isolate and solve problems. Once the Air Force and the Navy complete their ongoing upgrades to their installed system test facilities, they will be able to test systems for effectiveness under a wide range of realistic threat and operational conditions while still on the ground.

Open Air Range Provides Real-World Test Scenarios

Finally, when the hardware has been proven successful in each of the earlier steps, the electronic combat test process ends with open air testing against actual or simulated threat radars in real-world environments. Real-world phenomena encountered during open air testing can include terrain effects, multi-path propagation, electromagnetic interference from commercial systems, and other conditions that affect the atmospheric propagation of electronic signals. While often thought of as the place for a "final exam," probably because of the association open air ranges have with operational testing, open air ranges also can have a developmental role. According to DOD officials, a properly managed and operated open air

range can provide the proper mix of scientific accuracy and real-world effects to allow electronic combat system developers to know if what they have observed in the hardware-in-the-loop facility and installed system test facility will hold true in the real world. The example cited above, in which the AFEWES hardware-in-the-loop and EMTE open air range facilities together unraveled, recreated, and demonstrated how the F-16 was shot down in 1995 over Bosnia provides evidence of this.

Comments From the Office of the Secretary of Defense

OFFICE OF THE SECRETARY OF DEFENSE
WASHINGTON, DC 20301

Mr. Louis J. Rodrigues
Director, Defense Acquisition Issues
National Security and International
Affairs Division
U.S. General Accounting Office
Washington, D.C. 20548

10 MAR 1997

Dear Mr. Rodrigues:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report, "ELECTRONIC COMBAT: Testing Consolidation Master Plan Is Not Beneficial for DoD," dated November 13, 1996 (GAO Code 707149/OSD Case 1250). The Department non-concurs with the report.

See comment 1.

The draft report opens by stating that the Congress had criticized the DoD for not having a clear approach to consolidating test infrastructure, and then rationalizes why every consolidation specified in the Electronic Combat Test and Evaluation Master Plan, dated 21 March 1996, should not take place. This rationalization is in direct conflict with the GAO Report, "Defense Infrastructure," dated February 1997, GAO/HR-97-7. There were, and are, good reasons why electronic combat and other test assets are what they are and where they are. But, in keeping with the intent of the Congress and the Administration to reduce the test infrastructure, the Services made decisions to consolidate in areas where they would have the least impact on the ability of the Department to perform effective T&E. These decisions, documented in the Master Plan, also reflect the 1995 Base Realignment and Closure legislation (which are law), and the plans of the Services to implement Congressional direction. In addition, many of the upgrades that are questioned in the report were added in Defense Authorization and Appropriation Acts by the Congress.

See comment 2.

The recommendation that the Secretary of Defense ensure that the Vision 21 methodology includes the five criteria listed is not a meaningful nor helpful consequence of the report. The Department is already on record that criteria 1, 2, 4, and 5 are within the process stated in the "*Report to the President and Congress: Vision 21, The Plan for 21st Century Laboratories and Test and Evaluation Centers of the Department of Defense*" dated 30 April 1996. Criterion 3, "maintenance of geographical and topographical diversity," is desirable, but inconsequential so long as DoD maintains the capability to adequately replicate these characteristics through modeling and simulation, and other work-arounds. Indeed, to enforce criterion 3 would unnecessarily restrict the DoD from pursuing the intent of Congress to consolidate its test centers into as few as is practicable and possible; and thus, perpetuate the status quo.

See comment 3.

We do not concur with many of the findings asserted in the report. For example, regarding the EMTE BRAC decision, the Director, Test, Systems Engineering and Evaluation has previously determined that there will be no loss of test and evaluation capabilities due to

See comment 4.

See comment 5.

See comment 6.

See comment 7.

this relocation. Regarding AFEWES, the issue is not one of affordability, but of budgeting when workload dictates such a move: the Air Force is prepared to budget for this move as part of the future POM process. And, the Air Force firmly supports its BRAC95 estimate of the cost of this move. The intent of DoD is to reconstitute only those REDCAP and AFEWES capabilities for which there are test requirements.

DoD non-concurs with the language associated with the "matter for congressional consideration." It challenges implementation of BRAC decisions and represents a viewpoint to defer funding only for western facilities and installations. DoD funding for electronic combat test facilities at western test locations is required to support test and evaluation events scheduled for major acquisition programs, which will occur prior to the completion of the "Vision 21" study. The impact of deferring the allocation of funds for these specific activities will be very costly to acquisition programs and schedules.

Detailed comments on the report findings, recommendation and the "matter for congressional consideration" are provided in the Attachment 1. Technical concerns with the report are provided in Attachment 2.

The Department appreciates the opportunity to comment on the draft report. Our point of contact is Mr. Irvin Boyles, (703) 697-7933.

Patricia Sanders
Director, Test, Systems
Engineering and Evaluation

Attachments:
As stated

(GAO CODE 707149) OSD CASE 1250

"ELECTRONIC COMBAT: TESTING CONSOLIDATION MASTER PLAN IS NOT BENEFICIAL FOR DOD"

* * * * *

DOD COMMENTS IN RESPONSE TO THE RECOMMENDATION AND MATTER FOR CONGRESSIONAL CONSIDERATION

FINDINGS

o FINDING A: Planned Consolidation of Open Air Ranges Will Reduce Effectiveness. The GAO concluded that the proposal in the ELECTRONIC COMBAT CONSOLIDATION MASTER PLAN to relocate EMTE would eliminate a test facility that provides unique advantages and keep two testing facilities with overlapping capabilities. The GAO observed that DoD's acquisition regulations require systems be evaluated in operationally realistic environments, including the expected range of natural environmental conditions. The GAO found that DoD's current electronic combat open air ranges replicate diverse threat environments where the services must be prepared to conduct operations.

DOD RESPONSE: The DoD non-concurs with this finding. The Department considers the GAO conclusion to be untrue. The GAO did not substantiate its assertion that the currently planned elimination of EMTE will reduce effectiveness of test and evaluation at the remaining OARs. As stated in the 26 November 1996 response of the USD(A&T) to Senator Graham and Senator Mack, "The Director, Test, Systems Engineering & Evaluation has previously determined that there will be no loss of test and evaluation capabilities due to this relocation."

See comments 1, 2, 3, and 4.

Air space, freedom of maneuver, threat laydown and density, and the relative reduction of intruding RF signals are the important considerations for RF EC effectiveness tests. With respect to EC testing, operational realism and diversity have much more to do with threat density and available laydowns than with environmental phenomena. The environmental factors cited in the GAO report are not critical since they are accommodated through modeling. These considerations favor the Western OARs over EMTE.

See comment 8.

Since most tests of EC equipment require several months of testing at an OAR to complete, it is desirable that over the test period that the weather remain relatively stable and predictable. The Western EC OAR facilities offer the advantage of climatic stability over the Eglin EMTE facility. The test day is limited at Eglin due to weather-related factors, which drive up test costs for customers using the EMTE facility.

See comment 9.

See comment 10.

Attachment
1

See comment 11.

Moving EMTE threats to the Western Test Range to provide a consolidated EC environment with increased density, improved security, and combined flight and ground test synergy is the best technical and economic solution. Further, the major tactical aircraft training ranges at Fallon NAS and the Nellis AFB range complex provide excellent potential for greater economies through combining large scale testing and training.

- FINDING B: Testing Equipment in Diverse Environments is Critical. The GAO found that testing in diverse conditions provides performance data needed to understand environmental effects on electronic combat systems. The GAO concluded that this information is critical to making informed acquisition and mission planning decisions. The GAO also found that testing in diverse environments is also important for collecting data to support development of realistic computer models.

DOD RESPONSE: DoD non-concurs with this finding. The GAO ignores the fact that environment is well understood and accounted for in EC testing. It is the position of the DoD that the environmental factors present at EMTE are not critical in EC testing. The general ability to test equipment under conditions of diverse environments is critical, but the specific EC environment offered at EMTE is not critical to RF EC effectiveness testing. In contrast to RF systems, EO/IR systems, not addressed in the report, are extremely dependent on environmental diversity. However the EMTE move will virtually have no effect on the EO/IR weapons test infrastructure at Eglin.

See comment 12.

The GAO report does not establish the scientific basis for the GAO finding that the environmental data obtained at EMTE is of a higher value than that which is available on the western OARs. Except for terrain masking, environmental factors are of minimal concern to tactical aircraft conducting EC OAR testing. EMTE does not provide useful terrain masking. Of these environmental factors, those present at EMTE are the least significant. EC system hardware is subjected to rigorous environmental tests at the developing contractor's test facilities. The land/sea interface, which consists of issues concerning attenuation due to humidity and foliage in a DT/OT environment, is easily modeled for EC test operations in the RF spectrum. The environmental conditions found at EMTE (tropical temperatures, humidity, clouds, etc.) are of limited concern to the operation of inflight EC systems when considered in isolation to the operational scenario. In fact, the environmental conditions at EMTE that the draft report claims are critical to effective EC testing actually impinge on effective EC testing. Eglin's tropical weather patterns cause numerous cancellations and delays, which result in increased test costs, time delays and inefficient use of expensive test assets. When EC system testing progresses to open air testing, both Vandenberg AFB and Point Mugu can provide routine support to EC tests for land/sea and dense forest interface. If desired, the Navy also assesses the effects of overwater and near-land environmental conditions during open water suitability testing and battle group operations. These assessments can typically be accomplished by using either dedicated

See comment 13.

test facilities, such as the Point Mugu Sea Ranges, or by conducting detached test activities at training ranges or operational sites such as Roosevelt Roads and Key West, or Alaska and Iceland for cold weather operational testing. These training and operational sites easily support testing, and do not require a full-time T&E supporting infrastructure. In addition, the Sea Range of Pt Mugu, California, provides an expansive open air and sea environment to safely conduct fully instrumented air, surface and subsurface EC and weapons tests. Finally, once an EC system is operating at airspeeds and altitudes normal for tactical aircraft, the environmental conditions at the surface of the water (or sea/land interface) have little or no effect on the equipment's performance. The environmental control system of the host platform becomes the key parameter.

See comment 14.

- FINDING C: Plan would Eliminate Diversity Found in Current Open Air Ranges. The GAO concluded that DoD's proposed open air range consolidation, as described in the ELECTRONIC COMBAT CONSOLIDATION MASTER PLAN, would eliminate diversity by keeping only desert ranges and thereby reduce electronic combat open air range testing effectiveness.

  DOD RESPONSE: This finding is not germane to EC testing. While there may be a difference in diversity between EMTE and the western OARs, EMTE's utility as a T&E facility must be considered when determining if the planned consolidation would eliminate effective, useful diversity in EC test environments. The EMTE range cannot provide the level of operationally realistic EC testing that the western OARs can. Specifically:

  - EMTE has serious air space limitations. Eglin AFB buttresses against the main civilian north/south airways corridor, and southern west/east airways corridor. This limits the number of aircraft (typically to two) that can use EMTE concurrently. EMTE is also limited on aircraft run-in heading (north to south since east to west is constrained) and altitude (low altitude only), as well as by the limited orientation of threat systems (to the south only). These restrictions preclude testing EC systems in operationally significant scenarios using multiple aircraft to simulate coordinated SEAD or strike CAP/attack, maneuvering aircraft to simulate use of terrain masking, multi-axis attack. By comparison, western OARs include 1,700 square miles of instrumented land test ranges at China Lake and 20,000 square miles of exclusive-use, restricted airspace, plus the Nellis Range Complex.

See comment 15.

See comment 16.

  - The land and airspace at China Lake, Edwards and Nellis allow the operational tester the flexibility of using operationally relevant scenarios. Test aircraft can fly with loaded live ordnance while simulating ingress through hostile electronic or infrared threats, actually deliver the ordnance, and then egress through the same or a different route of flight. The tester can thus test the aircraft system and pilot interfaces in an operational electronic combat environment while delivering live ordnance on a real target for full mission spectrum testing. EMTE cannot provide this realism.

See comment 17.

- Different environmental conditions are applied against Western Test Range test results through the use of modeling and simulation (M&S). The relocation of EMTE will not eliminate any capability the DoD currently possesses through M&S.

o FINDING D: Current Open Air Ranges Represent Potential Threat Environments. The GAO found that both western ranges provide a capability for conducting essential electronic combat testing over terrain representative of projected middle-eastern threat environments. The GAO found that EMTE provides DoD with an environment more typical of most of the other projected U.S. threat locations, including North Korea and the Balkans.

DOD RESPONSE: The DoD partially non-concurs with this finding. This finding is not entirely true when referring to EMTE. EMTE does not represent most potential threats either from an environmental perspective or from a threat system perspective. From an environmental perspective, although North Korea, the Balkans, and Cuba have coastlines, they are all mostly covered by rocky, mountainous terrain of the sort present in western OARs, not EMTE. From the threat system perspective, while the DoD agrees that supporting littoral threat scenarios is important to testing, intelligence information does not support the value of the threat dispersion used at the EMTE facility. Not only do the threat systems in place at EMTE not reflect the total air threat for potential adversaries, but these systems do not include Naval surface to air missile (SAM) threats required for testing naval EC weapons systems. China Lake is the only facility with naval SAMs; EMTE's threat laydown is only a subset of what is presently available at the western test ranges. In addition, the systems in place at EMTE are limited in orientation to the south, due to airspace and FCC restrictions on the EMTE range. The previous discussion about the severe operational limitations of EMTE must be considered when assessing littoral threat scenarios in testing.

See comment 18.

o FINDING E: REDCAP AT NEW LOCATION WILL BE LESS CAPABLE. The GAO concluded that the ELECTRONIC COMBAT CONSOLIDATION MASTER PLAN proposal to move the REDCAP facility from Buffalo and collocate it with the Air Force's installed system test facility at Edwards AFB will reduce electronic combat testing effectiveness. The GAO concluded that the "core" REDCAP at the proposed new location will be less capable than the complete REDCAP at its current location. The GAO found that the computer model being developed as part of the "core" REDCAP will not simulate all of the current REDCAP testing features. The GAO found that the proposed "core" REDCAP will not be able to simulate a realistic scenario of a strike package of multiple aircraft approaching targets protected by multiple threat radars and threat aircraft incorporated into an integrated air defense system.

DOD RESPONSE: The Department non-concurs with this finding. DoD refutes this finding and maintains that REDCAP at Edwards will be more capable and responsive to customer needs. The digital REDCAP

See comment 19.

See comment 19.

computer model being developed as part of the "core" will be more cost-effective and will provide more capability at Edwards AFB, CA for scenario generation than the current REDCAP facility. Currently, REDCAP goes practically unused. The model's genesis predates BRAC 1995. Although all REDCAP equipment will be moved, customer requirements will dictate which REDCAP capabilities will be reconstituted at Edwards. This "core" capability fulfills all current and planned test requirements. There is no need to make available in the "core" REDCAP hardware functions that are not required by any customer, particularly when real equipment is available.

- FINDING F: Planned Consolidations May Increase Costs. The GAO observed that the ELECTRONIC COMBAT CONSOLIDATION MASTER PLAN did not contain any cost analysis or identify the savings expected from the consolidations. The GAO concluded, based on analysis of prior estimates used to support 1995 BRAC deliberations and other data provided by users, that the consolidations may increase DoD's testing costs. GAO found that (1)BRAC-related data indicates that a complete EMTE relocation would not be cost-effective, (2) Air Force cost estimates provided to the BRAC regarding the relocation of REDCAP and AFEWES were understated, and (3) increased costs that will be incurred by user organizations were not considered in Air Force cost estimates.

  DOD RESPONSE: The Department non-concurs with this. The GAO cost estimate discussed in the report is unsubstantiated. DoD does not agree that the planned relocation will increase costs to test customers.

See comment 20.

  The BRAC-related data mentioned by the draft report refer to the use of some EMTE assets for training. BRAC recommended leaving some assets in place to allow Air Force Special Operations Forces in Florida to train close by. This training consideration should not be a factor when considering the costs of test and evaluation.

See comment 21.

  The GAO does not provide a complete cost picture in that they portray only one side of the picture and do not include off-setting costs. Thus, the cost estimate GAO presents is considered to be incorrect and misrepresents the situation. For example, the cost to the user for out of the area test deployments relative to the special operations forces (SOF) and the 63rd Test Wing stationed near EMTE, is not offset by similar additive costs associated with other air units (e.g., the Navy VX-9 squadron at China Lake and AF test assets at Edwards), should the EC range (ECR) at China Lake be closed in lieu of relocating some of the EMTE capability.

See comment 22.

- FINDING G: Master Plan Includes No Evidence of Savings. The GAO found that the ELECTRONIC COMBAT CONSOLIDATION MASTER PLAN contains no costs data at all and includes no evidence that any savings will result from planned consolidations. The GAO found that the ELECTRONIC COMBAT CONSOLIDATION MASTER PLAN incorrectly states that selecting EMTE, REDCAP and AFEWES for relocation reflects decisions of the 1995 BRAC.

See comment 23.

DOD RESPONSE: These statements are misleading. The EMTE and REDCAP relocations are the result of the BRAC decisions. They are not "proposals" offered for approval in the ELECTRONIC COMBAT CONSOLIDATION MASTER PLAN. There was no requirement to do a cost analysis in the ELECTRONIC COMBAT CONSOLIDATION MASTER PLAN; the Master Plan provides a roadmap of planning that reflects the results of previous cost and effectiveness studies. The plan is based in part on data generated by BRAC 1995, and took into account the cost savings due to the synergy created by the close proximity of the Navy and Air Force facilities. The ELECTRONIC COMBAT CONSOLIDATION MASTER PLAN did not incorrectly cite BRAC 1995. The BRAC scaled back relocation of EMTE for training of Air Force special operations forces, as noted above.

- FINDING H: BRAC Found No Savings in Relocating EMTE in total. GAO concluded that the ELECTRONIC COMBAT CONSOLIDATION MASTER PLAN incorrectly states that DoD needs to relocate EMTE to comply with the BRAC decision. The GAO observed that the 1995 BRAC scaled back the Air Force's recommendation to transfer 17 systems designed to simulate various threat radars and missiles from the EMTE open air range at Eglin AFB to Edwards AFB. The GAO observed that the BRAC determined that the Air Force proposal was too costly and would "never net a return on investment". The GAO noted that ultimately, the BRAC did approve the movement of 10 systems. The GAO noted that the Air Force plans to leave behind some limited capability systems at Eglin AFB for use by the Special Operations Forces and the Air Warfare Center and Armaments Division. However, the GAO found that the limited capability systems left behind would not be instrumented to capture test data.

See comment 24.

- DOD RESPONSE: This finding is not germane to the ELECTRONIC COMBAT CONSOLIDATION MASTER PLAN. Although the Master Plan was based on cost analysis data generated by BRAC 1995, the authors took into account the cost savings of the synergy created by the close proximity of the Navy & Air Force facilities, as discussed above, and tried to eliminate redundant and marginal capabilities.

- FINDING I: REDCAP Relocation Costs Not Fully Disclosed. The GAO found that the cost of the $6.2 million contract to design and build a digital computer model of REDCAP was not included in the Air Force cost estimate that the BRAC Commission used in deciding to relocate REDCAP.

See comment 25.

DOD RESPONSE: The DoD non-concurs with this finding. It is misleading. The report attempts to reopen the BRAC decision by suggesting the REDCAP relocation costs were not fully disclosed by the Air Force. This is not true. All costs associated with the relocation were reviewed as part of the BRAC process. The Air Force estimates for the disestablishment of REDCAP do differ from the REDCAP contractor's estimate. That fact does not indicate that the Air Force estimate is understated, but rather shows that the Air Force, and coincidentally, the BRAC Commission simply did not accept the contractor's estimate at face value. The Air Force carefully

considered what was really required to provide the needed test capability. The Air Force stands by its estimate, and all indications to date validate its accuracy.

The finding suggests the FY96 award of a $6 million dollar contract to design and build a digital model of REDCAP, the Integrated Air Defense System (IADS), is an additional cost that the BRAC Commission did not see and was not included as part of the relocation. The GAO then uses the $6 million figure to calculate a new return on investment in an attempt to discredit the original BRAC decision for relocation. The report's manipulation of the digital REDCAP issue is without merit. The Air Force did not solicit the funding. In fact, Congress approved the creation and funding of the digital REDCAP after the BRAC decision had been made. However, once the funding had been established, the Air Force, working with congressional direction, awarded a contract for the digital REDCAP to best serve the needs of the warfighter. Thus, the requirement for the digital RECAP is independent of the BRAC decision. Based upon the congressional direction, it would have been done regardless. It is not a return on investment issue.

See comment 26.

Many systems at REDCAP are outdated, becoming expensive to maintain and are rarely used. Even if REDCAP were not moving, the digital IADS development would be necessary to keep the command and control test capability viable for the development of current and future systems. Recent upgrades to REDCAP have been predominantly software related and are included in the IADS.

- FINDING J: AFEWES Move Delayed Due to Cost. The GAO found that the Air Force is now attempting to modify their outyear budgets so they can afford to move the AFEWS facility sometime in the year 2000 timeframe.

DOD RESPONSE: The title of this finding is misleading. The suggestion that the AFEWES move has been delayed is not accurate. As stated on page 16 of the ELECTRONIC COMBAT CONSOLIDATION MASTER PLAN, AFEWES test capabilities will be relocated to Edwards AFB when workload dictates.

See comment 27.

- FINDING K: User Costs Will Increase With EMTE Closure. The GAO concluded that $19 million in additional costs will be incurred to send Special Operations Forces aircraft, their crews, and support personnel temporarily to the western test range more often than in the past as a result of the EMTE closure and relocation.

DOD RESPONSE: DoD non-concurs with this finding. It is not accurate. The closure of EMTE will not increase T&E user costs, since EMTE is suitable only for the most basic scenarios against limited threat systems. The draft report misinterprets BRAC's approval of leaving a limited number of threat systems in place at EMTE to support the needs of the USAF's Special Operations Forces and Armament Division, and a squadron from the Naval Air Warfare Center. The USAF took this action (leaving a limited number of threat systems in place at EMTE) for support of training of SOF

See comment 28.

See comment 29.

See comment 31.

units. While SOF would incur greater costs should they ever need to go to western ranges to test, they will not be traveling to western ranges to test but will continue to train at Eglin. This training consideration should not be a factor when considering the costs of T&E. Moreover the GAO showed no record of Test and Evaluation Master Plans from SOF to perform T&E using EMTE.

In addition, the finding uses a cost of $23M for AFSOF to test on western ranges without balancing that cost with savings incurred by closing EMTE. Nor did the GAO substantiate this large increase in TAD/TDY funding. No documentation is presented showing a requirement for AFSOF to use western ranges. Also, there is a SOF combined test force at Edwards with easy access to western ranges.

- FINDING L: Installed System Test Facility Consolidation Not Practical. The GAO concluded that the Navy construction of a new anechoic chamber and Navy and Air Force upgrades to current primary installed system test facilities have progressed to far to make any inter-service consolidation practical at this time.

  DOD RESPONSE: The DoD concurs with this finding.

- FINDING M: More Cost-Effective Alternatives to Planned Relocations Ignored. The GAO concluded that the 1994 Board of Directors study and the 1995 Joint Cross Service Group study, identified a more cost-effective inter-service approach than that reflected in the ELECTRONIC COMBAT CONSOLIDATION MASTER PLAN. The GAO concluded that the lack of inter-service cooperation undermined the more cost-effective efforts.

  DOD RESPONSE: DoD non-concurs with this finding. (1) The 1995 study cited in the draft report did not recommend a more cost effective consolidation. (2) The referenced Joint Service Studies were based upon incomplete and flawed evaluation criteria, were not approved by the Services, and do not represent a DoD position. The inter-Service consolidation recommendations were unrealistic and therefore were not considered in the preparation of either BRAC 1995 or the EC Consolidation Master Plan of March 1996. Specific examples of the DoD position and rationale were provided to the GAO on 15 August 1996, but evidently were not considered.

- FINDING N: Open Air Range Consolidation Does Not Reflect A More Cost Effective Alternative. The GAO observed that DoD determined, based on workload data, that it will only need two of the three current open air range facilities in the future. The GAO found that the 1994 Board of Directors study and the 1995 Joint Cross Service Group study ranked EMTE as a more valuable electronic combat test capability than the Navy's China Lake open air range. Yet, the ELECTRONIC COMBAT CONSOLIDATION MASTER PLAN recommends relocating test assets from EMTE to the Western Test Range managed by Edwards AFB.

  DoD RESPONSE: The DoD non-concurs with this finding. The referenced Joint Service Studies (JSS) do not represent an approved Department

See comment 30.

See comment 31.

See comment 32.

See comment 33.

study or position and were based upon incomplete and flawed evaluation criteria. Recommendations in the JSS were unrealistic and not considered in the preparation of either BRAC 1995 or the ELECTRONIC COMBAT CONSOLIDATION MASTER PLAN of March 1996. Specific examples of the DoD position and rationale were provided to the GAO on 15 August 1996.

The cost evaluations used by the GAO team are misleading in that GAO evaluated the potential savings to be made in closing a facility by comparing threat systems investment funding at the respective facilities, and the GAO did not accurately account for the differences in the investments made at each facility. An example of an inaccurate comparison is the comparison between EMTE and China Lake. EMTE's threat simulation program was greatly reduced in FY91 by the Air Force, while the Navy continued investing in China Lake. The estimated $47M in savings cited on Page 16 of the GAO report is based on the difference in threat systems investment lines between EMTE and China Lake, but does not take into account the additional investment that would be required to bring EMTE to a level of capability to meet Navy electronic combat test requirements, which cannot be met now at EMTE.

The Investment and Modernization Program data used in the financial analysis also included threat simulator development investments. Based on the Air Force decision in FY91 to build only less expensive, emitter-only, threat simulators for EMTE, their investment line is considerably lower than that of China Lake. This again provides EMTE a significant cost advantage in the study. These emitter-only simulators will not meet DT&E and OT&E test requirements for evaluation of electronic combat equipment because they cannot receive and process electronic combat signals.

The Navy I&M Program Element (PE) funding line used for cost comparisons included Navy investments made not only in the Electronic Combat Range (ECR) at China Lake, but also Point Mugu (ESCEL), Patuxent River (EWISTL), and the Navy Research Lab (ENEWS). The JSS cost studies did not separate the China Lake investments from the investments made at other sites using this PE funding line, resulting in an incorrect investment level for China Lake.

EMTE listed common range instrumentation test capabilities associated with their weapons delivery range, but did not include the cost of those capabilities in their cost-of-doing-business analysis for EC OAR. ECR listed these costs in their data. (ECR is a stand alone range requiring these capabilities. EMTE is not a stand alone range. It shares air space and test time with all other Eglin range operations. As a result EMTE has a definite capacity disadvantage because even in times of need all time at Eglin cannot be allocated to EC testing.)

The GAO did not consider or address the DoD Inspector General Audit Report, Meeting Threat Equipment Requirements Within DoD, No. 94-064, dated 21 March 1994, which recommended closing EMTE.

- FINDING O: Electronic Linking of REDCAP and AFEWES a More Cost-Effective Alternative. The GAO found that, according to a 1995 study conducted for the Air Force, electronic linking of REDCAP and AFEWES to an installed system test facility was far more cost-effective than relocating them. The GAO noted that the Air Force plans to relocate AFEWES and REDCAP at the same time that the Navy is undertaking a project to electronically link REDCAP and AFEWES hardware with the Navy's installed system test facility at Patuxent River, MD.

  DoD RESPONSE: DoD non-concurs with this finding. It is not true. REDCAP, as a Man-in-the-Loop command and control simulation facility shows potential for providing cost-effective linked information, but has not had requirements for it to be substantiated. REDCAP is already linked to the ISTF at Patuxent and will be linked to the one being developed at Edwards. However, severe data latency issues exist for testing integrated avionics over linked lines. Such is the case with AFEWES and the F-22. Facilities such as AFEWES cannot be electronically linked with the timing and measured data accuracy required to test the effectiveness of DoD jamming systems. Requirements for T&E measurements to the nanosecond (one thousandth of one millionth of a second) are common. Because of the laws of physics, facilities as geographically separated as AFEWES is from other T&E facilities cannot be electronically linked with timing and measured data accurate to the nanosecond, since the time it takes light to traverse these distances exceeds one nanosecond. In spite of ongoing funded investigations into the utility of linking REDCAP, AFEWES and ISTFs, no measurable data has been produced that would indicate the cost effectiveness of such links. A Joint Advanced Distributed Simulation (EW) study group is investigating the potential of aircraft, jamming system and threat simulator link viability for some cases.

  The relocation of REDCAP and AFEWES to Edwards will consolidate equipment needed by testers into existing facilities and capabilities. This will yield an increase in effectiveness of EC testing of integrated avionics systems and permit "one stop shopping" efficiencies that cannot be realized now. The 1995 study cited in the GAO report assumed that linking would be equivalent to collocation. This is in error: with linking, a tester must partition his test so that latency is not a problem. This, in turn puts limits on what test components are actually linked. Such restrictions do not exist with collocated test capabilities.

  Linking does not eliminate the large O&M costs associated with maintaining AFEWES and REDCAP at sites remotely located from other test activities.

- FINDING P: Master Plan Process Stifled By Intra-Service Focus. The GAO concluded that the failure of the ELECTRONIC COMBAT CONSOLIDATION MASTER PLAN effort to achieve any DoD-wide electronic combat testing consolidations despite direction from the Congress to do so is due to service parochialism. This resulted in focusing on intra-service rather than inter-service consolidations.

See comment 34.

See comment 35.

See comment 36.

DoD RESPONSE: The DoD non-concurs with this finding. It is not accurate. The position of the DoD is that the ELECTRONIC COMBAT CONSOLIDATION MASTER PLAN consolidates EC testing to the optimal degree supported by currently planned test workload and budgetary constraints. In recognition of further budgetary constraints which have become evident after completion of the EC Consolidation Master Plan, the DoD is now involved in the "Vision 21" study to determine required DoD test capabilities for the foreseeable future. This effort includes inter-Service focus.

- FINDING Q: "Gentlemen's Agreement" Prevented Inter-service Open Air Consolidation Effort. The GAO found that the Air Force and Navy representatives responsible for writing the ELECTRONIC COMBAT CONSOLIDATION MASTER PLAN reached a "gentlemen's agreement" that there would be no inter-service consolidation until all intra-service consolidations were complete.

  DoD RESPONSE: The DoD non-concurs with this finding. It is not true; there was no "Gentlemen's Agreement." This accusation is not substantiated by the GAO. As previously discussed, relocating portions EMTE, rather than closing/consolidating the other two OARs, is in the best interest of all DoD, due to the significant limitations of EMTE in the areas of capability and airspace restrictions. The draft report states that the ELECTRONIC COMBAT CONSOLIDATION MASTER PLAN ignores the previous studies because of parochial interest. This statement is completely incorrect in that all of the Services non-concurred with the Electronic Combat TCCMP due to procedural or factual errors in the study. The following memos were submitted rebutting these studies. Copies of these memos were provided to GAO on 15 August 1996, but this information was not included in the GAO report.

  - CNO memo Ser NAWC-22/700 of 12 Nov 1992 which states that the Navy submitted a dissenting position which was not incorporated by the OAR Electronic Combat Lead from Eglin. The report, as written, was unrealistic in a number of areas. There were many unresolved issues. The Navy could not concur with the OAR portion of the report.

  - Department of Army memo of 19 Nov. 1992 which lists a number of points of non-concurrence with the EC TCCMP.

  - Department of Air Force, HQ AFMC/DOR memo of 19 Oct 1992 which recommends that the Air Force non-concur with the plan. HQ AFMC further recommends that it be re-written under additional guidance provided by JCG(T&E).

- FINDING R: Intra-Service Focus Could Interfere With Broader Consolidation Effort. The GAO concluded that there was cause for concern that the intra-service focus that interfered with development of a DoD-wide ELECTRONIC COMBAT CONSOLIDATION MASTER PLAN will undermine the "Vision 21" effort.

See comment 37.

See comment 38.

DoD RESPONSE: DoD non-concurs. This finding is an unsubstantiated opinion and misleading. In order to preclude the appearance of the sort of Service parochialism discussed in the draft report, OSD is intimately involved in the preparation of the metrics, characteristics and data collection of the Vision 21 study. The Office of the DoD Inspector General is also involved to ensure the fairness and impartiality of the study and its conclusions.

RECOMMENDATION

- RECOMMENDATION: The GAO recommended that the Secretary of Defense ensure that the methodology for the ongoing Section 277/Vision 21 effort include the following criteria: (1) accurate, comparable, and reliable data on the true cost of operating the Services' test and evaluation infrastructure, (2) the needs of and costs to test facility customers, (3) the maintenance of geographical and topographical diversity in the test facility base, (4) the requirement that proposed consolidations be cost-effective for DoD as a whole, and (5) measures to ensure that the implementation of cost-effective decisions cannot be constrained or avoided by the individual services. (p. 19/GAO Report)

See comment 3.

DOD RESPONSE: The Department partially concurs with the recommendation but does not concur with the basis for the recommendation as presented in the report. Except for the third criterion, the criteria are the guiding principles of Vision 21. Criterion 3, the maintenance of geographical and topographical diversity in the test facility base, is desirable but inconsequential so long as DoD maintains the capability to adequately replicate these characteristics through modeling and simulation or work-arounds. To incorporate criterion 3 would unnecessarily restrict the DoD from pursuing the intent of Congress to consolidate its test centers into as few as is practicable and possible. Agreeing with most of the recommendations, however, does not imply concurrence with the report. Further, it must be remembered that the object of the Vision 21 effort, in the language of the Authorization Act, is to "consolidate the laboratories and T&E centers into as few laboratories and centers as is practical and possible in the judgment of the Secretary, by 1 October 2005." This will of necessity create some pain, and changes to the current structure.

MATTER FOR CONGRESSIONAL CONSIDERATION

See comment 39.

- SUGGESTION: The GAO suggested that Congress may wish to consider directing the Secretary of Defense to defer allocation of all (1) funds associated with transferring electronic combat test assets, (2) funds planned to be expended on constructing new electronic combat test facilities at western locations, until DoD completes its "Vision 21" plan for restructuring its laboratories and test and evaluation centers. (pp. 19-20/GAO Report)

DOD RESPONSE: The Department strongly non-concurs. As air defenses across the world get more and more sophisticated, so do the needs

for realistic electronic combat testing in secure environments. This "matter for congressional consideration" would delay needed EC test capabilities. Such delay would increase program costs, or systems might be fielded without adequate testing and increased risk to the warfighters. Investments to facilitate the relocation of EMTE and REDCAP to Edwards AFB are required in order for the Department to meet the 1995 Base Realignment and Closure legislation. Current and future improvements will be transportable and as such do not and will not tie the Department's hands in the future.

In addition, the language associated with this "matter for congressional consideration" goes beyond the purview of the report. It represents a biased and geopolitical viewpoint. This viewpoint would not likely be supported by "western" members of Congress. Furthermore, it does not define its use of "western". The statement also confuses the issue as to what constitutes the new electronic combat test facilities being addressed? The statement is so broad that it could be interpreted to cover the ECIT upgrade to the Air Force's installed system test facility at Edwards AFB, CA, and to cover new enhancements to the Navy's China Lake and Pt Mugu facilities. DoD funds for constructing new electronic combat test facilities at western test locations are planned to support test and evaluation events, scheduled for major acquisition programs, which will occur prior to the completion of the "Vision 21" study. The impact of deferring the allocation of funds for these specific activities would be very detrimental. These efforts have requirements that transcend Vision 21.

See comment 39.

The following are GAO's comments on DOD's letter dated March 10, 1997.

GAO Comments

1. The Congress directed DOD to develop a plan "to establish a DOD-wide infrastructure for electronic combat testing." DOD's proposed plan fails to establish a DOD-wide infrastructure. Instead, DOD's plan did not consider any of the 10 Army and Navy electronic combat test facilities as possibilities for consolidation or the results of DOD studies that identified consolidations that would result in a more cost-effective DOD-wide infrastructure.

Our report does not conflict with the report entitled Defense Infrastructure (GAO/HR-97-7, Feb. 1997). In fact, this report substantiates its conclusions. The prior report stated that:

". . . breaking down cultural resistance to change, overcoming service parochialism, and setting forth a clear framework for a reduced defense infrastructure are key to avoiding waste and inefficiency. To do this, the Secretary of Defense and the Service Secretaries need to give greater structure to their efforts by developing an overall strategic plan."

In this report, we point out that the process used by the services in developing the Electronic Combat Consolidation Master Plan did not overcome parochialism, as evidenced by the lack of effort to consolidate across service lines. The Master Plan does not reflect a DOD-wide strategic plan, but rather merely an Air Force plan to move Air Force functions to other Air Force locations.

DOD's comment that ". . . the Services made decisions to consolidate in areas where they would have the least impact on the Department to perform effective T&E" is not supported by the facts. For instance, the plan to close the EMTE electronic combat open air range at Eglin Air Force Base will leave DOD with no non-desert electronic combat test range for tactical fighters, and two desert test ranges—one for the Navy and one for the Air Force. This is contrary to DOD's testing policy that requires testing to be conducted in a range of natural environments. As an alternative, DOD could have considered, but decided to forego, the option of consolidating the test assets of the two desert ranges into one, and keep its only non-desert electronic combat open air range.

As our report shows, the Air Force intends to "relocate" the EMTE function from Eglin Air Force Base, not limit itself to the Base Closure and Realignment Commission (BRAC) directed realignment. If the Air Force

transfers more than eight threat systems and two podded threat systems out of Eglin, its actions will go beyond, not "reflect," the 1995 BRAC recommendation. The 1995 BRAC recommendation involves the movement of only 8 threat systems and 2 podded threat systems, but DOD's Master Plan states that EMTE consists of 65 highly instrumented threat systems and high fidelity validated simulators.

2. How funding for upgrades was authorized and appropriated is not relevant to the issue of whether a facility should have been considered for consolidation or whether more cost-effective consolidation alternatives exist.

3. According to Air Force test policy, modeling and simulation is not an adequate replacement for actual hardware testing because it cannot predict absolute performance and effectiveness with high confidence or achieve the same degree of fidelity for complex functions as testing of the hardware itself.

The ongoing vision 21 consolidation effort gives DOD the opportunity to consider how it will maintain geographical and topographical diversity, among other things, and still achieve "as few [facilities] as is practicable and possible." For instance, DOD could consider keeping its non-desert range at Eglin, and consolidate the Air Force's and the Navy's desert ranges into one to keep the diverse test environments required by its regulations and still reduce from three ranges to two.

4. There may be no significant loss of capabilities if the Air Force limits the movement from EMTE to the eight systems and two pods that are described in the BRAC decision and keeps the other residual test assets available for testing at Eglin. However, if the Air Force carries out the Master Plan proposal to "relocate" the EMTE function to accomplish a reduction from three to two electronic combat ranges, there will be a loss in DOD's current ability to test with high fidelity and confidence. Testing only in dry, desert air over rocky, mountainous terrain will limit DOD's real-world testing to one environment and one set of operating conditions. Moreover, the desert ranges are not representative of most places in which DOD must be prepared to fight.

5. Although the Air Force maintains there is no question of affordability in the proposed move of AFEWES, the 1995 BRAC found that such a move would cost $34.9 million and take over 100 years to achieve a return on that investment. The Air Force's refusal to consider electronic linking, despite

an independent Air Force contractor's conclusion that linking would be far more cost-effective, demonstrates that the Air Force is not in step with the rest of DOD, which is demonstrating electronic linking of AFEWES, REDCAP, and the Navy's anechoic facilities at Patuxent River, Maryland.

6. We agree that the Air Force should keep REDCAP and AFEWES test capabilities for which there are test requirements. These test requirements are outlined in Air Force Manual 99-112, Electronic Warfare Test and Evaluation Process—Direction and Methodology for EW Testing. According to the manual, hardware-in-the-loop facilities (such as AFEWES and REDCAP) are an important test category because they represent the first opportunity to test components against simulations of hostile weapon system hardware or actual hostile weapon system hardware. That is why we question the Air Force's plan to put REDCAP hardware in storage in favor of an unproven digital computer model.

7. We continue to believe that the transfer of test assets should be deferred until the ongoing vision 21 consolidation effort is complete because this would provide DOD with an opportunity to create a plan for a future DOD-wide infrastructure for its testing, instead of an infrastructure that preserves each service's ability to maintain its own set of separate facilities across the test spectrum. The 1995 BRAC decisions have a 6-year implementation period. The planned transfers do not have to be made immediately to satisfy BRAC. We have modified the words in the matter for congressional consideration to more clearly articulate our position. Also see comments 1, 2, and 3.

8. Open air ranges are used to evaluate electronic combat systems in background, clutter, noise, and dynamic environments. Dynamic environments contain numerous important variables besides those mentioned in DOD's comments. According to the Air Force's electronic combat test manual, an operationally realistic open air test environment includes real-world phenomena such as terrain effects, multi-path propagation, electromagnetic interference from commercial sources, and effects caused by atmospheric propagation factors (i.e., the tendency of atmospheric conditions to enhance or inhibit signal transmission).

Providing realistic and diverse representations of threat radar systems in the numbers ("density") and dispersion ("laydown") that the system under test would be expected to defeat in actual electronic combat does not negate the requirement to test in operationally realistic environments. Also see comment 3.

9. The disadvantage of climatic predictability at the desert test ranges is that the effects of various meteorological conditions cannot be observed.

10. The cost of testing at the western test range, the specifics of which the Air Force has classified, far exceed those at EMTE at Eglin. In fact, eliminating EMTE eliminates the Air Force's lower cost range. In addition, allowing foreign customers to utilize the Eglin range generates revenue, but for classified reasons most foreign customers are precluded from using the western range.

11. While it seems clear that moving EMTE's threat systems to the Air Force's western test range could improve the western test range's technical capability, it does not automatically follow that this is the most cost-effective solution for DOD as a whole to pursue.

12. If environmental effects were as well understood and accounted for in electronic combat testing as DOD's response claims, real-world testing at open air ranges would not be required; testing indoors at hardware-in-the-loop and installed system test facilities would be an adequate substitute. Environmental effects on electronic combat system performance can be more accurately determined on open air ranges where the system is exposed to the complexities of different real-world environments.

Furthermore, without the ability to test in at least two distinct representative environments (e.g. wet and flat versus dry and mountainous), DOD will be unable to predict with significant assurance how an electronic combat system will perform in any environment other than the one in which it was tested. Hence, because the electronic combat test environment provided by the Eglin range provides DOD with its only alternative to the desert test environment, DOD's response that "the specific electronic combat environment offered at EMTE is not critical to RF [radio frequency] testing . . ." is not supportable. In addition, DOD regulations and the Air Force electronic combat test process require testing under real-world representative environment and operating conditions whether or not DOD believes that a given specific test environment is not critical for a given type of testing.

13. We did not assert that testing conducted in the environment at EMTE is scientifically "of a higher value" than testing done in a desert environment. What we stated was that DOD must prepare to fight in diverse

environments; testing conducted in diverse environments is of a higher value than testing limited to a single environment.

An operationally realistic test environment allows testers to gain insight into understanding how a system will perform in that environment. Testers cannot assume that the system will perform the same way in different environments. If DOD reduces its testing capability to only a desert environment, it will not be able to prove its systems work in anything other than a desert environment. This is contrary to DOD testing policy that requires testing to be conducted in a range of natural environments. In addition, testing indoors in a contractor's laboratory is not considered an acceptable substitute for real-world testing on the aircraft according to the Air Force's electronic combat test process guide.

Neither Point Mugu nor Vandenberg Air Force Base have the necessary threat system test assets to create realistic threat environments for electronic combat testing for tactical aircraft systems. To utilize Point Mugu or Vandenburg for this purpose, DOD would essentially be recreating EMTE on the west coast. Moreover, no naval battle group currently has the capability to create a realistic open air threat density and laydown of hostile land-based surface-to-air missile and anti-aircraft artillery systems. Also see comments 2 and 10.

14. If these sites mentioned by DOD "easily support" electronic combat testing of tactical aircraft, they should have been considered for consolidation along with EMTE in the Master Plan process. However, the reality is that none of the places mentioned by DOD has the test assets to create the realistic threat densities and laydowns that DOD earlier in its response said were the most important factors in developing "operational realism and diversity."

DOD's statement that once an electronic combat system is operating at airspeeds and altitudes normal for tactical aircraft the environmental conditions at the surface have little or no effect on performance unrealistically assumes no aircraft will ever be called upon to fly at low altitudes (such as flying low to avoid radar detection). Moreover, DOD's statement is counter to its policy statement on the need to operationally test in different environments.

15. In addition to electronic combat testing, Eglin conducts other kinds of testing, including bombing and live missile firings. Moreover, the main civilian air corridor between Los Angeles and destinations further east,

including Las Vegas, one of the nation's fastest growing cities, buttresses against the restricted air space available to the Air Force and the Navy at their desert test ranges. Also see comment 1.

16. DOD's comment seems to assume that keeping EMTE would mean that the strengths of the Air Force's western test range, which it delineates here, would have to be sacrificed. We do not suggest that the western test range be closed instead of EMTE. Also see comment 1.

17. Operational testers have been using and continue to use operationally relevant scenarios at EMTE. Test aircraft at EMTE can also fly with live ordnance through simulated hostile airspace and live ordnance can be delivered on a real target. Also see comment 2.

18. Our point is that the body of potential hostile nations contains a variety of environments, not just desert. Testing at EMTE and in the desert allows the operational tester to gain insight into electronic combat system performance in multiple environments.

The threat dispersion at EMTE can be changed if necessary, as it has been in the past. In fact, the threat dispersion at all of the ranges should be changed regularly to ensure that testing includes operationally relevant scenarios since many modern threat systems are designed to be mobile.

China Lake is a facility with naval surface-to-air missiles located deep in a desert ringed by mountains. Placing naval surface-to-air missiles at EMTE with its flat terrain, humid environment and littoral location could provide a more realistic and operationally relevant scenario for naval aircraft.

Despite DOD's assertion that severe operational limitations exist at EMTE, EMTE's annual workload historically has been significantly greater than the two desert test ranges. The Air Force and the Navy both use EMTE for testing despite the presence of the desert ranges. Thus, it appears their past testing behavior indicates they believe the benefits of EMTE outweigh any such limitations.

19. REDCAP at Edwards will be less capable as a hardware-in-the-loop facility because the Air Force intends to put the hardware in storage, replacing it with a digital computer model to simulate actual hardware testing.

According to Air Force Manual 99-112, Electronic Warfare Test and Evaluation Process—Direction and Methodology for EW Testing, the Air Force's electronic combat testing policy requires hardware-in-the-loop testing. Also, REDCAP currently has paying customers who do want to use it. Furthermore, hardware-in-the-loop facilities such as REDCAP and AFEWES use "real equipment." It is in digital modeling, such as DOD's comment proposes as a substitute for REDCAP, where actual electronic combat systems are replaced by software representations instead of real equipment.

The software-based computer model of REDCAP being developed may cost less to operate than the actual REDCAP hardware-in-the-loop facility, just as flight simulators cost less to operate than actual aircraft. However, modeling and simulation is not hardware-in-the-loop testing. Because they are different kinds of testing with different purposes, they are not directly comparable for purposes of determining which is more cost-effective.

DOD's statement that "Currently, REDCAP goes practically unused" is not supported by recent usage data. Reimbursable costs from test customers are up significantly over the past 3 years. Recent customers include a major U.S. Air Force aircraft program that used the REDCAP Mission Level Assessment Tool for several months, as well as a foreign customer having some of its electronic combat hardware tested. See also comment 5.

20. DOD's Master Plan included no cost estimates. We reported (1) the cost estimates that were independently arrived at by BRAC, which do not support relocating AFEWES or all of EMTE; (2) known additional costs that the Air Force will incur by replacing REDCAP with a digital model, which will in turn allow the Air Force to keep down the cost-estimate for the REDCAP move; and (3) additional costs that current EMTE customers report they will incur as a result of the EMTE closing. DOD's comments provide no evidence to suggest that these are wrong.

21. According to the BRAC language, some EMTE assets were specifically directed to be left at Eglin "to support" several customers, including the Special Operations Forces, as well as the Air Force Materiel Command Armaments/Weapons Test and Evaluation activities, and other users. DOD's position that the BRAC legislation prohibits testing and limits customer support to providing training capability is not adressed in the BRAC direction.

22. We agree the cost analysis to support any test facility closure should include additional costs to users associated with the relocation.

23. According to the BRAC recommendation regarding Eglin, BRAC expected DOD to use the Master Plan process to come up with the "optimal" consolidation plan. Closing EMTE (not just relocating those 10 test assets recommended to be moved by BRAC), relocating AFEWES despite BRAC's determination that this would not be cost-effective, and ignoring Army and Navy test facilities completely as possibilities for consolidation, does not support DOD's claim that the Master Plan is "the result of BRAC decisions." Moreover, previous DOD cost-effectiveness studies concluded that the three relocations planned to be relocated by the Air Force will not be cost-effective.

24. The Navy and the Air Force authors of the Master Plan told us they did not consider costs in the Master Plan because there was no requirement to do so.

25. It is not clear why DOD raises the issue of the REDCAP contractor's estimate of the cost of moving REDCAP. We do not use that figure in our report. Our report shows that the Air Force intends to replace REDCAP hardware being moved from its current location with a digital computer model that will simulate REDCAP. The Air Force's contracted cost for the model is $6.2 million. If the Air Force was not replacing the REDCAP hardware with the digital model, it would have to reestablish the REDCAP hardware at some unknown additional cost. Hence, the cost to make REDCAP operational at the new location is either (1) the cost of the move plus the digital model (with current hardware going into storage) or (2) the cost of the move plus set-up costs for the current hardware (with no digital model). Since DOD has selected option number (1), $6.2 million should be added to the cost of the REDCAP move. See also comments 2 and 5.

26. REDCAP does have some outdated systems. But as our report shows, REDCAP also just completed a $75 million upgrade. Also, customer usage and receipts over the past 3 years have increased.

27. We have changed the title of this finding.

28. According to Special Operations Forces test officials, EMTE provides a more cost-effective test capability to meet their needs compared to traveling to the western test range. Also see comment 21.

29. Air Force officials reported to BRAC that they anticipated saving $3.7 million per year after spending $6.1 million to move the threat systems out of EMTE. Even if this savings materializes, it will not offset the additional costs anticipated by the current users of EMTE. Special Operations Forces officials told us they must use operational aircraft from Hurlburt Field, Florida, adjacent to Eglin, to accomplish their testing because they have no dedicated test aircraft at either Edwards or Eglin Air Force Base.

30. DOD has no studies to show that the relocations delineated in the Master Plan are cost-effective, and now claims that its 1994 and 1995 joint studies, which do not support the Master Plan moves, were incomplete and flawed. We spoke with Air Force, Army, and DOD Inspector General officials involved in preparation or oversight of the 1994 and 1995 studies and they do not agree the studies were flawed. They told us what made the recommendations of these studies "unrealistic" was not the content, but the refusal of the Navy to consider closing China Lake while the Air Force retained two open air ranges. Navy officials associated with China Lake do maintain the studies were incomplete and flawed.

The specific examples provided to us on 15 August 1996 represent the dissenting position that China Lake's open air range was not given adequate consideration in studies that compared it to the Eglin open air range. This data does not support the alternative position that the Master Plan proposal to relocate EMTE is cost-effective.

31. We agree that the Air Force's cuts in funding for investment at EMTE over the past several years, coupled with the Navy's increased investment funding at the China Lake range, could affect the outcome of a comparison of the two if the 1994 study was redone today. DOD, however, has not done such a study to demonstrate that the outcome would be different.

32. The claim that Eglin has a capacity disadvantage does not appear to be accurate. During the run up to the 1990-91 Gulf War, the Eglin Range conducted the largest share of electronic combat testing of the three open air ranges. During fiscal year 1993, 2,133 hours of testing were conducted at EMTE, while China Lake and the western test range conducted 1,649 and 1,085 hours, respectively.

33. The referenced DOD Inspector General's report compared EMTE with the western test range. We do not assert that EMTE should be kept in lieu of the

western test range. The Inspector General's report did not consider the Navy's open air range at China Lake compared to EMTE.

34. The 1995 study conducted for the Air Force by Georgia Tech Research Institute concluded that electronic linking would be far more cost-effective than relocating AFEWES and REDCAP. In addition, a 1994 Board of Directors synergy study concluded that moving the hardware-in-the-loop facilities would not be cost-effective. We know of no study that concludes it is less expensive to relocate and reassemble AFEWES or REDCAP hardware at a new location.

DOD's position that successful electronic linking will be impossible due to the laws of physics has not yet materialized. DOD's project to link REDCAP and AFEWES with Patuxent is well underway, and as DOD states, the REDCAP link "shows potential." Additional support for the linking project comes from the Georgia Tech study concluding that linking will be more cost-effective, and the 1994 DOD synergy study concluding that moving the hardware-in-the-loop facilities is less cost-effective. Hence, DOD could have advocated pursuing electronic linking instead of relocation of REDCAP and AFEWES in the Master Plan.

35. The 1994 synergy study conducted for DOD's Test and Evaluation Board of Directors concluded that it would take 200 years to recover the investment to relocate and reassemble the hardware-in-the-loop facilities at the Edwards Air Force Base installed system test facility for "one stop shopping." As a result, the Navy shows no inclination to relocate its hardware-in-the-loop facility from Point Mugu, California, to its installed system test facility at Patuxent River, Maryland.

36. Even taking into account the continued operations and maintenance costs at AFEWES and REDCAP, the 1994 DOD synergy study and the 1995 Georgia Tech Research Institute study concluded that these moves would not be cost-effective.

37. The memoranda cited by DOD were all written in 1992 and referred to another study that concluded that keeping China Lake's open air range was less cost-effective than EMTE. The DOD joint service studies cited in our report were conducted in 1994 and 1995. Although DOD asserts that it is not service parochialism that prevents interservice consolidation from occurring, we note that DOD has now produced three studies with a conclusion that China Lake is less cost-effective to keep, yet the Master Plan calls for assets to be relocated from one Air Force location to another

Air Force location. The Director of Air Force Test and Evaluation told us that this is because the Navy would not consider relocating China Lake's test assets.

38. As with the Electronic Combat Consolidation Master Plan, we believe that service parochialism may interfere with the ongoing vision 21 effort. There have been no DOD-wide electronic combat test consolidations in the Major Range Test Facility Base despite a number of studies that have recommended such consolidations.

39. We have modified the language from our draft matter for congressional consideration to ensure that our focus is not misconstrued by others.

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